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KITENGELA MUNICIPALITY
Sustainable • Resilient • Prosperous

CLIMATE RISK PROFILE

FOR **KITENGELA MUNICIPALITY**

Assessing Climate Hazards, Vulnerability and Resilience Strategies

 DROUGHT  FLOODING  HEAT STRESS

PREPARED BY:
Directorate of Environment
and Natural Resources

DATE:
2025

IN PARTNERSHIP WITH:

 COUNTY GOVERNMENT OF KAJIADO  KITENGELA MUNICIPALITY

Prepared by:

The preparation of this Climate Risk Profile was undertaken through a collaborative effort by the key technical officers from Kitengela Municipality. These officers provided essential sectoral expertise, local knowledge, and technical guidance throughout the process, ensuring that the analysis reflects the municipality's context, priorities, and development realities.

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KITENGELA MUNICIPALITY.



FOREWORD

Climate change is no longer a distant environmental concern; it is a defining development challenge of our time. Across Kenya, and particularly within Kitengela Municipality, the impacts of rising temperatures, erratic rainfall patterns, prolonged droughts, flash floods, and land degradation are increasingly evident. These changes are already affecting livelihoods, straining urban infrastructure, threatening food security, and placing vulnerable communities at heightened risk, especially in rapidly growing peri-urban areas and informal settlements within Kitengela.

This Urban Climate Risk Profile provides a comprehensive assessment of the municipality's exposure, sensitivity, and adaptive capacity to key climate hazards, including heat stress, extreme precipitation, surface flooding, prolonged dry spells, and soil erosion. By combining scientific climate projections with locally sourced knowledge, drawing from community experiences, ward-level planning inputs, and sectoral assessments, this document offers an evidence-based foundation for informed decision-making in Kitengela. It identifies climate risk hotspots, highlights vulnerable populations and systems, and outlines practical adaptation and mitigation strategies tailored to the municipality's fast-growing urban and peri-urban context.

The findings underscore an important reality: while infrastructure systems face varying levels of climate risk, it is the people of Kitengela, particularly residents of informal settlements, low-income households, women, children, the elderly, and persons with disabilities, who bear the greatest vulnerability. At the same time, local livelihoods, including small-scale agriculture, livestock keeping, and natural resource-based activities, remain highly exposed to drought, flooding, and land degradation. Rapid urbanization, land subdivision, and pressure on water and sanitation services further amplify these risks.

These insights compel us to integrate climate resilience into municipal planning, infrastructure development, service delivery, and investment prioritization. This Risk Profile aligns with national and Kajiado County climate policy frameworks and supports the mainstreaming of climate action into Kitengela's municipal development agenda. It is intended to guide the Municipal Board, County Departments, Ward Climate Change Planning Committees, development partners, civil society organizations, and the private sector in implementing coordinated, inclusive, and locally led climate action.



The Municipal Board commends the technical team, community representatives, and stakeholders who contributed to the preparation of this document. Their dedication reflects our shared commitment to proactive planning, inclusive governance, and sustainable urban development in Kitengela.

As we move forward, let this Urban Climate Risk Profile serve not merely as a report, but as a living guide, informing policy, shaping investments, and strengthening partnerships. Together, we can transform climate risks into opportunities for innovation, resilience, and inclusive growth.

Let us act decisively today to build a safer, stronger, and climate-resilient Kitengela Municipality for present and future generations.



EXECUTIVE SUMMARY.

Across the world, climate change has shifted the landscape of risk for communities, especially those living in urban areas. For municipal leaders, the most effective response begins with understanding the risks facing their communities. This risk assessment process helps identify priority investments and strategies to reduce vulnerability. Well-informed and prepared communities are more resilient and recover more quickly from climate-related shocks than those that are unprepared.

Climate change poses a significant threat to Kitengela Municipality and the wider Kajiado County. Rising temperatures, erratic rainfall, and extreme weather events are increasingly affecting livelihoods and human wellbeing. Locally, these impacts are driven by rapid urbanization, land subdivision, loss of vegetation cover, poor waste management, and increased reliance on fossil fuels and unsustainable energy sources. The effects are already visible in the form of periodic flooding in low-lying and poorly drained areas, declining agricultural productivity, reduced livestock yields, damage to infrastructure, and loss of livelihoods, contributing to rising levels of urban poverty. There has also been an increase in climate-sensitive diseases such as malaria, respiratory infections, and waterborne illnesses including diarrhea, particularly in areas with inadequate water and sanitation services.

