URBAN CLIMATE RISK PROFILE FOR LIMURU MUNICIPALITY

2026

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Disclaimer:

The Limuru Municipality's Urban Climate Risk Profile (2026) is intended solely for planning and informational purposes. The analysis and forecasts are subject to uncertainties in climate science and changing local conditions, and they are based on data available at the time of publication.

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Foreword

Climate change is no longer a distant threat; it is a daily reality for the people of Limuru Municipality. From flooded roads during the long rains to biting cold that keeps children out of school, our residents bear the brunt of a changing climate. This Urban Climate Risk Profile is our commitment to understanding these challenges and acting on them.

Developed through participatory processes that brought together municipal staff, ward administrators, community groups, and vulnerable populations, this profile identifies the hazards that threaten our infrastructure, our people, and our natural assets. It lays the groundwork for the Limuru Integrated Climate Risk Management Plan and will guide all adaptation investments we make.

I urge all departments, development partners, and citizens to use this document as a compass. Let us build a resilient, inclusive Limuru ready for tomorrow's climate.

Municipal Manager
Limuru Municipality

Executive Summary

This Urban Climate Risk Profile assesses the current and future climate risks facing Limuru Municipality. Three key hazards were identified through community consultations and climate data analysis: flooding, drought, and extreme cold temperatures. Using the IPCC risk framework (hazard × exposure × vulnerability), the profile evaluates risks to urban infrastructure, populations, and natural assets under current conditions and future climate scenarios (SSP2-4.5 and SSP5-8.5 for 2050 and 2100).

Key findings:

- Flooding poses very high risks to transport, stormwater drainage, and informal settlements today, and these risks will intensify significantly by 2050.
- Drought already creates high risks for water supply, agriculture, and vulnerable groups; future projections show increasing water stress.
- Extreme cold currently causes medium risks to health and education, but may slightly moderate under high-emission scenarios.

Most at risk: Informal settlement residents (Free Town, Njira Njeru), elderly persons, tea pickers, and boda boda operators.

Priority actions: Upgrade stormwater drainage, expand water harvesting, implement early warning systems, and climate-proof schools and health facilities.

The summary tables below present current and projected risk levels for each hazard.

Table ES-1. Summary of Flood Risks for Limuru Municipality

Category	Risk Level				
	Current	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Infrastructure & Services					
Stormwater Drainage	High	Very High	Very High	Very high	Very high
Water & Wastewater Management	Medium	High	High	High	Very High
Solid Waste Management	Medium	High	High	High	High
Transport and Mobility	High	Very High	Very High	Very High	Very High
Energy	Low	Medium	Medium	Medium	High
Economic Infrastructure	Medium	High	High	High	Very High
Social Infrastructure	Medium	High	High	High	Very High
Emergency Services	Medium	High	High	High	Very High
Populations					
Urban Residents	High	Very High	Very High	Very High	Very High

Category	Risk Level				
	Current	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Informal Settlement Residents	Very High	Very High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	High	Very High	Very High	Very High	Very High
Natural Assets					
Urban Green Infrastructure	Low	Medium	Medium	Medium	High
Urban Blue Infrastructure	Medium	High	High	High	Very High
Peri-urban and Agricultural Systems	Medium	High	High	High	Very High

Table ES-2. Summary of Drought risks for Limuru Municipality

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

Urban Blue Infrastructure	High	Very High	Very High	Very High	Very High
Peri-urban & Agricultural Systems	Very High	Very High	Very High	Very High	Very High

Table ES-3. Summary of Extreme Cold risks for Limuru Municipality

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

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List of Acronyms

Acronym	Meaning
CCCAP	County Climate Change Action Plan
EMCA	Environmental Management and Coordination Act
FLLoCA	Financing Locally Led Climate Action
GIS	Geographic Information System
IPM	Integrated Pest Management
KEFRI	Kenya Forestry Research Institute
KFS	Kenya Forest Service
LIWASCO	Limuru Water and Sewerage Company
NEMA	National Environment Management Authority
PCRA	Participatory Climate Risk Assessment
PWD	Person with Disability
RCP	Representative Concentration Pathway
SSP	Shared Socioeconomic Pathway
WEENR	Water, Environment, Energy and Natural Resources
RCRA	Rapid Climate Risk Assessment

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1. Context

1.1. Objective

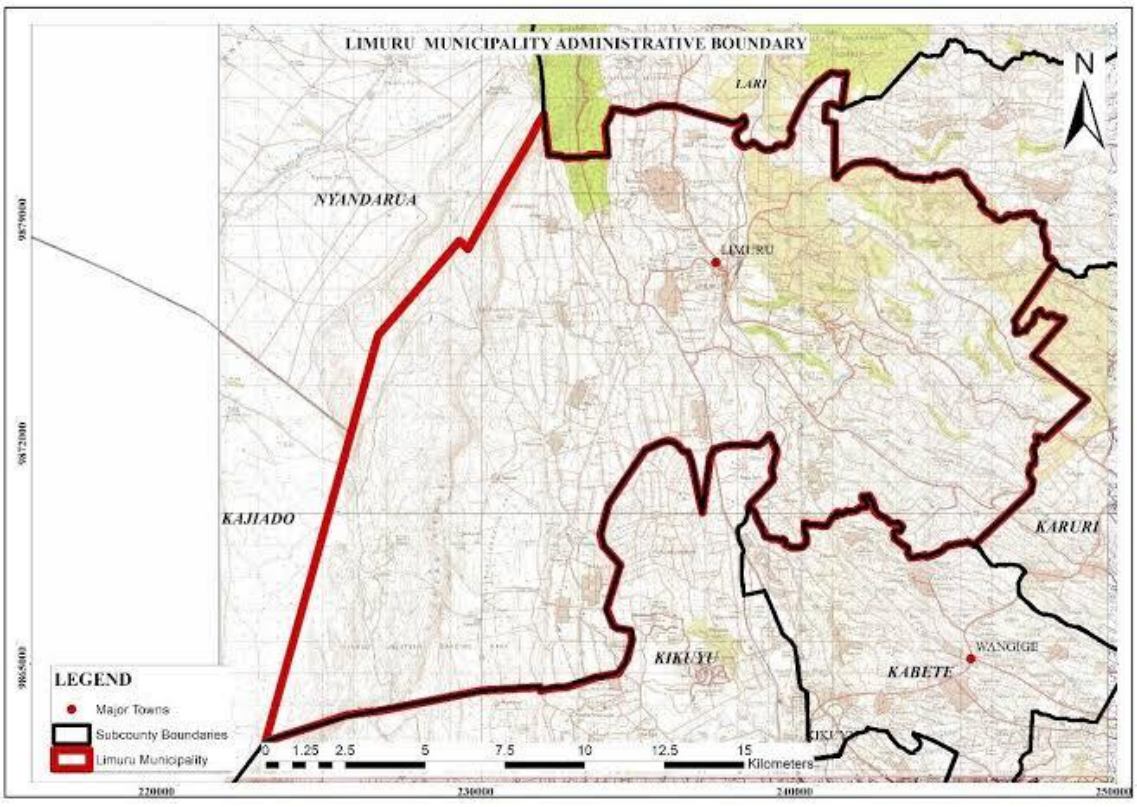
This Urban Climate Risk Profile aims to:

- Identify and prioritise the key climate hazards affecting Limuru Municipality.
- Assess the exposure, vulnerability, and impacts of these hazards on urban infrastructure, populations, and natural assets.
- Provide a robust evidence base for the Limuru Integrated Development Plan and the County Climate Change Action Plan.
- Empower municipal decision-makers and communities with actionable risk information to guide adaptation investments under the FLLoCA programme.

