URBAN CLIMATE RISK PROFILE FOR RUIRU MUNICIPALITY 2025

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Disclaimer:

The Ruiru Municipality's Urban Climate Risk Profile (2025) is intended solely for planning and informational purposes. The analysis and forecasts are subject to uncertainties in climate science and changing local conditions, and they are based on data available at the time of publication. Although every effort has been made to ensure accuracy, judgments or actions based on the information in this report are not the responsibility of the authors or contributors. Before implementing policies, investments, or interventions, users are advised to consult widely with appropriate authorities and technical specialists.

FOREWORD

Ruiru Municipality is one of the fastest-growing urban centres within Kiambu County and plays a strategic role in the economic landscape of the Nairobi Metropolitan Region. The municipality has evolved into a vibrant industrial and residential hub, hosting a wide range of manufacturing and commercial activities. Major industries such as Devki Steel Mills, Super Foam Limited, Spinners & Spinners Garment Factory, Ruiru Mabati Factory, and Ruiru Feeds Limited have significantly contributed to employment creation and economic growth. In addition, the development of Tatu Industrial City Park has further strengthened Ruiru's position as a key industrial destination, accommodating prominent companies including BIDCO, Copier, Dormans, Davis & Shirtliff Group, Tianlong, and Dr. Mattress.

At the same time, Ruiru serves as an important dormitory town for Nairobi, with a large proportion of residents commuting daily to the capital. The municipality benefits from strong connectivity through established road and rail transport networks that link it efficiently to Nairobi and other parts of the region. This combination of industrial expansion, population growth, and strategic location has accelerated urban development within the municipality.

However, rapid urbanization and industrial growth also increase the municipality's exposure to climate-related risks. Changing rainfall patterns, flooding in certain areas, increasing temperatures, and pressure on infrastructure and natural systems present growing challenges for sustainable urban development. Addressing these risks is essential to safeguarding livelihoods, maintaining industrial productivity, and ensuring the continued growth of the municipality.

The Ruiru Urban Climate Risk Profile (2025) provides a comprehensive assessment of climate hazards and their potential impacts on infrastructure, communities, the local economy, and critical services. By identifying key vulnerabilities and areas of exposure, this profile offers valuable evidence to support climate-resilient planning, investment, and decision-making within the municipality.

It is hoped that the findings and recommendations presented in this profile will guide efforts to strengthen resilience, protect critical infrastructure, and support sustainable growth within Ruiru Municipality, ensuring that it continues to thrive as a dynamic industrial and urban centre in the years to come.

Municipal Manager
Ruiru Municipality
2025

EXECUTIVE SUMMARY

Objective of the Rapid Climate Risk Assessment

The rapid climate risk assessment for Ruiru Municipality was conducted to identify the main climate hazards affecting the municipality, assess the exposure and vulnerability of key urban systems, and evaluate the potential impacts on infrastructure, populations, economic activities, and natural assets. The assessment aims to support municipal planning by providing evidence-based insights that can guide climate-resilient urban development, strengthen disaster preparedness, and inform priority adaptation actions.

Key Climate Hazards Identified

The assessment identified three priority climate hazards affecting the municipality:

- **Pluvial Flooding**
- **Extreme Heat**
- **Drought**

These hazards were selected based on their current impacts, projected future intensity, and the extent to which they affect urban infrastructure, livelihoods, and environmental systems in Ruiru.

Risk Results Summary by Hazard

Pluvial flooding is the most significant and widespread climate hazard affecting the municipality. Rapid urbanization has increased impervious surfaces while drainage infrastructure has not kept pace with development. As a result, intense rainfall events frequently cause surface runoff and localized flooding in residential areas, commercial centres, and transport corridors. Flooding also contributes to drainage blockages caused by poorly managed solid waste and encroachment on drainage channels and riparian areas. The risk level is currently very high for stormwater drainage systems, transport infrastructure, informal settlements, and economic infrastructure, and is expected to remain very high in future climate scenarios if mitigation measures are not implemented.

Extreme heat is an emerging urban hazard associated with increasing temperatures, dense development patterns, and limited urban vegetation. The urban heat island effect is particularly pronounced in densely built areas where buildings and paved surfaces absorb and retain heat. Informal settlements and low-income neighbourhoods are especially vulnerable due to limited ventilation, use of heat-absorbing roofing materials, and lack of green spaces. Heat-related risks are high for urban residents, economic infrastructure, and social services, and may increase in the future as temperatures continue to rise.

Drought poses significant risks to water security, peri-urban agriculture, and water-dependent livelihoods. Periodic dry spells reduce water availability for households, institutions, and small-scale farming activities in peri-urban areas. Increasing demand for water driven by population growth and urban development is expected to intensify these pressures. The risk level is very high for water supply systems and peri-urban agricultural systems, while urban residents and vulnerable groups face growing challenges related to water shortages and sanitation.

Key Takeaways for Risk Mitigation

To reduce the identified climate risks and strengthen resilience in Ruiru, several priority actions are recommended:

- Improve stormwater management through expansion and maintenance of drainage systems and protection of natural drainage corridors.
- Strengthen water resource management by increasing water storage capacity, promoting rainwater harvesting, and improving efficiency in water supply systems.
- Promote nature-based solutions, including urban tree planting, restoration of riparian zones, and expansion of green spaces to reduce flooding and urban heat.
- Upgrade infrastructure and informal settlements to improve drainage, sanitation, and climate resilience in high-risk neighbourhoods.
- Integrate climate risk considerations into urban planning and land-use management, particularly in rapidly developing areas.

Overall, implementing these measures will help reduce the vulnerability of infrastructure, ecosystems, and communities while supporting sustainable and climate-resilient development in Ruiru.

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

TABLE ES-1. SUMMARY OF FLOODING RISKS FOR RUIRU MUNICIPALITY

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

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

TABLE ES-2. SUMMARY OF EXTREME RISKS FOR RUIRU MUNICIPALITY

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

Urban Green Infrastructure	Major	**Medium**	**High**	**Very High**	**High**	**Very High**
Urban Blue Infrastructure	Catastrophic	**High**	**High**	**Very High**	**Very High**	**Very High**
Peri-urban & Agricultural Systems	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**

TABLE ES-3. SUMMARY OF DROUGHT RISKS FOR RUIRU MUNICIPALITY

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

TABLE OF CONTENTS

Foreword 3

Executive Summary 4

List of Acronyms 9

List of Figures 10

List of Tables 11

1. Context 12

1.1. Objective 12
1.2. Urban Context 12
1.3. Key Stakeholders & Inclusiveness 17

2. Hazard Assessment 19

2.1. Key Climate Hazards 19
2.2. Climate Indicators and Hazard Thresholds 20
2.3. Current Hazard Levels and Climate Projections 20
2.4. Current and Future Hazard Impact Areas 22

3. Exposure & Vulnerability Assessment 25

3.1 Urban Elements 25
3.2 Exposure, Vulnerability, and Impacts of Climate Hazards on Urban Elements 28

4. Climate Risk Assessment 39

4.1 Current and Future Climate Risks on Urban Elements 39
4.2. Climate Risk Hotspots 42

5. What's Next? 43

5.1 Key Findings 43
5.2 Most At-Risk Groups 44
5.3Key Trends Likely to Intensify Future Risks 44
5.2 Climate Adaptation and Resilience Solutions 47

Bibliography 50

Annex N1. Data Sources 51

LIST OF ACRONYMS

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

LIST OF FIGURES

Figure 1: Location map of Ruiru Municipality
Figure 2: Land use map of Ruiru Municipality
Figure 3. Stakeholder mapping for Ruiru Municipality
Figure 4: Climate risk hotspot map

LIST OF TABLES

Table 1: Hazard screening for Ruiru Municipality
Table 2: Climate indicators and hazard thresholds
Table 3: Urban elements inventory
Table 4: Interpretation of exposure & vulnerability levels
Table 5: Implementation matrix
Table 6: Exposure, vulnerability, and impacts of pluvial flooding
Table 7: Exposure, vulnerability, and impacts of drought
Table 8: Exposure, vulnerability, and impacts of extreme heat
Table 9: Risk Matrix
Table 10: Interpretation of risk levels
Table 11: Summary of flooding risks
Table 12: Summary of drought risks
Table 13: Summary of extreme heat risks
Table 14: Summary of climate risks affecting urban elements
Table 15: Climate adaptation and resilience solutions

1. CONTEXT

1.1. OBJECTIVE

This Urban Climate Risk Profile for Ruiru Municipality aims to:

1. Identify and prioritise the key climate hazards affecting Ruiru Municipality, including risks such as flooding, drought, and heat stress that may impact the municipality's rapidly growing urban and industrial areas.
2. Assess the exposure, vulnerability, and potential impacts of these hazards on critical urban systems, including infrastructure, residential areas, industries, livelihoods, and natural ecosystems within the municipality.
3. Provide an evidence base to inform planning and policy, particularly the integration of climate risk considerations into county and municipal development frameworks such as the Kiambu County Integrated Development Plan (CIDP) and the County Climate Change Action Plan (CCCAP).
4. Support informed decision-making by equipping municipal leaders, planners, and stakeholders with practical climate risk information that can guide the prioritisation of adaptation measures and investments within county programmes and development projects.
5. Strengthen climate resilience in Ruiru Municipality by promoting strategies that safeguard communities, protect critical infrastructure, and support sustainable economic and industrial growth.