Climate mitigation and adaptation are essential to safeguard livelihoods and ecosystems from climate variability. Building resilience in Kitengela requires proactive measures such as promoting climate-smart agriculture and sustainable livestock practices, improving water resource management, and strengthening public health systems to respond to emerging and reemerging diseases. There is also a need to invest in climate-resilient infrastructure that can withstand flooding and extreme weather events, while promoting clean and sustainable energy solutions to reduce emissions and environmental degradation.

Integrating climate adaptation into municipal planning, policies, and community initiatives within Kitengela Municipality will help reduce risks, protect vulnerable populations, and support sustainable urban growth. This Risk Profile analyzes both historical and current climate conditions and uses projected future scenarios to inform climate action. It provides a basis for planning, development, and service delivery aimed at achieving a resilient, sustainable, and inclusive Kitengela Municipality.



The main objective of this Climate Risk Profile is to assess the municipality's exposure, sensitivity, and adaptive capacity to climate-related hazards in order to inform evidence-based planning, decision-making, and investment. The profile generates localized climate risk information that integrates environmental, social, and economic dimensions to guide sustainable urban development, reduce vulnerability, and enhance preparedness. The assessment focuses on identifying key climate hazards, analyzing the exposure and sensitivity of critical sectors and systems, evaluating adaptive capacity at institutional, community, and household levels, mapping climate vulnerability hotspots, and recommending priority adaptation and mitigation measures for integration into municipal planning and development initiatives.

The key hazards identified in Kitengela Municipality include hydro-meteorological hazards such as pluvial flooding and flash floods, geo-hazards such as soil erosion and land degradation, and climatological hazards such as urban droughts and heat stress. These hazards interact with existing urban challenges, increasing the overall level of risk faced by communities, infrastructure, and natural systems.

Drought presents low risk to infrastructure and services, as it mainly affects water availability rather than causing direct physical damage. However, it poses very high risk to populations, particularly residents of informal settlements and low-income households who experience water shortages, food insecurity, and increased exposure to heat. Natural systems, especially peri-urban agriculture and livestock production, face critical risk due to prolonged dry periods that reduce yields and degrade land, undermining food security and livelihoods.

Flooding presents severe risk to infrastructure and services, particularly in areas with inadequate or poorly maintained drainage systems. Roads, stormwater infrastructure, and sanitation systems are frequently affected, leading to service disruptions and unsafe conditions. Populations living in low-lying areas and informal settlements face high risk due to poor housing and limited drainage, while natural systems show mixed impacts, with agricultural areas highly affected by flood damage and some green spaces providing limited buffering capacity.

Extreme rainfall events create critical risk by overwhelming drainage systems and disrupting transport networks. Flash floods damage homes, displace households, and threaten public safety, particularly in densely populated and poorly serviced areas. Peri-urban farming systems are also highly vulnerable to sudden waterlogging and soil erosion, which reduce productivity and damage soils.



Heat stress poses moderate risk to infrastructure but very high risk to populations. Urban residents, especially those in densely populated areas with limited access to water and cooling, are highly exposed to heat-related health impacts such as dehydration and heat stress. Water supply systems are also strained due to increased demand, while agricultural systems experience severe impacts, including reduced crop yields and livestock productivity.

Storms and high winds present high risk to infrastructure, particularly affecting transport systems, water supply, and drainage. While the overall risk to populations is moderate, vulnerable groups face greater exposure due to weaker housing and limited capacity to cope with extreme weather. Agricultural systems are highly affected, with crops damaged and soils eroded during storm events.

Across all hazards, informal settlements and low-income communities in Kitengela experience the highest levels of risk. Infrastructure systems tend to be more vulnerable during floods and storms, while populations and livelihoods face consistently high risk across all hazards. Periurban agriculture and livestock systems are particularly vulnerable due to their dependence on climate-sensitive resources. Rapid and often unplanned urban growth continues to increase exposure and vulnerability, making climate risk a growing concern for the municipality.

To address these challenges, priority actions include investing in resilient infrastructure such as improved stormwater drainage, upgraded roads, and reliable water supply systems, as well as protecting and restoring natural systems such as wetlands, riparian areas, and green spaces to enhance flood control and reduce heat stress. There is a need to prioritize informal settlements and vulnerable populations through inclusive adaptation planning, improved service delivery, and access to early warning systems. Promoting climate-smart agriculture and sustainable livestock practices, alongside strengthening institutional capacity, governance, and coordination, will be critical in supporting effective climate action.

By implementing these measures, Kitengela Municipality can reduce climate risks, protect livelihoods, and build a more resilient, sustainable, and inclusive urban future.



Table 1. Summary of Hazard 1 (Extreme Heat) risks for The Municipality of for Kitengela Municipality

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

Table 1: Summary of Hazard 2 (Changes in Precipitation Patterns) risks for the Kitengela Municipality.