1.2. Urban Context

Geographic area

Limuru Municipality is located in Kiambu County, approximately 25 km northwest of Nairobi. It covers an area of **285.1 km²** and comprises five wards: **Bibirioni, Limuru Central, Ndeiya, Limuru East, and Ngecha/Tigoni**. The municipality is situated at an altitude of 1,500–1,800 m above sea level, with the eastern parts dominated by tea plantations and the western lowlands (Ndeiya) characterized by semi-arid conditions.



[Map of Limuru Municipality with administrative boundaries.]

Governance Structure

Limuru Municipality is governed by a **Municipal Board** appointed by the Kiambu County Government, in accordance with the Urban Areas and Cities Act (2011). Key departments involved in climate resilience include:

- **Municipal Manager's Office** – overall coordination
- **Department of Environment & Climate Change** – lead for this profile
- **Department of Physical Planning & Urban Development**
- **Department of Water & Sanitation**
- **Department of Roads & Public Works**
- **Department of Health & Public Services**

The preparation of this profile was led by a **Municipal Technical Working Group**, with representation from all departments and community-based organisations.

Socio-economic Context

According to the 2019 Kenya Population and Housing Census, Limuru Sub-County (coterminous with the municipality) had a population of **159,314** (79,632 males, 79,682 females). The population is projected to reach **188,157 by 2027**, with an annual growth rate of 2.1%.

Ward	Population (2019)	Households	Density (persons/km²)
Bibirioni	32,150	9,800	620
Limuru Central	51,200	15,200	1,180
Ndeiya	28,900	8,100	310
Limuru East	26,064	7,300	540
Ngecha/Tigoni	21,000	6,200	480
Total	**159,314**	**46,600**	**559**

Source: KNBS 2019, projected using Kiambu CIDP 2023-2027

Economic Context

Limuru's economy is **agriculture-driven**, with tea and dairy as the primary sub-sectors. Formal employment is concentrated in tea estates, factories (Bata, tea processing), and public administration. A significant proportion of residents work in Nairobi and rely on daily commuting. Small-scale trade, transport (boda boda), and greenhouse farming (Ndeiya) provide supplementary livelihoods.

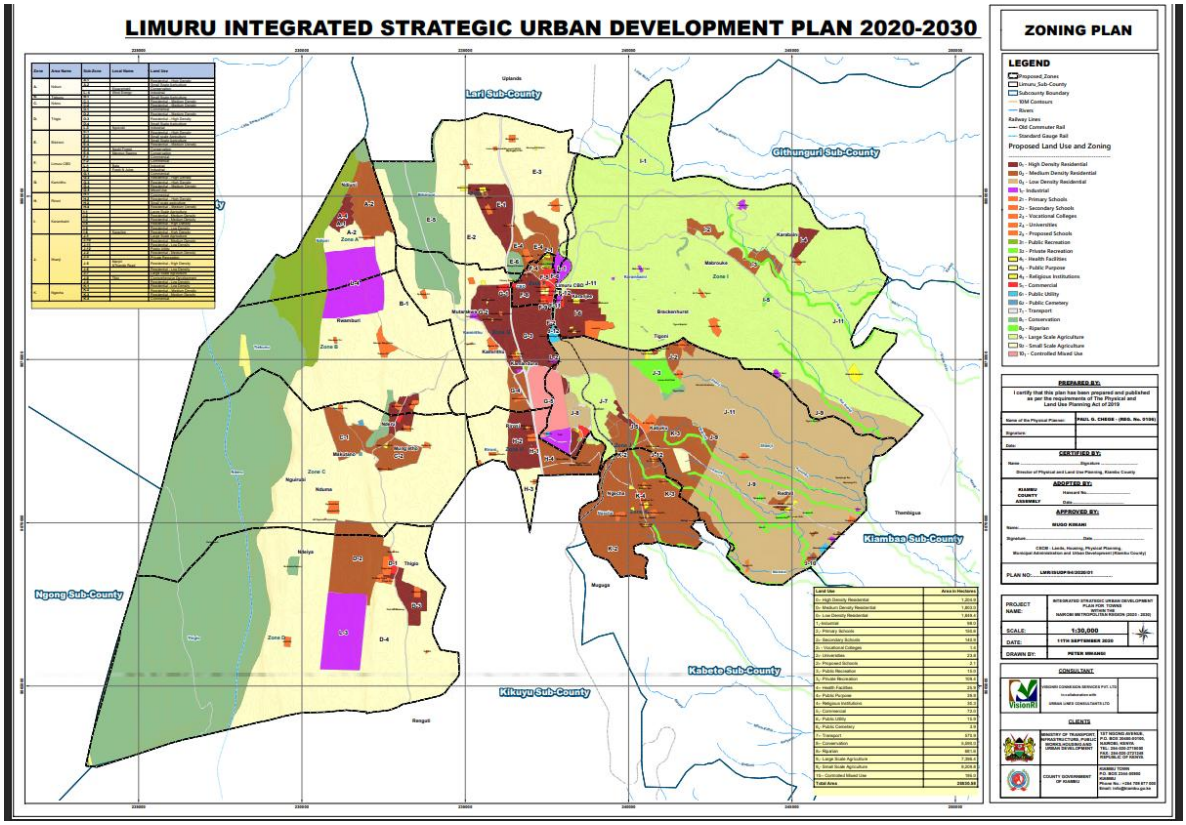
- **Tea plantations** cover ~40% of Limuru East and Ngecha/Tigoni.
- **Dairy farming** (zero grazing) is practiced in all wards, supplying cooperatives such as Limuru Dairy.
- **Manufacturing** includes tea processing, footwear (Bata), and food processing.
- **Unemployment** among youth is estimated at 22%, with drug and substance abuse identified as a growing concern during PCRA consultations.

Land-use Context

Land use in Limuru Municipality is a mix of:

- **Residential** – high-density in Limuru Town, medium-density estates, and scattered rural homesteads.
- **Commercial** – concentrated in Limuru Central (town centre, markets, banks, retail).
- **Agricultural** – tea estates, smallholder mixed farming, dairy, and greenhouse horticulture.
- **Industrial** – limited to tea factories, Bata, and agro-processing.
- **Institutional** – schools, health facilities, administrative offices.
- **Conservation** – Manguo Swamp (wetland), riparian reserves along the Nderu and Kamiti rivers.

Rapid population growth and peri-urban sprawl are converting agricultural land into residential developments, reducing pervious surfaces and increasing flood risk.



[Limuru Municipality Land use map.]

1.3. Key Stakeholders & Inclusiveness

Stakeholder engagement followed the **Financing Locally Led Climate Action (FLLoCA)** principles. A participatory approach was used at ward level, involving community members in hazard mapping, vulnerability assessment, and solution prioritisation. Special efforts were made to include women, youth, PWDs, elderly, and minority groups (e.g., Somali tea pickers).