1.2. URBAN CONTEXT

1.2.1 GEOGRAPHIC AREA

Ruiru Municipality is located in Kiambu County and forms part of the Nairobi Metropolitan Region, one of Kenya's most rapidly urbanizing areas. The municipality lies approximately 20 kilometres northeast of Nairobi's Central Business District, positioning it strategically as both a residential and industrial extension of the capital city. Due to its proximity to Nairobi and its strong transport connections, Ruiru plays an important role in supporting metropolitan economic activities while accommodating significant urban population growth.

Administratively, the municipality comprises three wards, namely Biashara, Gatongora and Gitothua. The municipality covers an estimated 201.1 square kilometres and had a population of 490,120 people according to the 2019 Kenya Population and Housing Census. Over recent years, the area has experienced rapid population growth driven by urban expansion, availability of relatively affordable housing, and its accessibility to Nairobi through major road and rail transport corridors. Ruiru therefore functions as a major commuter town, with many residents traveling daily to Nairobi for employment and business activities.

Topographically, Ruiru lies within the central Kenyan highlands, with elevations generally ranging between approximately 1,500 and 1,700 metres above sea level. The terrain is characterized by gently undulating landscapes interspersed with river valleys and drainage channels that form part of the broader Athi River Basin. These natural drainage systems play an important role in surface water flow and influence the municipality's exposure to flooding during periods of intense rainfall.

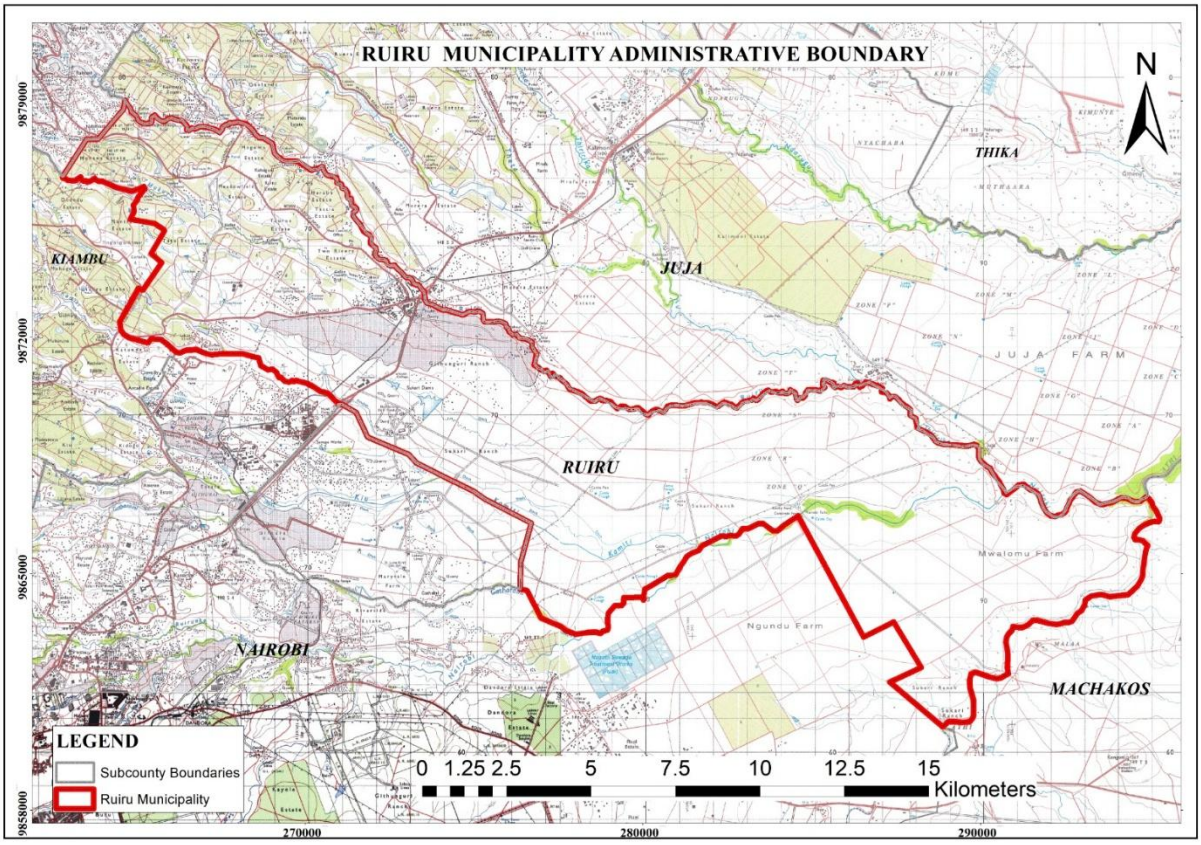

Figure 1: Map of Ruiru Municipality with administrative boundaries.

1.2. 2 GOVERNANCE STRUCTURE

Ruiru Municipality is governed by a Municipal Board appointed by the Kiambu County Government, in accordance with the Urban Areas and Cities Act (2011). The Technical officers involved in climate resilience include:

- Municipal Manager's Office – Joan Kihori
- Municipal Environment Officer – David Ndung'u
- Municipal Physical Planner – Daniel Murage
- Municiapl Economist – Ann Nganga
- Municipal Roads Engineer – Eng John Wachira
- GIS Special Analyst – Jennifer Kamze

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

1.2.3 SOCIO-ECONOMIC CONTEXT

According to the 2019 Kenya Population and Housing Census (KNBS), Ruiru Municipality had a total population of 490,120 people. Rapid population growth has been driven by the municipality's strategic location within the Nairobi Metropolitan Region, expanding residential developments, and significant industrial and commercial activity. The municipality continues to attract residents due to employment opportunities, housing availability, and its strong transport connectivity to Nairobi and surrounding towns.

Population growth is projected to continue, with numbers expected to exceed 575,000 by 2027, assuming an average annual growth rate of 2.1%, consistent with projections applied in the Kiambu County CIDP 2023–2027.

1.2.3.1 Population by Ward (Ruiru Municipality)

Ruiru Municipality comprises three wards: Biashara, Gitothua, and Gatongora. The population distribution for 2019 is as follows:

Ward	Population (2019)	Estimated Households*	Density Characteristics
Biashara	248,393	71,000	High-density urban and commercial centre
Gitothua	146,840	42,000	Moderate-density residential and peri-urban
Gatongora	194,887	56,000	Mixed residential and peri-urban development
Total	**490,120**	169,000	2,400 persons/km² (average across municipality)

*Households estimated using an average household size of 3.3–3.5 persons, consistent with KNBS 2019 census estimates.

It is important to note that:

- Biashara Ward is the core urban and commercial hub, hosting the majority of the municipality's population, including dense residential and industrial areas.
- Gatongora Ward has a significant population due to expanding residential and peri-urban developments, industrial estates, and growing commercial activity.
- Gitothua Ward is moderately populated, with mixed residential zones and peri-urban land uses.

The population distribution highlights the municipality's high-density urban areas, which are particularly susceptible to climate hazards such as flooding, heat stress, and pressure on infrastructure and services, while peri-urban areas face challenges related to land-use changes, water supply, and drainage management.

Source: Kenya National Bureau of Statistics (KNBS), 2019 Kenya Population and Housing Census; Kiambu County CIDP 2023–2027 projections

1.2.4 Economic Context

Ruiru Municipality has a diversified peri-urban economy shaped by industry, commerce, agriculture, and strong linkages to Nairobi. While urbanization and industrial development are expanding rapidly, agriculture remains an important source of livelihood, particularly in peri-urban wards such as Gitothua and Gatongora. Key agricultural activities include dairy farming, horticulture, poultry production, and small-scale mixed farming, which continue to support household incomes alongside growing commercial and service-sector activities.

Formal employment within the municipality is concentrated in industrial manufacturing, public administration, education, retail businesses, financial services, and light manufacturing. A significant proportion of residents commute daily to Nairobi for employment in government, private sector offices, construction, domestic work, and informal trade, reflecting Ruiru's role as both an industrial hub and a commuter town within the metropolitan region.

Key economic characteristics include:

- Industry and manufacturing: Ruiru hosts several major factories including Devki Steel Mills, Super Foam Limited, Spinners & Spinners Garment Factory, Ruiru Mabati Factory, and Ruiru Feeds Limited. Tatu Industrial City Park accommodates prominent companies such as BIDCO, Dormans, Davis & Shirtliff Group, Tianlong, Dr. Mattress, and Copier, making manufacturing a major employment and economic driver in the municipality.
- Agriculture: Peri-urban wards continue to support dairy farming (mainly zero-grazing systems), horticulture, poultry, and small-scale mixed farming, providing food security and supplementary household incomes.
- Commerce and trade: Biashara Ward serves as the municipality's main commercial hub, hosting wholesale and retail businesses, markets, transport services, and small enterprises. Local trade and service provision play a critical role in employment, particularly for youth and women.
- Transport and informal sector: Boda boda services, small-scale trade, and informal enterprises provide significant employment opportunities, especially for youth, supporting household livelihoods and daily commuting within and beyond the municipality.

Despite these economic opportunities, youth unemployment remains a concern, estimated at 18–22%, with emerging social challenges including underemployment and vulnerability to substance abuse, reflecting limited absorption into formal jobs.

Overall, Ruiru's economy is rapidly transitioning from a predominantly agricultural base toward a mixed industrial, service-oriented, and peri-urban system, driven by its strategic location within the Nairobi Metropolitan Region while retaining important agricultural foundations in its peri-urban wards.