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



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

Table 2: Summary of Hazard 3 (Fluvial Flooding) risks for The Kitengila Municipality.

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

Table 3: Summary of Hazard 4 (Drought) risks for The Kitengila Municipality.

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

Table 4: Summary of Hazard 5 (Wildfires & Bushfires) risks for The Kitengila Municipality

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



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

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List of Acronyms

Acronym	Full Meaning	Relevance to Climate Risk Profile
ASAL	Arid and Semi-Arid Lands	Areas highly vulnerable to drought and climate variability in Kenya
ARC	African Risk Capacity	Provides climate risk insurance mechanisms for African countries
ARV	Africa RiskView	Tool for monitoring drought and risk modelling
AU	African Union	Regional body supporting climate resilience initiatives
CAT DDO	Catastrophe Deferred Drawdown Option	Financial instrument for disaster response
CIDP	County Integrated Development Plan	Key county planning document integrating climate actions
CRA	Climate Risk Assessment	Process of identifying climate hazards, exposure, and vulnerability
CRM	Climate Risk Management	Integrated approach to managing climate-related risks
CRI	Climate Risk Insurance	Financial protection against climate shocks
DRR	Disaster Risk Reduction	Strategies to minimize vulnerabilities and disaster impacts
DRM	Disaster Risk Management	Broader framework including preparedness, response, and recovery
EDE	Ending Drought Emergencies	Kenya's strategy to build drought resilience
FLLoCA	Financing Locally Led Climate Action	Programme supporting county-level climate action
GEF	Global Environment Facility	Funding mechanism for environmental and climate projects
GoK	Government of Kenya	National authority for policy and regulatory frameworks
INFORM	Index for Risk Management	Tool for assessing disaster and climate risks
ITCZ	Inter-Tropical Convergence Zone	Influences rainfall patterns in Kenya
KALRO	Kenya Agricultural & Livestock Research Organization	Research on climate-resilient agriculture
KEFRI	Kenya Forestry Research Institute	Climate-related forestry research
KFS	Kenya Forest Service	Forest conservation and climate mitigation
KMD	Kenya Meteorological Department	Provides weather and climate data



KNBS	Kenya National Bureau of Statistics	Supplies socio-economic and demographic data
NAP	National Adaptation Plan	Framework guiding climate adaptation in Kenya
NCCAP	National Climate Change Action Plan	National climate action implementation plan
NCCRS	National Climate Change Response Strategy	Kenya's overarching climate policy
NDC	Nationally Determined Contributions	Kenya's commitments under the Paris Agreement
NDMA	National Drought Management Authority	Leads drought risk management in Kenya
NDMU	National Disaster Management Unit	Coordinates disaster response
NDOC	National Disaster Operations Centre	Emergency coordination center
NDRFS	National Disaster Risk Financing Strategy	Framework for financing disaster risk
NEMA	National Environment Management Authority	Environmental regulation and compliance
NGO	Non-Governmental Organization	Supports community climate resilience initiatives
PPP	Public Private Partnership	Collaboration model for climate investments
SDGs	Sustainable Development Goals	Global goals linked to climate resilience
SFDRR	Sendai Framework for Disaster Risk Reduction	Global disaster risk reduction framework
SPI	Standard Precipitation Index	Indicator for drought monitoring
VCI	Vegetation Condition Index	Measures drought severity using vegetation data
WFP	World Food Programme	Supports food security during climate shocks
WMO	World Meteorological Organization	Global climate and weather coordination body



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1. Context

1.1. Objective

The main objective of this Climate Risk Profile is to assess Kitengela Municipality's exposure, sensitivity, and adaptive capacity to climate-related hazards in order to inform evidence-based planning, decision-making, and investment. The profile aims to generate localized climate risk information that integrates environmental, social, and economic dimensions to guide sustainable urban development, reduce vulnerability, and enhance preparedness.

Specifically, the profile seeks to identify and characterize key climate hazards affecting Kitengela Municipality, analyze the exposure and sensitivity of critical sectors and systems, assess adaptive capacity at institutional, community, and household levels, map climate vulnerability hotspots, and recommend priority adaptation and mitigation measures for integration into municipal planning and development initiatives.

1.2. Urban Context

1.2.1. Geographic area

Kitengela Municipality is located within Kajiado County in southern Kenya, forming part of the rapidly growing Nairobi Metropolitan Region. The municipality has experienced significant population growth and urban expansion due to its proximity to Nairobi City and its role as a residential, commercial, and industrial hub. Kitengela's strategic location along major transport corridors, including the Nairobi–Namanga highway, has further accelerated development and land use changes.