Stakeholder mapping (Influence–Interest Matrix):

	Low Interest	**High Interest**
High Influence	National government agencies (KFS, KEFRI, KMD) Kiambu County Executive	Limuru Municipal Board Ward Administrators LIWASCO Tea factory managers
Low Influence	General public (not yet organised) Private developers	Community Based Organisations (CBOs) Farmers' cooperatives

		Boda boda associations PWD self-help groups Youth groups

Inclusiveness measures:

- PCRA validation workshops held in accessible venues with sign language interpretation.
- Separate focus group discussions for women, youth, and PWDs.
- Use of local language (Gikuyu) during community meetings.
- Targeted outreach to informal settlement residents (Free Town, Njira Njeru).

2. Hazard Assessment

Limuru Municipality experiences a bi-modal rainfall pattern (March–May long rains, October–December short rains) and a cool climate influenced by its elevation. Historical climate data (1981–2022) from the Kiambu County PCRA shows high inter-annual variability, with increasing intensity of extreme events.

2.1. Key Climate Hazards

Through the PCRA process, three hazards were prioritised by the community and validated with climate science:

Hazard	Hazard Likely (Y/N)	Significant Impact (Y/N)	High Priority (Y/N)	Key Hazard (Y/N)
Heat Stress				
Average surface temperature increase	Y	N	N	N
Extreme heat	N	N	N	N
Cold Stress				
Extreme cold (frost, cold spells)	Y	Y	Y	Y
Flooding				
Pluvial (surface) flooding	Y	Y	Y	Y
Fluvial (river) flooding	Y	Y	Y	Y
Waterlogging	Y	Y	Y	Y
Water Stress				
Drought (meteorological)	Y	Y	Y	Y
Mass Movement				
Landslides	Y (minor)	N	N	N
Gully erosion	Y	Y	Y	N (managed under flooding

Final key hazards: 1. Flooding, **2. Drought**, **3. Extreme Cold**.

2.2. Climate Indicators and Hazard Thresholds

Key Hazard	Climate Indicator	Data Source	Thresholds		
			Low	**Medium**	**High**
Flooding	Daily rainfall intensity (mm/day)	KMD, CORDEX-Africa	<20	20–50	>50
	River level (m) – Nderu, Kamiti	LIWASCO, WRA	Below bank	Near bank	Over bank
Drought	Standardised Precipitation Index (SPI-12)	KMD, CHIRPS	> -0.5	-0.5 to -1.5	< -1.5
	Soil moisture percentile	ERA5-Land	>30%	15–30%	<15%
Extreme Cold	Minimum temperature (°C)	KMD, CORDEX-Africa	>8	5–8	<5
	Frost days (days with Tmin < 0°C)	KMD	0	1–3	>3

Data sources are detailed in Annex N2.

2.3. Current Hazard Levels and Climate Projections

Future projections are derived from the Kiambu County PCRA, which downscaled CMIP5 models under RCP4.5 and RCP8.5 (equivalent to SSP2-4.5 and SSP5-8.5). For Limuru:

- **Flooding**: Historical trends show increased frequency of high-intensity rainfall during MAM and OND. Projections indicate a wet signal for annual rainfall (+5–10% by 2050) under both scenarios, but with greater temporal compression – more rain in fewer days. This increases pluvial and fluvial flood hazard.
- **Drought**: MAM rainfall is projected to decrease by 10–20% under RCP8.5 by 2050, while OND rainfall remains variable. Increased evaporative demand due to warming will exacerbate agricultural drought.

- **Extreme Cold**: Minimum temperatures are projected to rise by 0.8–1.5°C by 2050, reducing the frequency of frost. However, cold spells will still occur, particularly in higher areas (Ngecha/Tigoni).

Hazard	Current (Baseline)	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Flooding	High	High	Very High	High	Very High
Drought	Medium	High	Very High	High	Very High
Extreme Cold	Medium	Medium	Low	Medium	Low

Interpretation of hazard levels:

Level	Interpretation
Very High	Hazard events are likely to occur with very high frequency and/or intensity; extreme events may become the new normal.
High	Hazard events occur frequently; moderate to severe intensity.
Medium	Hazard events occur occasionally; moderate intensity.
Low	Hazard events are rare and/or mild.

2.4. Current and Future Hazard Impact Areas

Flooding:

Currently affects Limuru Central (town centre, Manguo swamp area, railway underpass), Bibirioni (Njira Njeru, Free Town), Ndeiya lowlands, and Limuru East (Juakali). Future floodplains are expected to expand along the Nderu and Kamiti rivers due to increased runoff and encroachment.

Drought:

Primarily affects **Ndeiya ward**, where rain-fed agriculture is dominant. Moderate water stress already occurs during dry spells (January–February, July–September). Under RCP8.5, Ndeiya is projected to shift from semi-humid to semi-arid conditions by 2050.

Extreme Cold:

Frost risk is highest in **Ngecha/Tigoni and Kinale (part of Lari, adjacent)**. Frost events currently occur 2–3 times per year; this may drop to 0–1 by 2100 under high emissions.

[Maps showing hazard extents under current and future scenarios to be inserted here.]

1. Exposure & Vulnerability Assessment

1.1. Urban Elements

Table 1. Urban elements inventory

Category	Subcategory	Included in RCRA (Y/N)	Available in GIS (Y/N)	Description
Infrastructure & Services				
Stormwater Drainage	Stormwater conveyance network	Y	N (partial)	Open drains, culverts along main roads; mostly absent in informal areas.
	Stormwater storage	N	N	No dedicated storage; Manguo swamp acts as natural retention.
Water & Wastewater Mgmt	Pumping stations	Y	Y	3 LIWASCO pumping stations.
	Groundwater abstraction	Y	N	Private boreholes in Ndeiya, Limuru Central.
	Water treatment facilities	Y	Y	Limuru Water Treatment Plant.
	Water supply networks	Y	Y	Piped system coverage ~70%; intermittent supply.
	Sewer networks	Y	Y	Only in Limuru Town centre; 85% use septic tanks.
	Wastewater treatment facilities	Y	Y	Limuru WWTP (trickling filters).

Solid Waste Management	Transfer facilities	Y	Y	1 transfer station at Limuru Town.
	Landfills and dump sites	Y	Y	Uncontrolled dumpsites (Manguo, Ndeiya).
	Recycling centers	Y	N	Informal sector; no formal facility.
	Collection fleet	Y	Y	2 compactor trucks, 3 tractors.
Transport and Mobility	Road networks	Y	Y	120 km tarmac, 250 km murram; many roads in poor condition.
	Bridges	Y	Y	5 major bridges (e.g., Nderu Bridge).
	Public transport networks	Y	N	Matatu routes (Limuru–Nairobi, Limuru–Nakuru).
	Transportation terminals	Y	Y	Limuru Town bus park.
	Non-motorised transport	N	N	No dedicated pedestrian/cycle lanes.
Energy	Poles and power lines	Y	Y	Kenya Power network; frequent outages during storms.
	Transformers and substations	Y	Y	6 substations.
	Streetlighting	Y	Y	Solar and grid-powered; mostly in town centre.
Economic Infrastructure	Markets	Y	Y	Limuru Main Market, Kiroe Market, Ngararigа Market.
	Businesses and commercial hubs	Y	N	~500 formal SMEs, many informal traders.