1.2.5 LAND-USE CONTEXT

Ruiru Municipality covers approximately 201.1 square kilometres and has undergone rapid urbanization, industrial growth, and population expansion in recent years. Its land use is diverse, reflecting a combination of residential, industrial, commercial, agricultural, and institutional activities, shaped by its strategic location within the Nairobi Metropolitan Region and its role as both an industrial hub and a commuter town for Nairobi.

Residential areas are primarily concentrated in Biashara Ward, forming the municipality's core urban centre, and include high-density estates, planned housing developments, and informal settlements. These residential zones are interspersed with commercial enterprises, educational institutions, and community amenities, reflecting Ruiru's function as both a residential and economic centre.

Industrial and commercial zones dominate parts of the northern and eastern corridors, including Tatu Industrial City Park and areas hosting factories such as Devki Steel Mills, Super Foam Limited, Spinners & Spinners Garment Factory, Ruiru Mabati Factory, and Ruiru Feeds Limited. Commercial activities, including retail, wholesale trade, and service centres, are concentrated in Biashara Ward and along major transport corridors like the Thika Superhighway, supporting employment and economic growth.

In peri-urban wards such as Gitothua and Gatongora, agriculture remains a key land use, including dairy farming, horticulture, poultry production, and small-scale mixed farming, which support household incomes and supply local markets. Open spaces and natural drainage channels in these areas are also crucial for stormwater management and flood mitigation.

Institutional and social facilities further shape the land use landscape. Key institutions include Zetech University, private and public schools, churches, mosques, healthcare facilities, and community centres. These institutions provide essential services while influencing urban density, transport demand, and surrounding land development patterns.

Transport and infrastructure corridors, including the Thika Superhighway, rail lines, and local road networks, define urban expansion and link residential, industrial, and commercial areas to Nairobi and neighbouring towns. Utilities and drainage infrastructure further guide land development and urban form.

Overall, Ruiru's land use reflects a dynamic peri-urban system where residential growth, industrial expansion, commercial activity, and peri-urban agriculture coexist. Rapid urbanization and population growth place increasing pressure on land, infrastructure, and environmental systems, heightening exposure to climate hazards such as flooding and heat stress. Effective land use planning is therefore essential to ensure sustainable growth, protection of livelihoods, and climate resilience in the municipality.

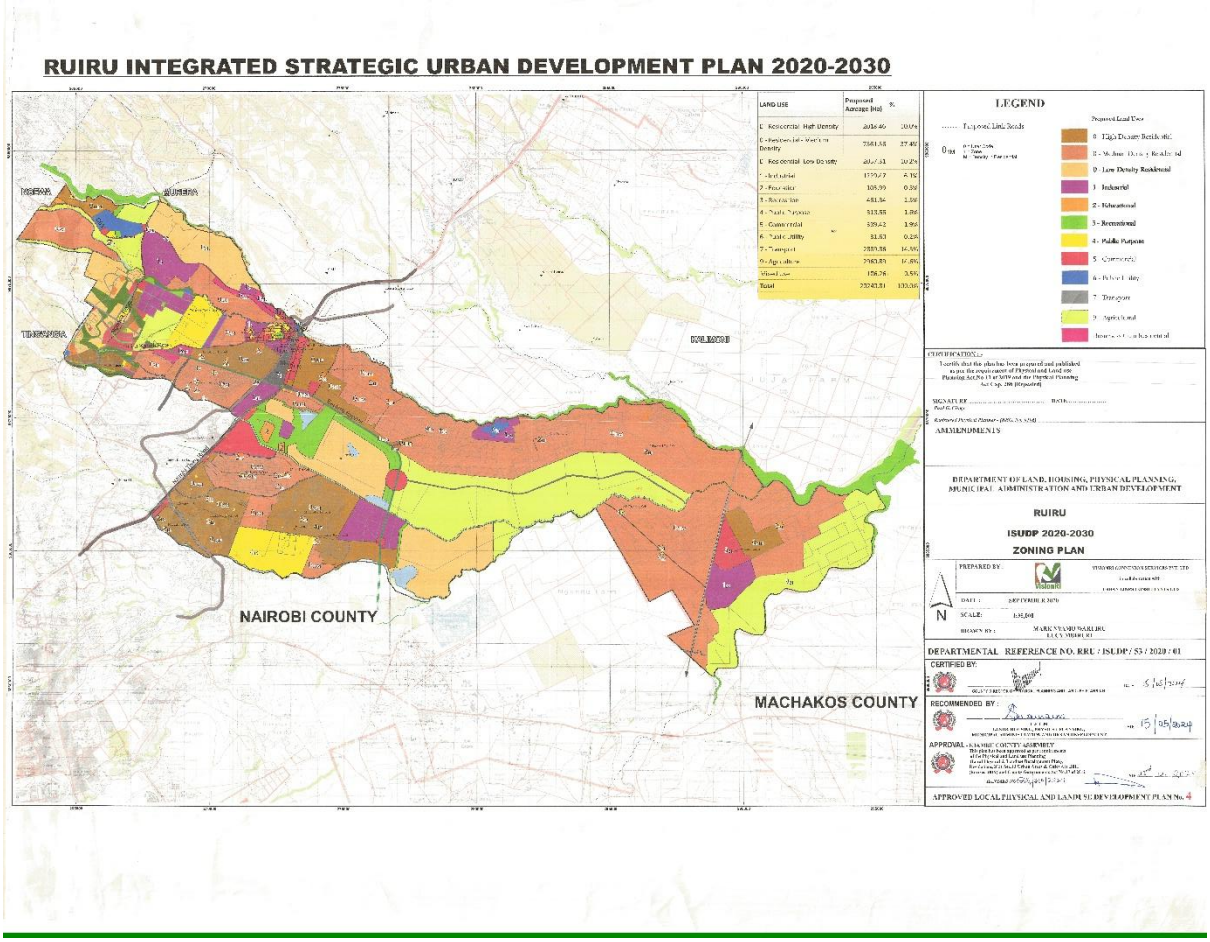

Figure 2: Ruiru Municipality Land use map

1.3. KEY STAKEHOLDERS & INCLUSIVENESS

Effective climate risk management in Ruiru Municipality requires the active participation and coordination of a wide range of stakeholders drawn from government institutions, the private sector, academia, and community groups. These stakeholders play different roles in urban governance, environmental management, infrastructure development, and community mobilization, all of which are critical in addressing climate-related risks and building urban resilience.

Key public sector stakeholders include the Ruiru Municipal Board, the Kiambu County Government, ward administrators, and relevant national government agencies responsible for environmental management, water resources, and climate services. Institutions such as the Kenya Meteorological Department provide climate information and early warning data, while regulatory agencies such as the National Environment Management Authority guide environmental compliance and climate-related policies. Utilities and service providers, including the Ruiru-Juja Water and Sewerage Company, are also key actors in ensuring resilient infrastructure and service delivery.

The private sector plays a significant role in shaping the urban landscape of Ruiru through investments in real estate development, manufacturing, commerce, and logistics. Large-scale developments such as Tatu City contribute to economic growth while also influencing land use patterns and infrastructure demand. Academic institutions such as Zetech University contribute

through research, innovation, and community outreach initiatives that support climate awareness and capacity building.

Community-level stakeholders include resident associations, farmers' groups, community-based organizations (CBOs), youth groups, women's groups, market traders, and informal sector groups such as boda boda associations. Their participation is essential because they directly experience climate hazards and can contribute valuable local knowledge on environmental changes, hazard-prone areas, and practical adaptation measures.

A participatory approach was implemented at the ward level, where community members were actively involved in hazard mapping, vulnerability assessments, and the prioritization of climate adaptation and resilience solutions. This approach ensured that local knowledge and lived experiences were incorporated into the climate risk assessment process, while also strengthening community ownership of proposed resilience interventions.

To better understand the roles and engagement priorities of these stakeholders, an Influence–Interest Matrix is used to categorize them based on their level of influence in decision-making and their level of interest in climate resilience and urban development.

Stakeholder Mapping (Influence–Interest Matrix) – Ruiru Municipality

	Low Interest	**High Interest**
High Influence	National government regulatory agencies (e.g. National Environment Management Authority, Water Resources Authority)	Kiambu County Government, Ruiru Municipal Board, Ward Administrators, Ruiru-Juja Water and Sewerage Company, Kenya Meteorological Department, major private developers (e.g. Tatu City)
Low Influence	Private developers, manufacturing industries, commercial enterprises	Community-Based Organisations (CBOs), resident associations, farmers' groups, boda boda associations, youth and women groups, religious institutions, educational institutions such as Zetech University, market trader associations

Figure 3. Stakeholder mapping for Ruiru Municipality

Inclusiveness Considerations

Inclusive stakeholder engagement is essential in addressing climate risks in Ruiru Municipality. Special attention should be given to vulnerable and marginalized groups including women, youth, persons with disabilities (PWDs), and residents of informal settlements who are often disproportionately affected by climate hazards such as flooding and heat stress. Mechanisms such as public participation forums, ward-level consultations, and community awareness programs should be strengthened to ensure their perspectives are integrated into municipal planning and climate adaptation initiatives. Strengthening collaboration among government agencies, academic institutions, private sector actors, and community groups will also enhance knowledge sharing, improve climate data utilization, and support the implementation of locally appropriate resilience solutions across Ruiru Municipality.

2. HAZARD ASSESSMENT

The hazard assessment identifies and analyzes the main climate-related hazards that currently affect and are likely to affect Ruiru Municipality in the future. Understanding these hazards is critical for assessing the potential risks to urban infrastructure, services, livelihoods, and ecosystems. The assessment examines the nature, frequency, and intensity of climate hazards, as well as their potential impacts on the municipality's rapidly growing urban environment.

