COUNTY GOVERNMENT OF ISIOLO

RAPID CLIMATE RISK ASSESSMENT

ISIOLO MUNICIPALITY

2025

Building Climate Resilience for a Sustainable Arid Future

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The information contained in this report is based on available data, projections, and modelling assumptions at the time of publication. While reasonable efforts have been made to ensure accuracy, the County Government of Isiolo does not guarantee completeness and shall not be liable for any loss arising from reliance on this document.

Foreword

Chairperson Isiolo municipality Board

Climate change is no longer a distant threat, it is a pressing reality that is reshaping the environmental, social and economic landscape of Isiolo Municipality. Our communities face increasing challenges from floods, droughts, heatwaves and ecosystem degradation, which threaten livelihoods, infrastructure and public services. These impacts are particularly severe for vulnerable groups, including children, the elderly, women and pastoralist households. As a municipality, it is our responsibility to understand these risks comprehensively and take decisive action to safeguard our residents and build long-term resilience.

This Climate Risk Profile provides an evidence-based assessment of the hazards, vulnerabilities, and exposures within our municipality. It captures historical climate trends, projected future risks, and the socio-economic and ecological factors that influence our resilience. By presenting detailed data, risk mapping and adaptive capacity assessments, this report serves as a strategic guide for decision-making, planning and investment in climatesmart development.

I commend all municipal staff, community representatives, development partners and stakeholders who contributed to this report. Your expertise, dedication, and collaboration have been invaluable in creating a resource that not only informs policy but also empowers communities to participate actively in adaptation initiatives.

The recommendations outlined in this profile including strengthening early warning systems, climate-proofing infrastructure, promoting sustainable land and water management and enhancing community-based adaptation are designed to guide Isiolo Municipality towards sustainable, resilient development. Implementing these actions will require multi-sectoral collaboration, innovative financing and a commitment to integrating climate resilience into all aspects of municipal planning.

As the Chairperson, I urge all stakeholders, government agencies, civil society, the private sector and development partners to use this Climate Risk Profile as a roadmap for action. Together, we can transform the challenges of climate change into opportunities for a more resilient, sustainable and prosperous Isiolo Municipality.

Hon. Hassan Wako Wario
Chairperson, Isiolo Municipal Board

Manager's Statement

Isiolo Municipality is growing rapidly, expanding its infrastructure, services and economic opportunities. At the same time, we are experiencing increasing environmental pressures that threaten our development gains and the wellbeing of our residents. As Municipal Manager responsible for planning and development, I recognize that building a resilient municipality is no longer optional, it is a necessity.

This Climate Risk Profile provides a structured and forward-looking assessment of the key hazards facing Isiolo, the systems and communities most exposed and the vulnerabilities that heighten our risk. It brings together data, stakeholder insights and technical analysis to help us better understand where we are most at risk today and how those risks are likely to evolve in the coming decades. More importantly, it outlines clear priorities and practical interventions to strengthen resilience while advancing sustainable urban development.

The preparation of this profile has been a collaborative and inclusive process. Municipal departments, county institutions, community representatives, civil society organizations, and development partners have contributed expertise and local knowledge. Through this partnership, we have documented historical trends, identified climate risk hotspots and developed actionable recommendations to guide investment decisions, spatial planning, infrastructure upgrades and service delivery improvements.

This report is not intended to sit on a shelf; it is a roadmap for action. The success of the mitigation and adaptation strategies outlined herein will depend on strong coordination, resource mobilization and sustained stakeholder engagement.

With collective commitment and strategic investment, Isiolo can safeguard its people, protect its infrastructure and natural assets, and position itself as a climate-resilient and future-ready municipality. Together, we can ensure that growth and resilience go hand in hand, securing a safer and more sustainable future for all.

Halake Osman Dadacha
CEO/Secretary/ Isiolo Municipality Board

Executive Summary

Objective of the Rapid Climate Risk Assessment

This Urban Climate Risk Profile for Isiolo County (Isiolo Municipality**)** provides a structured assessment of the municipality's key climate hazards, exposure patterns, vulnerabilities, and resulting risks to urban systems. The profile is designed as a decision-support tool to help the County Government, Municipal Board, and sector departments integrate climate risk considerations into spatial planning, infrastructure investment, land administration, and service delivery, including alignment with the CIDP, County Spatial Plan, Municipal IDeP, and ADPs. The assessment applies a rapid methodology using existing secondary data, stakeholder inputs, and GIS-informed screening to generate actionable priorities while laying groundwork for future detailed modelling.

Key Climate Hazards Identified

Five priority hazards were screened and selected based on likelihood, severity, and relevance to Isiolo municipality's urban context:

1. Extreme Heat
2. Pluvial Flooding (Urban/Flash Flooding)
3. Fluvial Flooding (River Flooding – Isiolo River influence)
4. Drought (Meteorological and Hydrological)
5. Extreme Wind and Dust Storms

Summary of Current and Future Hazard Levels

Projections indicate that climate risks will intensify toward mid-century and remain high toward end-century, driven by increasing temperatures, rainfall variability, stronger rainfall intensity events, and persistent drought cycles. The hazard assessment indicates:

- Extreme Heat: Medium currently, increasing to High in 2050 and remaining High by 2100.
- Pluvial Flooding**:** Medium currently, increasing to High by 2050 and remaining High by 2100.
- Fluvial Flooding: Medium currently, increasing to High by 2050 and remaining High by 2100.
- Drought**:** High currently and remains High through 2050 and 2100.
- Extreme Wind/Dust**:** Medium currently, Medium–High by 2050, and High by 2100.

Risk Results Summary

The climate risk matrix combining hazard likelihood and impact severity shows that the highest risks (High to Very High**)** concentrate in water security, mobility systems, economic activity areas, and vulnerable population groups. Key findings from the risk tables include:

- Extreme Heat produces High risks for water and wastewater management, transport and mobility, energy, economic infrastructure, social infrastructure, emergency services, urban residents, vulnerable groups, urban infrastructure, and periurban/Agriculture systems.

- Pluvial Flooding produces Very High risks across most infrastructure and population categories, including water and wastewater management, solid waste, transport, energy, markets/economic infrastructure, and settlements in low-lying poorly drained areas.
- Fluvial Flooding produces Very High risks for critical services and livelihoods, especially where drainage outfalls, roads/bridges, and settlements interact with riverine dynamics.
- Drought produces Very High risks for water and wastewater management, economic infrastructure, social services, emergency services, populations, urban green assets, and peri-urban production systems.
- Extreme Wind and Dust Storms generate High to Very High risks particularly for energy infrastructure, transport, solid waste management, economic infrastructure, urban residents, informal settlements, vulnerable groups, and peri-urban/agricultural systems.

Populations and Assets Most at Risk

The assessment identifies the following as most exposed and vulnerable:

- Informal settlements and riparian communities (high exposure to floods, poor housing quality, limited drainage, limited adaptive capacity). Particularly in Mabatani and Bulla Mpya Areas.
- Urban residents in dense areas **(e.g., Wabera, Bulla Pesa, Bulla Mpya)** facing heat stress, flooding, and service disruption.
- Vulnerable and marginalized groups including elderly persons, children, pregnant women, persons with disabilities, and low-income households.
- Critical infrastructure and services, especially:
    - Water supply and borehole-dependent systems- vulnerable to drought and contamination during floods.
    - Stormwater drainage networks -constrained by under sizing, blockage, and limited maintenance capacity, especially in the Isiolo urban core.
    - Transport corridors and crossings- including flood-prone internal roads and river crossings critical for local mobility i.e Kula mawe area bridge, Kambi bulle bridge and Daraja Fakir areas.
    - Energy distribution systems- vulnerable to wind damage, dust accumulation, and flood-related outages.
    - Markets and economic hubs- highly sensitive to floods, heat exposure, and dust/wind disruptions Including the open air market (soko mjinga)

Trends Likely to Intensify in the Future

The following trends are expected to increase climate risks over time:

- Rising temperatures increasing heat stress, reducing thermal recovery, and increasing cooling demand.
- Higher rainfall intensity events increasing urban flash flood frequency even where annual rainfall totals remain uncertain.
- Upstream-downstream River dynamics increasing the unpredictability of fluvial flooding in Isiolo due to rainfall in Mount Kenya and Laikipia catchments.
- Persistent drought cycles worsening water scarcity, increasing groundwater stress, and amplifying livelihood vulnerability.

- Greater wind intensity and dust generation linked to prolonged dry conditions, land degradation, and reduced vegetative cover.

Key Takeaways: What Can Be Done to Reduce High Risks

To reduce risk levels and strengthen resilience, the assessment prioritizes integrated and phased actions:

- Improve stormwater management through routine desilting, waste control (trash traps), and drainage capacity upgrades in flood hotspots within isiolo town particularly around Moti Plaza Road, Landmark area along Town Treasury Road.
- Strengthen water security through expanded and diversified supply (boreholes, storage, reuse), solar pumping, leakage control, and protection of intake points during floods.
- Enhance solid waste management to reduce drainage blockage and flood compounding, improve collection coverage, establish aggregation points, and progress toward engineered disposal site in Ngaremara, burat ward and circular economy systems.
- Climate-proof mobility and access by upgrading flood-prone road sections, improving culverts/bridges(Safi-estate prison farm), and integrating heat-shade measures for pedestrians and transport nodes through urban greening projects.
- Protect energy systems by reinforcing lines, elevating vulnerable components, and deploying distributed renewable solutions (e.g., mini-grids) for critical services.
- Reduce vulnerability in informal settlements through incremental upgrading (drainage, ventilation, access), targeted early warning, and planned relocation from the highestrisk zones such as Bulla mpya, Safi estate and shambani areas.
- Protect and restore natural buffers including riparian vegetation, floodplain management, and drought-resilient urban greening using native species.