	Industrial zones	Y	Y	Bata industrial area, tea factories.
Social Infrastructure	Government buildings	Y	Y	Municipal headquarters, ward offices.
	Education facilities	Y	Y	32 ECDE, 24 primary, 12 secondary, 1 vocational centre.
	Healthcare facilities	Y	Y	Limuru Sub-County Hospital, 6 dispensaries.
	Public spaces	Y	Y	Limuru Stadium, Manguo Swamp viewing point.
	Faith-based buildings	N	N	Numerous churches.
Emergency Services	Fire stations	Y	Y	1 fire station (town centre); limited capacity.
	Police stations	Y	Y	2 police stations, 3 posts.
	Early warning systems	N	N	None.
	Disaster management centers	N	N	None; rely on Kiambu County.
Populations				
Urban Residents	Population	Y	Y	See Section 1.2.
	Households	Y	Y	46,600 households; average size 3.4.
Informal Settlement Residents	Population in informal settlements	Y	N	Free Town (~2,500), Njira Njeru (~1,800), parts of Manguo.

	Households lacking land tenure	Y	N	~1,200 households.
	Households lacking basic services	Y	N	Limited water, sewer, waste collection.
Vulnerable & Marginalized	Low-income households	Y	N	~40% of households below poverty line.
	Women-headed households	Y	N	34% of households.
	Children and youth	Y	Y	<18 years: 45% of population.
	Elderly persons	Y	N	>65 years: 8% of population.
	People with disabilities (PWD)	Y	N	~5% of population (estimated).
	Unemployed youth	Y	N	22% unemployment rate.
	Seasonal workers	Y	N	Tea pickers, construction labour.
Natural Assets				
Urban Green Infrastructure	Urban parks and gardens	Y	Y	Limuru Memorial Park, small green spaces.
	Green corridors	N	N	None formalised.
	Urban forests	Y	Y	Remnant indigenous trees, eucalyptus woodlots.
Urban Blue Infrastructure	Natural wetlands	Y	Y	Manguo Swamp (key biodiversity site).
	Rivers	Y	Y	Nderu, Kamiti, Ngecha, Tigoni.

	Riparian zones	Y	N	Encroached, poorly mapped.
	Lakes/ponds	Y	Y	Small farm dams.
Peri-urban & Agricultural	Peri-urban agriculture	Y	N	Vegetables, dairy, poultry.
Systems	Agroforestry	Y	N	Scattered on farms.
	Forests and reserves	Y	Y	Part of Kereita Forest (adjacent).

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

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

Table 3. Interpretation of exposure and vulnerability levels

Level	Exposure Level Interpretation	Vulnerability Level Interpretation
High	A large number and high-value urban elements are located within the hazard footprint.	The urban element is vulnerable to the hazard due to high sensitivity and limited adaptive capacity.
Medium	A moderate number or mix of low- and medium-value elements are located within the hazard footprint.	The element is somewhat vulnerable due to moderate sensitivity and adaptive capacity
Low	Few or no critical urban elements lie within the hazard footprint.	The element is minimally vulnerable due to limited sensitivity and/or high adaptive capacity.

For this Urban Climate Risk Profile, the following matrix summarizes likely impacts on each urban element by combining the assigned exposure and vulnerability levels.

Table 4. Impact Matrix

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

Table 5. Exposure, Vulnerability, and Impacts of Flooding on Urban Elements

Hazard: Flooding

Category	Exposure (Description)	Exposure Level	Vulnerability (Sensitivity / Adaptive Capacity)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	Drains in Limuru Central, Manguo, Ndeiya lowlands are within 100-year floodplain. Many drains are undersized or blocked.	**High**	**Sensitivity:** Undersized, unlined drains; flat topography; blocked by solid waste. **Adaptive Capacity:** Low – no GIS inventory, limited maintenance budget.	**High**	**Catastrophic**
Water & Wastewater Mgmt	LIWASCO pumping stations (3) located near Nderu River; risk of inundation. WWTP adjacent to Manguo Swamp.	**High**	**Sensitivity:** Electrical equipment at ground level; WWTP designed for historical flood levels. **Adaptive Capacity:** Medium – some flood barriers but insufficient; no redundancy.	**Medium**	**Major**
Solid Waste Management	Dumpsites at Manguo and Ndeiya are flood-prone; waste washing into wetlands. Transfer station in town centre has poor drainage.	**High**	**Sensitivity:** Unlined dumpsites; waste blocks drains; hazardous leachate. **Adaptive Capacity:** Low – no flood-proofing, irregular collection.	**High**	**Catastrophic**

Transport and Mobility	Flooding of Nderu Bridge (Limuru-Nairobi highway), underpass at Kwaheri Bata, and numerous murram roads.	**High**	**Sensitivity:** Low-level bridges, unpaved roads easily eroded; siltation of culverts. **Adaptive Capacity:** Low – reactive maintenance, no climate-proof design standards.	**High**	**Catastrophic**
Energy	2 substations in low-lying areas; overhead lines vulnerable to falling trees during storms.	**Medium**	**Sensitivity:** Poles not flood-resistant; undergrounding absent. **Adaptive Capacity:** Medium – Kenya Power replaces poles after events.	**Medium**	**Moderate**
Economic Infrastructure	Limuru Main Market (ground floor shops) floods every 2-3 years. Tea factories use flood-prone access roads.	**High**	**Sensitivity:** Market drainage poor; goods stored at floor level. **Adaptive Capacity:** Low – no relocation, no insurance.	**High**	**Catastrophic**
Social Infrastructure	5 ECDE centres and 3 primary schools in flood zones (e.g., Manguo, Free Town). Limuru Sub-County Hospital access road floods.	**High**	**Sensitivity:** Schools lack raised floors; hospitals need 24/7 access. **Adaptive Capacity:** Low – no flood retrofitting.	**High**	**Catastrophic**
Emergency Services	Fire station in town centre – access may be cut off. No dedicated disaster centre.	**Medium**	**Sensitivity:** Single access route; no backup generator at fire station.	**High**	**Major**

			Adaptive Capacity: Low – no early warning, no evacuation plan.		
Populations					
Urban Residents	30% of urban population lives in flood-prone areas (Manguo, Free Town, parts of Ndeiya).	**High**	**Sensitivity:** Low awareness; children play in floodwater. **Adaptive Capacity:** Low – few households have flood insurance; no relocation assistance.	**High**	**Catastrophic**
Informal Settlement Residents	Free Town and Njira Njeru are entirely within floodplain; homes built with mud/wattle, no drainage.	**High**	**Sensitivity:** Extreme poverty; poor housing; lack of sanitation. **Adaptive Capacity:** Very low – no tenure security, no access to credit.	**High**	**Catastrophic**
Vulnerable & Marginalized Groups	Elderly, PWDs, and children disproportionately affected; mobility constraints.	**High**	**Sensitivity:** Reduced mobility; chronic illnesses worsened by damp. **Adaptive Capacity:** Low – limited social protection.	**High**	**Catastrophic**
Natural Assets					
Urban Green Infrastructure	Parks and woodlots experience waterlogging; trees uprooted.	**Medium**	**Sensitivity:** Shallow-rooted exotic species.	**Medium**	**Moderate**