The analysis draws on climate projections and historical climate information from sources such as the World Bank Climate Change Knowledge Portal and the Kenya Meteorological Department, which provide data on temperature trends, rainfall variability, and extreme weather events in central Kenya. These datasets help identify both current and future climate hazards under different climate scenarios.

In addition to scientific climate data, the hazard assessment incorporates local knowledge obtained through stakeholder consultations and ward-level participatory processes. Community members contributed to identifying hazard-prone areas, documenting past climate events, and highlighting the most significant climate-related challenges affecting their communities.

The hazard assessment therefore provides the foundation for subsequent stages of the Climate Urban Risk Profile, including exposure analysis, vulnerability assessment, and the identification of appropriate climate adaptation and resilience strategies for Ruiru Municipality.

2.1. KEY CLIMATE HAZARDS

A key hazard refers to a climate-related threat that warrants priority attention in planning and decision-making. Climate hazards refer to potentially damaging physical events or trends arising from climate variability and climate change that may cause loss of life, injury, property damage, environmental degradation, and disruption of economic and social activities. A hazard is classified as key when it meets three criteria: it is likely to occur within the urban area; it has the potential to cause significant damage or adverse impacts on populations, infrastructure and services, or natural assets; and it represents a high priority based on its frequency, severity, and/or overall magnitude of impact. Identifying key hazards ensures that risk reduction, adaptation planning, and resource allocation efforts are directed toward the most pressing and consequential climate threats facing the urban area.

TABLE 1: HAZARD SCREENING FOR RUIRU 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	Y	Y	Y	Y
Marine heatwaves	N	N	N	N
Flooding				
Changes in precipitation patterns	Y	Y	Y	N

Hazard	Hazard Likely (Y/N)	Significant Impact (Y/N)	High Priority (Y/N)	Key Hazard (Y/N)
Pluvial (surface level) flooding, including flash flooding and urban flooding	Y	Y	Y	Y
Fluvial (river) flooding	Y	Y	Y	N
Sea level rise	N	N	N	N
Coastal flooding, including storm surges	N	N	N	N
Waterlogging	N	N	N	N
Water Stress				
Drought (meteorological, hydrological)	Y	Y	Y	Y
Groundwater salinization	N	N	N	N
Saline intrusion	N	N	N	N

Based on the analysis of climate data and stakeholder input done (Flocca programme), the key climate hazards identified for Ruiru Municipality include flooding, extreme heat (heat stress), and drought or prolonged dry spells. Flooding is mainly associated with intense rainfall events and inadequate drainage systems in rapidly urbanizing areas. Extreme heat is becoming more pronounced due to rising temperatures and the increasing extent of built-up surfaces that reduce natural cooling. Drought and prolonged dry periods also pose risks to water availability, urban agriculture, and ecosystem health.

2.2. Climate Indicators and Hazard Thresholds

Table 2: Climate indicators and hazardous thresholds

Key Hazard	Climate Indicator	Data Source	Thresholds		
			Low	**Medium**	**High**
Pluvial Flooding	Number of days with precipitation >50mm	World Bank Climate Change Knowledge Portal, KMD	<3 days/year	3 – 6 Days/year	>6 days / year
Extreme Heat	Number of days with heat index > 35°C (Mean)	World Bank Climate Change Knowledge Portal	<5 days/season	5 – 15 Days/season	>15 days / season
Drought	Standardised Drought Index	SPEI Database	> -1.0	-1.0 to -1.5	< -1.5

Data sources are detailed in Annex N2.

2.3. Current Hazard Levels and Climate Projections

The assessment of climate hazard levels for Ruiru Municipality is informed by future climate projections and complemented by historical climate observations. From the sources mentioned earlier, they provide downscaled climate model outputs that help evaluate how climate

conditions may evolve over time and how they may influence the intensity and frequency of key climate hazards affecting the municipality.

The analysis considered two future climate scenarios: SSP2-4.5, which represents a moderate emissions pathway where greenhouse gas emissions gradually stabilize through mitigation efforts, and SSP5-8.5, which represents a high-emissions pathway characterized by rapid economic growth, increased energy demand, and continued reliance on fossil fuels. Considering both scenarios allows planners to understand a range of possible future climate conditions and better anticipate potential risks to urban systems and infrastructure.

Climate projections indicate that Ruiru Municipality in Kiambu County, within the Nairobi Metropolitan Region, is likely to experience increasing temperatures, more intense rainfall events, and greater variability in precipitation patterns over time. These projected trends align with recent observations from the Kenya Meteorological Department, which indicate an increasing frequency of extreme weather events in central Kenya, including heavy rainfall events and prolonged dry spells.

Under the SSP2-4.5 scenario, temperatures are projected to increase gradually throughout the century, with average temperature increases estimated at approximately 1.5–2.5°C by 2100. Although this pathway assumes some level of global mitigation, warming is still expected to intensify heat stress, particularly in built-up urban areas where dense infrastructure and limited vegetation contribute to localized urban heat island effects. Rainfall patterns are also projected to become more variable, with increased rainfall intensity during the long rains (March–May) and short rains (October–December) seasons. These changes may elevate the risk of pluvial flooding, especially in rapidly urbanizing areas where impervious surfaces such as roads, rooftops, and paved areas reduce natural infiltration and place additional pressure on stormwater drainage systems.

Under the SSP5-8.5 scenario, the projected impacts are more severe. Average temperatures could rise by more than 3–4°C by the end of the century, significantly increasing the frequency and intensity of extreme heat events. Such temperature increases are likely to exacerbate heat stress, particularly in densely populated neighbourhoods with limited green spaces and high building density. Higher temperatures may also accelerate evaporation and evapotranspiration rates, contributing to water stress and drought conditions, particularly during extended dry periods.

In addition to rising temperatures, rainfall under the SSP5-8.5 scenario is projected to become more erratic and intense. Short-duration, high-intensity rainfall events may become more frequent, increasing the likelihood of flash flooding and urban flooding in low-lying areas and locations with inadequate drainage infrastructure. These intense rainfall events can also contribute to soil erosion, infrastructure damage, and disruptions to transport and service delivery systems.

Overall, the climate projections indicate that heat stress, pluvial flooding, and drought or water stress—the key hazards identified for Ruiru Municipality—are likely to intensify in the future under both scenarios, with significantly higher risks under the SSP5-8.5 pathway. Understanding these projected hazard levels is therefore critical for informing climate-resilient urban planning, infrastructure investment, and disaster risk management strategies within the municipality.

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

Interpretation of hazard levels:

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

This table now clearly focuses on the three priority hazards for Ruiru Municipality and shows how their severity is projected to increase over time, especially under the SSP5-8.5 high-emission scenario, reinforcing the need for targeted climate adaptation measures.

2.4. CURRENT AND FUTURE HAZARD IMPACT AREAS

This section identifies the areas within Ruiru Municipality currently affected by, and projected to be at risk from, pluvial flooding, extreme heat, and drought. The assessment combines historical observations, local knowledge from ward-level participatory consultations, and climate projections (SSP2-4.5 and SSP5-8.5) from the World Bank Climate Change Knowledge Portal and Kenya Meteorological Department.

1. Pluvial (Urban/Flash) Flooding

Current Impact Areas:

- Biashara and Gitothua wards: Parts of Ruiru Town CBD, Ruiru foot bridge and Ruiru stadium – frequently experience surface water accumulation during heavy rainfall, poor drainage and impervious surfaces.
- Residential estates along Ruiru Githunguri Road and Eastern By pass – Informal and planned settlements such as Ukombozi, Mhasibu and parts of Gatongora are affected by flash flooding due to inadequate drainage.
- Riparian zones and low-lying areas along riverbeds and streams – Settlements near Ruiru River experience temporary waterlogging during heavy rainfall events.

Future Impact Areas (2050–2100):

- Flood-prone areas above will see increased frequency and intensity of flooding under both SSP2-4.5 and SSP5-8.5 scenarios.

- Expansion of urban residential and commercial areas along Thika Superhighway and side roads may create new hotspots due to encroachment on natural drainage channels.
- Low-lying neighborhoods lacking stormwater infrastructure are expected to experience longer-duration flooding and higher risk to property and mobility.

2. Extreme Heat

Current Impact Areas:

- Dense residential areas and town center – High building density, asphalt roads, and limited vegetation contribute to urban heat islands.
- Industrial zone as well as commercial zones along Thika Superhighway – Warehouses, factories, and large parking areas amplify heat retention.

Future Impact Areas (2050–2100):

- Extreme heat will intensify across the entire municipality, with the greatest impacts in highly urbanized areas under SSP5-8.5.
- Newly developed residential estates with minimal green cover will experience elevated temperatures.
- Public spaces and markets without shade or green buffers will become more vulnerable to heat stress events, particularly affecting vulnerable populations such as children, elderly, and outdoor workers.

3. Drought / Prolonged Dry Spells

Current Impact Areas:

- Gitothua and Gatong'ora Wards – Small-scale farms and horticultural plots already face water shortages during dry months.
- Water supply-sensitive neighborhoods – Areas relying on municipal or borehole water are vulnerable during periods of low rainfall. Water rationing done

Future Impact Areas (2050–2100):

- Drought conditions are projected to intensify and last longer under SSP5-8.5, affecting both residential water availability and peri-urban agriculture.
- Expansion of residential and industrial zones increases water demand, exacerbating stress on municipal supply systems.
- Areas without reliable water infrastructure will experience heightened vulnerability, particularly informal settlements.