Overall, Isiolo Municipality faces compound and intensifying climate risks driven by heat, drought, and flood hazards interacting with rapid urban growth and service gaps. Proactive, risk-sensitive planning and targeted investments can substantially reduce Very High risks and protect the most vulnerable residents while safeguarding critical infrastructure and economic activity.

Contents

List of Acronyms

Acronym	Full Meaning
CIDP	County Integrated Development Plan
GCA	Global Center on Adaptation
GIS	Geographic Information System
GoK	Government of Kenya
KMD	Kenya Meteorological Department
KNBS	Kenya National Bureau of Statistics
NCCAP	National Climate Change Action Plan
NAP	National Adaptation Plan
NDMA	National Drought Management Authority
NEMA	National Environment Management Authority
PWD	Persons with Disabilities
RCRA	Rapid Climate Risk Assessment
SPI	Standardized Precipitation Index
SSP2-4.5	Intermediate Emissions Scenario
SSP5-8.5	High Emissions Scenario

1. CONTEXT

1.1 Objective

This Urban Climate Risk Profile for Isiolo County, with a primary focus on Isiolo Municipality, seeks to provide a structured, evidence-based understanding of climate-related hazards, vulnerabilities, and risks affecting the urban system. The profile is intended to serve as a technical decision-support tool for county and municipal authorities in integrating climate risk considerations into spatial planning, infrastructure development, land administration, and sectoral investments.

Specifically, the objectives of this assessment are to:

I. Systematically identify historical and emerging climate hazards affecting Isiolo Municipality, including flooding, drought, extreme heat, strong winds, and rainfall variability.

II. Analyze exposure patterns of people, infrastructure, economic activities, and essential services to climate hazards.

III. Assess social, economic, and institutional vulnerability across wards and demographic groups.

IV. Evaluate adaptive capacity within county and municipal systems, including governance, infrastructure, and community coping mechanisms.

V. Provide a prioritized climate risk matrix to inform planning instruments such as the County Integrated Development Plan (CIDP), Municipal Integrated Development Plan (IDeP), Annual Development Plans (ADPs), and the County Spatial Plan.

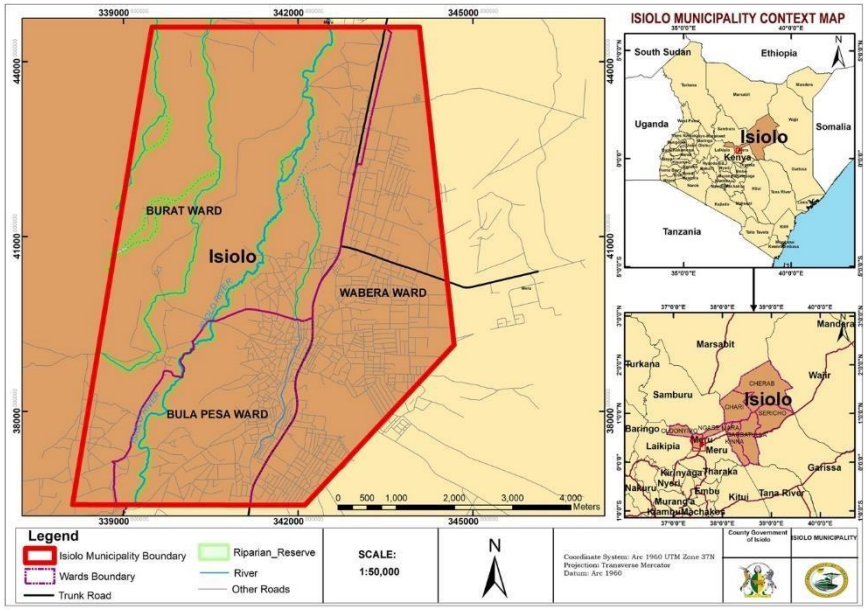
VI. Strengthen institutional coordination between county departments and national agencies responsible for climate information, disaster management, and environmental regulation.

The Rapid Climate Risk Assessment approach relies on existing secondary data, GIS-based spatial analysis, stakeholder consultations, and sector-level vulnerability screening. It is designed to provide actionable insights within a limited timeframe while laying the foundation for more detailed sectoral risk modelling in future phases.

1.2 Urban Context

The urban context of Isiolo Municipality is shaped by its strategic location within Isiolo County in northern Kenya, where it functions as the county headquarters and primary urban center along the A2 transport corridor

1.2.1 Geographic Area



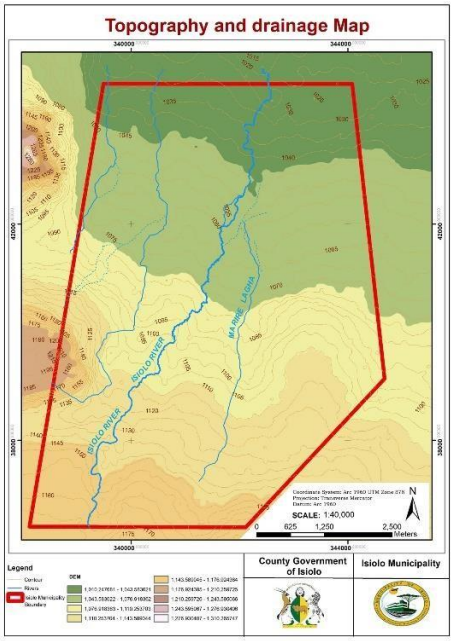
MAP 1 Geographic Context

The municipality lies approximately 285 kilometers north of Nairobi along the A2 highway, which connects central Kenya to northern Kenya and Ethiopia.

The county covers approximately 25,336 square kilometres and is characterized by arid and semi-arid lands (ASALs). However, the municipal area itself occupies approximately 40 square kilometres a relatively small but strategically significant footprint within this vast landscape. The town is situated at the confluence of several seasonal and perennial rivers, notably the Isiolo River, making it hydrologically sensitive.

1.2.1.1 Topography and Drainage

The municipality is generally flat to gently undulating, with low-lying areas adjacent to riverbanks and seasonal drainage channels. These low-lying areas are particularly prone to flash flooding during intense rainfall events. Surface runoff is often rapid due to sparse vegetation cover and compacted soils, increasing the risk of urban flooding.



MAP 2 Topography and Drainage

The hydrological dynamics of the Ewaso Nyiro Basin significantly influence flood risk patterns. During heavy rainfall upstream in Mount Kenya and Laikipia regions, downstream flooding may occur in Isiolo even when local rainfall is minimal. This upstream-downstream dynamic increases uncertainty and complicates early warning systems.

1.2.1.2 Climate Characteristics

Isiolo experiences a semi-arid climate characterized by:

- Low and highly variable annual rainfall (250–400 mm)
- Bimodal rainfall pattern (March–May and October–December)
- High inter-annual rainfall variability
- Frequent dry spells and prolonged drought periods
- High daytime temperatures often exceeding 30–35°C

Recent trends indicate:

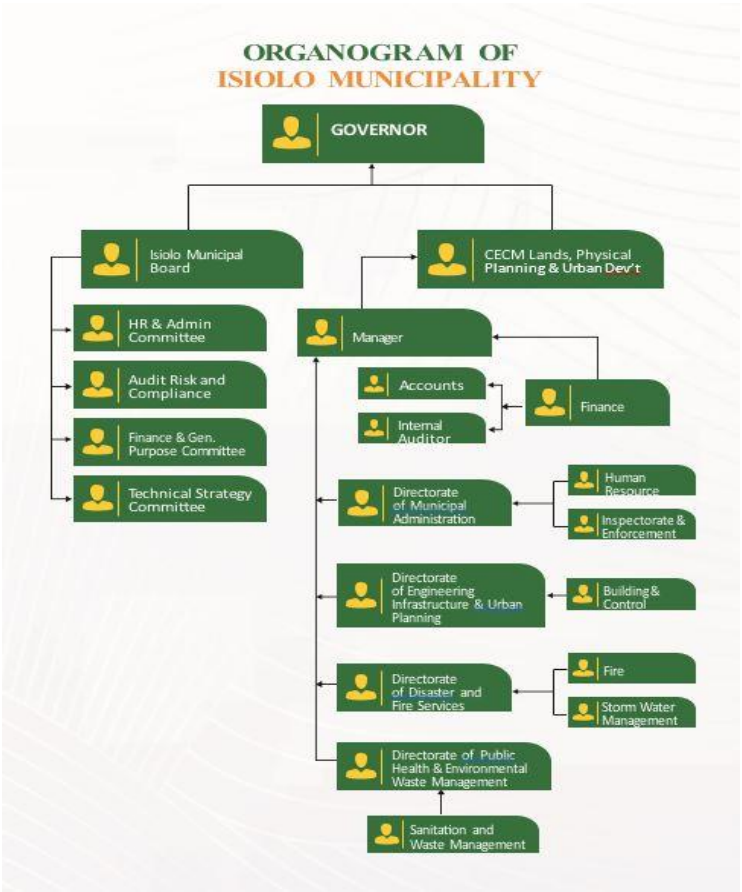
- Increased frequency of intense rainfall events leading to flash floods.
- Rising average temperatures contributing to heat stress.
- Greater unpredictability in seasonal rainfall onset and cessation.

1.2.1.3 Strategic Geographic Importance

Isiolo is considered a gateway to northern Kenya and is strategically positioned within national infrastructure corridors, including projects coordinated by the LAPSSET Corridor Development Authority. The presence of Isiolo International Airport further enhances its strategic significance.

This geographic positioning increases development pressure, urban expansion, and land-use change, thereby amplifying climate risk exposure.

1.2.2 Governance Structure



Isiolo County operates under Kenya's devolved governance framework as established by the 2010 Constitution. The county government is responsible for functions including spatial planning, water services (excluding national water works), county roads, health services, agriculture, and environmental management.

