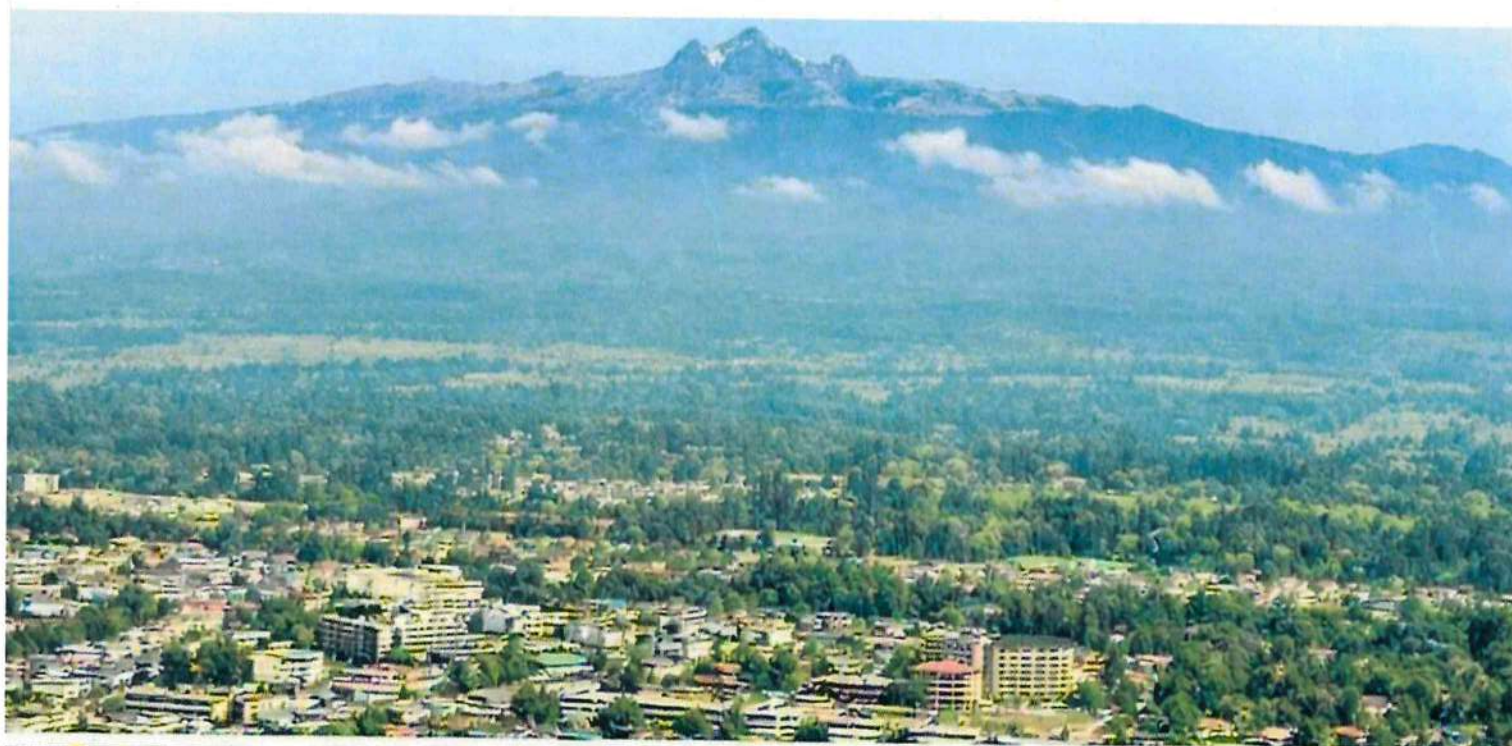




REPUBLIC OF KENYA
COUNTY GOVERNMENT OF NYERI



MUNICIPALITY OF NYERI
URBAN CLIMATE RISK PROFILE
2025





Municipality of Nyeri; Urban Climate Risk Profile

Prepared by:

COUNTY GOVERNMENT OF NYERI
NYERI MUNICIPALITY

Technical Team:

NYERI MUNICIPALITY BOARD MEMBERS
COUNTY DIRECTOR OF ENVIRONMENT AND CLIMATE CHANGE
COUNTY DIRECTOR OF PHYSICAL AND URBAN PLANNING
MUNICIPAL MANAGER
MUNICIPAL PLANNER
MUNICIPAL ENVIRONMENT OFFICER

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Municipality of Nyeri; Urban Climate Risk Profile

Foreword



Nyeri Municipality stands at a critical point in its development pathway. As a growing urban centre within Nyeri County and strategically located on the slopes of Mount Kenya, our municipality continues to experience rapid urbanization, infrastructure expansion, and increased demand for social and economic services. While this growth presents opportunities for prosperity and improved livelihoods, it also exposes us to heightened climate-related risks that must be proactively managed.

The Urban Climate Risk Profile for Nyeri Municipality has been developed to provide a comprehensive, evidence-based understanding of these risks. It assesses current and projected climate hazards, identifies exposed sectors and populations, and evaluates levels of vulnerability and potential impacts over short, medium, and long-term planning horizons. This Profile is therefore not only a diagnostic document, but also a strategic planning tool designed to guide informed decision-making.

Importantly, this report supports the integration of climate resilience into municipal planning instruments, infrastructure investments, land use management, disaster risk reduction strategies, and service delivery frameworks. It aligns with national climate policies and county development priorities, while strengthening our local capacity to anticipate, prepare for, and respond to climate related challenges.

As we move forward, Nyeri Municipality reaffirms its commitment to mainstreaming climate risk considerations into all aspects of urban governance. We will prioritize practical, inclusive, and sustainable actions that protect our people, strengthen our infrastructure, and preserve our natural resources for future generations.

Together, we can build a resilient Nyeri, capable of withstanding climate challenges while continuing to thrive as a vibrant and sustainable municipality.

Jeremiah Ichaura

Chairperson – Nyeri Municipality Board

COUNTY GOVERNMENT OF NYERI



Municipality of Nyeri; Urban Climate Risk Profile

Acknowledgement



The preparation of the Urban Climate Risk Profile for Nyeri Municipality has been made possible through the collective efforts and support of many institutions and individuals. As the Municipal Manager, I wish to express sincere appreciation to all stakeholders who contributed their time, knowledge, and resources to the successful development of this important document.

Special recognition goes to the technical teams from the Municipality and Nyeri County Government for their dedication in data collection, analysis, and stakeholder engagement throughout the process. Their commitment ensured that the report accurately reflects the climate risks affecting our urban systems, infrastructure, environment, and communities.

We also acknowledge the guidance and support provided by the State Department for Housing and Urban Development and the Kenya Urban Support Program, whose technical and financial assistance made the preparation of this profile possible.

Finally, we appreciate the participation of community representatives, development partners, and all stakeholders who shared valuable insights during consultations. Their contributions have helped shape a comprehensive understanding of climate risks and strengthened our commitment to building a resilient and sustainable municipality.

This Urban Climate Risk Profile will serve as an important reference for integrating climate considerations into urban planning, development, and decision-making in Nyeri Municipality.

CS Perister Kigwa
MUNICIPAL MANAGER



Municipality of Nyeri; Urban Climate Risk Profile

Executive Summary

This Urban Climate Risk Profile (UCRP) for Nyeri Municipality provides a rapid, evidence-based assessment of current and future climate risks to urban systems, populations, and natural assets. The profile is prepared in line with the Global Centre of Adaptation (GCA) Urban Climate Risk Profile Guidelines, 2025, and is informed primarily by the Nyeri County Participatory Climate Risk Assessment (PCRA, 2023), the climate information from Kenya Meteorological Department under State Department of Environment and Climate Change, the draft Nyeri County Spatial Plan, and stakeholder consultations.

The assessment identifies five priority climate hazards affecting Nyeri Municipality - Flooding (pluvial and fluvial), Drought and Water Stress, Heat Stress, Landslides and Gully Erosion, and Storms (extreme rainfall and strong winds). Flooding and water stress present the highest current and future risks, particularly to stormwater drainage, water supply systems, transport infrastructure, informal settlements, and vulnerable populations. Climate projections indicate increasing rainfall intensity and rising temperatures by 2050 and 2100, especially under high-emissions scenarios, which will exacerbate existing vulnerabilities. Without targeted adaptation measures, risks to infrastructure, service delivery, livelihoods, and public health will escalate.

Key recommended actions include immediate drainage maintenance and solid waste control, medium-term investments in water security and green infrastructure, and long-term integrated land-use planning and catchment management to build climate resilience across the municipality.

Summary of Flooding risks for Nyeri 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	Very High
		Risk Levels			



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Categories	Impact	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services						
Stormwater Drainage	Overtopping, blockage, localized flash flooding	Very High	Very High	Very High	Very High	Very High
Water & Wastewater Management	Flooded sewer lines, contamination of water sources	High	Very High	Very High	Very High	Very High
Solid Waste Management	Waste washed into drains and rivers, worsening floods	Very High	Very High	Very High	Very High	Very High
Transport and Mobility	Road flooding, bridge overtopping, traffic disruption	High	Very High	Very High	Very High	Very High
Energy	Power outages, substation flooding	Medium	High	High	High	High
Economic Infrastructure	Disruption to markets, SMEs, industrial areas	High	Very High	Very High	Very High	Very High



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Social Infrastructure	Flooding of schools, health facilities	Medium	High	High	High	High
Emergency Services	Reduced access and response time during floods	Medium	High	High	High	High
Populations						
Urban Residents	Property damage, health risks, displacement	High	Very High	Very High	Very High	Very High
Informal Settlement Residents	Loss of shelters, high exposure along riverbanks	Very High	Very High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Increased disease risk, livelihood loss	Very High	Very High	Very High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Erosion, degradation, loss of flood buffering	Medium	High	High	High	High
Urban Blue Infrastructure	Riverbank erosion, wetland degradation	Very High	Very High	Very High	Very High	Very High



Municipality of Nyeri; Urban Climate Risk Profile

Peri-urban and Agricultural Systems	Crop damage, soil erosion, livelihood loss	Very High	Very High	Very High	Very High	Very High
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Summary of Landslides and gully erosion risks for Nyeri 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
Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2- 4.5	2100 SSP5- 8.5
Infrastructure & Services						
Stormwater Drainage	Gully formation, collapse of drains	Very High	Very High	Very High	Very High	Very High
Water & Wastewater Management	Pipe breakage, contamination	Medium	Medium	High	High	High
Solid Waste Management	Waste exposed and washed into gullies	Medium	Medium	High	High	High



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Transport and Mobility	Road subsidence, landslide blockages	Very High	Very High	Very High	Very High	Very High
Energy	Damage to poles, buried cables	Medium	Medium	High	High	High
Economic Infrastructure	Damage to markets, workshops, SMEs	Very High	Very High	Very High	Very High	Very High
Social Infrastructure	Damage to schools, health center's	Medium	Medium	High	High	High
Emergency Services	Restricted access during slope failures	Medium	Medium	High	High	High
Populations						
Urban Residents	Property damage, safety risks	Medium	Medium	High	High	High
Informal Settlement Residents	House collapse, displacement	Very High	Very High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Loss of shelter and livelihoods	Very High	Very High	Very High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Vegetation loss, slope instability	Medium	Medium	High	High	High



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Urban Blue Infrastructure	Sedimentation of streams	High	High	Very High	Very High	Very High
Peri-urban and Agricultural Systems	Soil loss, reduced productivity	Very High	Very High	Very High	Very High	Very High

Summary of Drought and water stress risks for Nyeri 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	Very High
Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services						
Stormwater Drainage	Reduced base flows, sediment buildup	Medium	Medium	High	High	High
Water & Wastewater Management	Water shortages, reduced treatment efficiency	High	High	Very High	Very High	Very High



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Solid Waste Management	Reduced cleaning capacity, public health risks	Medium	Medium	High	High	High
Transport and Mobility	Dust, reduced road durability	Medium	Medium	High	High	High
Energy	Reduced hydropower reliability, cooling needs	Medium	Medium	High	High	High
Economic Infrastructure	Reduced productivity, higher operating costs	High	High	Very High	Very High	Very High
Social Infrastructure	Water shortages in schools & hospitals	High	High	Very High	Very High	Very High
Emergency Services	Limited water for firefighting	Medium	Medium	High	High	High
Populations						
Urban Residents	Intermittent supply, increased costs	High	High	Very High	Very High	Very High



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Informal Settlement Residents	Acute shortages, reliance on unsafe sources	High	High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Health risks, reduced coping capacity	High	High	Very High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Vegetation stress, loss of cooling	Medium	Medium	High	High	High
Urban Blue Infrastructure	Reduced flows, degraded water quality	High	High	Very High	Very High	Very High
Peri-urban and Agricultural Systems	Crop losses, livestock stress	High	High	Very High	Very High	Very High

Summary of Heat stress risks for Nyeri Municipality

	Time Horizon & Climate Scenario	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
	Hazard Level	Low	Medium	Medium	High	High
		Risk Levels				



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Categories	Impact	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services						
Stormwater Drainage	Thermal stress on structures, low flows	Low	Low	Low	Medium	Medium
Water & Wastewater Management	Higher demand, treatment stress	Low	Medium	Medium	High	High
Solid Waste Management	Odour, worker exposure, health risks	Low	Medium	Medium	High	High
Transport and Mobility	Road surface degradation, heat exposure	Low	Medium	Medium	High	High
Energy	Increased cooling demand, outages	Low	Low	Low	Medium	Medium
Economic Infrastructure	Productivity loss, heat-related downtime	Low	Medium	Medium	High	High



Municipality of Nyeri; Urban Climate Risk Profile

Social Infrastructure	Overheated schools and health facilities	Low	Medium	Medium	High	High
Emergency Services	Increased heat-related emergencies	Low	Medium	Medium	High	High
Populations						
Urban Residents	Discomfort, health stress	Medium	High	High	Very High	Very High
Informal Settlement Residents	Severe indoor heat, dehydration	Medium	High	High	Very High	Very High
Vulnerable and Marginalized Groups	Heat illness, mortality risk	Medium	High	High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Heat stress, reduced cooling capacity	Low	Medium	Medium	High	High
Urban Blue Infrastructure	Higher evaporation, lower cooling effect	Low	Medium	Medium	High	High
Peri-urban and Agricultural Systems	Crop stress, reduced yields	Medium	High	High	Very High	Very High



Municipality of Nyeri; Urban Climate Risk Profile

Summary of Extreme rainfall variability risks for Nyeri 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	Very High
Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2- 4.5	2100 SSP5- 8.5
Infrastructure & Services						
Stormwater Drainage	Overtopping during storms; inefficiency in dry periods	High	Very High	Very High	Very High	Very High
Water & Wastewater Management	Treatment overload and low-flow stress	High	Very High	Very High	Very High	Very High
Solid Waste Management	Waste mobilization during storms	High	Very High	Very High	Very High	Very High
Transport and Mobility	Flooded roads, erosion, delays	High	Very High	Very High	Very High	Very High
Energy	Disruption from storms and erosion	Medium	High	High	High	High



Municipality of Nyeri; Urban Climate Risk Profile

Economic Infrastructure	Business interruptions, damage	High	Very High	Very High	Very High	Very High
Social Infrastructure	School and health facility disruption	High	Very High	Very High	Very High	Very High
Emergency Services	Increased demand, reduced access	Medium	High	High	High	High
Populations						
Urban Residents	Property damage, safety risks	Medium	High	High	High	High
Informal Settlement Residents	Flooding, landslide exposure	High	Very High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Health risks, livelihood loss	Medium	High	High	High	High
Natural Assets						
Urban Green Infrastructure	Erosion and vegetation stress	Medium	High	High	High	High
Urban Blue Infrastructure	Flash flooding, sedimentation	Medium	High	High	High	High
Peri-urban and Agricultural Systems	Crop losses, soil erosion	Medium	High	High	High	High



Municipality of Nyeri; Urban Climate Risk Profile

Table of Contents

Foreword (optional)	1
Executive Summary	iv
Table of Contents	xvi
List of Acronyms	xvii
List of Figures (optional)	xix
List of Tables (optional).....	xix
1. Context.....	1
1.1. Objective.....	1
1.2. Urban Context	1
1.2.1. Geographic area	1
1.2.2. Governance Structure	2
1.2.3. Socio-economic Context	3
1.2.4. Economic Context	4
1.2.5. Land-use Context	4
1.3. Key Stakeholders & Inclusiveness	6
1.3.1 Purpose of Stakeholder Engagement in the UCRP	6
1.3.2 Legal and Policy Framework Guiding Engagement.....	7
1.3.3 The table below presents a list of stakeholders according to their levels of influence and interest.....	7
1.3.4 Policy and Institutional Framework	12
2. Hazard Assessment	16
2.1. Key Climate Hazards.....	16
2.2. Climate Indicators and Hazard Thresholds.....	18
2.3. Current Hazard Levels and Climate Projections	19
2.4. Current and Future Hazard Impact Areas	21
3. Exposure & Vulnerability Assessment	24
3.1. Urban Elements	25
3.2. Exposure, Vulnerability, and Impacts of Climate Hazards on Urban Elements.....	32
4. Climate Risk Assessment.....	84
4.1. Current and Future Climate Risks on Urban Elements	85
4.2. Climate Risk Hotspots.....	97
5. What's Next?	99
5.1. Key Findings	99
5.2. Climate Adaptation and Resilience Solutions	104
Bibliography	107
Annex 1. Historical Hazard Events.....	110
Annex 2. Data Sources.....	111