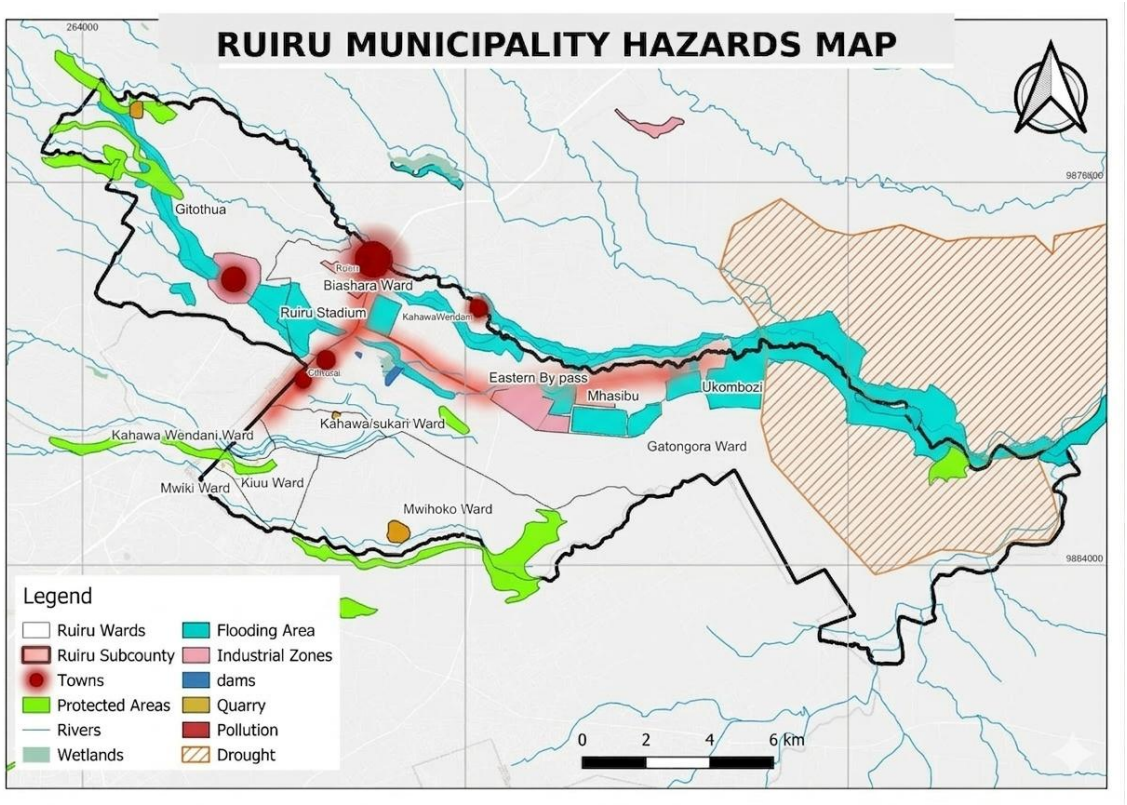

Figure 4: Maps showing the spatial extent, frequency, severity, and overlap of current and future key hazards

3. EXPOSURE & VULNERABILITY ASSESSMENT

The exposure and vulnerability assessment examines how key urban elements in Ruiru Municipality may be affected by the identified climate hazards—pluvial flooding, extreme heat, and drought. Exposure refers to the presence of people, infrastructure, services, and economic activities in areas that could be adversely affected by climate hazards. Vulnerability refers to the degree to which these elements are susceptible to harm due to their sensitivity and their capacity to cope with or adapt to climate impacts.

The assessment considers major urban systems including infrastructure and services, human settlements, economic activities, environmental assets, and vulnerable populations. Given the rapid urbanization occurring within Ruiru, many urban elements are increasingly exposed to climate hazards due to expansion into flood-prone areas, growing infrastructure demand, and environmental pressures associated with urban growth

3.1 URBAN ELEMENTS

TABLE 3. URBAN ELEMENTS INVENTORY

Category	Subcategory	Included in RCRA (Y/N)	Available in GIS (Y/N)	Description
Infrastructure & Services				
Stormwater Drainage	Stormwater conveyance network	Y	N	Many drainage systems are undersized, poorly maintained, or blocked by solid waste, reducing their ability to handle heavy rainfall.
	Stormwater storage	N	N	No storage
Water & Wastewater Mgmt	Pumping stations	N	Y	At the Water Company
	Groundwater abstraction	Y	Y	RUJUWASCO boreholes
	Water treatment facilities	Y	Y	2 Water Treatment Plants managed by RUJUWASCO
	Water supply networks	Y	Y	Piped system coverage ~98%; intermittent supply.
	Sewer networks	Y	Y	Across all the three wards
	Wastewater treatment facilities	Y	Y	Kibendera Waste Water Treatment Plant
Solid Waste Management	Transfer facilities	Y	N	None

	Landfills and dump sites	Y	N	Only existence of illegal dump sites
	Recycling centers	Y	N	Informal sector operating as sorting sites
	Collection fleet	Y	Y	1 Tipper truck, 1 Skip loader and 1 backhoe
Transport and Mobility	Road networks	Y	Y	Poor drainage design and increased impervious surfaces increase flood susceptibility and road deterioration.
	Bridges	N	N (Partially)	Gwa Kairu Bridge, Ruiru – Mugutha Bridge, Foot bridge at Ruiru Bus Stop along Thika Super Highway
	Public transport networks	Y	Y	Railway network
	Transportation terminals	Y	Y	Ruiru Town bus park
	Non-motorised transport	Y	Y	Foot paths within CBD and along Thika Super Highway
Energy	Poles and power lines	Y	Y	Kenya Power network; frequent outages during storms.
	Transformers and substations	Y	Y	Ruiru Power Plant
	Streetlighting	Y	Y	Solar and grid-powered; mostly across all wards
Economic Infrastructure	Markets	Y	Y	Ruiru Market and several other local markets
	Businesses and commercial hubs	Y	N	Many commercial areas lack adequate drainage and shading, making them vulnerable to both flooding and heat stress
	Industrial zones	Y	Y	Large paved surfaces increase heat retention and reduce infiltration, increasing vulnerability to both heat stress and urban flooding.
Social Infrastructure	Government buildings	Y	Y	SHA Offices, Railway Offices, Ruiru Municipality Office, NGAO Office

	Education facilities	Y	Y	16 ECDE, 16 primary, 16 secondary, 1 vocational centre
	Healthcare facilities	Y	Y	Ruiru Level 4 Hospital, Mutonya dispensary Level 2, Githunguri Health centre Level 3
	Public spaces	Y	Y	Ruiru Stadium, Ruiru Green Park
	Faith-based buildings	N	N	Numerous churches.
Emergency Services	Fire stations	Y	Y	1 fire station
	Police stations	Y	Y	Police stations and police posts
	Early warning systems	N	N	None.
	Disaster management centers	N	N	None; rely on Kiambu County.
Populations				
Urban Residents	Population	Y	Y	490,120 (2019 census)
	Households	Y	Y	129,470 households; average size 2.9
Informal Settlement Residents	Population in informal settlements	Y	N	Fort Jesus -12,500
	Households lacking land tenure	Y	N	-
	Households lacking basic services	Y	N	Limited water, sewer, waste collection.
Vulnerable & Marginalized	Low-income households	Y	N	~25% of households below poverty line.
	Women-headed households	Y	N	Estimated about 33% of households
	Children and youth	Y	Y	<18 years: 45% of population.
	Elderly persons	Y	N	>65 years: 5% of population.
	People with disabilities (PWD)	Y	N	~5% of population (estimated).
	Unemployed youth	Y	N	30% unemployment rate.

	Seasonal workers	Y	N	Construction labour, Factory workers
Natural Assets				
Urban Green Infrastructure	Urban parks and gardens	Y	Y	Ruiru Nord Mall Park, several private gardens
	Green corridors	N	N	Within Ruiru CBD
	Urban forests	Y	N	No forests
Urban Blue Infrastructure	Natural wetlands	Y	N	-
	Rivers	Y	Y	Ruiru
	Riparian zones	Y	N	Encroached, poorly mapped.
	Lakes/ponds	Y	Y	Tatu dam
Peri-urban & Agricultural	Peri-urban agriculture	Y	N	Vegetables, dairy, poultry
Systems	Agroforestry	Y	N	Scattered on farms.
	Forests and reserves	Y	N	-