			Adaptive Capacity: Medium – replanting after events.		
Urban Blue Infrastructure	Manguo Swamp receives contaminated floodwater; riparian zones eroded.	**High**	**Sensitivity:** Wetland already degraded; invasive species. **Adaptive Capacity:** Low – no active restoration programme.	**High**	**Catastrophic**
Peri-urban & Agricultural Systems	Tea and vegetable farms in valley bottoms flooded; dairy pathways impassable.	**High**	**Sensitivity:** Tea intolerant to waterlogging; soil erosion. **Adaptive Capacity:** Medium – farmers use cut-off drains but lack capital.	**Medium**	**Major**

Table 6. Exposure, Vulnerability, and Impacts of Drought on Urban Elements

Hazard: Drought

Category	Exposure (Description)	Exposure Level	Vulnerability (Sensitivity / Adaptive Capacity)	Vulnerability Level	Impact Level
Infrastructure & Services					
Water & Wastewater Mgmt	Ndeiya ward depends on boreholes that dry up. Limuru Town supply rationed during dry spells.	**High**	**Sensitivity:** Reliance on surface water (Nderu); limited groundwater; high non-revenue water (40%).	**High**	**Catastrophic**

			Adaptive Capacity: Low – few storage tanks; no desalination.		
Solid Waste Management	Reduced waste generation; but increased fire risk at dumpsites.	**Low**	**Sensitivity:** Dumpsites combustible. **Adaptive Capacity:** Low – no firefighting equipment on site.	**Medium**	**Minor**
Energy	Hydro-power from Thika basin indirectly affected; local solar irrigation used.	**Low**	**Sensitivity:** Not directly exposed. **Adaptive Capacity:** High – grid power stable.	**Low**	**Insignificant**
Economic Infrastructure	Tea factories process less leaf; income loss for farmers. Markets: reduced vegetable supply, higher prices.	**High**	**Sensitivity:** Tea yield drops ~30% in drought; perishable goods scarce. **Adaptive Capacity:** Low – no crop insurance, no irrigation for tea.	**High**	**Catastrophic**
Social Infrastructure	Schools: absenteeism due to hunger; boreholes dry. Health facilities: water shortages.	**Medium**	**Sensitivity:** Children malnutrition; hospital water tanks insufficient. **Adaptive Capacity:** Low – emergency water trucking is costly.	**High**	**Major**
Emergency Services	Increased fire calls; water for firefighting limited.	**Medium**	**Sensitivity:** Fire hydrants dry. **Adaptive Capacity:** Low – no dedicated drought response plan.	**High**	**Major**
Populations					

Urban Residents	All residents face water rationing; Ndeiya residents worst affected.	**High**	**Sensitivity:** Low per-capita storage; poor households buy expensive water. **Adaptive Capacity:** Low – rainwater harvesting uncommon.	**High**	**Catastrophic**
Informal Settlement Residents	No piped water; rely on venders who hike prices during drought.	**High**	**Sensitivity:** Extreme water poverty. **Adaptive Capacity:** Very low – no savings.	**High**	**Catastrophic**
Vulnerable & Marginalized Groups	Tea pickers (mostly women) lose daily wages. Elderly and HIV+ need clean water for medication.	**High**	**Sensitivity:** Income loss; health vulnerability. **Adaptive Capacity:** Low – no alternative livelihoods.	**High**	**Catastrophic**
Natural Assets					
Urban Green Infrastructure	Trees and lawns wilt; increased pest attacks.	**Medium**	**Sensitivity:** Exotic species not drought-tolerant. **Adaptive Capacity:** Low – no irrigation.	**High**	**Major**
Urban Blue Infrastructure	Nderu River baseflow reduces; Manguo Swamp shrinks.	**High**	**Sensitivity:** Wetland ecology stressed. **Adaptive Capacity:** Low – no environmental flow allocation.	**High**	**Catastrophic**

Peri-urban & Agricultural Systems	Rain-fed maize and beans fail; dairy farmers buy costly hay.	**High**	**Sensitivity:** Shallow soils; no irrigation. **Adaptive Capacity:** Low – few make silage; limited drought-tolerant breeds.	**High**	**Catastrophic**

Table 7. Exposure, Vulnerability, and Impacts of Extreme Cold on Urban Elements

Hazard: Extreme Cold

Category	Exposure (Description)	Exposure Level	Vulnerability (Sensitivity / Adaptive Capacity)	Vulnerability Level	Impact Level
Infrastructure & Services					
Transport and Mobility	Frost on roads in Ngecha/Tigoni; visibility affected by fog.	**Medium**	**Sensitivity:** High altitude roads; no de-icing equipment. **Adaptive Capacity:** Low – no warning signs.	**High**	**Major**
Energy	Power lines can snap under ice load (rare).	**Low**	**Sensitivity:** Occasional. **Adaptive Capacity:** Medium – quick repair crews.	**Medium**	**Minor**
Social Infrastructure	ECDE classrooms cold; children absent.	**High**	**Sensitivity:** Uninsulated buildings; no heating. **Adaptive Capacity:** Low – no warm-clothing programme.	**High**	**Major**

Emergency Services	Hypothermia cases rare but occur in informal settlements.	**Low**	**Sensitivity:** Elderly at risk. **Adaptive Capacity:** Low – no cold-wave protocol.	**Medium**	**Minor**
Populations					
Urban Residents	Residents in high areas (Ngecha/Tigoni) experience frostbite, respiratory illness.	**Medium**	**Sensitivity:** Poor housing; firewood used for heating. **Adaptive Capacity:** Low – few can afford warm clothing.	**High**	**Major**
Informal Settlement Residents	Makeshift houses offer no protection; children and elderly suffer most.	**High**	**Sensitivity:** Extreme poverty; no blankets. **Adaptive Capacity:** Very low.	**High**	**Catastrophic**
Vulnerable & Marginalized Groups	Elderly: arthritis, pneumonia. Orphans and street children: no shelter.	**High**	**Sensitivity:** Pre-existing conditions. **Adaptive Capacity:** Very low.	**High**	**Catastrophic**
Natural Assets					
Urban Green Infrastructure	Frost damage to ornamental plants.	**Low**	**Sensitivity:** Non-native species. **Adaptive Capacity:** Low – no protective covers.	**Medium**	**Minor**
Peri-urban & Agricultural Systems	Tea leaves damaged; reduced plucking.	**High**	**Sensitivity:** Tea susceptible to frost. **Adaptive Capacity:** Medium – planting windbreaks; early warning.	**Medium**	**Major**