List of Acronyms

Acronym	Full Term
ADB	African Development Bank
ASALs	Arid and Semi-Arid Lands
BPO	Business Process Outsourcing
CBD	Central Business District
CCAP	County Climate Action Plan
CCCF	County Climate Change Fund
CCD	Climate Change Directorate
CIDP	County Integrated Development Plan
CSO	Civil Society Organization
DEM	Digital Elevation Model
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EMCA	Environmental Management and Coordination Act
EPRA	Energy and Petroleum Regulatory Authority
FLLoCA	Financing Locally-Led Climate Action
GCA	Global Center on Adaptation
GHG	Greenhouse Gas
GIS	Geographic Information System
GoK	Government of Kenya



Municipality of Nyeri; Urban Climate Risk Profile

ICT	Information and Communication Technology
IDEP	Integrated Development and Economic Plan
IPCC	Intergovernmental Panel on Climate Change
KMD	Kenya Meteorological Department
KUSP	Kenya Urban Support Program
KUSP-II	Kenya Urban Support Program – Phase II
MIDP	Municipal Integrated Development Plan
NCCAP	National Climate Change Action Plan
NAP	National Adaptation Plan
NDMA	National Drought Management Authority
NEMA	National Environment Management Authority
NGO	Non-Governmental Organization
NYEWASCO	Nyeri Water and Sanitation Company
PCRA	Participatory Climate Risk Assessment
PWD	Persons with Disabilities
RCRA	Rapid Climate Risk Assessment
SSP	Shared Socioeconomic Pathway
UCRP	Urban Climate Risk Profile
UHI	Urban Heat Island
UNFCCC	United Nations Framework Convention on Climate Change
WRA	Water Resources Authority



List of Figures (optional)

Figure 1. Source, Year	2
Figure 2. The organogram of the Municipality	3
Figure 3. The Municipality current land use	6
Figure 4. Map showing the areas affected by drought in the municipality	22
Figure 5. Map showing the areas affected by landslides in the municipality	23
Figure 6. Map showing the areas affected by Rainfall Variability in the municipality	23
Figure 7. Map showing the areas affected by Heat Stress in the municipality	24
Figure 8. Exposure, Vulnerability, and Impacts of Drought and water stress on Urban Elements.....	54
Figure 9. Exposure, Vulnerability, and Impacts of Heat stress on Urban Elements.....	63
Figure 10. Map of Climate Risk Hotspots within the Municipality.....	98

List of Tables (optional)

Table 1. Key economic sectors and their contribution.....	4
Table 2. Current land use profile	5
Table 3. Projected land use up to 2034.....	5
Table 4. Stakeholder mapping for Nyeri Municipality	12
Table 5. Hazard screening for Nyeri Municipality	17
Table 6. Climate indicators and hazard thresholds selected for the assessment	18
Table 7. Current and future hazards levels for Nyeri Municipality	20
Table 8. Interpretation of hazard levels	21
Table 9. Urban elements inventory	25
Table 10. Interpretation of exposure and vulnerability levels.....	32
Table 11. Impact Matrix	33
Table 12. Exposure, Vulnerability, and Impacts of flooding on Urban Elements	34
Table 13. Exposure, Vulnerability, and Impacts of Landslides and gully erosion on Urban Elements	43
Table 14. Exposure, Vulnerability, and Impacts of Change in precipitation patterns on Urban Elements	73
Table 15. Risk matrix.....	84
Table 16. Interpretation of risk levels.....	84
Table 17. Summary of Flooding risks for Nyeri Municipality	85
Table 18. Summary of Landslides and gully erosion risks for Nyeri Municipality.....	88
Table 19. Summary of Drought and water stress risks for Nyeri Municipality	90
Table 20. Summary of Heat stress risks for Nyeri Municipality	92
Table 21. Summary of Extreme rainfall variability risks for Nyeri Municipality	94
Table 22. Summary of climate risks affecting urban elements for Nyeri Municipality.....	99
Table 23. Climate adaptation and resilience solutions recommended for Nyeri Municipality	104



1. Context

1.1. Objective

This Urban Climate Risk Profile aims to identify and assess key climate hazards affecting Nyeri Municipality, analyze exposure and vulnerability of urban systems, populations, and natural assets, evaluate current and future climate risks under different climate scenarios and provide a basis for climate adaptation and resilience planning at the municipal and county levels.

1.2. Urban Context

1.2.1. Geographic area

Nyeri Municipality is located in central Kenya within Nyeri County, on the western slopes of Mount Kenya and covers about **170.2 km²** of land. Geographic coordinates cover approximately **00°17.36'S–00°28.21'S latitude** and **36°50.62'E–37°05.7'E longitude** while **the altitude** ranges from about **1,600 m to 1,900 m above sea level**, with the highest point near **Nyeri Hill** and lower zones near **Marua Trading Centre**. It includes **Chaka sub location** and **five municipal ward areas: Kiganjo/Mathari, Kamakwa/Mukaro, Rware, Ruring'u, and Gatitu/Muruguru**. The municipality covers urban and peri-urban areas characterized by highland topography, river valleys, steep slopes and agricultural land used by small-scale farmers. Major rivers include Chania, Sagana, and tributaries draining Mount Kenya. Several forests under the Mount Kenya Forests fall under the municipality, among them being Muringato forest, Kabiruni forest and Nyeri hill. Attached below is the map of the municipality administrative boundaries;



Municipality of Nyeri; Urban Climate Risk Profile

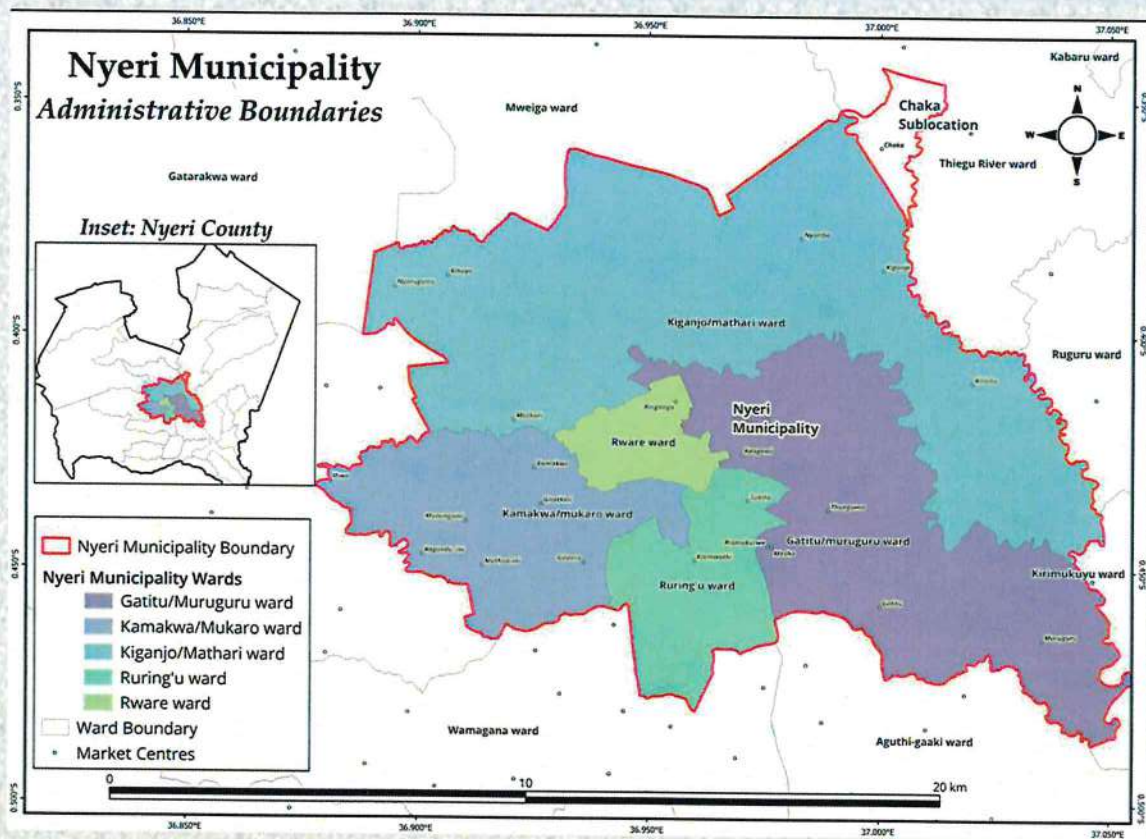


Figure 1. Source, Year

1.2.2. Governance Structure

Nyeri Municipality was formally established under the **Urban Areas and Cities Act (2011, amended 2019)** to provide structured local governance, urban services, planning, and development for the Nyeri urban area.

Nyeri Municipality operates under the County Government of Nyeri and is managed by the Nyeri Municipal Board. The **Municipal Manager** is the chief administrative officer responsible for implementing Municipal Board decisions and managing day-to-day operations. Key Directorates under the municipality include Physical Planning and development control, Engineering, Community Services, Roads & Transport, Health Services, and Disaster Management. Key units involved in the development of URCP and IDeP include Environment and climate change, gender youth and social services and Kenya metrological department.



Municipality of Nyeri; Urban Climate Risk Profile

The organogram of the Municipality is as described below.

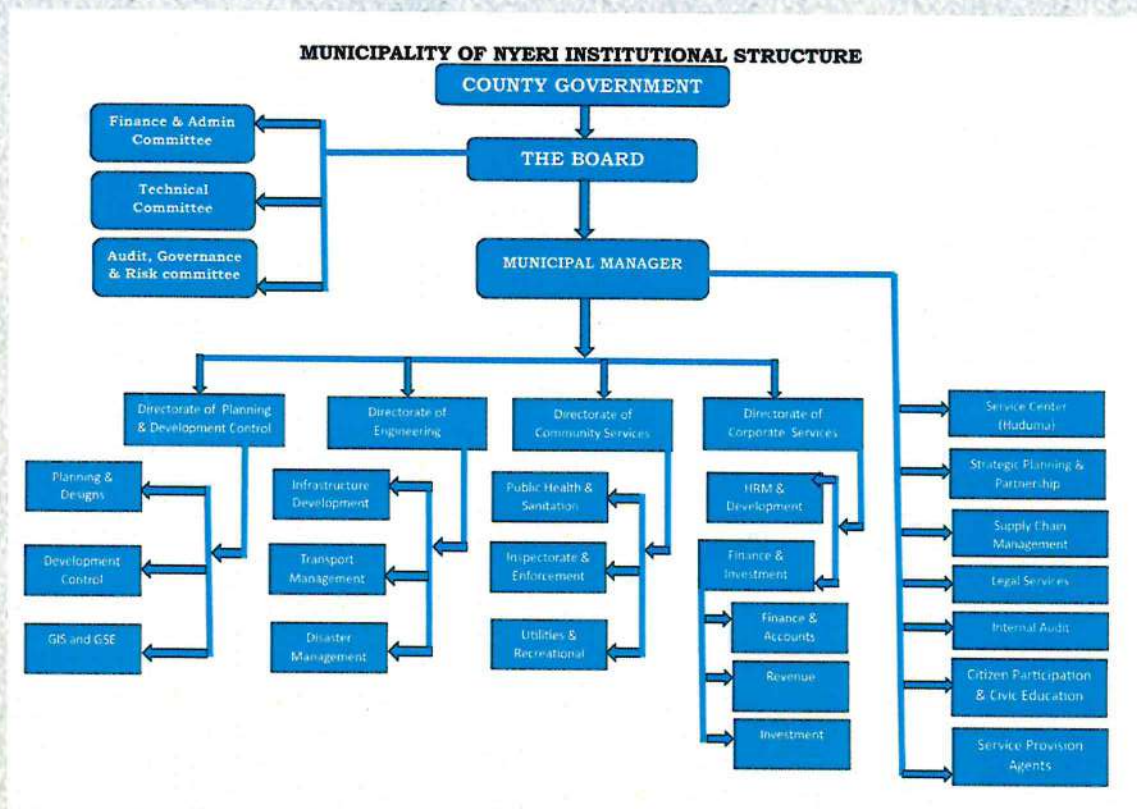


Figure 2. The organogram of the Municipality

1.2.3. Socio-economic Context

Nyeri Municipality is the principal urban center of Nyeri County, with a vibrant mix of economic activities including trade, services, small-scale industry, and agriculture in peri-urban areas. Agriculture, retail commerce, public administration, and education are prominent economic pillars. **Nyeri Municipality population is projected to grow from about 160,784 in 2024 to 168,818 by 2029**, indicating moderate growth, with population pressure in the urban area reflecting internal migration from rural parts of Nyeri County from people seeking jobs and services. The dominant **ethnic group in Nyeri is Kikuyu**, with Swahili and English also being widely spoken. Informal settlements such as Majengo exist along riverbanks and steep slopes. Youth, women-headed households, and low-income groups form a significant share of the population.



Municipality of Nyeri; Urban Climate Risk Profile

1.2.4. Economic Context

- Nyeri Municipality's economy is diversified but firmly grounded in **agriculture and agribusiness**, with growing **services, retail/shopping, manufacturing/processing, tourism, and ICT/BPO sectors**. The Municipality's urban economy benefits from:

Table 1. Key economic sectors and their contribution

Economic Sector	Role / Contribution
Agriculture Value chains	Backbone of county economy, strong link to municipality market and processing.
Manufacturing & Processing	Tea/coffee/dairy processing, bottling plants (Coca-Cola, milk).
Trade & Commerce	Retail markets, shops, services centered in urban wards.
Tourism & Hospitality	Visitor services linked to national parks, historical sites.
Services (incl. BPO)	Emerging IT/BPO employment hub with local firms.

1.2.5. Land-use Context

Current land use within the municipality includes residential areas, commercial and institutional zones, industrial areas, peri-urban agriculture, riparian corridors, and forested areas linked to the Mount Kenya ecosystem.

According to Nyeri Municipality broad land-use data from the Nyeri Town Integrated Strategic Urban Development Plan (2014-2034), approximately 77.2 % of the Municipality's land use is under agriculture, 10.6% as residential and only 1% for commercial use, as profiled in the table below.



Municipality of Nyeri; Urban Climate Risk Profile

Table 2. Current land use profile

Land Use Category	Area (ha)	% of Planning Area
Agriculture (general)	13,648	51.1%
Intensive Agriculture	6,975	26.1%
Recreational / Open Space	1,657	6.2%
Low Density Residential	1,397	5.2%
Medium Density Residential	949	3.6%
High Density Residential	471	1.8%
Commercial	259	1.0%
Education	455	1.7%
Public Purpose	398	1.5%
Industrial	167	0.6%
Transport	215	0.8%
Public Utility	60	0.2%
Total Planning Area	26,700	100%

Table 3. Projected land use up to 2034

Projection Focus	Expected Outcome
Urban densification	More compact urban expansion to accommodate population growth within the existing urban footprint.
Agricultural protection	Continued protection of essential agricultural zones to secure local food production.
Mixed land use	Expansion of mixed residential and commercial zones along major transport corridors.
Infrastructure expansion	Land re-designation for transport and utilities as the town grows. Spatial Plan guidance to align transport, drainage, and services.

The map of the Municipality current land use.