1.2.2.1 County Executive Structure

The executive arm consists of:

- The Governor
- The Deputy Governor
- County Executive Committee Members (CECs)
- Chief Officers
- Technical directorates

Climate risk management functions are distributed across several departments:

- Isiolo Municipality
- Lands, Physical Planning and Urban Development
- Water, Irrigation and Environment
- Roads, Transport and Public Works
- Health Services
- Trade and Cooperative Development

1.2.2.2 Municipal Governance

Isiolo Municipality is governed by a Municipal Board under the Urban Areas and Cities Act. The Board oversees municipal planning, service delivery coordination, and infrastructure development. The Municipal Manager heads day-to-day administration.

Planning instruments relevant to climate risk include:

- County Integrated Development Plan (CIDP)
- County Spatial Plan
- Municipal Integrated Development Plan (IDeP)
- Annual Development Plans
- Sectoral strategic plans

1.2.2.3 National-Level Coordination

Climate and environmental governance involve collaboration with national institutions such as:

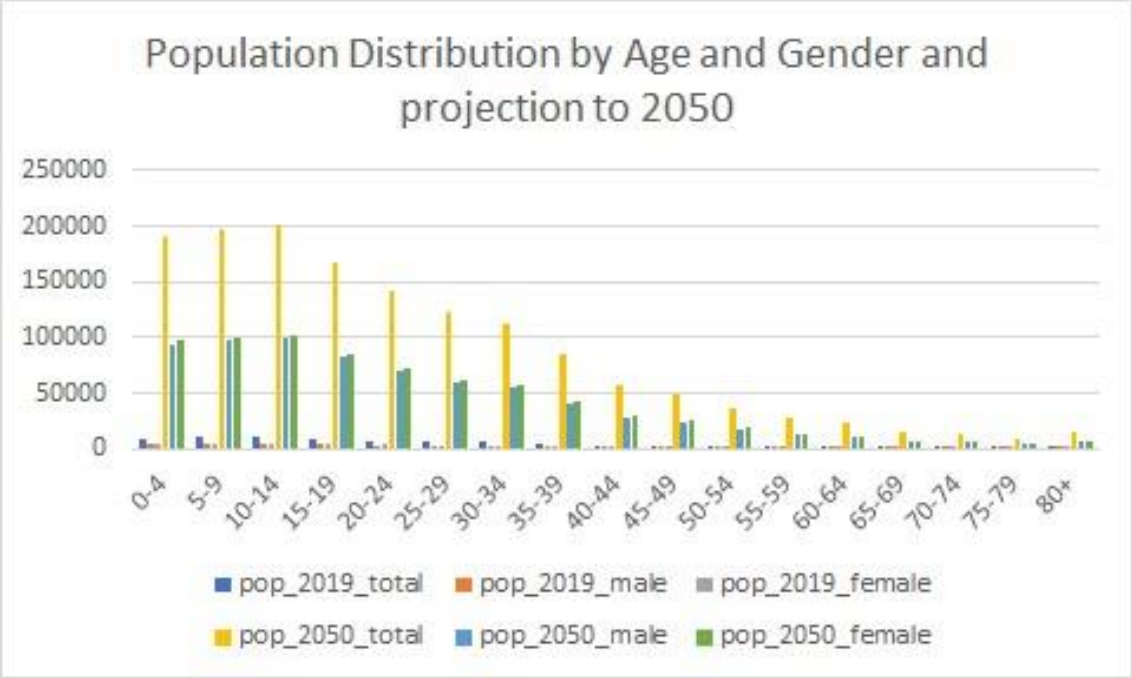
- Kenya Meteorological Department (climate data and forecasts)
- National Drought Management Authority (drought early warning and resilience programming)
- National Environment Management Authority (environmental compliance and impact assessment)

Institutional coordination remains a challenge due to overlapping mandates, limited technical capacity, and resource constraints.

1.2.3 Socio-Economic Context

Isiolo Municipality has experienced rapid demographic growth driven by rural-urban migration, infrastructure expectations, and expansion of trade networks.

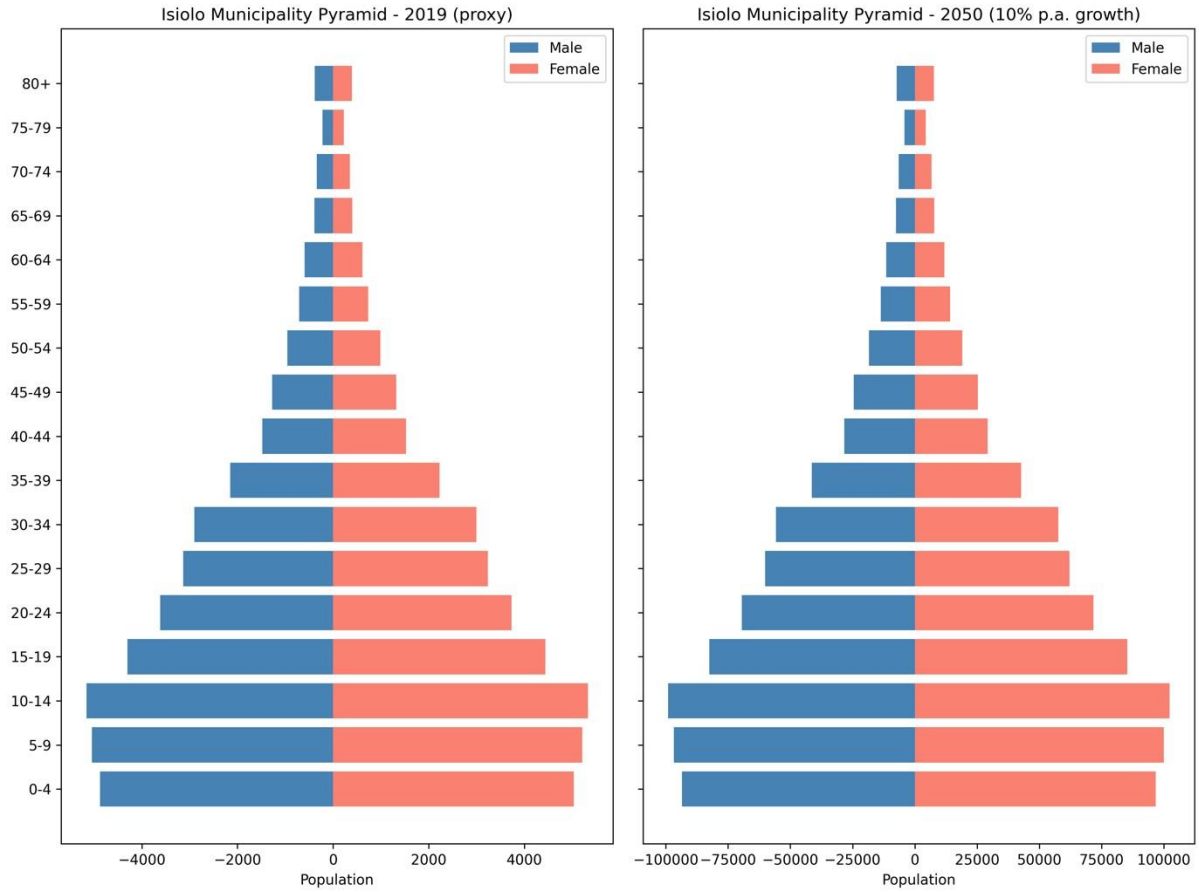
1.2.3.1 Population Structure



The Municipality exhibits a predominantly youthful demographic structure characterized by a broad population base and declining age cohorts at higher ages. Under a high-growth scenario of 10% annual increase, the municipality will experience exponential population expansion by 2050, intensifying pressure on infrastructure, housing, employment, water resources, and climate resilience systems. The persistence of a youth-dominated structure presents both an opportunity for demographic dividend and a significant governance challenge if employment creation and urban planning do not keep pace with population growth.

Population Distribution as per 2019 Census and Projection to 2050

age_group	pop_2019_total	pop_2019_male	pop_2019_female	pop_2050_total	pop_2050_male	pop_2050_female
0-4	9909	4874	5035	190197	93553	96644
5-9	10255	5045	5210	196838	96835	100003
10-14	10491	5161	5330	201368	99062	102306
15-19	8745	4302	4443	167855	82574	85280
20-24	7353	3617	3736	141136	69426	71710
25-29	6370	3134	3236	122268	60155	62113
30-34	5906	2905	3001	113362	55760	57602
35-39	4381	2155	2226	84090	41364	42727
40-44	3004	1478	1526	57660	28369	29291
45-49	2595	1277	1318	49809	24511	25298
50-54	1950	959	991	37429	18407	19022
55-59	1447	712	735	27774	13666	14108
60-64	1211	596	615	23244	11440	11805
65-69	794	391	403	15240	7505	7735
70-74	692	340	352	13282	6526	6756
75-79	448	220	228	8599	4223	4376
80+	779	383	396	14952	7351	7601
TOTAL	76330	37549	38781	1465103	720727	744377



According to the 2019 Census, Isiolo County has approximately 268,000 residents, with a significant proportion residing in and around the municipal area. The population structure is youthful, with a high dependency ratio.

Urban growth is characterized by:

- Expansion of informal settlements
- Increasing land subdivision
- Rising demand for housing
- Growth of peri-urban settlements

1.2.3.2 Vulnerable Populations Key vulnerable groups include:

- Informal settlement residents in flood-prone zones i.e Mabatani, Bulla pesa, Maisha Bora areas
- Women-headed households
- Youth engaged in informal employment
- Pastoralists transitioning to urban livelihoods in shambani, Bulla dakah and LMD
- Persons with disabilities
- Elderly populations exposed to heat stress

1.2.3.3 Social Services and Infrastructure Gaps

- Limited sewerage coverage
- Inadequate stormwater drainage systems
- Water shortages during prolonged drought
- Overstretched health facilities during climate shocks
- Poor road accessibility during heavy rainfall

Climate risks exacerbate existing socio-economic inequalities. Flood events disproportionately affect low-income households located along riparian reserves and seasonal waterways.