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

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

TABLE 4. INTERPRETATION OF EXPOSURE AND VULNERABILITY LEVELS

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

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

TABLE 5. IMPACT MATRIX

	Vulnerability Level

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

TABLE 6. EXPOSURE, VULNERABILITY, AND IMPACTS OF PLUVIAL FLOODING ON URBAN ELEMENTS

Hazard: Pluvial Flooding

Category	Exposure (Description)	Exposure Level	Vulnerability (Sensitivity / Adaptive Capacity)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	Sections of the municipality have limited stormwater infrastructure	**High**	**Sensitivity:** Existing drains are shallow or poorly maintained and easily blocked by debris and waste. **Adaptive Capacity:** Limited investment in modern drainage systems and poor protection of drainage corridors.	**High**	**Catastrophic**
Water & Wastewater Management	Water pipelines and underground utilities are located within flood-prone road reserves and drainage corridors.	**High**	**Sensitivity:** Floodwater infiltration can damage pipes and disrupt supply. **Adaptive Capacity:** Limited redundancy in water distribution infrastructure.	**Medium**	**Major**
Solid Waste Management	Informal dumps along the roads and streets	**High**	**Sensitivity:** Unlined dumpsites; Waste blocks drains increasing runoff; hazardous leachate. **Adaptive Capacity:** Low – no flood-proofing, irregular collection.	**High**	**Catastrophic**
Transport and Mobility	Major roads and access streets in low-lying estates and the town centre experience water accumulation during intense rainfall events.	**High**	**Sensitivity:** Poor road drainage and silted culverts cause water to pond on road surfaces. **Adaptive Capacity:** Limited routine maintenance and insufficient stormwater channels along	**High**	**Catastrophic**

			roads, no climate-proof design standards		
Energy	Transformer stations at ground level in estates, Pole infrastructure exposed; overhead lines vulnerable to falling trees during storms.	**Medium**	**Sensitivity:** Poles not flood-resistant; undergrounding absent. **Adaptive Capacity:** Medium – Kenya Power replaces poles after events.	**Medium**	**Moderate**
Economic Infrastructure	Businesses established in low-lying blocks	**High**	**Sensitivity:** CBD drainage poor ; goods stored at floor level, Damage to goods & stock, Lost income during closures **Adaptive Capacity:** No insurance, Limited business continuity planning	**High**	**Catastrophic**
Social Infrastructure	Access roads to some dispensaries floods, and flooding in some schools	**High**	**Sensitivity:** Interruption of services **Adaptive Capacity:** Low – no flood retrofitting.	**High**	**Catastrophic**
Emergency Services	No dedicated disaster centre.	**Medium**	**Sensitivity:** No backup generator at fire station, slower response times **Adaptive Capacity:** Low – no early warning, emergency protocols exist, resource constraints	**High**	**Major**
Populations					
Urban Residents	Residential zones in low lying areas have poor drainage	**High**	**Sensitivity:** Low awareness; children play in floodwater. **Adaptive Capacity:** Low – few households have flood insurance; no relocation assistance, uneven coping resources	**High**	**Catastrophic**
Informal Settlement Residents	Settlements such as Fort Jesus and Gitambaya have high population densities and limited drainage infrastructure, increasing exposure to pluvial flooding.	**High**	**Sensitivity:** Poor waste management leads to blockage of drainage channels, worsening flooding, inadequate coverage **Adaptive Capacity:** Limited access to formal stormwater systems and	**High**	**Catastrophic**

			municipal services, Lack of formal land tenure discourages investment in resilient infrastructure.		
Vulnerable & Marginalized Groups	Elderly, PWDs, and children disproportionately affected; mobility constraints, low income households	**High**	**Sensitivity:** Reduced mobility; chronic illnesses worsened by damp. **Adaptive Capacity:** Low – limited social protection.	**High**	**Catastrophic**
Natural Assets					
Urban Green Infrastructure	The Parks and gardens may experience waterlogging; trees uprooted	**Medium**	**Sensitivity:** Shallow-rooted exotic species, Soil compaction reduces absorption **Adaptive Capacity:** Replanting or mainatenance after events	**Medium**	**Moderate**
Urban Blue Infrastructure	Rapid urban expansion and increasing impervious surfaces increase the volume of runoff entering Ruiru River during intense rainfall events.	**High**	**Sensitivity:** Solid waste dumping and sedimentation reduce water conveyance capacity, Channel modification and loss of riparian vegetation increase erosion and overflow risk.. **Adaptive Capacity:** Limited protection and restoration of riparian buffers, Inadequate integration of blue-green infrastructure in urban planning and stormwater management.	**High**	**Catastrophic**
Peri-urban & Agricultural Systems	Peri-urban areas within the municipality still support small-scale agriculture, including horticulture, dairy farming, and mixed cropping. Farms located in low-lying areas and along drainage channels or near watercourses such as Ruiru River are exposed to runoff	**High**	**Sensitivity:** Agricultural fields are susceptible to waterlogging and soil erosion during heavy rainfall. **Adaptive Capacity:** Small-scale farmers often have limited resources to implement flood control measures such as drainage improvements or soil conservation practices, Rapid	**Medium**	**Major**

	accumulation during intense rainfall events.		conversion of agricultural land to urban uses reduces natural water infiltration areas.		

TABLE 7. EXPOSURE, VULNERABILITY, AND IMPACTS OF EXTREME HEAT ON URBAN ELEMENTS

Hazard: Extreme Heat

Category	Exposure (Description)	Exposure Level	Vulnerability (Sensitivity / Adaptive Capacity)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	Limited drainage infrastructure can worsen urban heat by reducing evaporative cooling; impervious surfaces increase heat retention.	**High**	**Sensitivity:** Shallow or blocked drains retain heat; concrete and asphalt surfaces absorb heat. **Adaptive Capacity:** Minimal cooling infrastructure or shaded areas; little investment in heat-resilient urban design.	**High**	**Major**
Water & Wastewater Management	Water supply systems are exposed to heat stress; high temperatures can affect storage and distribution.	**High**	**Sensitivity:** Pipes and reservoirs exposed to sun; water loss through evaporation. **Adaptive Capacity:** Limited alternative water sources; intermittent supply reduces resilience during heatwaves.	**High**	**Major**
Solid Waste Management	Open dumps, especially in informal areas, exacerbate heat due to decomposition, releasing odors and methane.	**High**	**Sensitivity:** Waste piles increase ambient temperature and attract pests. **Adaptive Capacity:** Irregular collection and lack of waste containment	**High**	**Major**
Transport and Mobility	Roads, Railway and transport hubs exposed to direct sunlight; urban heat	**High**	**Sensitivity:** Asphalt heats quickly; minimal shaded bus stops	**High**	**Major**

	increases discomfort and heat-related risks for commuters.		**Adaptive Capacity:** No heat shelters or green corridors; limited cooling interventions.		
Energy	High electricity demand for cooling (fans, ACs) stresses the grid; transformer stations exposed to high ambient heat.	**Medium**	**Sensitivity:** Overloaded transformers; poles and substations vulnerable to thermal expansion. **Adaptive Capacity:** Kenya Power maintenance limited; few community-level cooling solutions.	**High**	**Major**
Economic Infrastructure	Businesses, especially those in metal/roofed structures or unshaded areas, experience high indoor temperatures.	**High**	**Sensitivity:** Heat reduces worker productivity and damages heat-sensitive goods. **Adaptive Capacity:** Limited use of insulation or passive cooling; few businesses have contingency plans.	**High**	**Major**
Social Infrastructure	Schools, health facilities, and community centers exposed to high ambient heat, affecting learning and service delivery.	**High**	**Sensitivity:** Poorly ventilated classrooms; outdoor activities increase heat stress. **Adaptive Capacity:** Limited access to cooling or shaded areas; insufficient heat-health awareness programs.	**High**	**Catastrophic**
Emergency Services	Emergency services may be impacted by heat stress, reducing response efficiency during prolonged heatwaves.	**Medium**	**Sensitivity:** Personnel vulnerable to heat-related illness; vehicles and equipment may overheat. **Adaptive Capacity:** Limited heat adaptation protocols, hydration, and shaded rest areas.	**Medium**	**Moderate**
Populations					
Urban Residents	Residential zones with limited tree cover, reflective roofing, or ventilation experience high indoor and outdoor temperatures.	**High**	**Sensitivity:** Elderly, children, and people with chronic illnesses are highly sensitive. **Adaptive Capacity:** Few households	**High**	**Catastrophic**

			have cooling devices; poor building design for thermal comfort.		
Informal Settlement Residents	Settlements such as Fort Jesus and Gitambaya experience extreme heat due to dense housing, metal roofs, and lack of shade.	**High**	**Sensitivity:** Overcrowding, poor ventilation, and heat-absorbing materials increase risk of heatstroke. **Adaptive Capacity:** Limited access to water, shade, and cooling devices; low-income residents cannot afford cooling solutions.	**High**	**Catastrophic**
Vulnerable & Marginalized Groups	Elderly, PWDs, and children disproportionately affected; mobility constraints, low income households	**High**	**Sensitivity:** Reduced thermoregulation, chronic illnesses exacerbated.. **Adaptive Capacity:** Limited social protection, awareness, and community cooling initiatives.	**High**	**Catastrophic**
Natural Assets					
Urban Green Infrastructure	Parks, gardens, and street trees provide cooling, but coverage is limited in densely built areas.	**Medium**	**Sensitivity:** Elderly, children, and people with chronic illnesses are highly sensitive. **Adaptive Capacity:** Replanting or mainatenance after events	**Medium**	**Moderate**
Urban Blue Infrastructure	Rivers, drainage channels, and wetlands can provide localized cooling through evaporation.	**High**	**Sensitivity:** Encroachment, pollution, and reduced water volumes limit cooling potential. **Adaptive Capacity:** Limited integration of blue infrastructure into urban heat mitigation strategies.	**Medium**	**Moderate**
Peri-urban & Agricultural Systems	Farms and peri-urban green spaces may buffer heat locally, but are increasingly under urban expansion.	**High**	**Sensitivity:** Reduced vegetation cover and irrigation-dependent crops stressed by heat. **Adaptive Capacity:** Limited adaptation measures; small-scale	**Medium**	**Major**

			farmers may lack irrigation or shade structures.		