The municipality encompasses a mix of urban, peri-urban, and rural landscapes, including residential estates, informal settlements, commercial centers, and agricultural and pastoral areas. This diversity of land uses contributes to both economic opportunities and increased exposure to climate risks. Rapid land subdivision, conversion of agricultural land to urban use, and encroachment into environmentally sensitive areas such as wetlands and drainage corridors have heightened vulnerability to flooding, water scarcity, and land degradation.



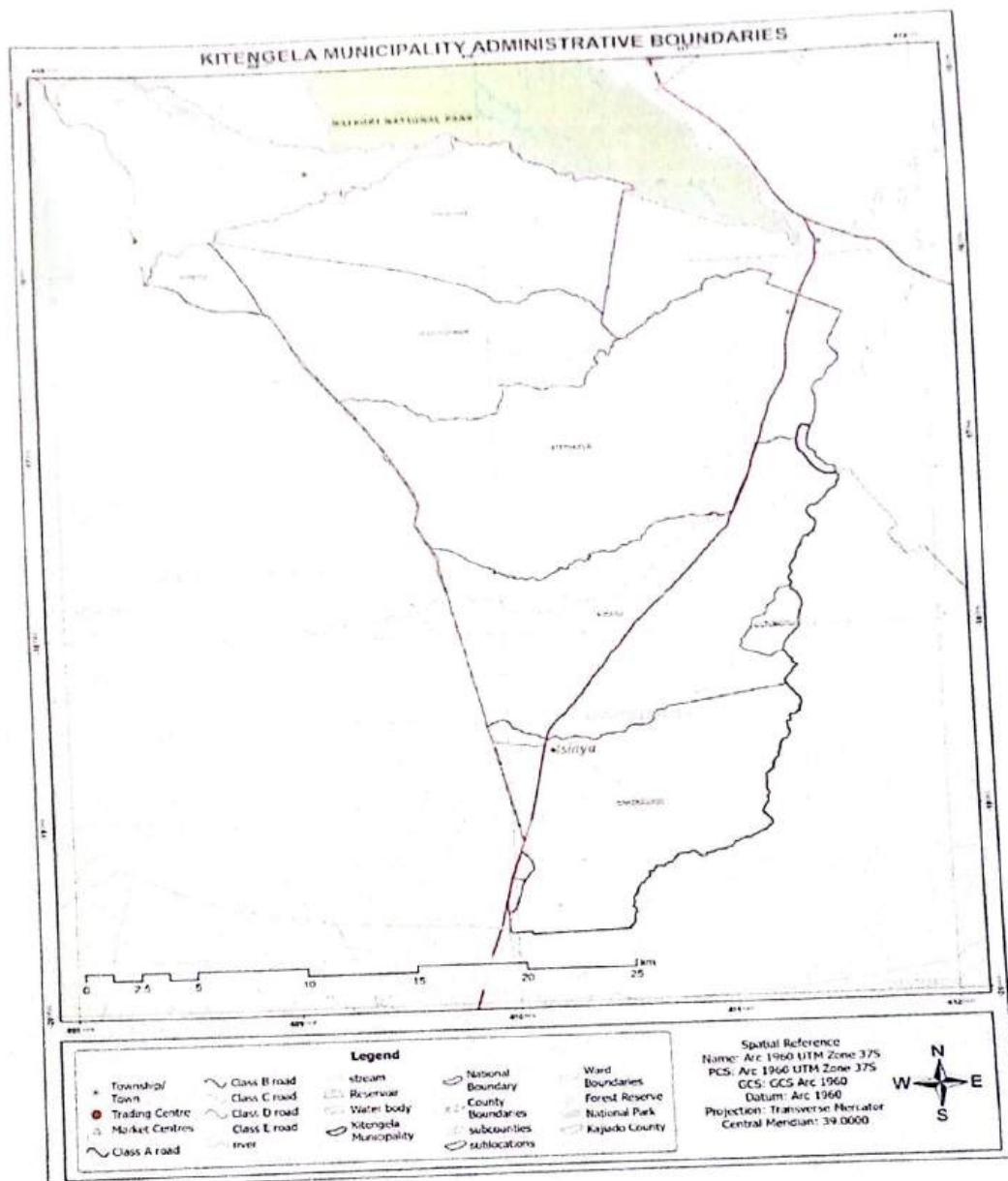


Figure 1: Boundary Map.

Kitengela's climate is characterized by semi-arid conditions, with bimodal rainfall patterns and frequent dry spells. These conditions, combined with increasing climate variability, place pressure on water resources, agriculture, and urban infrastructure. As the municipality continues to grow, there is a critical need to integrate climate resilience into urban planning and development to ensure sustainable and inclusive growth.