Municipality of Nyeri; Urban Climate Risk Profile

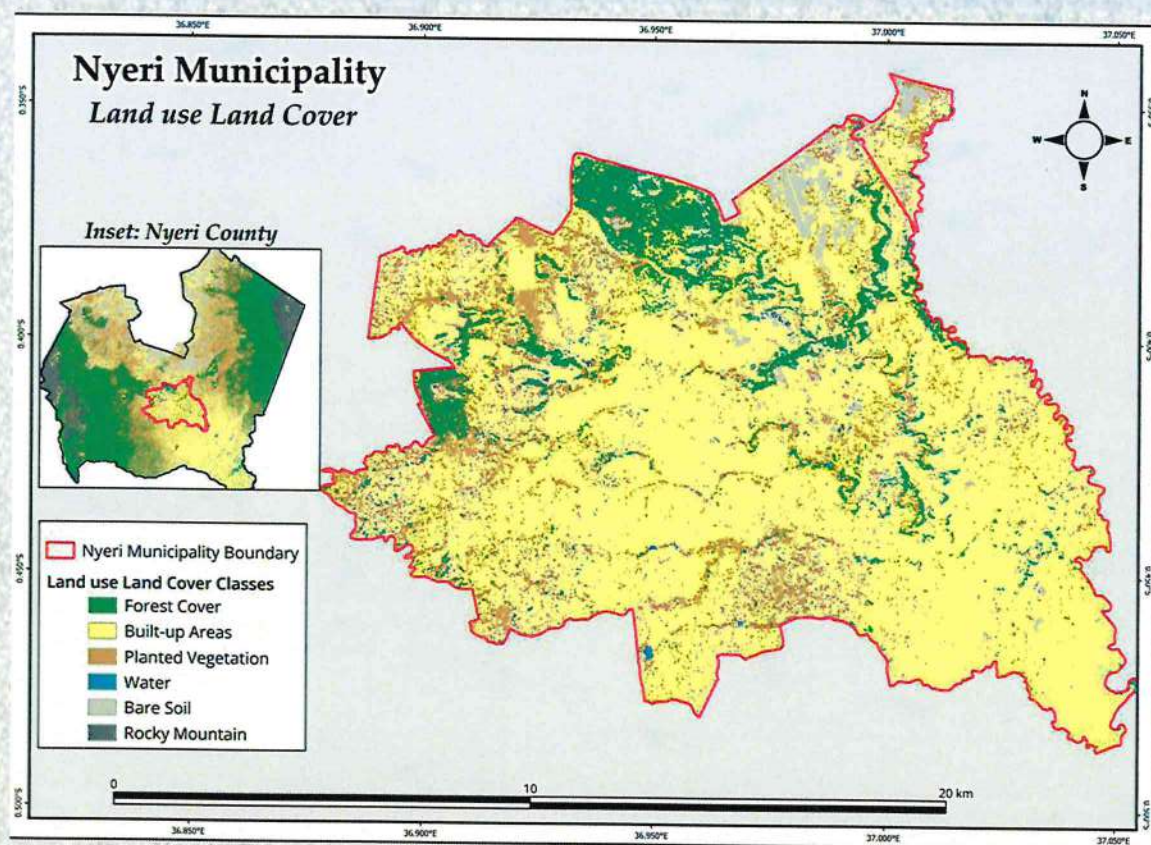


Figure 3. The Municipality current land use

1.3. Key Stakeholders & Inclusiveness

1.3.1 Purpose of Stakeholder Engagement in the UCRP

Stakeholder engagement in the development of the Urban Climate Risk Profile ensures that there is a common understanding of the challenges and aspirations as it reflects **local realities, lived experiences, and indigenous knowledge**, provides actionable information on the municipality's priorities for addressing its most pressing risks, and **builds ownership for implementation and mainstreaming of** climate actions into county and municipal plans (CIDP, MIDP, sector plans). Stakeholder engagement also ensures that the document is scientifically **credible, socially inclusive, and politically legitimate**.



1.3.2 Legal and Policy Framework Guiding Engagement

Stakeholder participation in the UCRP preparation is guided by:

- Constitution of Kenya (2010) – Article 10 & Article 174 (public participation and devolution)
- Climate Change Act (2016) – stakeholder consultation and county climate governance
- Urban Areas and Cities Act (2011, amended 2019) – participatory urban planning
- County Governments Act (2012) – citizen engagement frameworks
- Nyeri County Public Participation Act (2015)
- Nyeri County Climate Change Fund Regulations
- Nyeri Municipality Integrated Development and Economic Plan (IDEP)
- National Climate Change Action Plans (NCCAPs)
- Nyeri Participatory Climate Risk Assessment (PCRA)
- Nyeri County Climate Action Plan (CCAP)

1.3.3 The table below presents a list of stakeholders according to their levels of influence and interest.



Municipality of Nyeri; Urban Climate Risk Profile

High	High Influence – Low Interest National Government Ministries Ministry of Environment & Forestry Ministry of Transport, Infrastructure, Housing Ministry of Devolution & ASALs Ministry of Water, Sanitation & Irrigation National Regulatory Agencies National Environment Management Authority (NEMA) Water Resources Authority (WRA) Energy & Petroleum Regulatory Authority (EPRA) County Government Leadership (Non-technical) Nyeri County Governor County Assembly Leadership	High Influence – High Interest Nyeri Municipality Government. Municipal planning & environment/land-use departments – Lead technical teams for urban planning and climate profiling. Municipal engineering/infrastructure units – Integrate climate risks into infrastructure design. Urban disaster risk management unit– Concerned with hazards like floods and heatwaves. Nyeri County Government – Climate & Environment Leadership. Department of Water, Environment & Climate Change (County) – Leads locally-led climate resilience initiatives (e.g., FLLoCA implementation). County Climate Change Unit & Director – Drives county-wide climate planning; facilitates participatory risk assessments. County Disaster Risk Management Office – Integrates climate risks into emergency planning.
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County Executive Committee Members (relevant sectors) • Large Private Sector Corporations Major commercial banks with lending power - Real estate developers and property owners - Large industrial firms (manufacturing/agro-processing) • National Political Leaders & MPs Local Members of Parliament Senators / Party leadership involved in county oversight	• National Government Bodies (Climate & Urban Policy) State Department for Housing and Urban Development (SDHUD) – Sets urban planning/climate risk guidelines under national programs like KUSP-II. - Kenya Meteorological Department (KMD) – Provides climate data essential for profile analysis. - National Disaster Management Authority (NDMA) – Coordinates national disaster risk assessment frameworks. - National Environment Management Authority (NEMA) – Ensures compliance with environmental/climate regulations. • Development Partners & Funders. Global Center on Adaptation (GCA) – Provided the climate risk profile guideline used in Kenya. World Bank / Kenya Urban Support Program (KUSP-II) – Ties eligibility for urban development grants to completed profiles.
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	Bilateral and multilateral climate funds (e.g., Adaptation Fund/Green Climate Fund) – Interested in risk assessments to justify financing Local & Ward Climate Committee Ward Climate Change Committees (across Nyeri wards) – Carry community-level climate data and voices into higher planning Civil Society & NGOs Actively Working on Climate. Local environmental NGOs / community groups focused on climate action, adaptation, and natural resource management (e.g., tree planting, watershed protection groups) – strongly invested in risk identification and action outcomes. Academic & Research Institutions Universities / research centers with sustainability, climate, and urban planning expertise – provide evidence and analytical support. Private Sector Partners (Strategic) Urban utilities & service providers (e.g., water, energy, waste management) with climate risk implications. Local developers/infrastructure firms engaged in resilient design.
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Municipality of Nyeri; Urban Climate Risk Profile

Low Influence – Low Interest	Low Influence – High Interest
General Public (Non-affected / Unorganized) Residents with no specific involvement in climate, planning, or disaster committees Individuals unaware of climate risk issues. Small Retailers & Informal Traders (Unions not Climate-focused) Street vendors and micro traders without formal representation in planning forums. Non-Environmental Religious/Charitable Groups Churches, community savings groups, etc., that do not prioritize environmental/climate matters. Hobby/Interest Groups Unrelated to Climate or Urban Planning. Social clubs, sports clubs, entertainment groups, hobby associations. Peripheral Small Businesses (Non-climate/Non-planning). Local businesses with no direct environmental or infrastructure interface (e.g., small kiosks, hair salons)	Community Members in Climate-Vulnerable Areas. Residents in flood-prone zones, informal settlements, or areas affected by drought, heat stress, or poor drainage Urban poor and peri-urban households within Nyeri Municipality. Community-Based Organizations (CBOs) Local self-help groups Youth groups Women groups Residents' associations (non-political) Ward-Level Climate and Environmental Champions. Individual ward climate volunteers Community mobilizers trained under climate or environmental programs. Small-Scale Farmers & Urban/Peri-Urban Producers. Urban agriculture groups Small livestock keepers within municipal boundaries. Local NGOs and CSOs (Small / Localized). Grassroots environmental NGOs Tree-growing and watershed protection groups



Municipality of Nyeri; Urban Climate Risk Profile

● Peripheral National Bodies (Irrelevant Mandates). Government offices whose mandates do not intersect climate, urban planning, or environment (e.g., agencies focused solely on unrelated sectors like national arts council without community climate agenda).	Youth-led climate action organizations ● Informal Sector Associations. Informal traders' groups Market vendor's associations Jua kali artisans ● Schools, Teachers, and Environmental Clubs. Primary and secondary school eco-clubs Teachers involved in environmental education. ● Youth and Women Climate Networks Youth climate advocates Women-led climate adaptation groups
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Low

High

Table 4. Stakeholder mapping for Nyeri Municipality

1.3.4 Policy and Institutional Framework

1.3.4.1 National Policy and Legal Framework

Kenya has a well-established climate governance framework that provides the legal and policy basis for urban climate risk management in Nyeri Municipality.

a) Climate Change Act, 2016

- Establishes the National Climate Change Council and Climate Change Directorate (CCD).
- Requires mainstreaming of climate change adaptation and mitigation into national and county planning and budgeting.
- Guides Nyeri Municipality to integrate climate risk considerations into the Municipal Integrated Development Plan (MIDP) and sector plans.

b) National Climate Change Action Plan (NCCAP)



Municipality of Nyeri; Urban Climate Risk Profile

- Operationalizes the Climate Change Act through priority adaptation and mitigation actions.
- Identifies urban resilience, water security, disaster risk reduction, and ecosystem protection as key adaptation themes relevant to Nyeri.

c) Kenya National Adaptation Plan (NAP) 2015–2030

- Provides long-term adaptation priorities for climate-sensitive sectors such as water, agriculture, infrastructure, and health.
- Supports municipal-level climate risk assessments and adaptation planning.

d) Physical and Land Use Planning Act, 2019

- Mandates risk-informed land-use planning and development control.
- Enables Nyeri Municipality to restrict development in flood-prone and environmentally sensitive areas identified in the UCRP.

e) Disaster Risk Management and Sectoral Policies

- National Disaster Risk Management Policy, Water Act, Environmental Management and Coordination Act (EMCA), and Energy policies support preparedness, response, and resilient infrastructure development.

1.3.4.2 County-Level Policy and Institutional Framework

Nyeri County Government plays a central role in enabling and implementing urban climate resilience.

a) Nyeri County Integrated Development Plan (CIDP)

- Sets medium-term development priorities for infrastructure, social services, environment, and economic development.
- Provides the main entry point for mainstreaming climate risks and adaptation actions identified in the Urban Climate Risk Profile.

b) Nyeri County Climate Change Fund (CCCF) Regulations

- Establishes a dedicated financing mechanism for community-driven and locally prioritized climate adaptation projects.



Municipality of Nyeri; Urban Climate Risk Profile

- Can support climate-resilient urban interventions such as drainage improvements, water security, and ecosystem restoration.

c) Nyeri County Environment and Climate Change Policies

- Promote sustainable natural resource management, catchment protection, and ecosystem-based adaptation.
- Align urban climate actions with watershed protection in the Aberdare ecosystem, which is critical to Nyeri's water security.

d) Sectoral County Departments

- Departments of Water, Roads, Health, Environment, Trade, and Social Services are responsible for implementing climate-responsive measures within their mandates.

1.3.4.3 Municipal-Level Planning Framework

Nyeri Municipality is the primary implementing entity for urban climate resilience actions.

a) Municipal Integrated Development Plan (MIDP)

- Translates county priorities into urban-specific development actions.
- The Urban Climate Risk Profile provides the evidence base to integrate climate risk reduction and adaptation measures into the MIDP.

b) Nyeri Municipality Spatial and Land-Use Plans

- Guide zoning, infrastructure development, and environmental protection.
- Enable incorporation of flood risk zones, green and blue infrastructure, and climate-resilient design standards.

c) Municipal By-laws and Development Control

- Support enforcement of drainage protection, riparian setbacks, solid waste management, and building standards relevant to climate risk reduction.



Municipality of Nyeri; Urban Climate Risk Profile

1.3.4.4 Institutional Roles and Responsibilities

Institution	Role in Urban Climate Risk Management
National Climate Change Directorate (CCD)	Policy guidance, coordination, and reporting on climate action
Kenya Meteorological Department (KMD)	Climate data, projections, and early warning information
Nyeri County Government	Planning, budgeting, and implementation of climate-responsive development
Nyeri Municipality	Urban planning, infrastructure management, service delivery, and local adaptation actions
County Disaster Management Unit	Preparedness, response, and recovery from climate-related hazards
Water Resources Authority (WRA)	Protection and regulation of water resources and catchments
NEMA	Environmental regulation and enforcement
Community Institutions & CSOs	Local knowledge, community-based adaptation, and public participation
Development Partners	Technical and financial support for climate resilience initiatives



2. Hazard Assessment

This chapter identifies and analyses climate related hazards that affect Nyeri Municipality, examining the trends by looking at their frequency, intensity and severity, and spatial distribution, and evaluates their historical occurrences and projected climate change influence. This assessment forms the foundation for risk analysis, vulnerability mapping, and adaptation planning.

2.1. Key Climate Hazards

Based on the criterion for screening of key hazards, as presented in Table 10, the following hazards were identified in Nyeri Municipality:

1. Pluvial and fluvial flooding
2. Landslides and gully erosion
3. Drought
4. Heat stress through average surface temperature increase
5. Change in precipitation patterns



Municipality of Nyeri; Urban Climate Risk Profile

Table 5. Hazard screening for Nyeri Municipality

Hazard	Hazard Likely (Y/N)	Significant Impact (Y/N)	High Priority (Y/N)	Key Hazard (Y/N)
Heat Stress				
Average surface temperature increase	Y	Y	Y	Y
Average ocean temperature increase	N	N	N	N
Extreme heat	N	N	N	N
Marine heatwaves	N	N	N	N
Cold Stress				
Average surface temperature during winter	N	N	N	N
Extreme cold (e.g., cold spells, frost)	N	N	N	N
Snowfall and ice storms	N	N	N	N
Flooding				
Changes in precipitation patterns	Y	Y	Y	Y
Pluvial (surface level) flooding, including flash flooding and urban flooding	Y	Y	Y	Y
Fluvial (river) flooding	Y	Y	Y	Y
Sea level rise	N	N	N	N
Coastal flooding, including storm surges	N	N	N	N
Waterlogging	N	N	N	N
Water Stress				
Drought (meteorological, hydrological)	Y	Y	Y	Y
Groundwater salinization	N	N	N	N



Municipality of Nyeri; Urban Climate Risk Profile

Hazard	Hazard Likely (Y/N)	Significant Impact (Y/N)	High Priority (Y/N)	Key Hazard (Y/N)
Saline intrusion	N	N	N	N
Wildfire				
Wildfires & bushfires	Y	Y	N	N
Storms				
Extreme wind	Y	N	N	N
Tropical cyclones	N	N	N	N
Sand and dust storms	N	N	N	N
Hailstorms	N	N	N	N
Mass Movement				
Landslides	Y	Y	Y	Y
Coastal erosion	N	N	N	N
Gully erosion	Y	Y	Y	Y
Marine Conditions				
Ocean acidification	N	N	N	N
Geophysical*				
Subsidence	N	N	N	N
Earthquakes	N	N	N	N
Volcanos	N	N	N	N

2.2. Climate Indicators and Hazard Thresholds

Table 6. Climate indicators and hazard thresholds selected for the assessment



Municipality of Nyeri; Urban Climate Risk Profile

Key Hazard	Climate indicator	Data source	Threshold		
			Low	Medium	High
Flooding	Daily rainfall (mm)	KMD,			>50 mm/day
Landslides	Rainfall intensity & slope	County records			Prolonged heavy rainfall
Drought	Consecutive dry days	KMD			>30 days
Heat stress	Max temperature	KMD			>30°C
Rainfall variability	Seasonal rainfall deviation	KMD			±20%

[Record the data sources used in Annex-N2.]

2.3. Current Hazard Levels and Climate Projections

Nyeri Municipality has historically experienced a relatively cool and humid highland climate, characterized by bimodal rainfall patterns and moderate temperatures. However, recent climate observations indicate increasing variability and intensification of climate hazards, driven by broader regional climate change trends. Chronic hazards such as rainfall variability, gradual temperature increase, and prolonged dry spells are increasingly influencing the frequency, intensity, and spatial extent of acute hazards, including flooding, landslides, heat stress, and drought.

Over the past two decades, rainfall events have become more erratic, with short duration, high-intensity winds occurring more frequently, particularly during the long rains (March–May). These events, accompanied by poor drainage infrastructure, have increased the incidence of pluvial flooding in the Central Business District (CBD) and fluvial flooding along the Chania and Sagana river systems, within the Municipality. The same rainfall intensification has



Municipality of Nyeri; Urban Climate Risk Profile

heightened landslide risks in steeply sloped areas such as Kamakwa/Mukaro, where saturated volcanic soils are highly unstable.

At the same time, prolonged dry spells and delayed onset of rains have become more common, increasing drought and water stress risks, especially during the dry seasons. Reduced river flows and groundwater recharge have affected domestic water supply, agriculture, and other ecosystem services. Rising average temperatures, though gradual, are contributing to heat stress, particularly in highly built-up wards such as Rware, where impervious surfaces and low greening amplify urban heat island effects.