Table 4.4. Exposure, Vulnerability, and Impacts of Landslides on Urban Elements

Hazard: Landslides / Mass Movement

Category	Exposure (Description)	Exposure Level	Vulnerability (Sensitivity / Adaptive Capacity)	Vulnerability Level	Impact Level
Infrastructure & Services					
Transport and Mobility	Roads on steep slopes: Limuru–Ngecha, Tigoni–Kinale escarpment. Cuts and fills are unstable.	**High**	**Sensitivity:** Unengineered cuts; no slope drainage; debris blocks roads. **Adaptive Capacity:** Low – reactive clearing; no slope monitoring.	**High**	**Catastrophic**
Water & Wastewater Mgmt	Pipelines crossing landslide-prone areas (Ngecha).	**Medium**	**Sensitivity:** Cast iron pipes brittle; break easily under soil movement. **Adaptive Capacity:** Low – no flexible joints; repairs take weeks.	**High**	**Major**
Energy	Power poles on unstable slopes; lines snapped by falling trees.	**Medium**	**Sensitivity:** Wooden poles; shallow foundations. **Adaptive Capacity:** Medium – Kenya Power responds; no preventive relocation.	**Medium**	**Moderate**

Social Infrastructure	3 primary schools and 1 health centre located near steep slopes (Ngecha/Tigoni).	**High**	**Sensitivity:** Buildings without retaining walls; foundations at risk. **Adaptive Capacity:** Low – no geotechnical assessments.	**High**	**Catastrophic**
Emergency Services	Access to affected areas cut off; no landslide early warning.	**Medium**	**Sensitivity:** Single road access in many areas. **Adaptive Capacity:** Very low – no specialised rescue equipment.	**High**	**Major**
Populations					
Urban Residents	2,500 residents live on or below steep slopes (Tigoni, Ngecha, Kinale border).	**High**	**Sensitivity:** Poor housing; unaware of risk. **Adaptive Capacity:** Very low – no insurance, no relocation options.	**High**	**Catastrophic**
Informal Settlement Residents	Some informal clusters on steep, low-value land (e.g., Kinale fringe).	**High**	**Sensitivity:** Makeshift structures; no drainage. **Adaptive Capacity:** Very low – land tenure insecure.	**High**	**Catastrophic**
Vulnerable & Marginalized Groups	Elderly and children unable to evacuate quickly.	**High**	**Sensitivity:** Mobility constraints. **Adaptive Capacity:** Very low.	**High**	**Catastrophic**
Natural Assets					

Urban Green Infrastructure	Forest patches on steep slopes act as stabilisers; some cleared for farming.	**Medium**	**Sensitivity:** Deforestation increases risk. **Adaptive Capacity:** Medium – KFS enforces protection; community tree planting.	**Medium**	**Moderate**
Peri-urban & Agricultural Systems	Tea plantations on steep slopes; terracing reduces but does not eliminate risk.	**High**	**Sensitivity:** Tea bushes shallow-rooted; soil exposure. **Adaptive Capacity:** Medium – farmers build cut-off drains; limited extension support.	**Medium**	**Major**

Table 5.4. Exposure, Vulnerability, and Impacts of Strong Winds on Urban Elements

Hazard: Strong Winds / Storms

Category	Exposure (Description)	Exposure Level	Vulnerability (Sensitivity / Adaptive Capacity)	Vulnerability Level	Impact Level
Infrastructure & Services					
Energy	Overhead power lines throughout municipality; trees near lines.	**High**	**Sensitivity:** Wooden poles; no undergrounding. **Adaptive Capacity:** Medium – Kenya	**Medium**	**Major**

			Power repairs; no preventive vegetation management.		
Transport and Mobility	Falling trees block roads; signage damaged; boda boda accidents.	**High**	**Sensitivity:** Unprotected roadsides; no windbreaks. **Adaptive Capacity:** Low – reactive clearing.	**High**	**Major**
Social Infrastructure	School roofs blown off (e.g., Ngecha Primary, 2019). Health facility roofing at risk.	**High**	**Sensitivity:** Corrugated iron sheets; poor fastening. **Adaptive Capacity:** Low – no building codes enforced.	**High**	**Catastrophic**
Economic Infrastructure	Market stalls overturned; tea factories: power outages disrupt processing.	**High**	**Sensitivity:** Lightweight structures; dependence on grid power. **Adaptive Capacity:** Low – no backup power at markets.	**High**	**Catastrophic**
Emergency Services	Access blocked; increased callouts for fallen trees.	**Medium**	**Sensitivity:** Single access routes. **Adaptive Capacity:** Low – no chainsaws on fire engine.	**High**	**Major**
Populations					
Urban Residents	Roofs damaged; injuries from flying debris.	**High**	**Sensitivity:** Poor-quality roofing; no insurance.	**High**	**Major**

			Adaptive Capacity: Low – no emergency repair funds.		
Informal Settlement Residents	Structures completely destroyed; no shelter.	**High**	**Sensitivity:** Makeshift materials; no structural integrity. **Adaptive Capacity:** Very low.	**High**	**Catastrophic**
Vulnerable & Marginalized Groups	Boda boda riders exposed; children walking to school at risk.	**High**	**Sensitivity:** No protective gear; no alternative transport. **Adaptive Capacity:** Very low.	**High**	**Catastrophic**
Natural Assets					
Urban Green Infrastructure	Trees uprooted; loss of mature specimens.	**High**	**Sensitivity:** Shallow-rooted exotics (eucalyptus). **Adaptive Capacity:** Medium – replanting programmes exist.	**Medium**	**Major**
Peri-urban & Agricultural Systems	Tea bushes damaged; hail accompanying wind damages leaves.	**High**	**Sensitivity:** Tea bushes exposed; no windbreaks. **Adaptive Capacity:** Low – farmers lack capital for shelter belts.	**High**	**Catastrophic**

2. Climate Risk Assessment

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.

Table 8. 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 9. Interpretation of risk levels

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

2.1. Current and Future Climate Risks on Urban Elements

Table 10. Summary of Flooding risks for Limuru Municipality

Category	Impact Level	Current Risk	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Hazard Level		High	High	Very High	High	Very High
Infrastructure & Services						

Stormwater Drainage	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**
Water & Wastewater Mgmt	Major	**High**	**High**	**Very High**	**High**	**Very High**
Solid Waste Management	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**
Transport and Mobility	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**
Energy	Moderate	**Medium**	**High**	**High**	**High**	**Very High**
Economic Infrastructure	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**
Social Infrastructure	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**
Emergency Services	Major	**High**	**High**	**Very High**	**High**	**Very High**
Populations						
Urban Residents	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**
Informal Settlement Residents	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**
Vulnerable & Marginalized Groups	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**
Natural Assets						
Urban Green Infrastructure	Moderate	**Medium**	**High**	**High**	**High**	**Very High**
Urban Blue Infrastructure	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**

Peri-urban & Agricultural Systems	Major	**High**	**High**	**Very High**	**High**	**Very High**

Table 9. Summary of Drought risks for Limuru Municipality

Category	**Impact Level**	**Current Risk**	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Hazard Level		Medium	High	Very High	High	Very High
Infrastructure & Services						
Water & Wastewater Mgmt	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**
Solid Waste Management	Minor	**Low**	**Medium**	**Medium**	**Medium**	**High**
Energy	Insignificant	**Very Low**	**Low**	**Low**	**Low**	**Medium**
Economic Infrastructure	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**
Social Infrastructure	Major	**Medium**	**High**	**Very High**	**High**	**Very High**
Emergency Services	Major	**Medium**	**High**	**Very High**	**High**	**Very High**
Populations						
Urban Residents	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**
Informal Settlement Residents	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**