1.2.4 Economic Context

Isiolo's economy is primarily driven by:

- Livestock trade and pastoralism
- Retail and wholesale trade
- Public administration
- Transport and logistics services
- Informal sector activities

1.2.4.1Climate Sensitivity of Key Sectors

Livestock Sector
Highly sensitive to drought, pasture degradation, and water scarcity. Heat stress affects livestock productivity and increases mortality rates.

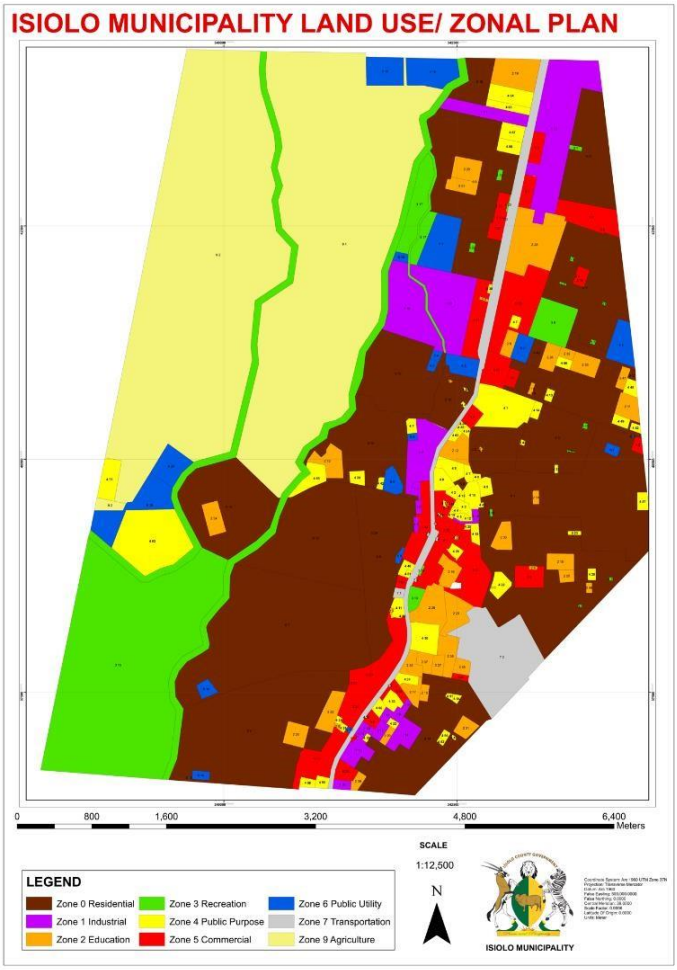
Trade and Commerce
Flooding disrupts market activities, damages goods, and restricts mobility along major transport corridors.

Transport Sector
Roads and bridges are vulnerable to washouts and erosion during heavy rainfall events. Poor drainage design increases infrastructure deterioration.

Informal Economy
Street vendors and small traders operate in open-air markets with limited shelter from extreme heat or rainfall.

Projected economic growth linked to national infrastructure corridors increases asset exposure in hazard-prone areas unless risk-sensitive land-use planning is implemented.

1.2.5 Land-Use Context



Land use within Isiolo Municipality reflects rapid urbanization without fully integrated spatial controls.

1.2.5.1 Current Land Use Patterns • High-density residential (formal and informal)

- Commercial core (Wabera)
- Institutional land (schools, hospitals, government offices)
- Transport corridors
- Riverine agriculture
- Open grazing and peri-urban land

1.2.5.2 Land-Use Pressures

- Encroachment into riparian reserves
- Informal subdivision without proper planning approvals I.e in chechelesi and kambi garba
- Settlement expansion into floodprone lowlands I,e in shambani and maisha bora.

MAP 3 Isiolo Municipality Land Use Plan • Reduction of natural vegetation cover

- Increasing impervious surfaces contributing to runoff within isiolo town, Tullu roba and Kiwanjani areas resulting from infrastructural development.

1.2.5.3 Climate-Relevant Land-Use Risks

- Settlements along the Isiolo River face recurrent flooding.
- Informal drainage channels are obstructed by solid waste.
- Urban heat intensifies due to limited green spaces.
- Road embankments disrupt natural water flow, increasing flood pooling.

Future urban expansion, if not guided by climate-informed spatial planning, may significantly increase exposure to both flooding and heat stress.

1.3 Key Stakeholders and Inclusiveness

The preparation of this Rapid Climate Risk Assessment adopts a participatory and inclusive approach to ensure that diverse voices and vulnerable groups are represented.

1.3.1Stakeholder Engagement Methods

- Technical workshops with county departments
- Ward-level public participation forums
- Key informant interviews
- GIS participatory mapping sessions
- Validation meetings with community representatives
- Sector-specific consultations (water, health, livestock, trade)

1.3.2 Inclusiveness Principles

- Gender-responsive engagement
- Youth inclusion
- Representation of informal settlement residents
- Inclusion of pastoralist voices
- Engagement with private sector actors
- Collaboration with national technical agencies

Stakeholder mapping identifies influence-interest dynamics to guide engagement intensity and communication strategies.

Stakeholder Mapping Quadrant matrix representation

	High Influence	**Low Influence**
High Interest	County Government, Municipal Board, NDMA, KMD	Community groups, traders, pastoralists
Low Interest	National regulators, investors	Peripheral vendors, absentee landowners

2.0 HAZARD ASSESSMENT

Climate hazards in Isiolo Municipality are shaped by its semi-arid climate, riverine setting, rapid urbanization, and increasing climate variability. The municipality is particularly exposed to hydro-meteorological hazards due to its location along the Ewaso Nyiro River basin and its expanding settlement footprint into low-lying and poorly drained areas. This section identifies, screens, and characterizes the most relevant climate hazards affecting the municipality and assesses their current and projected severity under different climate scenarios.

2.1 Key Climate Hazards

A hazard screening exercise was conducted using historical records, stakeholder consultations, and review of climate data from the Kenya Meteorological Department and drought early warning reports from the National Drought Management Authority.

Based on likelihood, impact magnitude, and relevance to urban systems, **five key hazards** were selected:

1. Extreme Heat
2. Pluvial (Urban/Flash) Flooding
3. Fluvial (River) Flooding
4. Drought (Meteorological & Hydrological)
5. Extreme Wind and Dust Storms

2.1.1 Hazard Screening – Isiolo Municipality

Hazard	Hazard Likely (Y/N)	Significant Impact (Y/N)	High Priority (Y/N)	Key Hazard (Y/N)
Heat Stress				
Average surface temperature increase	Y	Y	Y	Y
Extreme heat	Y	Y	Y	Y
Cold Stress	N	N	N	N
Extreme cold	N	N	N	N
Flooding				
Changes in precipitation patterns	Y	Y	Y	Y
Pluvial (flash/urban flooding)	Y	Y	Y	Y

Fluvial (river flooding)	Y	Y	Y	Y
Sea level rise	N	N	N	N
Coastal flooding	N	N	N	N
Waterlogging	Y	Y	Y	Y
Water Stress				
Drought (meteorological/hydrological)	Y	Y	Y	Y
Groundwater salinization	N	Low	N	N
Wildfire				
Wildfires & bushfires	N	Low	Low	N
Storms				
Extreme wind	Y	Y	Medium	Y
Tropical cyclones	N	N	N	N
dust storms	Y	Medium	Medium	Y
Mass Movement				
Landslides	N	N	N	N
Gully erosion	Y	Medium	Medium	N
Geophysical				
Earthquakes	Low	Medium	Low	N

2.1.2 Justification of Selected Key Hazards

Extreme Heat: Increasing temperature trends, high urban heat exposure, limited green cover, and vulnerable populations make heat stress a major concern.

Pluvial Flooding: Poor drainage infrastructure and high-intensity rainfall events cause frequent urban flooding, particularly in Wabera, Bulla Pesa, and Bulla Mpya.

Fluvial Flooding: Overflow of the Isiolo River during upstream heavy rainfall leads to recurrent inundation of riparian settlements in maisha bora and shambani.

Drought: Persistent rainfall variability severely impacts water supply, livestock productivity, and livelihoods.

Extreme Wind & Dust Storms: Dry season winds damage light structures, increase respiratory illnesses, and exacerbate soil erosion.

2.2 Climate Indicators and Hazard Thresholds

The following indicators were selected to quantify hazard levels. **2.2.1 Climate Indicators and Thresholds**

Key Hazard	Climate Indicator	Data Source	Low	Medium	High
Extreme Heat	Number of days > 35°C per year	Kenya Meteorological Department	<30 days	30–60 days	>60 days
Pluvial Flooding	Daily rainfall intensity (mm/day)	KMD rainfall stations	<40 mm	40–70 mm	>70 mm
Fluvial Flooding	River discharge level (m^3/s)	Basin hydrological data	Bankfull	10% above bankfull	20%+ above bankfull
Drought	Standardized Precipitation Index (SPI)	National Drought Management Authority	-0.5 to -1	-1 to -1.5	< -1.5
Extreme Wind	Maximum wind speed (km/h)	KMD	<40 km/h	40–60 km/h	>60 km/h

2.3 Current Hazard Levels and Climate Projections

2.3.1 Historical Trends

Over the past three decades, Isiolo Municipality has experienced:

- Increasing frequency of high-intensity rainfall events.
- More prolonged dry spells between rainy seasons.
- Gradual increase in mean annual temperature.
- Recurrent drought cycles (approximately every 2–3 years).
- Severe flood events linked to El Niño years.