Future climate projections based on Shared Socioeconomic Pathways (SSP2-4.5 and SSP5-8.5) indicate that these trends will intensify. Under both scenarios, Nyeri Municipality is expected to experience increased rainfall intensity, higher temperatures, and greater rainfall variability, with more pronounced impacts under the high-emissions SSP5-8.5 pathway. By mid-century (2050), several hazards are projected to shift from medium to high levels, while by the end of the century (2100), very high hazard levels are anticipated for flooding, drought, and rainfall variability if no significant adaptation measures are implemented.

Table 7. Current and future hazards levels for Nyeri Municipality

Hazard	Hazard Level				
	Current (Baseline)	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Flooding	Medium	High	High	High	Very High
Landslides	Medium	Medium	High	High	High
Drought	Medium	Medium	High	High	Very High
Heat stress	Low	Medium	Medium	High	High
Rainfall variability	Medium	High	High	High	Very High

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



Municipality of Nyeri; Urban Climate Risk Profile

Table 8. Interpretation of hazard levels

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

2.4. Current and Future Hazard Impact Areas

The most significant current and projected hazard types include; Drought which is recurrent and increasing in frequency, Flooding (riverine/pluvial) experienced more along the river line corridors, Landslides/Soil erosion happening in the steeper terrain of informal settlements and Urban heat stress due to urbanization and limited green spaces within the central district centre.



Municipality of Nyeri; Urban Climate Risk Profile

Map showing the areas affected by drought in the municipality.

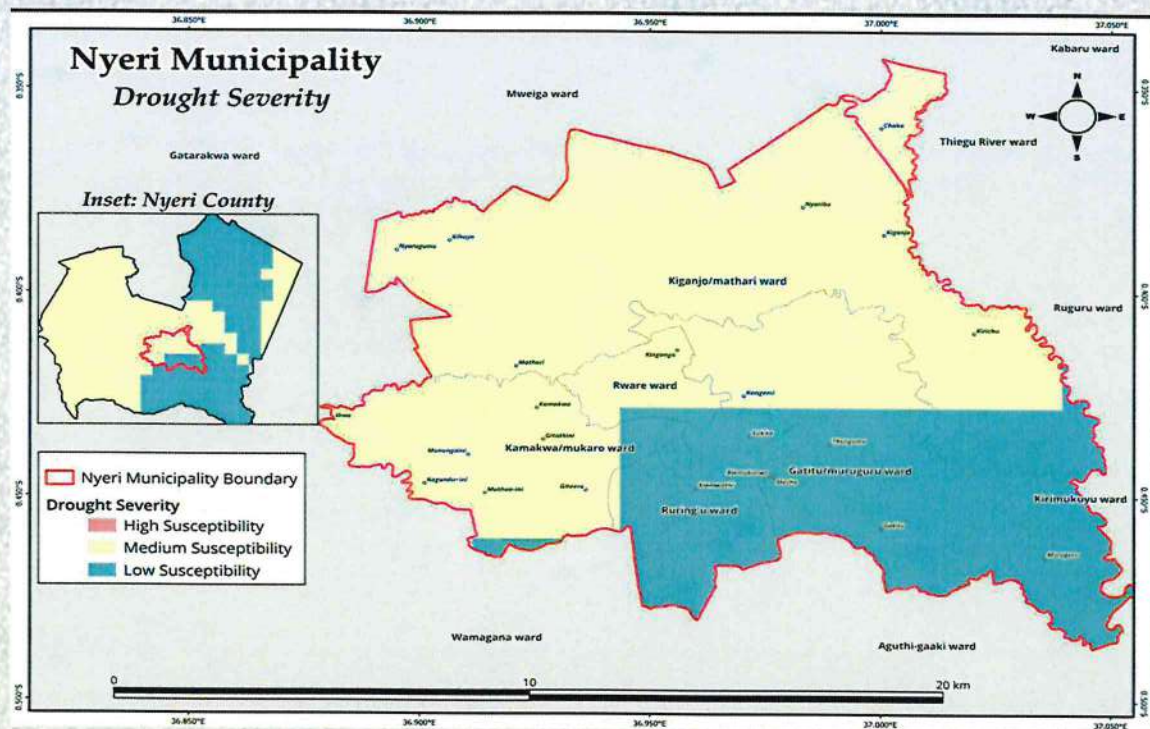
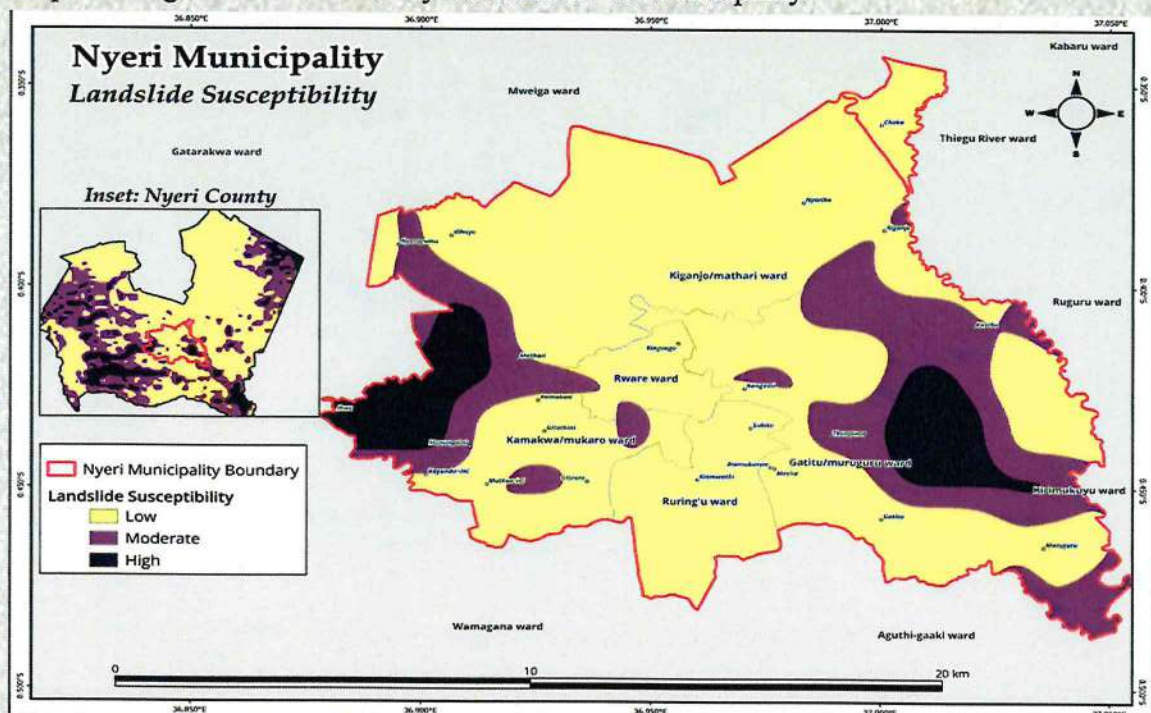


Figure 4. Map showing the areas affected by drought in the municipality

Map showing the areas affected by landslides in the municipality.





Municipality of Nyeri; Urban Climate Risk Profile

Figure 5. Map showing the areas affected by landslides in the municipality

Map showing the areas affected by Rainfall Variability in the municipality.

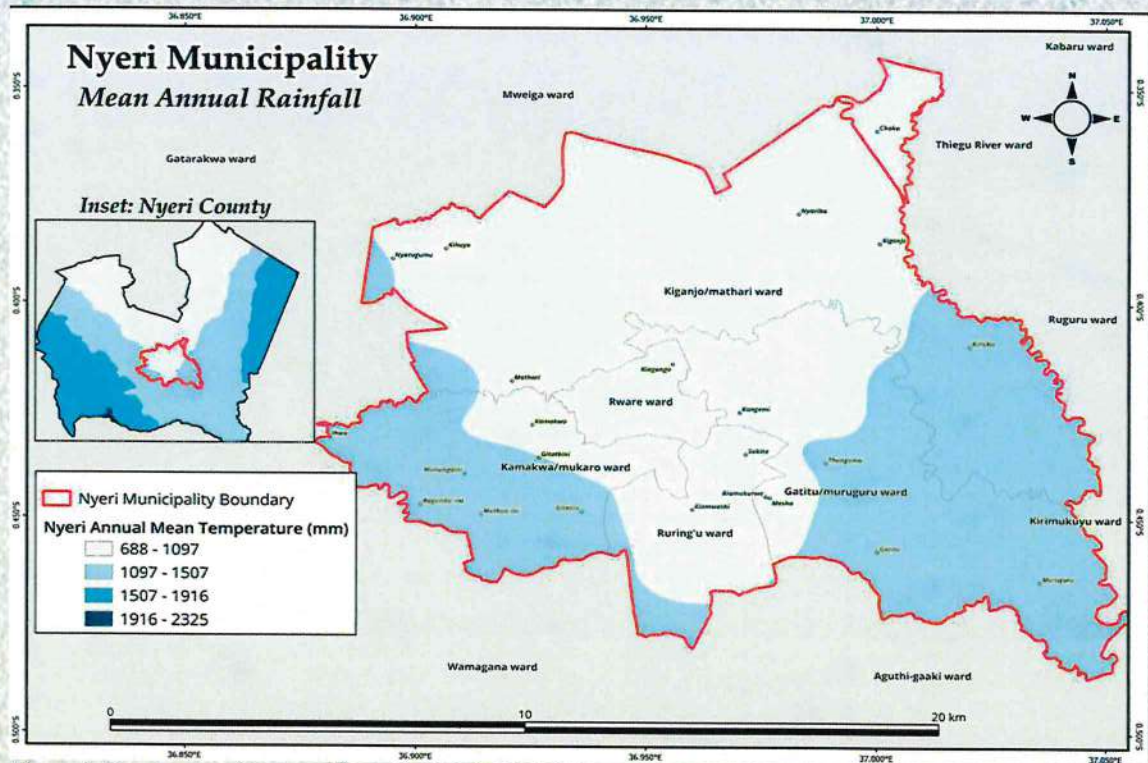


Figure 6. Map showing the areas affected by Rainfall Variability in the municipality



Municipality of Nyeri; Urban Climate Risk Profile

Map showing the areas affected by Heat Stress in the municipality.

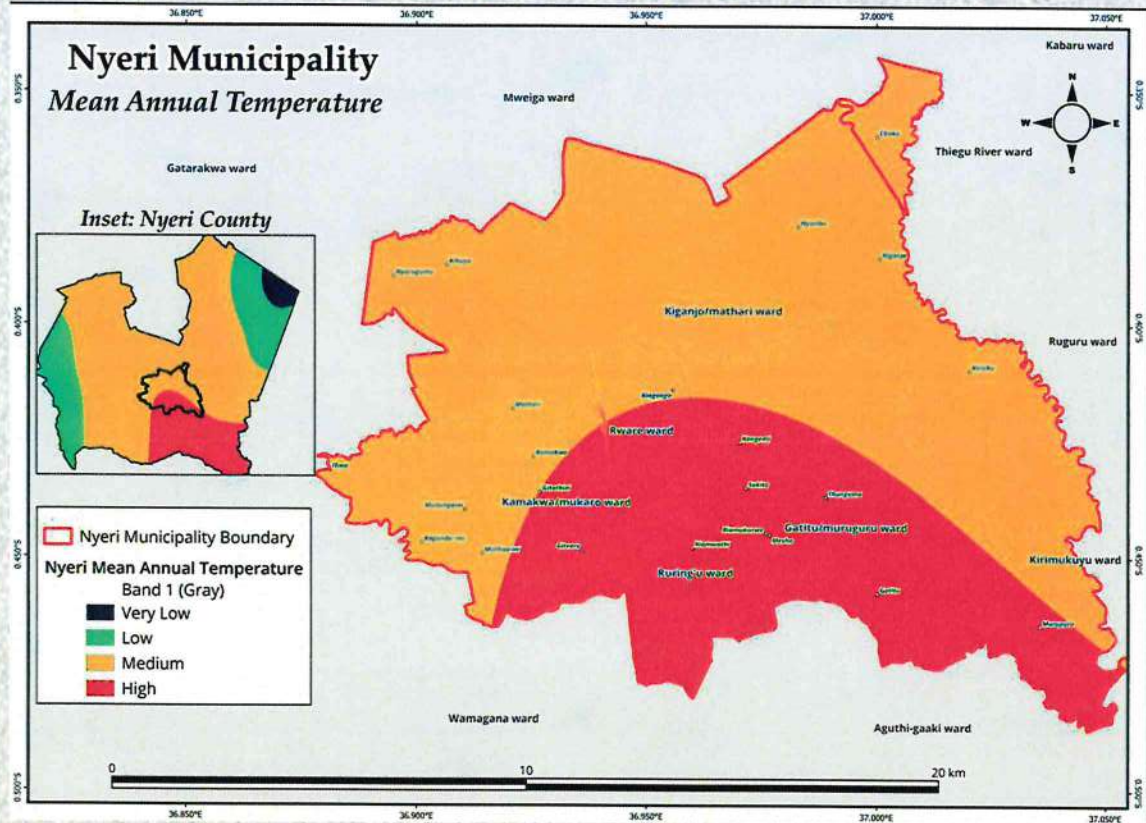


Figure 7. Map showing the areas affected by Heat Stress in the municipality

3. Exposure & Vulnerability Assessment

This section examines how climate hazards identified in Section 2 interact with Nyeri Municipality's urban systems, populations, and natural assets. Building on the hazard assessment and spatial analysis, it evaluates the degree of exposure of key urban elements to current and projected climate hazards, as well as their vulnerability, considering both sensitivity and adaptive capacity. The assessment draws on municipal infrastructure data, ward-level socio-economic characteristics, land-use patterns, and insights from the Nyeri County Integrated Development Plan (CIDP 2023–2027) and related sectoral reports. Particular attention is given to informal settlements, critical infrastructure, and environmentally sensitive areas, where climate impacts are already evident and are expected to intensify under future climate scenarios. The findings of this section provide the analytical basis for determining climate impacts and risks in subsequent sections of the Urban Climate Risk Profile.



Municipality of Nyeri; Urban Climate Risk Profile

3.1. Urban Elements

Key exposed urban elements within Nyeri Municipality include storm water drainage systems, roads and bridges, water supply infrastructure, economic and social infrastructure such as markets and health facilities, blue infrastructure such as riparian ecosystems, informal settlements residents and vulnerable and marginalized groups among others.

Table 9. Urban elements inventory

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
Infrastructure & Services				
Stormwater Drainage	Stormwater drainage conveyance network	Y	Y(Partial)	Includes open drains, culverts, roadside channels, and natural drainage lines conveying stormwater. Critical for flood risk assessment, especially in low-lying areas and along rivers such as Chania and Sagana tributaries.



Municipality of Nyeri; Urban Climate Risk Profile

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Stormwater storage	Y	N	Includes detention ponds, retention basins, and informal floodplains.
Water & Wastewater Management	Pumping stations	Y	Y	Facilities used to pump water or wastewater where gravity flow is insufficient. Important for service continuity during floods and power outages.
	Groundwater abstraction	Y	N	Boreholes and wells used for municipal and private water supply. Locations often available in tabular form but not fully mapped in GIS. Relevant for drought and groundwater depletion risk.
	Water treatment facilities	Y	Y	Includes Nyeri Water and Sanitation Company (NYEWASCO) treatment plants. Critical assets exposed to flooding, landslides, and drought-related water scarcity.
	Water supply networks	Y	Y(Partial)	Distribution pipelines supplying treated water to households and institutions. GIS coverage often incomplete or outdated but essential for service disruption analysis.
	Sewer networks	Y	Y(Limited)	Sewer lines serving the central business district and planned areas. Informal and peri-urban areas largely rely on on-site sanitation.
	Wastewater treatment facilities	Y	Y	Centralized wastewater treatment plants serving Nyeri town. Key for pollution control during extreme rainfall events.



Municipality of Nyeri; Urban Climate Risk Profile

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
Solid Waste Management	Transfer facilities	N	N	Waste transfer points and collection yards used before transport to disposal sites. Often informal and poorly documented.
	Landfills and dump sites	Y	Y	Includes designated dumpsites serving Nyeri Municipality. High climate risk due to flooding, leachate runoff, and slope instability.
	Recycling centers	N	N	Small-scale or informal recycling activities exist but are not formally integrated into municipal systems or RCRA datasets.
	Collection fleet	Y	N	Municipal and contracted waste collection vehicles. Climate risks include access disruption during flooding.
Transport and Mobility	Road networks	Y	Y	Bitumen and gravel roads forming the primary transport network. Highly exposed to flooding, erosion, and waterlogging.
	Bridges	Y	Y	River and drainage crossings, especially near River Chania. Vulnerable to flooding and scour.
	Public transport networks (rail, bus, mini-bus, etc.)	Y	N	Bus and mini-bus (matatu) routes operating on road network. Routes are disrupted during floods.
	Transportation terminals	Y	Y	Bus parks and termini in urban areas. Often affected by waterlogging and congestion during heavy rains.