Vulnerable & Marginalized Groups	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**
Natural Assets						
Urban Green Infrastructure	Major	**Medium**	**High**	**Very High**	**High**	**Very High**
Urban Blue Infrastructure	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**
Peri-urban & Agricultural Systems	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**

Table 10. Summary of Extreme Cold risks for Limuru Municipality

Category	**Impact Level**	**Current Risk**	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Hazard Level		Medium	Medium	Low	Medium	Low
Infrastructure & Services						
Transport and Mobility	Major	**High**	**High**	**Medium**	**High**	**Medium**
Energy	Minor	**Low**	**Low**	**Low**	**Low**	**Low**
Social Infrastructure	Major	**High**	**High**	**Medium**	**High**	**Medium**
Emergency Services	Minor	**Low**	**Low**	**Low**	**Low**	**Low**
Populations						
Urban Residents	Major	**High**	**High**	**Medium**	**High**	**Medium**
Informal Settlement Residents	Catastrophic	**Very High**	**Very High**	**High**	**Very High**	**High**

Vulnerable & Marginalized Groups	Catastrophic	**Very High**	**Very High**	**High**	**Very High**	**High**
Natural Assets						
Urban Green Infrastructure	Minor	**Low**	**Low**	**Very Low**	**Low**	**Very Low**
Peri-urban & Agricultural Systems	Major	**High**	**High**	**Medium**	**High**	**Medium**

Table 4.5. Summary of Landslide Risks for Limuru Municipality

Category	**Impact Level**	**Current Risk**	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Hazard Level		Medium	High	Very High	High	Very High
Infrastructure & Services						
Transport and Mobility	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**
Water & Wastewater Mgmt	Major	**Medium**	**High**	**Very High**	**High**	**Very High**
Energy	Moderate	**Medium**	**High**	**High**	**High**	**Very High**
Social Infrastructure	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**
Emergency Services	Major	**Medium**	**High**	**Very High**	**High**	**Very High**
Populations						
Urban Residents	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**

Informal Settlement Residents	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**
Vulnerable & Marginalized Groups	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**
Natural Assets						
Urban Green Infrastructure	Moderate	**Low**	**Medium**	**High**	**Medium**	**High**
Peri-urban & Agricultural Systems	Major	**Medium**	**High**	**Very High**	**High**	**Very High**

Table 4.6. Summary of Wind Risks for Limuru Municipality

Category	**Current**	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Infrastructure & Services					
Energy	High	Very High	Very High	Very High	Very High
Transport and Mobility	High	Very High	Very High	Very High	Very High
Social Infrastructure	High	Very High	Very High	Very High	Very High
Economic Infrastructure	High	Very High	Very High	Very High	Very High
Emergency Services	Medium	High	Very High	High	Very High
Populations					
Urban Residents	High	Very High	Very High	Very High	Very High
Informal Settlement Residents	Very High	Very High	Very High	Very High	Very High
Vulnerable & Marginalized Groups	Very High	Very High	Very High	Very High	Very High
Natural Assets					
Urban Green Infrastructure	Medium	High	Very High	High	Very High
Peri-urban & Agricultural Systems	High	Very High	Very High	Very High	Very High

2.2. Climate Risk Hotspots

Climate risks are not evenly distributed across Limuru Municipality. The following wards face the highest multi-hazard risk:

1. **Limuru Central** – High flood risk (town centre, Manguo area) combined with moderate drought risk. Dense population, critical infrastructure, and economic assets are concentrated here.
2. **Ndeiya** – Very high drought risk, moderate flood risk in low-lying areas. Highest water insecurity and agricultural losses.
3. **Free Town / Njira Njeru (Bibirioni)** – Catastrophic flood and cold risk due to informal housing, poor drainage, and extreme poverty.
4. **Ngecha/Tigoni** – High extreme cold risk affecting tea production and vulnerable groups.

3. What's Next?

3.1. Key Findings

4. **Flooding** is the most pervasive and severe hazard, with **very high** risks already affecting stormwater drainage, transport, solid waste, economic and social infrastructure, and all population groups. These risks will become **very high to catastrophic** under all future scenarios.
5. **Drought** poses **very high** risks to water supply, agriculture, and vulnerable livelihoods, particularly in Ndeiya. Risks will escalate to **very high** by 2050 under RCP8.5.
6. **Extreme cold** currently causes **high** risks for informal settlement residents and tea farmers, but these may slightly decline under high-emission scenarios.

Most at-risk groups:

- Residents of informal settlements (Free Town, Njira Njeru)
- Elderly persons and children
- Female tea pickers (dependent on daily wages)
- Boda boda operators
- Smallholder farmers in Ndeiya

Trends intensifying future risks:

- Rapid urbanisation reducing pervious surfaces and increasing runoff.
- Continued encroachment on riparian reserves and wetlands.
- Increasing water demand from population growth.
- Limited municipal budget for maintenance and new infrastructure.

Table 11. Summary of climate risks affecting urban elements for

Limuru Municipality

Category	Current	Mid-term (2050)	Long-term (2100)
Infrastructure & Services			
Stormwater Drainage	Flooding (Very High)	Flooding (Very High)	Flooding (Very High)
Water & Wastewater Mgmt	Drought (High), Flooding (High)	Drought (Very High), Flooding (Very High)	Drought (Very High), Flooding (Very High)
Solid Waste Management	Flooding (Very High)	Flooding (Very High)	Flooding (Very High)

Transport and Mobility	Flooding (Very High), Cold (High)	Flooding (Very High), Cold (Medium)	Flooding (Very High), Cold (Medium)
Economic Infrastructure	Flooding (Very High), Drought (High)	Flooding (Very High), Drought (Very High)	Flooding (Very High), Drought (Very High)
Social Infrastructure	Flooding (Very High), Cold (High)	Flooding (Very High), Cold (Medium)	Flooding (Very High), Cold (Medium)
Emergency Services	Flooding (High), Drought (Medium)	Flooding (Very High), Drought (High)	Flooding (Very High), Drought (High)
Populations			
Urban Residents	Flooding (Very High), Drought (High), Cold (High)	Flooding (Very High), Drought (Very High), Cold (Medium)	Flooding (Very High), Drought (Very High), Cold (Medium)
Informal Settlement Residents	All three hazards (Very High)	All three hazards (Very High)	All three hazards (Very High)
Vulnerable & Marginalized Groups	All three hazards (Very High)	All three hazards (Very High)	All three hazards (Very High)
Natural Assets			
Urban Blue Infrastructure	Flooding (Very High), Drought (High)	Flooding (Very High), Drought (Very High)	Flooding (Very High), Drought (Very High)
Peri-urban & Agricultural Systems	Drought (Very High), Flooding (High), Cold (High)	Drought (Very High), Flooding (Very High), Cold (Medium)	Drought (Very High), Flooding (Very High), Cold (Medium)

6.1. Climate Adaptation and Resilience Solutions

The following solutions are drawn from community consultations and the Kiambu County PCRA adaptation strategies. They are prioritised as immediate (0-2 years), mid-term (3-7 years), and long-term (8-15 years).