Heat trends indicate rising nighttime minimum temperatures, reducing thermal recovery and increasing health risks. Rainfall trends show greater variability rather than consistent increases in total rainfall.

Climate projections under SSP2-4.5 (moderate emissions) and SSP5-8.5 (high emissions) indicate:

- Continued temperature rise of 1.5–3.5°C by 2050.
- Increased rainfall intensity despite uncertain total annual rainfall.

- More extreme drought cycles.
- Amplified hydrological variability.

2.3.2 Current and Future Hazard Levels – Isiolo Municipality

Hazard	Current (Baseline)	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Extreme Heat	Medium	High	High	High	High
Pluvial Flooding	Medium	High	High	High	High
Fluvial Flooding	Medium	High	High	High	High
Drought	High	High	High	High	High
Extreme Wind/Dust	Medium	Medium	High	High	High

2.3.3 Interpretation of Hazard Levels

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

By 2050 under high emissions, extreme heat and drought are expected to reach very high levels, significantly affecting water systems and public health. Flood intensity is projected to increase due to extreme rainfall events.

2.4 Current and Future Hazard Impact Areas

2.4.1. Extreme Heat Impact Areas

- High-density settlements in Wabera and Bulla Pesa
- Informal housing with corrugated iron roofing in Mabatini area
- Market areas and bus parks (soko mjinga, Westgate)
- Areas with limited tree cover especially within the isiolo Urban core.

2.4.2. Pluvial Flooding Impact Areas

- Poorly drained sections of Wabera CBD
- Poorly Drained areas Near prison Farm in Bulla Pesa area.
- Informal settlements in Bulla Mpya, mabatini and
- Road intersections with blocked culverts
- Low-lying residential plots

2.4.3. Fluvial Flooding Impact Areas

- Riparian settlements along Isiolo River
- Riverine agricultural zones
- Bridges and low-water crossings along isiolo river particularly in Maisha Bora and Shambani areas

2.4.4. Drought Impact Areas

- Peri-urban livestock zones (Burat ward) particularly in LMD and shambani.
- Borehole-dependent neighborhoods in chechelesi and Kambi garba.
- Water trucking supply chains in shambani and Mwangaza.

2.4.5. Extreme Wind Impact Areas

- Temporary and semi-permanent housing
- Open markets
- Construction zones • Isiolo Town – Urban core.

2.4.6 Hazard Overlap Zones

Areas along riparian corridors face combined flood and heat risks. Informal settlements face compound risks of:

- Flood damage
- Heat stress
- Water scarcity
- Wind damage

These overlapping hazards increase vulnerability and reduce recovery capacity.

3. 0 EXPOSURE & VULNERABILITY ASSESSMENT

This section evaluates how climate hazards interact with urban systems in Isiolo Municipality by examining exposure (what lies within hazard footprints) and vulnerability (how sensitive and adaptive those elements are). The analysis considers physical infrastructure, populations, economic systems, and natural assets. Exposure is spatially assessed using ward-level hazard overlays, while vulnerability reflects structural integrity, socio-economic conditions, governance capacity, and service reliability.

3.1 Urban Elements Inventory – Isiolo Municipality

3.1.1 Urban Elements Inventory

Category	Subcategory	Included in RCRA	GIS Available	Description
Stormwater Drainage	Drainage conveyance network	Y	Partial	Open channels in Wabera & Bulla Pesa; limited culverts; mostly undersized and unlined
	Stormwater storage	Y	No	No engineered retention ponds; natural depressions act as temporary storage
Water & Wastewater	Groundwater abstraction	Y	Yes	Boreholes in Burat & periurban wards supplying town water
	Water supply networks	Y	Partial	Piped distribution in CBD; limited coverage in informal areas

	Sewer networks	Y	No	Minimal sewer coverage; reliance on septic tanks
	Wastewater treatment	Y	No	No major centralized WWTP; localized septic systems
Solid Waste	Dump sites	Y	Yes	Open dumping areas near town periphery
	Collection fleet	Y	No	Limited municipal trucks
Transport	Road networks	Y	Yes	A2 highway; internal gravel roads; flood-prone crossings
	Bridges	Y	Yes	River crossings over Ewaso Nyiro River
	Bus parks/terminals	Y	Yes	Main bus park in Wabera
Energy	Power lines & substations	Y	Partial	Overhead lines; exposed transformers
	Streetlighting	Y	Partial	Concentrated in CBD
Economic	Markets	Y	Yes	Isiolo Main Market; livestock markets
	Commercial hubs	Y	Yes	Wabera CBD

Social	Schools	Y	Yes	Primary & secondary schools across wards
	Health facilities	Y	Yes	Isiolo County Referral Hospital; dispensaries
	Government buildings	Y	Yes	County HQ, municipal offices
Emergency	Fire station	Y	Yes	Single station in CBD
	Police stations	Y	Yes	Central police station
Populations	Urban residents	Y	Yes	Dense CBD & peri-urban settlements
	Informal settlements	Y	Partial	Bulla Mpya & riverine zones
Natural Assets	Rivers & riparian zones	Y	Yes	Ewaso Nyiro riparian corridor
	Urban agriculture	Y	Yes	Riverine farming plots
	Rangelands	Y	Yes	Peri-urban grazing land

3.2 Exposure, Vulnerability & Impact by Hazard

3.2.1 Hazard-1: Extreme Heat

Key Impact Pattern: Urban heat island + prolonged heatwaves

Category	Exposure	Exposure Level	Vulnerability	Vulnerability Level	Impact
Stormwater Drainage	Open concrete channels exposed to direct sunlight	Medium	Sensitivity: thermal cracking; evaporation	Medium	Moderate
Water Supply	Boreholes & tanks exposed to high evapotranspiration	Medium	Sensitivity: high demand surge; limited storage	High	Major
Transport	Asphalt roads soften; pedestrians exposed	High	Limited shading; no heat-resilient pavement	High	Catastrophic
Energy	Transformers overheat	Medium	Aging infrastructure; limited redundancy	High	Major
Markets	Open-air trading areas	High	No shading; informal structures	High	Catastrophic
Health Facilities	Increased heatrelated illness	High	Limited cooling capacity	Medium	Major
Urban Residents	Dense housing with iron sheet roofs	High	High sensitivity; low cooling access	High	Catastrophic
Informal Settlements	Poor ventilation; overcrowding	High	Very high sensitivity; low adaptive capacity	High	Catastrophic
Urban Green Infra	Sparse tree cover	Low	Limited irrigation	Medium	Minor
Blue Infrastructure	River flow reduces during heat	Medium	Dependent on upstream rainfall	High	Major

3.2.2 Hazard-2: Pluvial (Urban/Flash) Flooding

Key Impact Pattern: Intense rainfall overwhelming drainage

Category	Exposure	Exposure Level	Vulnerability	Vulnerability Level	Impact
Stormwater Drainage	Undersized culverts	Low	Blocked by solid waste	High	Moderate
Road Network	Flooded intersections in Wabera	Low	Gravel roads easily eroded	High	Moderate
Markets	Ground-level stalls inundated	Low	No elevation or flood barriers	High	Moderate
Health Facilities	Access roads flooded	Medium	Limited alternate access	Medium	Moderate
Energy	Low-mounted transformers	Medium	Water damage risk	High	Major
Urban Residents	Flood pooling in low-lying areas	Low	Informal drainage obstruction	High	Moderate
Informal Settlements	Built in drainage paths	Low	Very high sensitivity	High	Moderate
Solid Waste	Dump sites washed downstream	Medium	Open dumping practices	High	Major
Riparian Zones	Sediment overload	Medium	Already degraded	Medium	Moderate

3.2.3 Hazard-3: Fluvial Flooding (River Flooding)

Key Impact Pattern: Overflow of Ewaso Nyiro River

Category	Exposure	Exposure Level	Vulnerability	Vulnerability Level	Impact
Bridges	River crossings overtopped	Medium	Structural fatigue	High	Major
Riparian Settlements	Located within floodplain	Low	High structural fragility	High	Moderate
Urban Agriculture	Located along riverbanks	Low	Direct inundation	High	Moderate
Road Network	Washed-out low water crossings	Medium	Limited redundancy	High	Major
Water Infrastructure	River intake contamination	Medium	Limited treatment redundancy	High	Major

Emergency Services	Access disrupted	Medium	Single central fire station	Medium	Moderate
Urban Residents	Floodplain housing	Low	Limited insurance & relocation options	High	Moderate

3.2.4 Hazard-4: Drought

Key Impact Pattern: Water scarcity & livelihood stress

Category	Exposure	Exposure Level	Vulnerability	Vulnerability Level	Impact
Water Supply	Boreholes stressed	Low	High dependence on groundwater	High	Moderate
Urban Residents	Water rationing	Low	Limited household storage	High	Moderate
Livestock Areas	Pasture degradation	Low	Pastoral livelihoods highly climatesensitive	High	Moderate
Markets	Reduced livestock trade	Medium	Income variability	High	Major
Health	Malnutrition risk	Medium	Vulnerable children & elderly	High	Major
Urban Green Infra	Vegetation die-off	Medium	No irrigation system	Medium	Moderate

3.2.5 Hazard-5: Extreme Wind & Dust Storms

Key Impact Pattern: Structural damage + air quality issues

Category	Exposure	Exposure Level	Vulnerability	Vulnerability Level	Impact
Energy	Overhead power lines exposed	Medium	Poles unreinforced	High	Major
Markets	Temporary roofing uplift	Low	Informal structures	High	Moderate
Urban Residents	Dust inhalation	Medium	Limited respiratory protection	Medium	Moderate
Health Facilities	Increased respiratory cases	Medium	Limited surge capacity	Medium	Moderate

Transport	Reduced visibility	Medium	No wind barriers	Medium	Moderate
Urban Green Infra	Tree uprooting	Medium	Sparse deeprooted vegetation	Medium	Moderate

3.3. Overall Observations

- Extreme Heat- presents the most catastrophic impacts, especially for dense settlements and informal housing.
- Flooding (pluvial & fluvial) - causes moderate-to-major infrastructure disruption, particularly transport and markets.
- Drought -severely affects water systems and economic stability, particularly livestock trade.
- Extreme wind - causes infrastructure and public health stress but generally localized moderate impacts.