Municipality of Nyeri; Urban Climate Risk Profile

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Vehicle depots	N	N	Limited formal depots; mostly private facilities not critical for climate risk analysis.
	Non-motorized transport networks	Y	Y(Partial)	Footpaths and walkways. Often lack drainage and are easily waterlogged.
	Freight and logistics hubs	N	N	No major logistics hubs within the municipality.
Energy	Energy power plants	N	N	No power generation plants within the municipality.
	Poles and power lines	Y	Y	Overhead electricity distribution infrastructure vulnerable to storms and falling trees.
	Transformers and substations	Y	Y	Electricity distribution substations sensitive to flooding and overheating.
	Streetlighting	Y	Y(Partial)	Public lighting infrastructure vulnerable to flooding and electrical faults.
Economic Infrastructure	Markets	Y	Y	Open-air and covered markets central to livelihoods; highly exposed to flooding and waterlogging.
	Businesses and commercial hubs	Y	Y(Partial)	CBD and commercial corridors vulnerable to flooding, heat stress, and service disruptions.
	Industrial zones/parks and logistics parks	N	N	No major industrial parks within the municipality.
Social Infrastructure	Government buildings and service centers	Y	Y	County and municipal offices providing essential services; exposed to flooding and heat stress.
	Education facilities	Y	Y	Schools and colleges affected by flooding, heat stress, and water shortages.



Municipality of Nyeri; Urban Climate Risk Profile

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Healthcare facilities	Y	Y	Hospitals and clinics sensitive to floods, disease outbreaks, and power disruptions.
	Public spaces	Y	Y(Partial)	Parks, playgrounds, and open spaces providing cooling and social functions.
	Faith-based buildings	Y	Y(Partial)	Churches and religious facilities often used as community shelters during emergencies.
	Cultural and heritage assets	Y	N	Historical and cultural sites with limited spatial documentation.
Emergency Services	Fire stations	Y	Y	Fire response facilities sensitive to access disruption during floods.
	Police stations	Y	Y	Security facilities providing emergency response and coordination.
	Telecommunications networks	Y	Y(Partial)	Mobile towers and communication lines sensitive to storms and power failure.
	Early warning systems	Y	N	Community-based and institutional warning mechanisms; largely non-spatial.
	Disaster management centers and shelters	Y	N	Temporary and permanent facilities used during emergencies; limited mapping.
	Evacuation routes	Y	N	Roads and paths used during emergencies; not formally designated or mapped.
Populations				



Municipality of Nyeri; Urban Climate Risk Profile

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
Urban Residents	Population	Y	Y	Total population residing within municipal boundaries.
	Households	Y	Y	Household distribution across wards and neighborhoods.
Informal Settlement Residents	Population living in informal settlements	Y	Y(Approx)	Residents in high-density and unplanned areas with high exposure to floods and service gaps.
	Households lacking land tenure	Y	Y	Tenure-insecure households increasing vulnerability to displacement.
	Households / residents lacking access to basic services	Y	Y(Partial)	Areas lacking piped water, sewerage, or waste services.
Vulnerable and Marginalized Groups	Low-income households	Y	Y(Proxy)	Economically vulnerable groups sensitive to climate shocks.
	Women-headed households	Y	Y(Proxy)	Households with increased care burdens and limited resources.
	Children and youth	Y	Y(Proxy)	High sensitivity to heat, flooding, and disease.
	Elderly persons	Y	Y(Proxy)	Vulnerable to heat and cold stress.
	People with disabilities (PWD)	Y	N	Reduced mobility and evacuation capacity.
	Homeless populations	Y	N	Highly exposed to weather extremes.
	Unemployed or precariously employed workers	Y	Y(Proxy)	Livelihoods easily disrupted by climate events.
	Seasonal workers / migrant laborers	Y	N	Temporary populations with limited social protection.
	Nomadic groups in peri-urban areas	N	N	Minimal presence in Nyeri Municipality.
	Urban refugees and migrants	Y	N	Small but vulnerable populations.



Municipality of Nyeri; Urban Climate Risk Profile

Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Minority ethnic groups in urban areas	Y	N	Socially vulnerable groups within urban areas.
Natural Assets				
Urban Green Infrastructure	Urban parks and gardens	Y	Y	Provide cooling, recreation, and storm water regulation.
	Green corridors	Y	Y(Partial)	Linear green spaces along roads and rivers.
	Street landscaping	Y	Y(Partial)	Trees and planted areas reducing heat and runoff.
	Urban forests and forest reserves	Y	Y	Nearby forest areas contributing to climate regulation.
Urban Blue Infrastructure	Natural wetlands	Y	Y	Flood buffering and water filtration functions; some encroachment.
	Rivers	Y	Y	River Chania and tributaries; major flood risk zones.
	Riparian zones	Y	Y	River buffer areas sensitive to encroachment.
	Lakes, ponds and reservoirs	Y	Y	Water storage and supply sources.
	Coastal ecosystems	N	N	Not applicable to Nyeri.
	Urban agriculture	Y	Y(Partial)	Small-scale farming in open and peri-urban spaces.
Peri-urban and Agricultural Systems	Peri-urban agriculture	Y	Y	Crop and livestock systems sensitive to drought and floods.
	Agroforestry systems	Y	Y(Partial)	Trees integrated with farming improving resilience.
	Forests and forest reserves	Y	Y	Catchment protection and climate regulation.
	Protected areas and national parks	Y	Y	Adjacent conservation areas influencing hydrology.
	Savannahs and rangelands	N	N	Not significant within the municipal area.



Municipality of Nyeri; Urban Climate Risk Profile

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

1. **Flooding:** - High exposure of storm water drainage, roads, informal settlements, and riparian zones.
 - High vulnerability due to undersized drainage, encroachment, and limited maintenance.
 - Impacts range from major to catastrophic in flood-prone wards.
2. **Drought:** - Medium exposure of water supply systems and peri-urban agriculture.
 - High vulnerability of low-income households and farmers.
 - Impacts are moderate to major.

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

Table 10. Interpretation of exposure and vulnerability levels

Level	Exposure Level Interpretation	Vulnerability Level Interpretation
High	Few or no critical urban elements lie within the hazard footprint or area of impact.	The urban element is vulnerable to the climate hazard due to high natural sensitivity – considering physical and non-physical characteristics – and limited adaptive capacity.
Medium	A moderate number or a mix of low- and medium-value urban elements are located within the hazard footprint.	The urban element is somewhat vulnerable to the climate hazard due to moderate sensitivity and adaptive capacity.



Municipality of Nyeri; Urban Climate Risk Profile

Low	A large number and high-value urban elements (e.g., critical infrastructure, dense neighborhoods, major economic assets) are located within the hazard footprint.	The urban element is minimally vulnerable to the climate hazard due to limited sensitivity and/or a high degree of adaptive capacity.
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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 11. Impact Matrix

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

Record any data sources used to complete the table in Annex-N2.] Table 8

Table 12. Exposure, Vulnerability, and Impacts of flooding on Urban Elements

Hazard: Flooding

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Storm/water Drainage	- Drainage channels located in flood-prone low-lying areas (CBD, Majengo, parts of Ruring'u) - High exposure to intense rainfall and storm runoff. - Large portions of Nyeri CBD (Rware, Gatitu/Muruguru) rely on undersized and aging drainage systems designed for lower rainfall intensities. Increased impervious surfaces exacerbate run off volumes	High	High Sensitivity: - Undersized and poorly maintained drains - Blockage from solid waste and sediment	High	Catastrophic (Frequent flooding, infrastructure damage, traffic disruption, public health risks)
			Low Adaptive Capacity: - Limited routine maintenance funding - Limited climate resilient/ flood-proofing infrastructure.		



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Water & Wastewater Management	- Sewer lines and treatment facilities exposed to floodwaters - Water sources exposed to contamination during floods NYEWASCO intake points and treatment facilities are located near Chania River and flood-prone zones.	Medium	Sensitivity: - Aging pipelines - Dependence on surface water sources - High risk of contamination during over flows; pumping stations susceptible to siltation. Adaptive Capacity: - Limited water storage and reuse systems - Limited climate resilient/ flood-proofing infrastructure.	High	Major (Sewer overflows, water contamination, disease risk)
Solid Waste Management	- Waste collection points and dumpsites exposed to flooding - Waste washed into drains and rivers during storms	High	Sensitivity: - Inadequate waste segregation and containment - Informal dumping in flood-prone areas	High	Catastrophic (Blocked drains, worsened flooding,

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Transport and Mobility	- Roads, bridges, and footpaths exposed to flash floods - Low-lying road sections frequently inundated	Medium	Adaptive Capacity: - Limited recycling and transfer infrastructure - Weak enforcement of waste bylaws	High	environmental pollution)
			Sensitivity: - Poor road drainage - Erosion and pothole formation during floods		Major (Traffic disruption, accidents, economic losses)
			Adaptive Capacity: - Incremental road upgrades ongoing - Limited redundancy in transport route		



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Energy	- Power substations and distribution lines exposed to flooding - Flood-induced access constraints for repairs	Medium	Sensitivity: - Overhead power lines vulnerable to storm damage - Limited flood protection for substations	Medium	Moderate (Power outages affecting services and businesses)
			Adaptive Capacity: - National grid response mechanisms - Limited local backup power systems		
Economic Infrastructure	- Markets and commercial areas located in flood-prone zones - Informal trading areas exposed to surface flooding	Medium	Sensitivity: - Temporary or semi-permanent structures - High daily dependence on uninterrupted access	High	Major (Income loss, business interruption)



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: • Limited insurance coverage • Low access to flood-resilient infrastructure finance		
Social Infrastructure	• Schools and clinics exposed to surface flooding • Access roads to facilities often flooded	Medium	Sensitivity: • High occupancy rates • Limited flood-resilient building design	Medium	Moderate (Service disruption, health and safety risks)
			Adaptive Capacity: • Government support systems exist • Limited retrofitting and drainage improvements		



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Emergency Services	- Emergency response routes exposed to flooding - Increased emergency demand during flood events	Medium	Sensitivity: - Dependence on road accessibility - Limited flood-specific equipment Adaptive Capacity: - County disaster management structures in place - Limited early warning dissemination at local level	Medium	Moderate (Delayed response, increased flood losses)
Populations					
Urban Residents	- Residents exposed to household and street flooding - Increased health risks during flood events	Medium	Sensitivity: - Dependence on municipal services - Exposure to contaminated floodwater	High	Major



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Informal Settlement Residents	Settlements located along rivers, floodplains, and drainage corridors.	High	Adaptive Capacity: - Some access to information and services - Limited household flood protection measures		
			Sensitivity: - Poor housing materials - Lack of drainage and sanitation	High	Catastrophic (Loss of property, displacement, health impacts)
			Adaptive Capacity: - Low income and insecure tenure - Limited access to early warning and emergency support		



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Vulnerable and Marginalized Groups	● Elderly, women, children, and persons with disabilities exposed to flood risks.	High	Sensitivity: - Limited mobility and health challenges - High dependency on caregivers	High	Catastrophic
			Adaptive Capacity: - Limited social protection and evacuation support - Dependence on informal networks		
Natural Assets					
Urban Green Infrastructure	● Urban trees and green spaces exposed to waterlogging and erosion.	Medium	Sensitivity: - Degraded or compacted soils - Encroachment reduces buffering capacity	Medium	Moderate



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Urban Infrastructure	- Rivers and streams subject to riverine flooding - Riparian zones encroached and degraded	High	Adaptive Capacity: - Potential for restoration and expansion - Community-led greening initiatives		
			Sensitivity: - Reduced natural flood storage capacity - Pollution from upstream and urban runoff	High	Catastrophic (Severe flooding, ecosystem degradation)
			Adaptive Capacity: - Weak enforcement of riparian regulations - Limited restoration investment		



Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Peri-urban and Agricultural Systems	- Farms exposed to floodwaters and soil erosion - Low-lying agricultural areas prone to waterlogging	High	Sensitivity: - Soil erosion and crop damage - Dependence on rain-fed agriculture	High	Catastrophic (Crop loss, food insecurity, income loss)
			Adaptive Capacity: - Limited drainage and flood-resilient farming practices - Extension services exist but under-resourced		

Table 13. Exposure, Vulnerability, and Impacts of Landslides and gully erosion on Urban Elements

Hazard: Landslides and Gully erosion



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	- Drainage channels located on steep slopes and valley edges - Concentrated runoff triggering gully formation	High	Sensitivity: - Poorly lined/open drains accelerate soil erosion - Discharge of runoff onto unprotected slopes	High	Catastrophic (Drain collapse, expanded gullies, downstream flooding)
			Adaptive Capacity: - Limited slope-stabilized drainage designs - Inadequate routine inspection of erosion hotspots		



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Water & Wastewater Management	- Pipelines and sewer lines crossing steep slopes and river valleys - Treatment facilities affected by slope instability	Medium	Sensitivity: - Buried pipes exposed by erosion and slope failure - Sewer blockages from sediment inflow	Medium	Moderate (Service disruption, contamination risks)
			Adaptive Capacity: - Limited slope protection around pipelines - Emergency repair capacity exists but reactive		
Solid Waste Management	- Informal dumping on slopes and gullies - Waste accumulation destabilizing soils	Medium	Sensitivity: - Waste blocks natural drainage paths - Increased water infiltration and slope failure	Medium	Moderate (Accelerated erosion, environmental degradation)



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: - Weak enforcement of waste disposal regulations - Limited engineered disposal sites		
Transport and Mobility	- Roads and footpaths on steep terrain and cut slopes - Bridge approaches exposed to gully erosion	High	Sensitivity: - Inadequate slope stabilization and drainage - Erosion undermining road foundations Adaptive Capacity: - Spot road upgrades and gabion works - Limited systematic slope risk mapping	High	Catastrophic (Road collapse, isolation of neighborhoods)



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Energy	- Power poles and distribution lines on unstable slopes - Access roads to substations affected by landslides	Medium	Sensitivity: - Pole foundations undermined by erosion - Overhead lines vulnerable to slope movement Adaptive Capacity: - National utility response mechanisms - Limited proactive slope stabilization	Medium	Moderate (Power outages, repair delays)
Economic Infrastructure	- Markets and small enterprises near valley edges and slopes - Peri-urban workshops exposed to slope instability	High	Sensitivity: - Informal structures with shallow foundations - Limited structural reinforcement	High	Catastrophic (Business losses, asset destruction)



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: • Low insurance coverage • Limited access to relocation or retrofitting finance		
Social Infrastructure	• Facilities located near steep slopes and eroding drainage lines.	Medium	Sensitivity: • High occupancy and safety risks • Buildings not designed for slope instability. Adaptive Capacity: • Some government support for repairs • Limited preventive slope reinforcement	Medium	Moderate (Service disruption, safety risks)



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Emergency Services	- Emergency access routes prone to landslides - Increased rescue demand during heavy rainfall	Medium	Sensitivity: - Dependence on road access - Limited landslide rescue equipment Adaptive Capacity: - County disaster response structures exist - Limited early warning for slope failure	High	Moderate (Delayed response, increased casualties)
Populations					
Urban Residents	Households located near slopes, gullies, and cut embankments.	Medium	Sensitivity: - Housing damage from slope failure - Safety risks during heavy rainfall	Medium	Moderate



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: - Some access to information and municipal support - Limited household slope protection measures		
Informal Settlement Residents	Settlements on steep slopes, riverbanks, and gully edges.	High	Sensitivity: - Poor-quality housing materials - Lack of drainage and slope stabilization Adaptive Capacity: - Low income and insecure land tenure - Limited relocation options	High	Catastrophic (Loss of homes, displacement, fatalities)



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Vulnerable and Marginalized Groups	Elderly, women, children, and PWDs in landslide-prone areas.	High	Sensitivity: - Limited mobility and evacuation capacity - Health vulnerabilities Adaptive Capacity: - Limited social protection and targeted evacuation plans - Dependence on informal support systems	High	Catastrophic
Natural Assets					



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Urban Green Infrastructure	Vegetated slopes and open spaces exposed to erosion.	Medium	Sensitivity: - Vegetation loss increases slope instability - Soil compaction from development Adaptive Capacity: - High potential for bio-engineering and re-vegetation - Community greening initiatives	Medium	Moderate
Urban Blue Infrastructure	Riverbanks and riparian corridors exposed to gully erosion.	Medium	Sensitivity: - Encroachment weakens bank stability - Increased sediment loads from upstream	High	Major (Channel widening,