Table 12. Climate adaptation and resilience solutions recommended for

Limuru Municipality

Category	Immediate (0-2 years)	Mid-term (3-7 years)	Long-term (8-15 years)
Infrastructure & Services			
Stormwater Drainage	- Desilt and unblock all primary drains. - Install trash screens at critical points. - Map drainage network in GIS.	- Construct lined drains in flood hotspots (Limuru Town, Manguo). - Rehabilitate Manguo Swamp as retention basin.	- Implement sustainable urban drainage systems (SUDS) for all new developments. - Riparian zone restoration.
Water & Wastewater Mgmt	- Distribute 500 domestic rainwater tanks. - Repair non-revenue water leaks. - Solarise 3 boreholes.	- Expand Ndeiya water supply with piped system from Karimenu II dam. - Construct 2 community water pans.	- Build climate-resilient centralised water treatment plant. - Recycle WWTP effluent for agriculture.
Solid Waste Management	- Provide 200 waste bins in flood-prone areas. - Conduct monthly clean-ups (river banks, drains). - Formalise waste pickers cooperative.	- Establish material recovery facility (MRF). - Close and rehabilitate Manguo dumpsite. - Introduce separate waste collection.	- Develop circular economy plan; zero waste to landfill. - Construct sanitary landfill for residual waste.

Transport and Mobility	- Repair flood-damaged bridges (Nderu). - Install flood warning signs at low points. - Grade 50 km of murram roads.	- Climate-proof 20 km of roads (raised embankments, culverts). - Pave high-traffic murram roads. - Construct footbridge at Kwaheri Bata.	- Integrate climate resilience into all road design standards. - Develop non-motorised transport network.
Energy	- Trim trees near power lines. - Install 100 solar streetlights in dark spots.	- Underground power lines in flood zones. - Promote solar water heating by-law.	- Decentralised mini-grids for Ndeiya.
Economic Infrastructure	- Provide raised stalls in Limuru Market. - Train 200 farmers on drought-tolerant crops.	- Build cold storage facility at Limuru Market. - Support tea cooperatives with weather index insurance.	- Establish climate-smart agriculture demonstration centre.
Social Infrastructure	- Retrofit 10 ECDE centres with insulation and warm floors. - Install water tanks in 15 schools.	- Construct raised access road to Sub-County Hospital. - Climate-proof 5 health dispensaries.	- Build model climate-resilient school.
Emergency Services	- Develop ward-level contingency plans. - Train 50 Community Emergency Response Teams (CERT).	- Equip fire station with flood rescue boat. - Install 3 automated weather stations for early warning.	- Establish municipal disaster operations centre.
Populations			

Urban Residents	- Awareness campaign on flood safety and rainwater harvesting. - Distribute mosquito nets in flood zones.	- Subsidise household rainwater tanks. - Expand health insurance coverage for vulnerable groups.	- Incorporate climate resilience into housing bylaws.
Informal Settlement Residents	- Relocate 50 most at-risk households to safer land. - Provide basic sanitation facilities (temporary).	- Develop participatory slum upgrading plan (Free Town). - Secure land tenure for residents.	- In-situ upgrading with flood-proof housing and services.
Vulnerable & Marginalized Groups	- Register elderly/PWDs for social protection cash transfers. - Distribute warm clothing in Ngecha/Tigoni.	- Establish livelihoods diversification programme (tea pickers). - Provide grants for youth agribusiness.	- Fully inclusive climate action plan with reserved budgets.
Natural Assets			
Urban Green Infrastructure	- Plant 5,000 indigenous trees (riparian, schools). - Protect remnant urban forests.	- Develop green corridor along Nderu River. - Establish community tree nurseries.	- Increase tree cover to 20% of municipal area.
Urban Blue Infrastructure	- Demarcate and peg riparian reserves. - Remove encroachers along Kamiti River.	- Restore 5 km of riparian zone with bamboo. - Develop Manguo Swamp eco-tourism site.	- Fully rehabilitated Manguo Wetland as Ramsar site candidate.

Peri-urban & Agricultural Systems	- Train 500 farmers on hay-making and silage. - Distribute drought-tolerant maize seed.	- Expand drip irrigation on 200 acres (Ndeiya). - Promote agroforestry on tea buffer zones.	- Transform Ndeiya into climate-smart agriculture hub.

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Annex N1. Historical Hazard Events (optional)

Event 1: Severe Flooding – Limuru Town & Manguo

- **Date/Period:** April–May 2018
- **Location:** Limuru Central (town centre, Kwaheri Bata underpass), Manguo Swamp area.
- **Intensity:** 120 mm rainfall in 24 hours (11 May 2018); Nderu River burst its banks. Flood depth 0.5–1.2 m in low-lying areas.
- **Social Impacts:** 2 fatalities (drowning), 1,200 people displaced. Schools closed for 1 week.
- **Physical Impacts:** Nderu Bridge approach washed away; 15 km of roads damaged; 50 houses destroyed in Free Town.
- **Economic Impacts:** KES 120 million in damages (roads, bridges, private property). Businesses lost stock worth KES 8 million.
- **Ecological Impacts:** Manguo Swamp received silt and raw sewage; water hyacinth infestation followed.

Event 2: Severe Drought – Ndeiya

- **Date/Period:** January–March 2017
- **Location:** Ndeiya ward.
- **Intensity:** 70% below average long rains; soil moisture deficit persisted for 4 months.
- **Social Impacts:** 8,000 people faced acute water shortage; water trucking by county government.
- **Physical Impacts:** 12 community boreholes dried up; piped supply pressure zero.
- **Economic Impacts:** Maize harvest failure (90% loss); livestock deaths (200 cattle, 500 goats).
- **Ecological Impacts:** Acute stress on remaining trees; wildlife (monkeys) raided farms.

Event 3: Extreme Cold / Frost – Ngecha/Tigoni

- **Date/Period:** July 2021
- **Location:** Ngecha/Tigoni ward.
- **Intensity:** Minimum temperature –1.2°C; widespread frost.
- **Social Impacts:** 300 children absent from ECDE due to cold; 20 elderly persons treated for pneumonia.
- **Physical Impacts:** No significant infrastructure damage.
- **Economic Impacts:** Tea production dropped 15% for 2 weeks; frost damage to 50 ha of tea.
- **Ecological Impacts:** Minor damage to young trees

Annex N2. Data Sources

Page	Data	Data Source
9	Population figures, ward-wise	KNBS 2019, Kiambu CIDP 2023-2027
11	Hazard screening	PCRA Limuru Sub-County consultations, 2023
12	Climate indicators, thresholds	KMD, CHIRPS, CORDEX-Africa, ERA5-Land
13	Current hazard levels	Kiambu County PCRA (Chapter 3)
13	Future hazard projections	Kiambu County PCRA (Chapter 4) – downscaled CMIP5
16	Urban elements inventory – infrastructure	Limuru Municipal Board asset register (2024)
17	Informal settlement data	Ward administrators, PCRA community mapping
19–33	Exposure, vulnerability, impacts	PCRA community workshops, 2023; expert judgment
34–37	Risk levels	Derived using IPCC AR5 risk framework
38	Climate risk hotspots	PCRA hazard maps, municipal physical planning
40	Adaptation solutions	PCRA adaptation strategies (Table 4,15,16)