Compound risk zones include:

- Riparian informal settlements (heat + flood + drought stress)
- Wabera CBD (heat + pluvial flood)
- Peri-urban Burat (drought + wind + livestock vulnerability)

4.0 Climate Risk Assessment

Not all climate hazards affect Isiolo County (Isiolo Municipality) in the same way. Some occur frequently but cause limited disruption. Others may happen less often but, when they do, they severely disrupt livelihoods, services and infrastructure. To make informed decisions, we must therefore look not only at how likely a hazard is, but also at how serious its consequences would be.

The risk matrix in this section brings these two dimensions together: **hazard level** (how intense or frequent the event is) and **impact level** (how severely it affects people, infrastructure and services). By combining them, we are able to determine the overall level of risk ranging from *Very Low* to *Very High*.

For example, a high-level hazard such as drought, when combined with major impacts on water supply and livelihoods, results in a **Very High risk**, requiring urgent and coordinated action. Similarly, intense rainfall events that intersect with undersized drainage systems elevate pluvial flooding risks to high or very high levels. On the other hand, hazards with moderate impacts may fall into medium or low risk categories, where management and monitoring are sufficient.

This structured approach helps us move beyond general concern and toward clear priorities. It tells us where immediate investment is needed, where systems must be strengthened and where risks can be managed through routine maintenance and monitoring.

For Isiolo Municipality, the matrix provides a transparent and practical decision-making tool ensuring that resources are directed to the areas of greatest need and that resilience-building efforts are proportional to the level of risk. Ultimately, it supports smarter planning, safer infrastructure and better protection for our communities.

For this Urban Climate Risk Profile, the following matrix summarizes overall risk for each urban element by combining the assessed hazard level and the estimated impact level. ***Risk matrix table***

		Hazard Leve		
		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.

Interpretation of risk levels table

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

4.1.1. Extreme heat risks for isiolo municipality

	Time Horizon & Climate Scenario	**Current**	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
	Hazard Level	Medium	High	High	High	High
				Risk Levels		
Categories	**Impact**	**Current**	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Storm water Drainage	Moderate	Medium	High	High	High	High
Water & Wastewater Management	Major	High	Very high	Very high	Very high	Very high
Solid Waste Management	Moderate	Medium	High	High	High	High
Transport and Mobility	Major	High	Very high	Very high	Very high	Very high
Energy	Major	High	Very high	Very high	Very high	Very high
Economic Infrastructure	Major	High	Very high	Very high	Very high	Very high
Social Infrastructure	Major	High	Very high	Very high	Very high	Very high
Emergency Services	Major	High	Very high	Very high	Very high	Very high
Urban Residents	Major	High	Very high	Very high	Very high	Very high
Informal Settlement Residents	Moderate	Medium	High	High	High	High

Vulnerable and Marginalized Groups	Major	High	Very high	Very high	Very high	Very high
Urban Green Infrastructure	Moderate	Medium	high	high	High	High
Urban Blue Infrastructure	Major	High	Very high	Very high	Very high	Very high
Peri-urban and Agricultural Systems	Major	High	Very high	Very high	Very high	Very high

4.1.2 Pluvial flooding risks for Isiolo Municipality

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

Informal Settlement Residents	Major	High	Very high	Very high	Very high	Very high
Vulnerable and Marginalized Groups	Major	High	Very high	Very high	Very high	Very high
Natural Assets						
Urban Green Infrastructure	Moderate	Medium	high	high	High	High
Urban Blue Infrastructure	Major	High	Very high	Very high	Very high	Very high
Peri-urban and Agricultural Systems	Major	High	Very high	Very high	Very high	Very high

4.1.3. Fluvial flooding risks for isiolo municipality

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

Urban Residents	Major	High	Very high	Very high	Very high	Very high
Informal Settlement Residents	Major	High	Very high	Very high	Very high	Very high
Vulnerable and Marginalized Groups	Major	High	Very high	Very high	Very high	Very high
Natural Assets						
Urban Green Infrastructure	Moderate	High	High	High	High	High
Urban Blue Infrastructure	Major	High	Very high	Very high	Very high	Very high
Peri-urban and Agricultural Systems	Major	High	Very high	Very high	Very high	Very high

4.1.4 Drought risks for Isiolo Municipality

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

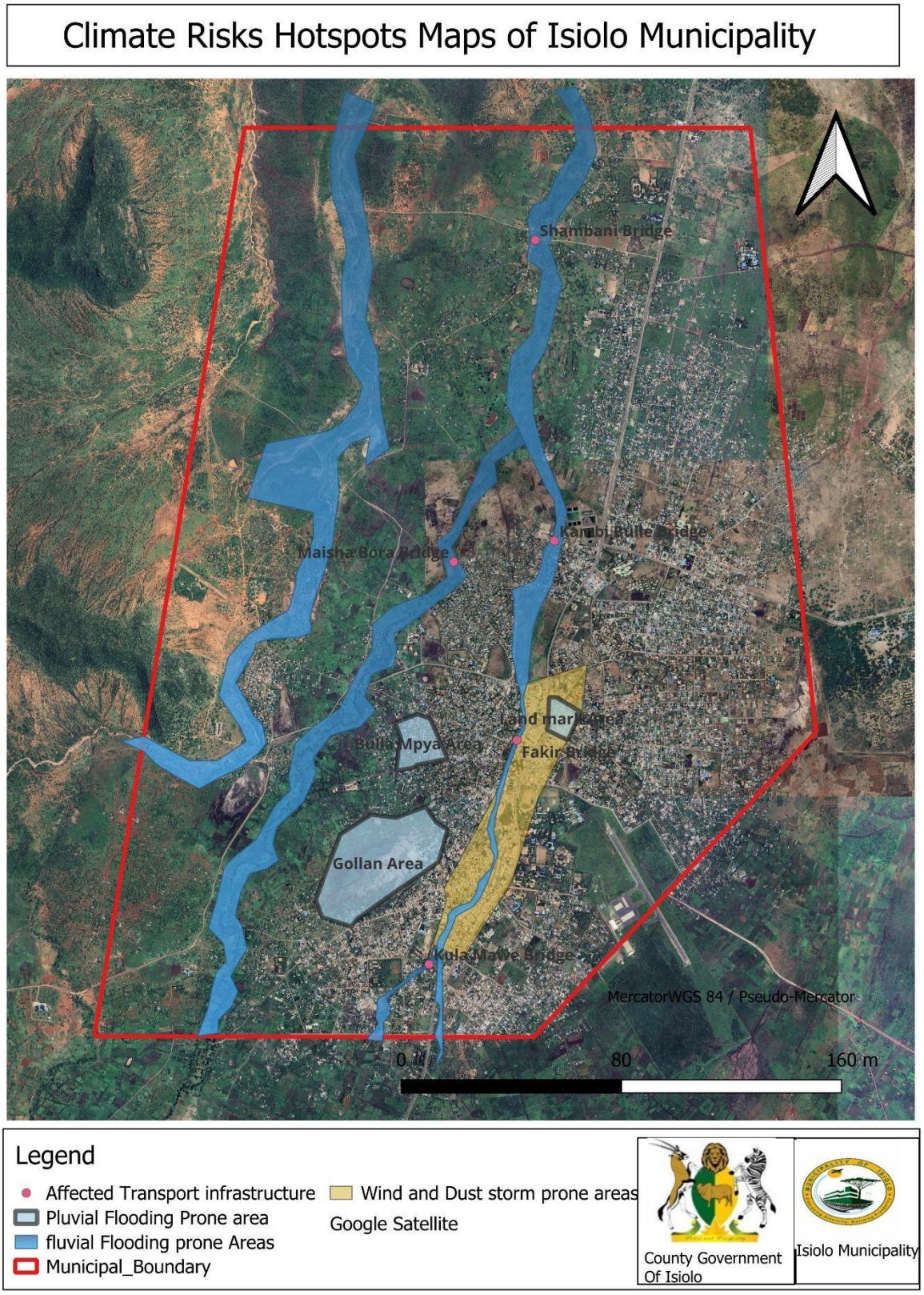
Populations						
Urban Residents	Major	Very high	Very high	Very high	Very high	Very high
Informal Settlement Residents	Major	Very high	Very high	Very high	Very high	Very high
Vulnerable and Marginalized Groups	Major	Very high	Very high	Very high	Very high	Very high
Natural Assets						
Urban Green Infrastructure	Major	Very high	Very high	Very high	Very high	Very high
Urban Blue Infrastructure	Major	Very high	Very high	Very high	Verry high	Very high
Peri-urban and Agricultural Systems	Major	Very high	Very high	Very high	Very high	Very high

4.1.5 Extreme wind and dust storms risks for Isiolo municipality

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

Energy	Major	High	High	Very high	Very high	Very high
Economic Infrastructure	Major	High	High	Very high	Very high	Very high
Social Infrastructure	Moderate	Medium	Medium	High	High	High
Emergency Services	Moderate	Medium	Medium	High	High	High
Populations						
Urban Residents	Major	High	High	Very high	Very high	Very high
Informal Settlement Residents	Major	High	High	Very high	Very high	Very high
Vulnerable and Marginalized Groups	Major	High	High	Very high	Very high	Very high
Natural Assets						
Urban Green Infrastructure	Major	High	High	Very high	Very high	Very high
Urban Blue Infrastructure	Moderate	Medium	Medium	High	High	High
Peri-urban and Agricultural Systems	Major	High	High	Very high	Very high	Very high

4.2 Climate Risk Hotspots



MAP 4 Climate Risk Hotspot

Across Isiolo Municipality, the impacts of climate hazards are unevenly felt, with certain neighbourhoods repeatedly bearing the greatest burden. Some areas experience flooding more

often, others struggle more with extreme heat, and some face persistent water stress during drought periods. These patterns are shaped by location, land use, infrastructure quality, and socio-economic conditions. What this assessment shows clearly is that **risk has "hotspots"**: places where floods, heat, drought, and dust storms keep colliding with daily life and alreadystressed services.