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: - Weak enforcement of riparian protection - Limited riverbank stabilization projects		downstream flooding)
Peri-urban and Agricultural Systems	Farms on steep slopes exposed to soil erosion and landslides.	High	Sensitivity: - Loss of topsoil and crops - Limited terracing and soil conservation Adaptive Capacity: - Some extension services for soil conservation - Low adoption of climate-smart practices	High	Catastrophic (Land degradation, food and income losses)



Figure 8. Exposure, Vulnerability, and Impacts of Drought and water stress on Urban Elements

Hazard: Drought and Water stress

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	- Prolonged dry periods reduce base flows in drainage channels - Sediment accumulation and cracking of drains during drought	Medium	Sensitivity: - Dry, compacted channels reduce future infiltration - Increased damage when rains return after drought	Medium	Moderate (Reduced system efficiency, increased post-



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: - Limited integration of water harvesting in drainage design - Minimal maintenance during dry periods		drought flood risk)
Water & Wastewater Management	- Reduced river flows and groundwater recharge - Increased abstraction pressure during droughts	High	Sensitivity: - High dependence on surface water sources - Limited storage and reuse capacity Adaptive Capacity: - Water rationing plans exist - Limited alternative sources (reuse, rainwater harvesting)	Medium	Major (Water shortages, sanitation failures, public health risks)

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Solid Waste Management	- Increased waste accumulation due to reduced water for cleaning - Dry conditions increase dust and waste dispersion	Medium	Sensitivity: - Organic waste decomposes faster in heat - Open dumping exacerbated by dry conditions	Medium	Moderate (Public health risks, environmental degradation)
			Adaptive Capacity: - Limited mechanized cleaning - Weak waste segregation systems		
Transport and Mobility	- Roads exposed to dust, surface cracking, and material degradation - Reduced water availability for construction and maintenance	Medium	Sensitivity: - Unpaved roads degrade rapidly in dry conditions - Heat stress affects road surfaces	Medium	Moderate (Increased maintenance costs, reduced safety)



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: • Routine maintenance programs exist • Limited climate-resilient road materials		
Energy	• Hydropower generation affected by reduced river flows • Increased electricity demand for pumping and cooling	Medium	Sensitivity: • Dependence on national hydropower mix • Limited local renewable diversification Adaptive Capacity: • National grid balancing mechanisms • Growing solar uptake but still limited	Medium	Moderate (Power shortages, increased costs)



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Economic Infrastructure	- Water-dependent businesses (food processing, hospitality) exposed to shortages - Markets affected by reduced supply and higher costs	Medium	Sensitivity: - High dependence on reliable water supply. - Informal enterprises lack storage capacity.	High	Major (Business losses, reduced livelihoods)
			Adaptive Capacity: - Limited insurance and water efficiency investments - Low access to climate finance		
Social Infrastructure	- Schools and hospitals affected by water shortages - Increased demand for sanitation during drought	High	Sensitivity: - High water demand facilities - Limited on-site storage	Medium	Major (Service disruption, hygiene risks)



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: - Emergency water trucking sometimes available - Limited rainwater harvesting infrastructure		
Emergency Services	- Increased demand during drought-related health and fire incidents - Limited water for firefighting	Medium	Sensitivity: - Dependence on municipal water supply - Increased wildfire risk during drought Adaptive Capacity: - Emergency response structures exist - Limited dedicated water reserves	Medium	Moderate
Populations					



Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Urban Residents	- Household water rationing and rising water costs - Increased heat and hygiene stress	Medium	Sensitivity: - Dependence on piped water - Health impacts from reduced hygiene	High	Major
			Adaptive Capacity: - Some access to storage tanks and information - Limited household rainwater harvesting		
Informal Settlement Residents	- High exposure to water scarcity and price shocks - Reliance on vendors and unsafe water sources	Medium	Sensitivity: - Poor sanitation and overcrowding - Limited water storage	High	Major (Health crises, livelihood losses)



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: • Low income and insecure tenure • Limited access to alternative water sources		
Vulnerable and Marginalized Groups	• Elderly, women, children, and PWDs disproportionately affected by water scarcity.	Medium	Sensitivity: • Higher health and care needs • Increased burden of water collection	High	Major
			Adaptive Capacity: • Limited social protection and targeted support • Dependence on informal coping mechanisms		
Natural Assets					

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Urban Green Infrastructure	Urban trees and parks exposed to prolonged moisture stress.	High	Sensitivity: - Specific site species grown - Limited irrigation during drought	Low	Moderate (Loss of cooling, urban heat amplification)
			Adaptive Capacity: - Potential for drought-tolerant species - Limited maintenance budget		
Urban Blue Infrastructure	Rivers and wetlands experience reduced flows and drying.	High	Sensitivity: - Over-abstraction and pollution - Reduced ecological resilience	Medium	Major (Ecosystem degradation,



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Peri-urban and Agricultural Systems	• Rain-fed farming exposed to prolonged dry spells • Reduced pasture and crop productivity	High	Adaptive Capacity: • Weak enforcement of abstraction controls • Limited restoration efforts		water insecurity)
			Sensitivity: • Dependence on rainfall • Limited irrigation infrastructure Adaptive Capacity: • Some extension services available • Low uptake of drought-resilient crops	Medium	Major (Food insecurity, income loss)

Figure 9. Exposure, Vulnerability, and Impacts of Heat stress on Urban Elements

Hazard: Heat Stress.



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	- Concrete-lined drains exposed to prolonged high temperatures - Dry conditions reduce shading and increase thermal stress	Low	Sensitivity: - Thermal cracking and reduced lifespan of concrete structures - Reduced infiltration capacity during dry periods	Medium	Minor (Infrastructure degradation, increased repair needs)
			Adaptive Capacity: - Limited use of green or shaded drainage designs - Minimal heat-specific maintenance planning		



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Water & Wastewater Management	- Increased evaporation from reservoirs and storage tanks - Higher water demand during hot periods	Medium	Sensitivity: - Limited storage and cooling of treatment facilities - Increased stress on pumping and distribution systems	Medium	Moderate (Water shortages, service interruptions)
			Adaptive Capacity: - Some demand-management measures exist - Limited reuse and rainwater harvesting uptake		
Solid Waste Management	- Waste collection and disposal sites exposed to high temperatures - Faster decomposition of organic waste	Medium	Sensitivity: - Increased odors, pests, and health risks - Fire risk at dumpsites during hot, dry periods	Medium	Moderate (Public health concerns, environmental degradation)



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Transport and Mobility	- Roads and pedestrian infrastructure exposed to high surface temperatures - Public transport users exposed to heat stress	Medium	Adaptive Capacity: - Limited waste covering and cooling measures - Weak enforcement of waste management standards		
			Sensitivity: - Asphalt softening and surface deformation - Limited shading along walkways and stops	Medium	Moderate (Reduced mobility, safety risks)
			Adaptive Capacity: - Incremental road upgrades underway - Minimal use of heat-resilient materials		



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Energy	- Increased electricity demand for cooling and water pumping - Heat exposure of transformers and substations	Low	Sensitivity: - Overloading of power distribution networks - Reduced efficiency of equipment at high temperatures Adaptive Capacity: - National grid balancing mechanisms - Limited distributed renewable and storage system	Medium	Minor (Power outages, increased energy costs)
Economic Infrastructure	- Markets, workshops, and informal enterprises exposed to extreme heat - Outdoor economic activities highly affected	Medium	Sensitivity: - Heat reduces labor productivity - Informal structures offer little thermal protection	Medium	Moderate (Income loss, reduced productivity)

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Social Infrastructure	- Schools and health facilities exposed to overheating - High indoor temperatures during heatwaves	Medium	Adaptive Capacity: - Limited cooling and shading investments - Low insurance and climate finance access	Medium	Moderate (Health risks, learning disruptions)
			Sensitivity: - Overcrowded classrooms and wards - Limited ventilation and cooling systems Adaptive Capacity: - Some passive ventilation designs - Limited retrofitting and cooling budgets		

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Emergency Services	- Increased demand during heat-related illnesses and fires - Outdoor responders exposed to heat stress	Medium	Sensitivity: - Physical strain on personnel - Dependence on reliable water and power Adaptive Capacity: - Existing emergency response structures - Limited heat-specific response planning	Medium	Moderate
Populations					
Urban Residents	- Exposure to higher daytime and nighttime temperatures - Urban heat-island effects in dense areas	High	Sensitivity: - Heat-related illnesses - Increased water and energy needs	Medium	Major



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: - Some access to cooling and information - Limited household greening and insulation		
Informal Settlement Residents	- Densely built settlements with poor ventilation - Limited tree cover and shading	High	Sensitivity: - Heat-trapping housing materials - Overcrowding and poor sanitation	Medium	Major (Severe health impacts, reduced livelihoods)
			Adaptive Capacity: - Low income and limited access to cooling - Insecure tenure limits upgrading		



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Vulnerable and Marginalized Groups	Elderly, children, pregnant women, PWDs exposed to extreme heat.	High	Sensitivity: - Reduced thermoregulation and health conditions - Dependence on caregivers Adaptive Capacity: - Limited targeted interventions - heat-health interventions - Reliance on informal support networks	Medium	Major
Natural Assets					
Urban Green Infrastructure	Urban trees and green spaces exposed to heat and moisture stress.	Medium	Sensitivity: - Limited irrigation and maintenance - Loss of canopy cover increases heat-island effects	Medium	Moderate (Reduced cooling services,



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Urban Infrastructure	Reduced river flows and increased water temperatures.	High	Adaptive Capacity: - Potential for urban greening and shade expansion - Community tree-planting initiatives		increased urban heat)
			Sensitivity: - Pollution and over-abstraction reduce cooling capacity - Reduced ecological resilience	Medium	Moderate of cooling and ecosystem services)
			Adaptive Capacity: - Limited restoration and protection efforts - Weak enforcement of riparian buffers		

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Peri-urban and Agricultural Systems	• Crops and livestock exposed to heat stress • Increased evapotranspiration rates	High	Sensitivity: • Reduced yields and livestock productivity • Heat-sensitive crop varieties	Medium	Major (Food insecurity, income losses)
			Adaptive Capacity: • Some extension services available • Low uptake of heat-tolerant practices		

Table 14. Exposure, Vulnerability, and Impacts of Change in precipitation patterns on Urban Elements

Hazard: Change in precipitation patterns

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Stormwater Drainage	- Drainage systems exposed to intense short-duration rainfall events - High runoff variability between dry spells and heavy rains	Medium	Sensitivity: - Undersized drains not designed for peak intensities - Sedimentation and damage after long dry periods	High	Major (Flash flooding, infrastructure damage)
			Adaptive Capacity: - Limited climate-resilient and flexible drainage design - Infrequent maintenance and limited monitoring		

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Water & Wastewater Management	- Water intakes exposed to both flooding and reduced base flows - Sewer systems stressed by sudden inflow peaks	Medium	Sensitivity: - Combined storm water-sewer interactions in some areas - Treatment processes disrupted by fluctuating volumes	High	Major (Overflows, contamination, supply interruptions)
			Adaptive Capacity: - Some emergency operational procedures exist - Limited storage and flow-balancing infrastructure		
Solid Waste Management	- Waste sites exposed to flooding during heavy rains - Dry periods increase waste accumulation in drains	Medium	Sensitivity: - Poor containment of waste - Waste washed into drains during intense rainfall	High	Major (Blocked drainage, amplified flood risk)

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Transport and Mobility	- Roads and footpaths exposed to wash-outs and erosion - Bridges affected by fluctuating river levels	Medium	Adaptive Capacity: - Limited waste segregation and transfer facilities - Weak enforcement of disposal regulations		
			Sensitivity: - Poor road drainage and slope protection - Rapid surface degradation after heavy storms	High	Major (Disrupted mobility, economic losses)
			Adaptive Capacity: - Periodic road upgrades ongoing - Limited redundancy in transport routes		



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Energy	- Power infrastructure exposed to storm damage and flooding - Variable rainfall affects hydropower generation	Medium	Sensitivity: - Overhead lines vulnerable to storms - Dependence on national hydropower mix Adaptive Capacity: - National grid balancing mechanisms - Limited local distributed generation	Medium	Moderate (Outages, increased costs)
Economic Infrastructure	- Markets and businesses exposed to both flooding and water scarcity - Informal trading areas highly sensitive to rainfall variability	Medium	Sensitivity: - Temporary structures vulnerable to damage - Supply chains disrupted by weather extremes	High	Major (Business interruption, income loss)



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Social Infrastructure	Facilities affected by flooding during heavy rains and shortages during dry spells.	High	Adaptive Capacity: - Low insurance coverage - Limited access to climate-resilient infrastructure finance		
			Sensitivity: - High occupancy and service demand - Limited flexible water and drainage systems	Medium	Major (Service disruption, health risks)
			Adaptive Capacity: - Government support mechanisms exist - Limited retrofitting and storage capacity		



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Emergency Services	- Increased emergency demand during extreme rainfall events - Access routes exposed to flooding and erosion	Medium	Sensitivity: - Dependence on road accessibility - Limited specialized equipment Adaptive Capacity: - County disaster response structures exist - Limited early warning and local preparedness	Medium	Moderate
Populations					
Urban Residents	Exposure to both flash floods and intermittent water shortages.	Medium	Sensitivity: - Health risks from contaminated water - Property damage from flooding	Medium	Moderate



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: - Some access to information and services - Limited household-level adaptation		
Informal Settlement Residents	Settlements in flood-prone and poorly drained areas.	High	Sensitivity: - Poor housing quality and lack of services - High exposure to floodwaters and sanitation failures	Medium	Major
			Adaptive Capacity: - Low income and insecure tenure - Limited early warning and coping capacity		



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Vulnerable and Marginalized Groups	Elderly, children, women, and PWDs exposed to rainfall extremes.	High	Sensitivity: - Limited mobility and health vulnerabilities - Dependence on caregivers Adaptive Capacity: - Limited targeted social protection - Reliance on informal support networks	Medium	Major
Natural Assets					
Urban Green Infrastructure	Green spaces exposed to both waterlogging and drought stress.	Medium	Sensitivity: - Poor soil structure and limited maintenance - Loss of vegetation cover during extremes	Medium	Moderate (Reduced flood regulation and cooling services)



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: - Potential for nature-based solutions - Community greening initiatives		
Urban Infrastructure	- Rivers experience rapid flow fluctuations - Increased erosion and sedimentation	High	Sensitivity: - Encroachment reduces buffering capacity - Pollution during high-flow events	Medium	Major (Flooding, ecosystem degradation)
			Adaptive Capacity: - Weak enforcement of riparian protection - Limited restoration investment		



Municipality of Nyeri; Urban Climate Risk Profile

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Peri-urban and Agricultural Systems	Rain-fed agriculture exposed to erratic rainfall patterns.	Medium	Sensitivity: - Crop failure from both drought and flooding - Soil erosion on slopes	High	Major (Food insecurity, income loss)
			Adaptive Capacity: - Extension services exist - Limited irrigation and water harvesting		



4. Climate Risk Assessment

This section synthesizes the findings from the hazard assessment and the exposure and vulnerability analysis to determine the overall climate risks facing Nyeri Municipality. Climate risk is assessed by combining the severity of current and future climate hazards with the magnitude of their impacts on urban infrastructure, populations, and natural assets, under both current conditions and future climate scenarios.

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 15. Risk matrix

		Hazard Level		
		Low	Medium	High
Impact Level	Catastrophic	High	Very High	Very High
	Major	Medium	High	Very High
	Moderate	Low	Medium	High
	Minor	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 16. 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.



Municipality of Nyeri; Urban Climate Risk Profile

High	High risks should be actively addressed. Develop and implement mitigation actions promptly. Monitor environmental indicators and ensure readiness of emergency or adaptation measures.
Medium	Medium risks should be managed. Plan and implement mitigation activities to reduce them to acceptable levels. Regularly review climate data and risk levels.
Low	Low risks are acceptable under current conditions. Minimal control or monitoring is needed, provided they remain stable and do not escalate.
Very Low	Very low risks are negligible in terms of likelihood and consequences. No immediate action is required beyond routine monitoring and periodic review.