TABLE 8. EXPOSURE, VULNERABILITY, AND IMPACTS OF DROUGHT ON URBAN ELEMENTS

Hazard: Drought

Category	Exposure (Description)	Exposure Level	Vulnerability (Sensitivity / Adaptive Capacity)	Vulnerability Level	Impact Level
Infrastructure & Services					
Water & Wastewater Management	Water supply pipelines, reservoirs, and boreholes are exposed to reduced inflows and drying during drought periods.	**High**	**Sensitivity:** Limited water storage and high reliance on surface and shallow groundwater. **Adaptive Capacity:** Low redundancy; intermittent supply; limited alternative sources.	**High**	**Catastrophic**
Solid Waste Management	Informal dumps and collection systems rely on water for waste management; dry conditions increase dust and decomposition issues.	**Medium**	**Sensitivity:** Dust exposure and accumulation of dry waste can cause health hazards. **Adaptive Capacity:** Fire response available	**Medium**	**Moderate**
Energy	Hydropower and small-scale solar/water-dependent energy systems exposed to reduced water availability; transformer equipment affected by high ambient temperatures during drought.	**Medium**	**Sensitivity:** Energy demand increases for pumping water and cooling. **Adaptive Capacity:** Limited alternative energy supply or backup systems.	**Medium**	**Moderate**
Transport and Mobility	Road surfaces may crack under prolonged dry heat; lack of vegetation increases dust and visibility issues.	**High**	**Sensitivity:** Softening of asphalt, Expansion joints stress, Worker heat stress **Adaptive Capacity:** Road design not heat-adapted, Limited shading	**High**	**Major**

Social Infrastructure	Schools, health facilities, and community centers may face water shortages, affecting sanitation and service delivery.	**High**	**Sensitivity:** Poor water storage, reliance on municipal supply. **Adaptive Capacity:** Limited water-saving technologies or emergency water supply plans.	**High**	**Major**
Emergency Services	Firefighting and medical emergency services are stressed due to water scarcity.	**Low**	**Sensitivity:** Limited water for firefighting; high fire risk in dry conditions. **Adaptive Capacity:** Limited heat early-warning systems, Health staff trained but resources limited	**High**	**Major**
Populations					
Urban Residents	Residents in low-income and densely populated areas face water rationing, high costs, and sanitation challenges.	**High**	**Sensitivity:** Limited household water storage, health risks from reduced hygiene. **Adaptive Capacity:** Low-income residents cannot afford alternative water sources.	**High**	**Catastrophic**
Informal Settlement Residents	Settlements such as Fort Jesus and Gitambaya experience acute water shortages, limited access to municipal supply, and poor sanitation.	**High**	**Sensitivity:** High population density increases per capita water stress. **Adaptive Capacity:** Lack of formal water connections, inability to purchase water from private vendors consistently.	**High**	**Catastrophic**
Vulnerable & Marginalized Groups	Elderly, PWDs, women, children, and low-income households disproportionately affected.	**High**	**Sensitivity:** Increased susceptibility to dehydration, heat stress, and waterborne diseases. **Adaptive Capacity:** Limited social support and relief programs.	**High**	**Catastrophic**
Natural Assets					

Urban Green Infrastructure	Parks, gardens, and street trees suffer from water scarcity, reducing their cooling and ecosystem services.	**Medium**	**Sensitivity:** Trees and vegetation die-off; reduced shade and carbon sequestration.**Adaptive Capacity:** Protective covers	**Medium**	**Major**
Urban Blue Infrastructure	Rivers, drainage channels, and wetlands experience low water levels, reducing cooling, groundwater recharge, and aquatic habitat health.	**High**	**Sensitivity:** Reduced flow in Ruiru River and streams; water quality declines. **Adaptive Capacity:** Limited water allocation and conservation measures in urban planning.	**High**	**Major**
Peri-urban & Agricultural Systems	Small-scale farms and peri-urban agriculture face soil moisture deficits, crop failure, and livestock stress.	**High**	**Sensitivity:** Rain-fed agriculture is highly sensitive to reduced rainfall. **Adaptive Capacity:** Limited irrigation, water storage, or drought-resistant crops; conversion to urban land reduces natural resilience.	**High**	**Catastrophic**

4. CLIMATE RISK ASSESSMENT

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

TABLE 9. RISK MATRIX

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

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

TABLE 10. INTERPRETATION OF RISK LEVELS

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

4.1 CURRENT AND FUTURE CLIMATE RISKS ON URBAN ELEMENTS

TABLE 11. SUMMARY OF FLOODING RISKS FOR RUIRU MUNICIPALITY

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

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

TABLE 12. SUMMARY OF EXTREME RISKS FOR RUIRU MUNICIPALITY

Category	**Impact Level**	**Current Risk**	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Hazard Level		Medium	High	Very High	High	Very High
Infrastructure & Services						
Water & Wastewater Mgmt	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**

Solid Waste Management	Minor	**Low**	**Medium**	**Medium**	**Medium**	**High**
Energy	Insignificant	**Very Low**	**Low**	**Low**	**Low**	**Medium**
Economic Infrastructure	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**
Social Infrastructure	Major	**Medium**	**High**	**Very High**	**High**	**Very High**
Emergency Services	Major	**Medium**	**High**	**Very High**	**High**	**Very High**
Populations						
Urban Residents	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**
Informal Settlement Residents	Catastrophic	**High**	**Very High**	**Very High**	**Very High**	**Very High**
Vulnerable & Marginalized Groups	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**
Natural Assets						
Urban Green Infrastructure	Major	**Medium**	**High**	**Very High**	**High**	**Very High**
Urban Blue Infrastructure	Catastrophic	**High**	**High**	**Very High**	**Very High**	**Very High**
Peri-urban & Agricultural Systems	Catastrophic	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**

TABLE 13. SUMMARY OF DROUGHT RISKS FOR RUIRU MUNICIPALITY

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

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

4.2. CLIMATE RISK HOTSPOTS

Climate risks are not evenly distributed across Ruiru Municipality. The following wards face the highest multi-hazard risk due to a combination of rapid urbanization, high population density, infrastructure gaps, and environmental exposure:

- **Biashara Ward** – Highly urbanized with dense commercial and residential development. Limited drainage infrastructure and extensive impervious surfaces increase exposure to pluvial flooding and extreme heat, particularly in the central business district and market areas.

- **Gitothua Ward** – Characterized by rapidly expanding residential estates and informal settlements. Inadequate stormwater drainage, poor waste management, and high settlement density increase vulnerability to flooding, heat stress, and sanitation challenges.

- **Gitambaya Ward** – Contains dense settlements including areas such as Fort Jesus. These communities face significant exposure to pluvial flooding, extreme heat, and water scarcity, driven by limited infrastructure, informal housing structures, and constrained access to municipal services.

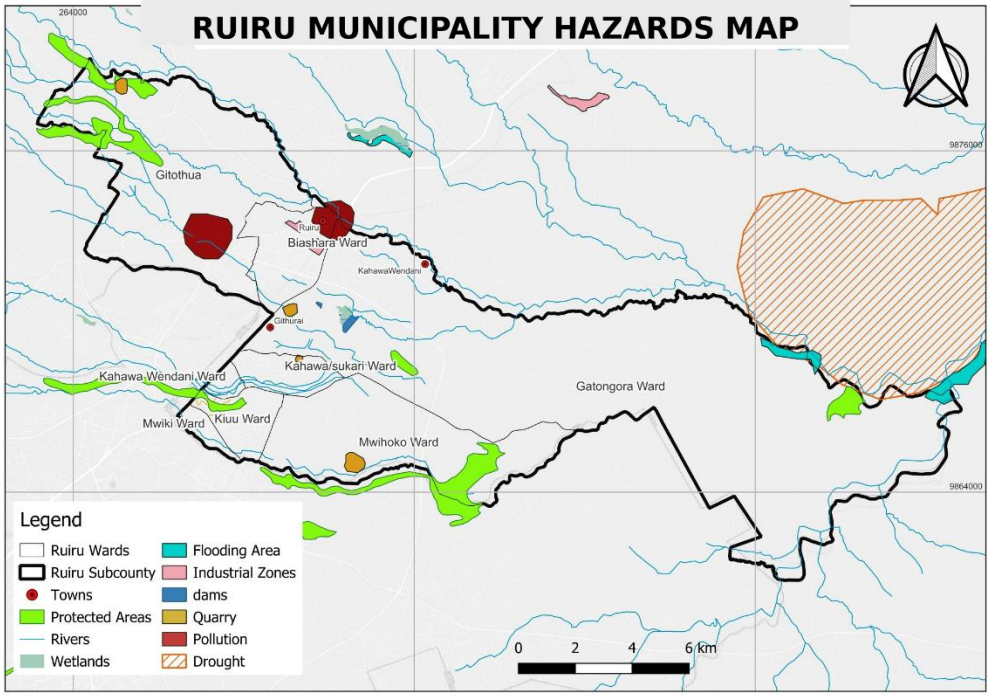

Figure 5: Climate risk hotspot map

5. WHAT'S NEXT?

5.1 KEY FINDINGS

a) Pluvial flooding is the dominant and most widespread hazard in the municipality. Heavy rainfall combined with rapid urban expansion, inadequate stormwater drainage, and increased impervious surfaces results in frequent surface runoff and localized flooding. The impacts are already significant across transport networks, drainage systems, solid waste infrastructure, commercial areas, and residential neighbourhoods, particularly in densely built urban wards. Without major improvements in drainage and land-use management, these risks are projected to remain very high and may escalate to catastrophic levels in highly exposed areas under future climate scenarios.

b) Drought presents substantial risks to water security, peri-urban agriculture, and water-dependent livelihoods. Although Ruiru is within the Nairobi Metropolitan Region, periodic dry spells already place pressure on municipal water supply systems and small-scale farming activities in peri-urban zones. Increasing population growth and urban demand are expected to intensify water scarcity, particularly during prolonged dry periods. By 2050 under high-emission scenarios, drought risks to water supply infrastructure and agricultural production could increase to very high levels.

c) Extreme heat is emerging as a growing urban climate hazard. High-density development, limited tree cover, and the widespread use of heat-absorbing materials such as corrugated metal roofing and asphalt contribute to urban heat island effects, particularly in informal settlements and commercial areas. While heat risks are currently moderate to high in certain areas, they are expected to increase gradually in the future, especially under high-emission scenarios.