Hotspot 1: The urban core (Wabera CBD and nearby areas)

This is where Isiolo is busiest—markets, transport hubs, shops, offices, and high pedestrian movement. It is also where **heat stress is strongest** because buildings and paved surfaces trap heat and there are limited cooling spaces and trees. When heavy rain falls, the same built-up surfaces produce fast runoff, and **pluvial flooding** happens quickly where drains are blocked or too small. For many people, the impact is immediate: movement becomes difficult, business slows down, and access to services is disrupted.

Hotspot 2: Dense settlements and informal areas (e.g., Bulla Pesa, Bulla Mpya and similar zones)

These areas face the toughest combination of challenges. During heatwaves, homes with ironsheet roofs become extremely hot. During intense rainfall, water pools in low-lying spaces and follows informal drainage paths. And when drought hits, water becomes expensive and harder to access. In these settlements, even a "small" climate shock can become a major household crisis because people have fewer savings, fewer safe alternatives, and weaker infrastructure around them. This is why the assessment consistently shows **high to very high risks** here— especially for health, sanitation, housing safety, and livelihoods.

Hotspot 3: River and riparian zones (Ewaso Nyiro/Isiolo River corridors, crossings, and nearby settlements)

Along the river, the key risk is **fluvial flooding**. When it rains heavily upstream, river levels can rise quickly—even when Isiolo itself has not received much rainfall. In these areas, floods can cut off access routes, damage crossings, erode riverbanks, and affect farms or homes close to the floodplain. Communities living near the river often face uncertainty because floods can come suddenly, and recovery can be slow when infrastructure and housing are fragile.

Hotspot 4: Peri-urban areas and livelihood zones (notably Burat and surrounding grazing/farming zones)

In peri-urban Isiolo, **drought is the main pressure**. When rains fail, water sources reduce, boreholes are strained, pasture declines, and livestock productivity drops—affecting food security and incomes. Strong **winds and dust storms** add another layer of hardship: poor air quality increases respiratory illness, dust affects equipment and solar systems, and visibility problems disrupt movement on roads. These impacts are especially hard on households that depend on livestock and small-scale farming.

Hotspots that cut across the whole municipality

Some risks show up as "problem corridors" across multiple wards:

- **Key roads and crossings** that get cut off during floods

- **Drainage chokepoints** where blockage causes repeated flooding downstream
- **Borehole-dependent areas** where drought quickly becomes a service delivery emergency

What changes in the future (2050 and 2100)

The hotspots do not disappear—they intensify. By mid-century and beyond, **heat becomes more widespread**, **flood events become more disruptive where drainage remains weak**, and **drought stress becomes more persistent**, especially for water supply systems and periurban livelihoods. The biggest concern is **compound risk zones**—places where heat, flooding, drought, and weak services overlap—because people there have the hardest time recovering before the next shock arrives.

5.0. What's Next?

5.1 Key Findings

5.1.1Summary of climate risks affecting urban elements for Isiolo Municipality

	List of Key Hazards		
Category	**Current**	**Mid-term (2050)**	**Long-term (2100)**
Stormwater Drainage	Pluvial Flooding	Pluvial, Fluvial Flooding	Pluvial, Fluvial Flooding
Water & Wastewater Management	Drought, Fluvial Flooding	Drought, Fluvial Flooding	Drought, Fluvial Flooding
Solid Waste Management	Pluvial Flooding, Wind/Dust	Pluvial Flooding, Wind/Dust	Pluvial Flooding, Wind/Dust
Transport and Mobility	Pluvial Flooding, Fluvial Flooding, Wind/Dust	Pluvial, Fluvial, Wind/Dust	Pluvial, Fluvial, Wind/Dust
Energy	Fluvial Flooding, Wind/Dust	Fluvial Flooding, Wind/Dust	Fluvial Flooding, Wind/Dust
Economic Infrastructure	Drought, Fluvial Flooding, Wind/Dust	Drought, Fluvial Flooding, Wind/Dust	Drought, Fluvial Flooding, Wind/Dust
Social Infrastructure	Drought, Fluvial Flooding	Drought, Fluvial Flooding	Drought, Fluvial Flooding
Emergency Services	Drought, Fluvial Flooding	Drought, Fluvial Flooding	Drought, Fluvial Flooding
Populations			
Urban Residents	Drought, Pluvial, Fluvial, Wind/Dust	Drought, Pluvial, Fluvial, Wind/Dust	Drought, Pluvial, Fluvial, Wind/Dust

Informal Settlement Residents	Drought, Pluvial, Fluvial, Wind/Dust	Drought, Pluvial, Fluvial, Wind/Dust	Drought, Pluvial, Fluvial, Wind/Dust
Vulnerable and Marginalized Groups	Drought, Pluvial,	Drought, Pluvial,	Drought, Pluvial,
	Fluvial, Wind/Dust	Fluvial, Wind/Dust	Fluvial, Wind/Dust
Natural Assets			
Urban Green Infrastructure	Drought, Wind/Dust	Drought, Wind/Dust	Drought, Wind/Dust
Urban Blue Infrastructure	Drought, Fluvial Flooding	Drought, Fluvial Flooding	Drought, Fluvial Flooding
Peri-urban and Agricultural Systems	Drought, Fluvial Flooding, Wind/Dust	Drought, Fluvial Flooding, Wind/Dust	Drought, Fluvial Flooding, Wind/Dust

5.1.2 Main Takeaways

1. **Water resilience must be the top priority.**
   Drought and flooding together create sustained Very High risks for water supply and wastewater systems across all time horizons.
2. **Flood management is central to protecting mobility and economic activity.**
   Pluvial and fluvial flooding threaten roads, markets, and essential services—especially in dense and low-lying areas.
3. **Heat is a growing public health and productivity issue.**
   Urban heat exposure is already significant and will intensify, particularly in densely built-up neighborhoods.
4. **Vulnerability drives risk as much as hazard intensity.**
   Informal settlements and marginalized groups face repeated exposure with limited recovery capacity.
5. **Natural assets are both protective and vulnerable.**
   Riparian zones, urban vegetation, and peri-urban landscapes play a buffering role— but are themselves highly exposed to drought and flood pressures.
6. **Without intervention, High and Very High risks will persist.**
   Projections indicate that many risks remain elevated through 2050 and 2100 unless proactive adaptation measures are implemented.

5.2. Climate Adaptation and Resilience Solutions

5.2.1 Climate Adaptation and Resilience Solutions — Recommended Solutions

CATEGORY	RECOMMENDED SOLUTIONS		
	Immediate	**Mid-term**	**Long-term**
Infrastructure & Services			
Storm water Drainage	• Sediment removal and clearing blocked culverts and open channels	• Increasing culvert capacity and implementing modular storm water drainage systems • Installation of trash traps and routine maintenance programs	• Transition to climate-resilient drainage systems • Integrated watershed-based urban flood management master plan
Water & Wastewater Management	• Emergency water storage tanks and rationing protocols • Leak detection and rapid repair campaigns	• Expansion of borehole capacity and solarpowered pumping • Wastewater reuse for irrigation	• Diversified water supply (surface + groundwater + reuse) • Climate-resilient water treatment plants with redundancy and smart monitoring
Solid Waste Management	• Emergency waste collection in floodprone areas • Public awareness campaigns on drainage blockage prevention	• Establishment of decentralized waste aggregation points within the municipality • Community-based waste segregation awareness campaigns and programs	• Engineered sanitary landfill and circular economy systems (recycling, composting) • Implementation of smart waste management tracking technologies

Transport and Mobility	• Construction of shaded motorcycle staging and parking infrastructure • Emergency repair of eroded and flood- damaged roads	•Use of Climate-resilient pavement materials and road elevation in flood hotspots Provision of shaded public seating amenities along pedestrian walkways	• Integrated climate-resilient transport network with redundancy • Smart mobility planning incorporating heat and flood risk modelling
Energy	• Temporary reinforcement of vulnerable power lines	• Elevation of substations in flood-prone zones • Distributed renewable energy (solar mini-grids for critical services)	• Urban renewable energy transition strategy
Economic Infrastructure (e.g., Markets)	• Temporary shading structures and water access points in markets • Emergency livelihood support during climate shocks	• Climate-resilient market redesign (raised platforms, drainage, roofing) • Micro-insurance and business continuity training for traders	• Relocation or redevelopment of high-risk markets • Climate-proof value chains and cold storage infrastructure
Social Infrastructure (Health, Education)	• Cooling measures in health facilities (fans, ventilation, shading) • Heat-health awareness campaigns	• Retrofitting buildings with passive cooling and backup energy systems • Flood-resilient access roads to health facilities	• Climate-resilient public building codes and green building standards • Expanded healthcare capacity for climate-related diseases
Emergency Services	• Early warning dissemination for floods, heat waves, and storms • Emergency response training and equipment upgrades	• Decentralized emergency response units and evacuation planning • Climate risk mapping and communication systems	• Integrated disaster risk management system with predictive analytics • Climate-resilient emergency infrastructure and logistics hubs
Populations			