4.1. Current and Future Climate Risks on Urban Elements

Table 17. Summary of Flooding risks for Nyeri 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	Very High
Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2- 4.5	2100 SSP5- 8.5
Infrastructure & Services						



Municipality of Nyeri; Urban Climate Risk Profile

Stormwater Drainage	Overtopping, blockage, localized flash flooding	Very High	Very High	Very High	Very High	Very High
Water & Wastewater Management	Flooded sewer lines, contamination of water sources	High	Very High	Very High	Very High	Very High
Solid Waste Management	Waste washed into drains and rivers, worsening floods	Very High	Very High	Very High	Very High	Very High
Transport and Mobility	Road flooding, bridge overtopping, traffic disruption	High	Very High	Very High	Very High	Very High
Energy	Power outages, substation flooding	Medium	High	High	High	High
Economic Infrastructure	Disruption to markets, SMEs, industrial areas	High	Very High	Very High	Very High	Very High
Social Infrastructure	Flooding of schools, health facilities	Medium	High	High	High	High



Municipality of Nyeri; Urban Climate Risk Profile

Emergency Services	Reduced access and response time during floods	Medium	High	High	High	High
Populations						
Urban Residents	Property damage, health risks, displacement	High	Very High	Very High	Very High	Very High
Informal Settlement Residents	Loss of shelters, high exposure along riverbanks	Very High	Very High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Increased disease risk, livelihood loss	Very High	Very High	Very High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Erosion, degradation, loss of flood buffering	Medium	High	High	High	High
Urban Blue Infrastructure	Riverbank erosion, wetland degradation	Very High	Very High	Very High	Very High	Very High
Peri-urban and Agricultural Systems	Crop damage, soil erosion, livelihood loss	Very High	Very High	Very High	Very High	Very High



Municipality of Nyeri; Urban Climate Risk Profile

Table 18. Summary of Landslides and gully erosion risks for Nyeri 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
Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2- 4.5	2100 SSP5- 8.5
Infrastructure & Services						
Stormwater Drainage	Gully formation, collapse of drains	Very High	Very High	Very High	Very High	Very High
Water & Wastewater Management	Pipe breakage, contamination	Medium	Medium	High	High	High
Solid Waste Management	Waste exposed and washed into gullies	Medium	Medium	High	High	High
Transport and Mobility	Road subsidence, landslide blockages	Very High	Very High	Very High	Very High	Very High
Energy	Damage to poles, buried cables	Medium	Medium	High	High	High



Municipality of Nyeri; Urban Climate Risk Profile

Economic Infrastructure	Damage to markets, workshops, SMEs	Very High	Very High	Very High	Very High	Very High
Social Infrastructure	Damage to schools, health centres	Medium	Medium	High	High	High
Emergency Services	Restricted access during slope failures	Medium	Medium	High	High	High
Populations						
Urban Residents	Property damage, safety risks	Medium	Medium	High	High	High
Informal Settlement Residents	House collapse, displacement	Very High	Very High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Loss of shelter and livelihoods	Very High	Very High	Very High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Vegetation loss, slope instability	Medium	Medium	High	High	High
Urban Blue Infrastructure	Sedimentation of streams	High	High	Very High	Very High	Very High
Peri-urban and Agricultural Systems	Soil loss, reduced productivity	Very High	Very High	Very High	Very High	Very High



Municipality of Nyeri; Urban Climate Risk Profile

Table 19. Summary of Drought and water stress risks for Nyeri 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	Very High
Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services						
Stormwater Drainage	Reduced base flows, sediment buildup	Medium	Medium	High	High	High
Water & Wastewater Management	Water shortages, reduced treatment efficiency	High	High	Very High	Very High	Very High
Solid Waste Management	Reduced cleaning capacity, public health risks	Medium	Medium	High	High	High



Municipality of Nyeri; Urban Climate Risk Profile

Transport and Mobility	Dust, reduced road durability	Medium	Medium	High	High	High
Energy	Reduced hydropower reliability, cooling needs	Medium	Medium	High	High	High
Economic Infrastructure	Reduced productivity, higher operating costs	High	High	Very High	Very High	Very High
Social Infrastructure	Water shortages in schools & hospitals	High	High	Very High	Very High	Very High
Emergency Services	Limited water for firefighting	Medium	Medium	High	High	High
Populations						
Urban Residents	Intermittent supply, increased costs	High	High	Very High	Very High	Very High
Informal Settlement Residents	Acute shortages, reliance on unsafe sources	High	High	Very High	Very High	Very High



Municipality of Nyeri; Urban Climate Risk Profile

Vulnerable and Marginalized Groups	Health risks, reduced coping capacity	High	High	Very High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Vegetation stress, loss of cooling	Medium	Medium	High	High	High
Urban Blue Infrastructure	Reduced flows, degraded water quality	High	High	Very High	Very High	Very High
Peri-urban and Agricultural Systems	Crop losses, livestock stress	High	High	Very High	Very High	Very High

Table 20. Summary of Heat stress risks for Nyeri Municipality

Categories	Impact	Time Horizon & Climate Scenario	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
		Hazard Level	Low	Medium	Medium	High	High
		Risk Levels					
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5	



Municipality of Nyeri; Urban Climate Risk Profile

Infrastructure & Services						
Stormwater Drainage	Thermal stress on structures, low flows	Low	Low	Low	Medium	Medium
Water & Wastewater Management	Higher demand, treatment stress	Low	Medium	Medium	High	High
Solid Waste Management	Odour, worker exposure, health risks	Low	Medium	Medium	High	High
Transport and Mobility	Road surface degradation, heat exposure	Low	Medium	Medium	High	High
Energy	Increased cooling demand, outages	Low	Low	Low	Medium	Medium
Economic Infrastructure	Productivity loss, heat-related downtime	Low	Medium	Medium	High	High
Social Infrastructure	Overheated schools and health facilities	Low	Medium	Medium	High	High



Municipality of Nyeri; Urban Climate Risk Profile

Emergency Services	Increased heat-related emergencies	Low	Medium	Medium	High	High
Populations						
Urban Residents	Discomfort, health stress	Medium	High	High	Very High	Very High
Informal Settlement Residents	Severe indoor heat, dehydration	Medium	High	High	Very High	Very High
Vulnerable and Marginalized Groups	Heat illness, mortality risk	Medium	High	High	Very High	Very High
Natural Assets						
Urban Green Infrastructure	Heat stress, reduced cooling capacity	Low	Medium	Medium	High	High
Urban Blue Infrastructure	Higher evaporation, lower cooling effect	Low	Medium	Medium	High	High
Peri-urban and Agricultural Systems	Crop stress, reduced yields	Medium	High	High	Very High	Very High

Table 21. Summary of Extreme rainfall variability risks for Nyeri Municipality



Municipality of Nyeri; Urban Climate Risk Profile

	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	Very High
Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Infrastructure & Services						
Stormwater Drainage	Overtopping during storms; inefficiency in dry periods	High	Very High	Very High	Very High	Very High
Water & Wastewater Management	Treatment overload and low-flow stress	High	Very High	Very High	Very High	Very High
Solid Waste Management	Waste mobilization during storms	High	Very High	Very High	Very High	Very High
Transport and Mobility	Flooded roads, erosion, delays	High	Very High	Very High	Very High	Very High
Energy	Disruption from storms and erosion	Medium	High	High	High	High
Economic Infrastructure	Business interruptions, damage	High	Very High	Very High	Very High	Very High



Municipality of Nyeri; Urban Climate Risk Profile

Social Infrastructure	School and health facility disruption	High	Very High	Very High	Very High	Very High
Emergency Services	Increased demand, reduced access	Medium	High	High	High	High
Populations						
Urban Residents	Property damage, safety risks	Medium	High	High	High	High
Informal Settlement Residents	Flooding, landslide exposure	High	Very High	Very High	Very High	Very High
Vulnerable and Marginalized Groups	Health risks, livelihood loss	Medium	High	High	High	High
Natural Assets						
Urban Green Infrastructure	Erosion and vegetation stress	Medium	High	High	High	High
Urban Blue Infrastructure	Flash flooding, sedimentation	Medium	High	High	High	High
Peri-urban and Agricultural Systems	Crop losses, soil erosion	Medium	High	High	High	High

Overall risk assessment indicates there is Very High Risk of Flooding impacts on informal settlements, drainage, and transport (2050–2100, SSP5-8.5). High Risk of Landslides affecting roads and settlements on steep slopes and Medium Risk of Drought impacts on water supply and agriculture (current to mid-term).



4.2. Climate Risk Hotspots

The Chania River corridor and adjacent low-lying neighborhoods in Rware especially Majengo and Kiawara informal settlements, Kiganjo/Mathari in areas of Nyaribo and Kingongo experience frequent localized flooding during intense rainfall events, where impermeable surfaces and insufficient storm water infrastructure exacerbate runoff risks. High runoff and drainage blockages occur here due to urban expansion without proportional drainage upgrades. This increases flash-flood exposure in built-up zones.

Dense built-up environments in Rware, limited green spaces, and roof materials trap heat, elevating daytime temperatures for urban residents and contributing to discomfort and health stress. Water stress pressure resulting from rising population and demand strains supply networks, raising chronic water stress in dry spells.

The wards on the periphery of Nyeri town including Ruring'u and parts of Gatitu/Muruguru and Kamakwa/Mukaro are transitioning from peri-urban to more built development. The sloping terrain and hillside development here elevates landslide and erosion risk during intense downpours, particularly where drainage infrastructure is poor and vegetation cover has been reduced. These areas also show storm water channel instability and higher gully formation risk, which undermines road edges and service connectivity. Peri-urban zones are further exposed to drought and water stress as they rely on fluctuating informal sources when piped supply is irregular.



Municipality of Nyeri; Urban Climate Risk Profile

Map of Climate Risk Hotspots within the Municipality.

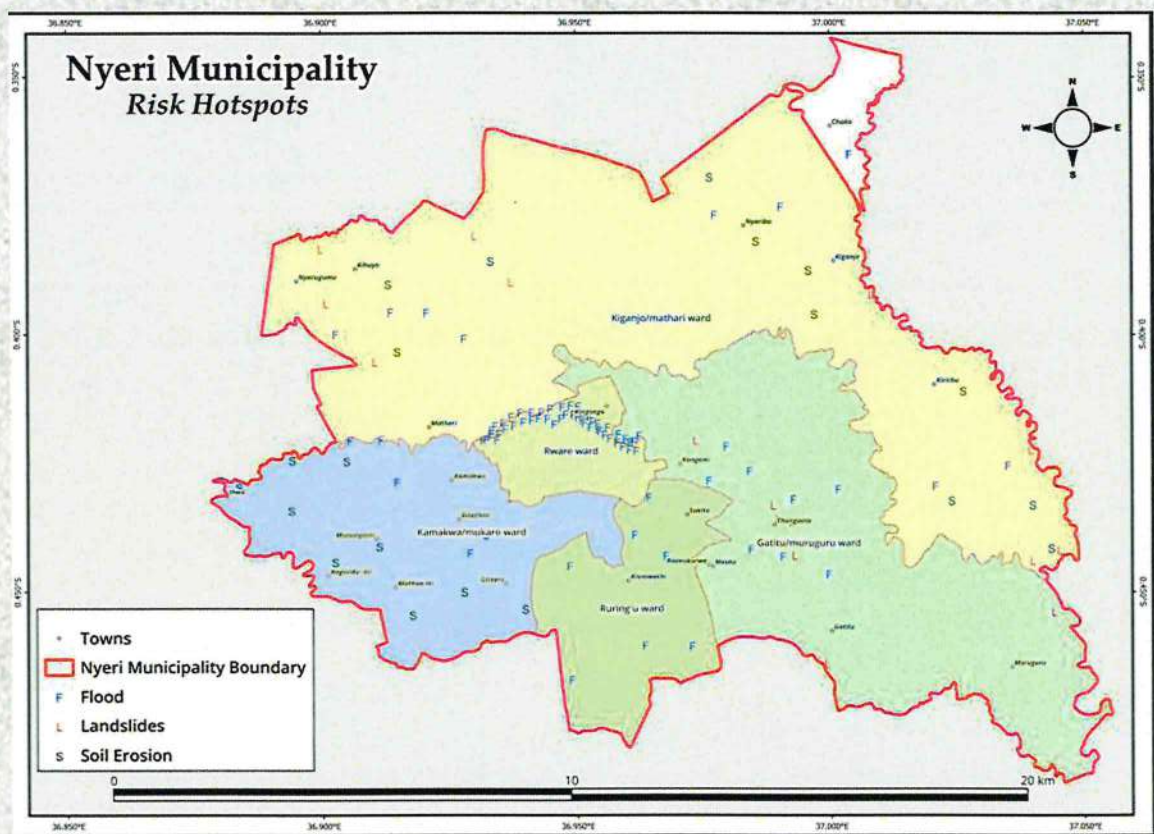


Figure 10. Map of Climate Risk Hotspots within the Municipality



5. What's Next?

5.1. Key Findings

Nyeri Municipality experiences flooding and landslides as the most critical risks and informal settlement residents and vulnerable groups are disproportionately affected because of the terrain and landscape of where they have settled. In conclusion the climate risks will intensify significantly in the long term.

Table 22. Summary of climate risks affecting urban elements for Nyeri Municipality.

Category	List of Key Hazards		
	Current	Mid-term (2050)	Long-term (2100)
Infrastructure & Services			
Stormwater Drainage	- Localized flooding due to undersized and blocked drains. - Erosion of open channels during heavy rains.	- Increased pluvial flooding from higher rainfall intensity - Frequent drain overflows and infrastructure damage.	- Severe and recurrent urban flooding - Structural failure of drainage systems without major upgrades
Water & Wastewater Management	- Seasonal water shortages - Sewer overflows during heavy rainfall	- Reduced water availability due to prolonged droughts - Increased contamination risks from flooding	- Chronic water stress - Failure of aging water and wastewater systems under extreme events



Municipality of Nyeri; Urban Climate Risk Profile

Category	List of Key Hazards		
	Current	Mid-term (2050)	Long-term (2100)
Solid Waste Management	• Waste clogging drainage systems • Flooding around dumpsites	• Increased waste generation and flood-related waste dispersal	• Persistent environmental pollution • Flooded and unstable waste disposal sites
Transport and Mobility	• Flooded roads during heavy rainfall • Landslide risks on steep sections	• Increased road washouts and traffic disruption	• Major transport network failures • Reduced connectivity and mobility reliability
Energy	• Occasional power outages during storms	• Increased disruption from storms and heat stress on infrastructure	• Chronic instability of energy supply • Damage to transmission and distribution systems
Economic Infrastructure	• Weather-related damage to markets and SMEs	• Reduced productivity due to heat stress and flooding	• Long-term economic losses • Decline in urban competitiveness
Social Infrastructure	• Flooding of schools and health facilities in low-lying areas	• Increased service disruption from extreme events	• Structural damage and relocation needs for key facilities
Emergency Services	• Limited capacity during flood events	• Increased demand for disaster response	• Overstretched emergency services • High disaster response costs



Municipality of Nyeri; Urban Climate Risk Profile

Category	List of Key Hazards		
	Current	Mid-term (2050)	Long-term (2100)
Populations			
Urban Residents	Exposure to flooding and water shortages	Increased health risks (waterborne and heat-related diseases)	- Declining urban livability - Increased displacement risk
Informal Settlement Residents	High exposure to floods and poor sanitation	Intensified flooding and disease outbreaks	Severe vulnerability, displacement, and livelihood loss
Vulnerable and Marginalized Groups	Limited adaptive capacity	Increased poverty and health risks	Deepened social inequality and chronic vulnerability
Natural Assets			
Urban Green Infrastructure	Degradation of green spaces	Reduced ecosystem services (cooling, flood buffering)	- Loss of urban green cover - Increased urban heat island effects
Urban Blue Infrastructure	Pollution of rivers and wetlands	Increased flooding and reduced water quality	- Degraded river systems - Loss of natural flood regulation
Peri-urban and Agricultural Systems	Variable rainfall affecting productivity	Frequent droughts and crop failures	- Unsustainable agriculture - Food insecurity and land degradation



Municipality of Nyeri; Urban Climate Risk Profile

The climate risk assessment for Nyeri Municipality highlights a clear escalation of risks across infrastructure, populations, and natural systems from the current period to mid-century (2050) and long-term (2100). Flooding and Water Extremes Are the Dominant Climate Risks affecting storm water drainage, roads, markets, and low-lying neighborhoods. By 2050, pluvial flooding is expected to become more frequent and severe, overwhelming existing drainage and wastewater systems and by 2100, without significant upgrades, flooding will pose a systemic risk, disrupting urban services, damaging infrastructure, and increasing displacement, particularly in informal settlements.

Growing Water Stress Threatens Urban Sustainability which would result in seasonal water shortages, compounded by high demand and catchment degradation. Mid-term projections indicate reduced water availability and increased contamination risks during flood events and in the long term, chronic water stress could undermine public health, economic activity, and ecosystem health if supply and wastewater systems are not climate-proofed.

Infrastructure Vulnerability Will Increase Without Adaptation since storm water drainage, transport networks, and energy systems are highly exposed to climate hazards and are not designed for future extremes. Flooding, erosion, and heat stress are expected to cause frequent service disruptions by 2050 and by 2100, climate impacts could result in structural failure and high maintenance costs, threatening the reliability of essential services.

Informal Settlements and Vulnerable Groups Face Disproportionate Risks since they are highly exposed to flooding, poor sanitation, and disease outbreaks. Climate change will intensify existing social vulnerabilities, increasing health risks, livelihood losses, and displacement. Women, children, the elderly, and low-income households have limited adaptive capacity, making climate risks a major equity and development concern.