5.2 MOST AT-RISK GROUPS

The following population groups are particularly vulnerable to climate hazards within Ruiru Municipality:

- Residents of informal settlements such as Fort Jesus and Gitambaya
- Elderly persons, children, and persons with disabilities
- Informal sector workers, including market traders and casual labourers
- Boda boda operators and transport workers exposed to extreme weather
- Small-scale farmers in peri-urban areas, whose livelihoods depend on rainfall and water availability

5.3KEY TRENDS LIKELY TO INTENSIFY FUTURE RISKS

Several ongoing trends are expected to amplify climate risks across the municipality:

- Rapid urbanization and densification, leading to increased impervious surfaces and reduced natural drainage capacity.
- Encroachment into riparian corridors and drainage channels, reducing the ability of natural systems to absorb and convey stormwater.
- Rising water demand driven by population growth, industrial development, and expansion of residential estates.
- Limited municipal resources for maintaining existing infrastructure and expanding climate-resilient systems such as drainage, water storage, and green infrastructure.

TABLE 14. SUMMARY OF CLIMATE RISKS AFFECTING URBAN ELEMENTS FOR RUIRU MUNICIPALITY

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

Transport and Mobility	Flooding (Very High), Heat (High)	Flooding (Very High), Heat (Very High)	Flooding (Very High), Heat (Very High)
Economic Infrastructure	Flooding (Very High), Drought (High), Heat (High)	Flooding (Very High), Drought (Very High), Heat (Very High)	Flooding (Very High), Drought (Very High), Heat (Very High)
Social Infrastructure	Flooding (High), Heat (High), Drought (Medium)	Flooding (Very High), Heat (Very High), Drought (High)	Flooding (Very High), Heat (Very High), Drought (High)
Emergency Services	Flooding (High), Heat (Medium), Drought (Medium)	Flooding (Very High), Heat (High), Drought (High)	Flooding (Very High), Heat (High), Drought (High)
Populations			
Urban Residents	Flooding (Very High), Heat (High), Drought (High)	Flooding (Very High), Heat (Very High), Drought (Very High)	Flooding (Very High), Heat (Very High), Drought (Very High)
Informal Settlement Residents	Flooding (Very High), Heat (Very High), Drought (Very High)	All three hazards (Very High)	All three hazards (Very High)
Vulnerable & Marginalized Groups	Flooding (Very High), Heat (Very High), Drought (High)	All three hazards (Very High)	All three hazards (Very High)
Natural Assets			

Urban Blue Infrastructure	Flooding (Very High), Drought (High), Heat (Medium)	Flooding (Very High), Drought (Very High), Heat (High)	Flooding (Very High), Drought (Very High), Heat (High)
Urban Green Infrastructure	Heat (High), Drought (High), Flooding (Medium)	Heat (Very High), Drought (Very High), Flooding (High)	Heat (Very High), Drought (Very High), Flooding (High)
Peri-urban & Agricultural Systems	Drought (Very High), Heat (High), Flooding (High)	Drought (Very High), Heat (Very High), Flooding (Very High)	Drought (Very High), Heat (Very High), Flooding (Very High)

5.2 Climate Adaptation and Resilience Solutions

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

TABLE 15. CLIMATE ADAPTATION AND RESILIENCE SOLUTIONS RECOMMENDED FOR RUIRU MUNICIPALITY

Category	Immediate (0-2 years)	Mid-term (3-7 years)	Long-term (8-15 years)
Infrastructure & Services			
Stormwater Drainage	• Desilt and unblock drains in Ruiru Town CBD, along Ruiru Kamiti Road • Install trash screens on storm water drains at the entry of River Ruiru • Map entire municipal drainage network in GIS	• Construct lined drains in flood hotspots (Fort Jesus, Gitambaya) • Rehabilitate wetland/lowlands as retention basin	• Implement Sustainable Urban Drainage Systems (SUDS) for all new developments • Restore riparian zones along Ruiru River
Water & Wastewater Mgmt	• Distribute 500 domestic rainwater tanks • Repair non-revenue water leaks (Rujuwasco network) • Solarise at least 5 municipal boreholes	• Expand piped water supply to underserved areas • Construct at least 2 community water pans	• Build climate-resilient centralised water treatment plant • Recycle treated effluent for urban agriculture
Solid Waste Management	• Provide 100 waste bins in flood-prone areas. •Conduct monthly clean-ups (river banks, drains). • Formalise waste pickers cooperative.	• Establish material recovery facility (MRF). • Introduce separate waste collection.	• Develop circular economy plan; zero waste to landfill. • Construct sanitary landfill for residual waste.
Transport and Mobility	• Repair flood-damaged culverts • Install flood warning signage at low points	• Climate-proof 20 km of roads (raised embankments, culverts). • Pave high-traffic murram roads.	• Integrate climate resilience into all municipal road standards • Develop non-motorised transport network.
Energy	- Trim trees near power lines. - Install 100 solar streetlights in dark spots.	- Underground power lines in flood zones. - Promote solar water heating by-law.	• Develop decentralised solar mini-grids for peri-urban areas
Economic Infrastructure	• Provide raised stalls at Juakali Market	- Encourage climate-resilient building standards in commercial and industrial	- Establish climate-smart agriculture demonstration centre.

		developments. - Improve drainage and infrastructure around markets, commercial centres, and industrial zones.	
Social Infrastructure	- Improve drainage and sanitation facilities in schools and health centres. - Establish shade and cooling areas in public institutions to reduce heat stress.	- Retrofit schools and healthcare facilities with improved ventilation, water storage, and flood-resilient infrastructure.	- Integrate climate-resilient design into all future public infrastructure developments including hospitals, schools, and community centres.
Emergency Services	-Strengthen early warning dissemination and disaster preparedness plans. -Train municipal staff and communities on emergency response to floods, heatwaves, and drought.	- Establish a municipal disaster coordination centre and strengthen emergency response capacity.	-Integrate advanced climate information systems and early warning technologies into municipal planning and disaster management.
Populations			
Urban Residents	- Support community awareness programs on flood preparedness, water conservation, and heat risk management. - Improve waste management and drainage maintenance in high-risk neighbourhoods.	- Upgrade informal settlements with improved drainage, sanitation, and access to water services. - Promote climate-resilient housing improvements.	- Implement long-term inclusive urban planning strategies that reduce settlement in high-risk areas and improve housing resilience across the municipality.
Informal Settlement Residents	- Relocate most at-risk households to safer land. - Provide basic sanitation facilities (temporary).	- Develop participatory slum upgrading plan - Secure land tenure for residents.	- In-situ upgrading with flood-proof housing and services.
Vulnerable & Marginalized Groups	- Register elderly/PWDs for social protection cash transfers.	- Establish livelihoods diversification programme - Provide grants for youth agribusiness.	- Fully inclusive climate action plan with reserved budgets.
Natural Assets			
Urban Green Infrastructure	- Protect riparian corridors and prevent waste dumping along waterways such as the Ruiru River.	- Expand urban parks, green corridors, and nature-based stormwater management systems.	- Develop an integrated green-blue infrastructure network to enhance flood regulation, urban cooling, and ecosystem services.

	- Initiate tree planting and urban greening programs.	- Restore degraded riparian zones and wetlands.	
Urban Blue Infrastructure	- Demarcate and peg riparian reserves. - Remove encroachers along Ruiru River.	- Restore 5 km of riparian zone with bamboo.	- Fully rehabilitated riparian areas
Peri-urban & Agricultural Systems	- Promote water harvesting and soil conservation practices among smallholder farmers.	- Introduce climate-smart agriculture practices and drought-resistant crops. - Improve irrigation efficiency and agricultural extension services.	- Strengthen long-term sustainable land management and protect agricultural zones to maintain food security and ecosystem resilience.

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ANNEX N1. DATA SOURCES

Page	Data	Data Source
12	Population figures, ward-wise	KNBS 2019, Kiambu CIDP 2023-2027
19	Hazard screening	PCRA Kiambu Sub-County consultations, 2023
20	Climate indicators, thresholds	KMD, World Climate Knowledge Portal
20	Current hazard levels	Kiambu County PCRA (Chapter 3)
21	Future hazard projections	Kiambu County PCRA (Chapter 4)
25	Urban elements inventory – infrastructure	Kiambu Municipal Board asset register (2024)
28	Informal settlement data	Ward administrators, PCRA community mapping
28-38	Exposure, vulnerability, impacts	PCRA community workshops, 2023; expert judgment
39	Risk levels	Derived using IPCC AR5 risk framework
42	Climate risk hotspots	PCRA hazard maps, municipal physical planning
47	Adaptation solutions	PCRA adaptation strategies (Table 4,15,16)