Urban Residents	•Public awareness Campaigns on heat safety guidance	• Household rainwater harvesting promotion • Community cooling centers and tree planting campaigns	• Climate-resilient housing programs and building regulations • Urban planning reforms reducing heat exposure and flood risk
Informal Settlement Residents	• Drainage clearance campaigns and temporary flood barriers • Emergency shelter and health outreach during extreme events	• Incremental settlement upgrading (ventilation, drainage, road access) • Secure tenure initiatives to enable adaptation investments	• Planned relocation from high-risk zones with livelihood support • Inclusive climate-resilient housing developments
Vulnerable and Marginalized Groups	• Targeted social protection during climate shocks • Mobile health and nutrition services	• Livelihood diversification programs and climate insurance • Community-based adaptation training	• Long-term poverty reduction and resilience-building programs • Inclusive climate governance and participation frameworks
Natural Assets			
Urban Green Infrastructure	• Rapid tree planting in heat hotspots • Protection of existing vegetation	• Development of irrigated urban parks and green corridors • Promotion of drought-resistant native species	• Urban forest strategy integrated into land-use planning • Green infrastructure networks for microclimate regulation
Urban Blue Infrastructure	• Riverbank stabilization and debris removal • Protection of water intake points during floods	• Restoration of riparian buffers along the Isiolo River • Creation of detention ponds and wetlands	• Integrated river basin management and floodplain zoning enforcement • Urban water-sensitive design integrated into planning frameworks

Peri-urban and Agricultural Systems	• Emergency livestock water and fodder support • Farmer advisories on drought coping practices	• Climate-smart agriculture training and irrigation expansion • Livestock diversification and market access improvements	• Integrated peri-urban food systems with resilient value chains • Landscape-scale rangeland restoration and water harvesting systems

lmplementation Matrix for Isiolo Municipality Rapid Climate Risk Assessment

Climate Risk	Strategic Objective	Proposed Intervention/Action	Lead Implementing Agency	Supporting Institutions	Timeframe	Estimated Resources	Monitoring Indicators
Urban Flooding during Intense Rainfall	Reduce flood risk in flood-prone areas within Isiolo Municipality	Develop and implement an integrated urban drainage system including stormwater channels and culverts	Isiolo Municipality	County Department of Roads & Public Works, Kenya Urban Roads Authority (KURA), National Government	Short–Medium Term (1–5 years)	High	Number of drainage systems constructed; reduction in flood incidents
		Rehabilitation and desilting of existing drainage infrastructure	Municipality	Public Works Department	Short Term (1–2 years)	Medium	Kilometers of drainage cleared
		Flood risk mapping and zoning of flood-prone areas	County Department of Lands & Physical Planning	National Land Commission, Survey Department	Short Term	Medium	Updated flood hazard maps produced
		Enforcement of land-use regulations preventing development in flood-prone zones	County Government	NEMA, Physical Planning Department	Continuous	Low	Number of illegal developments controlled
		Establish community early warning systems for heavy rainfall events	NDMA	Kenya Meteorological Department	Short Term	Medium	Operational early warning systems

Extreme Heat / Heat Stress	Enhance resilience of urban population to extreme heat	Promote urban greening initiatives including tree planting along streets and public spaces	Municipality	Kenya Forest Service, Community Groups	Medium Term	Medium	Number of trees planted
		Encourage climate-sensitive urban design including shaded walkways and reflective roofing	County Physical Planning Department	Developers, NCA	Medium–Long Term	Medium	Adoption of climate-smart building designs
		Public awareness programs on heat-related health risks	County Health Department	Red Cross, NGOs	Short Term	Low	Community awareness campaigns conducted
Strong Winds and Dust Storms	Reduce infrastructure damage and environmental degradation caused by wind	Establish windbreaks and vegetation buffers around settlement edges	County Environment Department	Community Associations	Medium Term	Medium	Vegetation buffers established
		Strengthen building standards to ensure wind-resistant construction	County Planning Department	National Construction Authority	Medium Term	Medium	Compliance with building codes
Poor Road Connectivity During Rainy Seasons	Improve all-weather accessibility within the municipality	Upgrade key access roads to all-weather standards (graveling, drainage improvement)	County Department of Roads	Kenya Rural Roads Authority (KeRRA), KURA	Medium Term	High	Kilometers of roads upgraded
		Regular maintenance of	Municipality	County Public Works	Continuous	Medium	Reduced road closure incidents

		roads and drainage systems					
Water Scarcity During Dry Periods	Enhance sustainable water supply systems	Expand water supply infrastructure including boreholes and storage facilities	Isiolo Water and Sewerage Company (IWASCO)	County Government, Water Resources Authority	Medium Term	High	Increased water supply capacity
		Promote rainwater harvesting in households and public institutions	Municipality	NGOs, Community Groups	Short–Medium Term	Medium	Number of rainwater harvesting systems installed
		Develop drought contingency planning for urban water supply	NDMA	Water Resources Authority	Short Term	Medium	Operational drought response plans
Urban Environmental Degradation	Improve ecosystem resilience and environmental management	Restore degraded riparian areas along seasonal rivers	County Environment Department	NEMA, Community Groups	Medium Term	Medium	Riparian zones restored
		Promote solid waste management systems to prevent drainage blockage	Municipality	Private waste collectors	Short Term	Medium	Reduction in waste accumulation
Public Health Risks from Climate Variability	Strengthen climate-resilient health systems	Improve sanitation and drainage in informal settlements	County Health Department	Municipality	Medium Term	Medium	Improved sanitation coverage
		Disease surveillance and early response	County Health Department	Ministry of Health	Continuous	Medium	Reduced disease outbreaks

		systems for climate-sensitive diseases					

Cross-Cutting Implementation Actions

Action	Responsible Institution	Timeline	Indicator
Establish a **Municipal Climate Change Coordination Unit**	Isiolo Municipality	Short Term	Unit established
Integrate climate risk considerations into the **Isiolo Municipality Local Physical Land Use Development Plan**	County Department of Lands & Physical Planning	Short Term	Climate risks integrated in planning documents
Mobilize climate financing from national and international sources	County Government	Continuous	Amount of climate funding secured
Strengthen data collection and climate monitoring	Kenya Meteorological Department	Continuous	Availability of climate data

Implementation Timeframe Classification

Timeframe	Definition
Short Term	0 – 2 Years
Medium Term	3 – 5 Years
Long Term	6 – 10 Years
Continuous	Ongoing actions

Historical Hazard events

Hazard Event / Type	Date / Period	Location	Intensity	Social Impacts	Physical Impacts	Economic Impacts	Ecological Impacts
Fluvial Flooding (Ewaso Nyiro River)	March–May 2018 (Long Rains)	Riparian areas along Ewaso Nyiro River; Maisha Bora & Shambani crossings; parts of Bulla Pesa & Bulla Mpya	River levels rose above bankfull following upstream rainfall; low-water crossings submerged; localized flood depths approx. 0.5–1.2m	Temporary displacement of households; increased waterborne disease risk; disruption to schools and markets; vulnerable groups (informal settlers, elderly, children) most affected	Road and crossing damage; riverbank erosion; contamination of shallow wells; damage to temporary housing	Market disruptions; transport interruptions; repair costs for roads and drainage	Riverbank erosion; sediment deposition on farms; degradation of riparian vegetation

Prolonged Drought	2020–2022 (Multiseason drought)	Municipalitywide; severe in Burat ward and boreholedependent areas	Consecutive below-average rainfall seasons; declining borehole yields; severe water stress	Water rationing; increased food insecurity; malnutrition risk among children; pastoral households heavily affected	Strain on boreholes and pumps; vegetation dieoff; increased reliance on water trucking	Reduced livestock productivity; declining market activity; higher household water expenditure	Rangeland degradation; reduced river flows; tree mortality due to water stress
Pluvial (Urban/Flash) Flooding	Oct–Nov 2023 (Short Rains / El Niño)	Wabera CBD; Bulla Pesa; drainage intersections near Prison Farm	High-intensity rainfall (>70 mm/day est.); drains overwhelmed; flood depths approx. 0.3–0.8m; localized ponding lasting hours–days	Temporary displacement; disruption to schools and public services; exposure to contaminated floodwater	Blocked culverts; erosion of gravel roads; water ingress into homes and shops	Loss of trader stock; transport delays; increased drainage maintenance costs	Sediment buildup in drains; solid waste washed into river systems

Extreme Heat Episode	Feb–Mar 2024	Wabera urban core; high-density residential zones; markets and bus park	Sustained daytime temperatures above 35°C; reduced nighttime cooling	Heat-related illnesses; dehydration; reduced productivity of outdoor workers; elderly and children most affected	Transformer overheating; increased water demand; stress on supply systems	Reduced market trading hours; higher household spending on water and cooling	Vegetation stress; reduced river flow levels; drying of open green spaces
Extreme Wind & Dust Storm	August 2021 (Dry season)	Municipalitywide; peri-urban zones and open markets	Strong gusts (>60 km/h est.) with heavy dust; shortduration highimpact event	Respiratory distress cases increased; damage to informal shelters	Roof damage; uprooted trees; temporary power interruptions	Business disruptions in open markets; repair costs for damaged structures	Soil erosion; loss of shallowrooted vegetation; dust deposition on surfaces

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Data Sources

Page	Data	Data Source
Section 1.2	Population statistics (2019 Census)	Kenya National Bureau of Statistics (KNBS), 2019 Population & Housing Census
Section 2.1	Drought frequency & early warning bulletins	National Drought Management Authority (NDMA)
Section 2.3	Climate projections (SSP2-4.5 & SSP5-8.5 scenarios)	World Bank Climate Change Knowledge Portal
Section 4	Risk matrix methodology	Global Center on Adaptation (GCA) Urban Climate Risk Profile Guidelines
Section 5.2	Adaptation references lution	Kenya National Climate Change Action Plan (NCCAP); Kenya Climate Change Act (2016); Sectoral best practices
Annex N1	Historical hazard event documentation	NDMA Situation Reports; Municipal incident records; Local media archives