Economic and Social Systems Are Increasingly at Risk since climate impacts on markets, SMEs (Small and Medium Sized Enterprises), schools, health facilities, and transport corridors will reduce productivity and service delivery. Heat stress and flooding are expected to raise operating costs and reduce economic competitiveness by mid-century and long-term impacts may require relocation or redesign of critical social infrastructure, increasing fiscal pressure on the municipality.

Degradation of Natural Assets Reduces Climate Resilience since urban green and blue infrastructure (rivers, wetlands, open spaces) is already degraded and polluted. Continued degradation will reduce natural flood buffering, cooling, and water purification services and



Municipality of Nyeri; Urban Climate Risk Profile

loss of peri-urban agricultural productivity increases risks of food insecurity and land degradation, especially by 2100.

Emergency and Disaster Response Capacity Will Be Overstretched since current emergency services have limited capacity to manage increasing climate-related disasters. By 2050, demand for emergency response is expected to rise sharply due to floods, disease outbreaks, and infrastructure failures and without early planning, long-term climate impacts could result in frequent emergencies and escalating response costs.



5.2. Climate Adaptation and Resilience Solutions

Table 23. Climate adaptation and resilience solutions recommended for Nyeri Municipality

Category	Recommended Solutions		
	Immediate	Mid-term	Long-term
Infrastructure & Services			
Stormwater Drainage	- Desilt and rehabilitate existing drains - Enforce solid waste control in drainage corridors	- Upgrade drainage capacity to climate-resilient standards - Introduce nature-based drainage (swales, retention ponds)	- Integrated urban flood management system - City-wide green-blue infrastructure network
Water & Wastewater Management	- Repair leakages and illegal connections - Protect water sources and intakes	- Expand water storage and diversify sources - Climate-proof sewer and wastewater systems	- Integrated water resources management - Circular water reuse and smart water systems
Solid Waste Management	- Improve waste collection coverage - Prevent dumping in rivers and drains	- Develop engineered landfills and transfer stations - Promote recycling and waste segregation	- Circular economy approach - Zero-waste and resource recovery systems
Transport and Mobility	- Routine maintenance of roads and culverts - Improve drainage along transport corridors	- Climate-resilient road design and materials - Improve public transport systems	- Climate-proofed transport network - Low-carbon and resilient mobility systems



Municipality of Nyeri; Urban Climate Risk Profile

Category	Recommended Solutions		
	Immediate	Mid-term	Long-term
Energy	• Protect substations from flooding • Improve maintenance of distribution lines	• Promote decentralized renewable energy (solar) • Improve grid resilience	• Smart, resilient, and low-carbon energy systems • Energy storage and micro grids
Economic Infrastructure	• Flood-proof markets and business areas • Climate risk awareness for SMEs	• Relocate or retrofit high-risk economic assets • Support climate-resilient local enterprises	• Climate-resilient urban economy • Diversified and low-carbon economic base
Social Infrastructure	• Improve drainage and access around schools and health facilities • Emergency preparedness plans	• Retrofit public buildings for flood and heat resilience • Decentralize critical services	• Relocate or redesign facilities away from high-risk zones • Resilient service delivery systems
Emergency Services	• Strengthen early warning and response coordination • Train local disaster response teams	• Upgrade emergency infrastructure and equipment • Integrate climate risk into disaster planning	• Fully integrated disaster risk management system • Predictive risk and response systems
Populations			
Urban Residents	• Public awareness on flood and heat risks • Household rainwater harvesting	• Improve access to climate-resilient housing • Urban cooling initiatives	• Climate-resilient neighborhoods • Improved urban livability and safety



Municipality of Nyeri; Urban Climate Risk Profile

Category	Recommended Solutions		
	Immediate	Mid-term	Long-term
Informal Settlement Residents	• Improve drainage and sanitation • Flood risk mapping and early warning	• In-situ upgrading of informal settlements • Secure tenure and basic services	• Planned relocation from high-risk zones • Inclusive, resilient housing development
Vulnerable and Marginalized Groups	• Targeted social protection and health outreach • Inclusive disaster preparedness	• Livelihood diversification and skills training • Improved access to services	• Reduced vulnerability through inclusive development • Intergenerational resilience building
Natural Assets			
Urban Green Infrastructure	• Protect existing green spaces • Urban tree planting	• Expand green corridors and parks • Integrate green spaces into land-use planning	• City-wide green network • Enhanced urban cooling and flood regulation
Urban Blue Infrastructure	• River clean-ups and riparian protection • Control pollution sources	• Restore wetlands and river buffers • Integrate rivers into flood management	• Fully restored river systems • Long-term ecosystem-based flood management
Peri-urban and Agricultural Systems	• Promote water-efficient farming • Soil and water conservation measures	• Climate-smart agriculture • Diversified crops and irrigation systems	• Resilient peri-urban food systems • Sustainable land and water management



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Municipality of Nyeri; Urban Climate Risk Profile

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Municipality of Nyeri; Urban Climate Risk Profile

Annex 1. Historical Hazard Events

Hazard Type	Date/Period	Location (Wards)	Intensity & Description	Social Impacts	Physical Impacts	Economic Impacts	Ecological Impacts
River Flooding	Apr–May 2018	Ruring'u, Kamakwa, Majengo	Prolonged heavy rainfall causing Chania tributaries to overflow	>1,200 people affected; displacement in informal settlements	Damage to roads, footbridges, drainage	Business disruption, crop losses	Riparian erosion, siltation
Landslides & Gully Erosion	Mar–Apr 2020	Kiganjo, Gatitu	Saturated soils on steep slopes	Temporary relocation of households	Damage to access roads	Increased maintenance costs	Loss of topsoil
Urban Flooding	Oct–Nov 2023	Kamakwa CBD, Majengo	Intense rainfall overwhelming drainage	Traffic disruption, health risks	Flooded markets and roads	Loss of daily income	Blocked drains affecting waterways
Drought	2016 – 2017, 2022	All wards	Below-average rainfall seasons	Water shortages, livelihood stress	Reduced water supply	Agricultural losses	Vegetation stress



Municipality of Nyeri; Urban Climate Risk Profile

Annex 2. Data Sources.

Page / Section	Data	Data Source
Section 2: Urban Context	Administrative boundaries (county, sub-county, wards)	Kenya National Bureau of Statistics (KNBS); Survey of Kenya
Section 2: Urban Context	Population size, density, growth trends	KNBS, <i>2019 Kenya Population and Housing Census</i>
Section 2: Urban Context	Urbanization trends and settlement patterns	Nyeri County Government; UN-Habitat
Section 2: Urban Context	Socio-economic indicators (poverty, employment)	KNBS; Nyeri County CIDP
Section 2: Urban Context	Land use and zoning	Nyeri Municipality Integrated Development Plan (MIDP); Nyeri Spatial Plan
Section 2: Urban Context	Informal settlement's location and characteristics	Nyeri County Government; UN-Habitat urban profiles
Section 3: Climate Hazards	Historical rainfall and temperature data	Kenya Meteorological Department (KMD)
Section 3: Climate Hazards	Extreme rainfall and drought records	KMD; NDMA drought bulletins
Section 3: Climate Hazards	Climate change projections (SSP/RCP scenarios)	IPCC AR6; CORDEX Africa datasets
Section 3: Climate Hazards	Flood-prone areas and historical flood events	Nyeri County Disaster Management Unit; media reports
Section 3: Climate Hazards	Landslide and erosion-prone zones	Ministry of Lands; Nyeri County GIS
Section 4: Exposure	Stormwater drainage network	Nyeri Municipality Engineering Department
Section 4: Exposure	Water supply and sewer networks	Nyeri Water and Sanitation Company (NYEWASCO)



Municipality of Nyeri; Urban Climate Risk Profile

Page / Section	Data	Data Source
Section 4: Exposure	Solid waste facilities and collection routes	Nyeri Municipality Environment Department
Section 4: Exposure	Transport infrastructure (roads, bridges)	Kenya Urban Roads Authority (KURA); KeNHA
Section 4: Exposure	Energy infrastructure (substations, lines)	Kenya Power and Lighting Company (KPLC)
Section 4: Exposure	Markets, industrial areas, economic nodes	Nyeri Municipality; County Trade Department
Section 4: Exposure	Schools, health facilities, emergency services	Ministry of Health; Ministry of Education; Nyeri County Government
Section 4: Exposure	Urban green spaces and open areas	Nyeri County GIS; NEMA
Section 4: Exposure	Rivers, wetlands, riparian corridors	Water Resources Authority (WRA); NEMA
Section 5: Vulnerability	Housing conditions and building materials	KNBS Census; Nyeri Municipality
Section 5: Vulnerability	Water access, sanitation coverage	NYEWASCO; Ministry of Water
Section 5: Vulnerability	Health vulnerability and disease incidence	Ministry of Health; County Health Department
Section 5: Vulnerability	Poverty and social vulnerability indicators	KNBS; Nyeri County CIDP
Section 5: Vulnerability	Gender, age, disability data	KNBS; Nyeri County Social Services
Section 5: Impacts	Flood impacts on infrastructure and services	Nyeri County Disaster Reports



Municipality of Nyeri; Urban Climate Risk Profile

Page / Section	Data	Data Source
Section 5: Impacts	Economic losses and service disruptions	Nyeri County Government; World Bank urban studies
Section 5: Impacts	Agricultural productivity and climate sensitivity	Ministry of Agriculture; FAO
Section 5: Impacts	Ecosystem degradation and land cover change	NEMA; satellite imagery (Landsat, Sentinel)
Cross-cutting	Policy and institutional framework	Government of Kenya Climate Change Act (2016); CIDP; MIDP
Cross-cutting	Adaptation best practices and benchmarks	GCA; World Bank; UNDP; UNEP
Cross-cutting	Disaster risk management and early warning	NDMA; WMO guidelines



Annex 3. Stakeholder Consultation Workshop.



COUNTY GOVERNMENT OF NYERI MUNICIPALITY OF NYERI OFFICE OF THE MUNICIPAL MANAGER



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NYERI. Kamukunji,

municipality@nyeri.go.ke/

REPORT ON THE STAKEHOLDERS' CONSULTATIVE FORUM HELD ON 3RD MARCH 2026 AT ELAND HOTEL

1. Introduction

The Municipality of Nyeri convened a Stakeholders' Consultative Forum on 3rd March 2026 at Eland Hotel on 3rd March 2026. The forum brought together key stakeholders to deliberate on critical draft policy and planning instruments aimed at strengthening governance, service delivery, environmental management, and risk preparedness within the Municipality.

Attendance - As per the attached attendance register.

2. Opening of the Meeting

The meeting was called to order at 9:00 a.m. by the Municipal Manager. The session commenced with a word of prayer led by Mrs. Grace Wanjiru Kahoro.

3. Opening Remarks by the Chairman Nyeri Municipal Board

In his opening remarks, the Chairman welcomed all stakeholders and emphasized the importance of participatory governance in municipal planning and policy formulation.

He stated that the purpose of the meeting was to:

- Listen to stakeholders' views and recommendations;
- Incorporate their inputs into the Municipality's governance and planning instruments;
- Strengthen policy frameworks to enhance service delivery and sustainable development.

He reiterated that stakeholders are partners in governance, not mere observers, and that their contributions would directly shape the final documents guiding municipal operations.

4. Key Areas for Consultation

The forum focused on stakeholder inputs and deliberations on the following draft documents:

1. Draft Solid Waste Management Policy



2. Draft Solid Waste Management Plan
3. Draft Urban Climate Risk Profile
4. Draft Risk Management Policy

5. Purpose and Significance of the Draft Documents

5.1 Draft Solid Waste Management Policy and Plan

The review of the Solid Waste Management Policy and Plan aims to assess effectiveness, identify implementation gaps, and propose practical improvements in waste collection, disposal, recycling,

environmental protection, and public health safeguards. These instruments are intended to enhance operational efficiency, reduce environmental degradation, and promote sustainable waste management practices within the Municipality.

5.2 Draft Urban Climate Risk Profile

The development of Urban Climate Risk Profile seeks to identify climate-related vulnerabilities, assess exposure to climate risks, and inform adaptation and mitigation strategies to strengthen resilience and sustainable urban planning.

5.3 Draft Risk Management Policy

The proposed Risk Management Policy aims to establish a structured framework for identifying, assessing, and mitigating operational, financial, environmental, and institutional risks, while strengthening accountability and ensuring continuity in service delivery.

6. Importance of Stakeholder Engagement

The Chairman emphasized that the documents under review directly influence service delivery to residents, businesses, and institutions. Policies shaped through meaningful consultation are more realistic, practical, and implementable.

Stakeholders were encouraged to engage openly and constructively, and the technical team committed to documenting all submissions for incorporation into the final drafts.

Stakeholders who may not have presented their views during the forum were informed that they could also submit written comments through the official municipal email address: municipality@nyeri.go.ke within the stipulated consultation period.

7. Stakeholder Comments and Resolutions

Stakeholders provided detailed feedback across the various draft documents.

7.1 Solid Waste Management Policy and Plan



Municipality of Nyeri; Urban Climate Risk Profile

Stakeholders emphasized the need for a clear legal and regulatory framework to strengthen implementation of the Solid Waste Management Policy. They recommended alignment with national legislation, including provisions under the Environmental Management and Coordination Act (EMCA) 2025 and related Producer Responsibility Regulations. It was proposed that Producer Responsibility Organizations (PROs) be recognized and integrated into the municipal framework to enhance accountability in waste management.

Participants stressed the importance of involving Resident Associations in waste management initiatives to improve compliance and community participation. The role of youth organizations was highlighted, particularly in inculcating discipline among school-going children regarding environmental cleanliness and responsible waste disposal.

Stakeholders called for stronger private sector engagement in waste collection and recycling initiatives. They recommended the establishment of Material Recovery Facilities (MRFs) within the Municipality to improve waste segregation and recycling efficiency. Special attention was drawn to the need for proper handling and disposal of electronic waste (e-waste).

Concerns were raised regarding irregular waste collection, which leads to overflow and littering in residential and commercial areas. Participants emphasized the importance of regular collection schedules to prevent environmental and public health risks. Additionally, stakeholders observed that the town often remains untidy after hawkers vacate their trading spaces and recommended enhanced supervision, enforcement, and structured post-market clean-up mechanisms.

The forum resolved that the final Solid Waste Management Policy and Plan would incorporate a strengthened legal framework, promote producer responsibility mechanisms, enhance stakeholder participation (including youth and resident associations), encourage private sector engagement, establish material recovery facilities, address e-waste management, and ensure regular waste collection and improved town cleanliness.

7.2 Urban Climate Risk Profile

Stakeholders highlighted the frequent occurrence of mudslides in steep terrain areas and urged the Municipality to implement slope stabilization and erosion control measures as part of its climate risk mitigation strategies. In addition, they recommended informing the public about the risk rating through the placement of signage at various strategic sites.

Participants recommended mapping all water bodies within the Municipality in collaboration with relevant stakeholders to enhance planning, conservation, and risk management.

It was further proposed that dams in Ngangarithi be put into productive use for farming and recreational purposes to generate revenue for the Municipality. At the same time, stakeholders emphasized the need to fence off open dams and install safety signage to reduce accidents and enhance public safety.



Municipality of Nyeri; Urban Climate Risk Profile

The forum resolved that these environmental and climate resilience measures be incorporated into the final Urban Climate Risk Profiles and related planning instruments.

7.3 Risk Management Policy

Stakeholders recommended that the Risk Management Policy clearly define governance and oversight structures. In particular, they proposed that the role of the County Assembly be explicitly recognized as an oversight body to enhance accountability and transparency in risk management processes.

Concerns were also raised about limited awareness of existing risk management frameworks. Stakeholders called for capacity-building initiatives and clearer reporting mechanisms. Financial risk mitigation strategies were emphasized as a critical component of the policy.

The forum resolved that the Risk Management Policy would incorporate the oversight role of the County Assembly, clearly define institutional responsibilities, strengthen reporting mechanisms, and provide for regular training and capacity building.

8. General Resolutions of the Forum

The forum collectively resolved that:

1. All stakeholder recommendations will be incorporated into the final drafts of the respective documents.
2. Revised drafts will be shared with stakeholders for validation before formal adoption.
3. Continuous stakeholder engagement will be maintained during implementation to monitor progress and address emerging issues.
4. Stakeholders may continue submitting additional written comments through hand delivery or email; municipality@nyeri.go.ke within the consultation period.

9. Conclusion

The Stakeholders' Consultative Forum provided an important platform for dialogue between the Municipality and its stakeholders. The recommendations made will significantly strengthen the policy foundation of the Municipality of Nyeri and enhance sustainable development, environmental management, risk preparedness, and service delivery.

The Municipality expressed appreciation to all participants for their active engagement and reaffirmed its commitment to inclusive, transparent, and accountable governance.

The session concluded with a closing prayer led by Mr. James Kimani.



Municipality of Nyeri; Urban Climate Risk Profile



Reported by:

Stephen Githinji - APHO

Verified by:

Perister Kigwa – Municipal Manager.