In terms of location, Kitengela Municipality lies along the A104 corridor, specifically the Nairobi-Namanga Highway, which serves as a major transport and economic artery within



Kajiado County and the wider Nairobi Metropolitan Region. This corridor connects Kitengela directly to Nairobi, Kenya's capital and largest city, as well as to Namanga at the Kenya-Tanzania border, making it a key route for both domestic and cross-border trade. The highway plays an important regional role by facilitating the movement of goods and people between Kenya and the wider East African region, and has been a major driver of economic growth and urban expansion within Kitengela.

The municipality also benefits from its proximity to key transport and logistics infrastructure, including the Standard Gauge Railway, with nearby stations such as Athi River and Syokimau enhancing connectivity to Nairobi and Mombasa. This has supported increased residential, commercial, and industrial development in Kitengela, as businesses and commuters take advantage of improved accessibility. In addition, Kitengela is well connected to surrounding towns such as Athi River, Isinya, and Kajiado, further strengthening its role as a strategic urban and economic hub.

As a result of this strategic location, Kitengela Municipality continues to experience rapid growth in population, real estate development, and commercial activity. If effectively planned and managed, this growth presents significant opportunities for economic development, investment, and regional integration. However, it also underscores the need for sustainable urban planning that integrates climate resilience, infrastructure development, and environmental management to support long-term growth and livability.

Table 5: Population table

Division	2019 KPHs			2023 Projections			2027 Projections		
	Total	Mal	Femal	Total	Male	Female	Total	Male	Female
Kitengela	154,436	75,515	78,864	191,319.1	93,614.2	97,698.6	237,010.8	115,971.5	121,031.1
Oloorsirko n	17,439	9,374	8,064	21,603.86	11,612.76	9,989.88	26,763.48	14,386.17	12,375.75
Isinya	14,429	7,300	7,129	17,875.00	9,043.42	8,831.58	22,143.9	11,203.2	10,940.7
Kisaju	7,556	4,040	3,514	9,360.559	5,006.09	4,353.23 ¹	11,596.09	6,201.66	5,392.88
Keekonyok ie	7,962	3,901	4,057	9,863.521	4,837.61	5,025.91	12,219.19	5,992.95	6,226.22
Kitengela Municipalit y	201,822	100,187	101,628	250,022.069	124,114.1	125,899.3	309,733.5	153,755.6	155,967.1



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Oloorsirko n	17,439	937 67 4	8064	21603.86 24 31	11612.7 6 4	9989.88 7 2	8 26763.4	14386.1 7 5	12375.7 5 1
Isinya	14,429	7,30	7,129	17875.00	9043.42	8831.58	22143.9	11203.2	10940.7
Kisaju	7,556	404 0	3514	9360.559 09	5006.09	4353.23 ¹	11596.0 9	6201.66 1	5392.88 8
Keekonyok ie	7,962	3,90 1 5	4,057	9863.521 06 87	4837.61	5025.91 2	12219.1 9 7	5992.95 8 1	6226.22 8 3
Kitengela Municipalit y	201,822	100, 187	101,62 8	250022.0 69	124114. 1	125899. 3	309733. 5	153755. 6	155967. 1



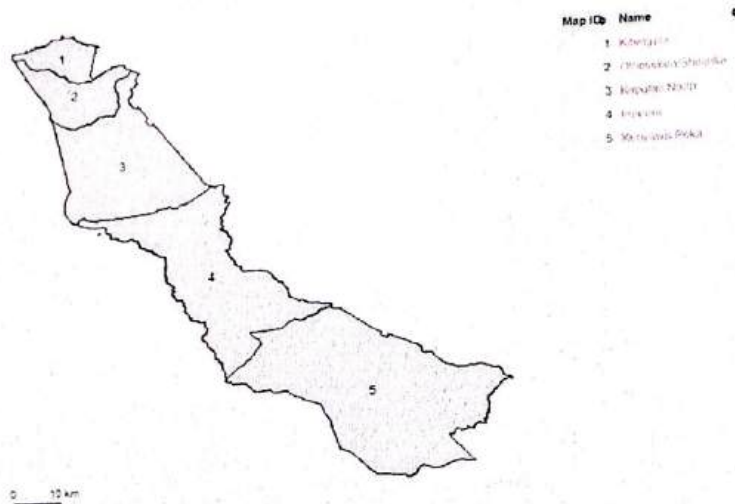


Figure 2: Kitengela Municipality respective wards which consist of No 1 to 3 wards.



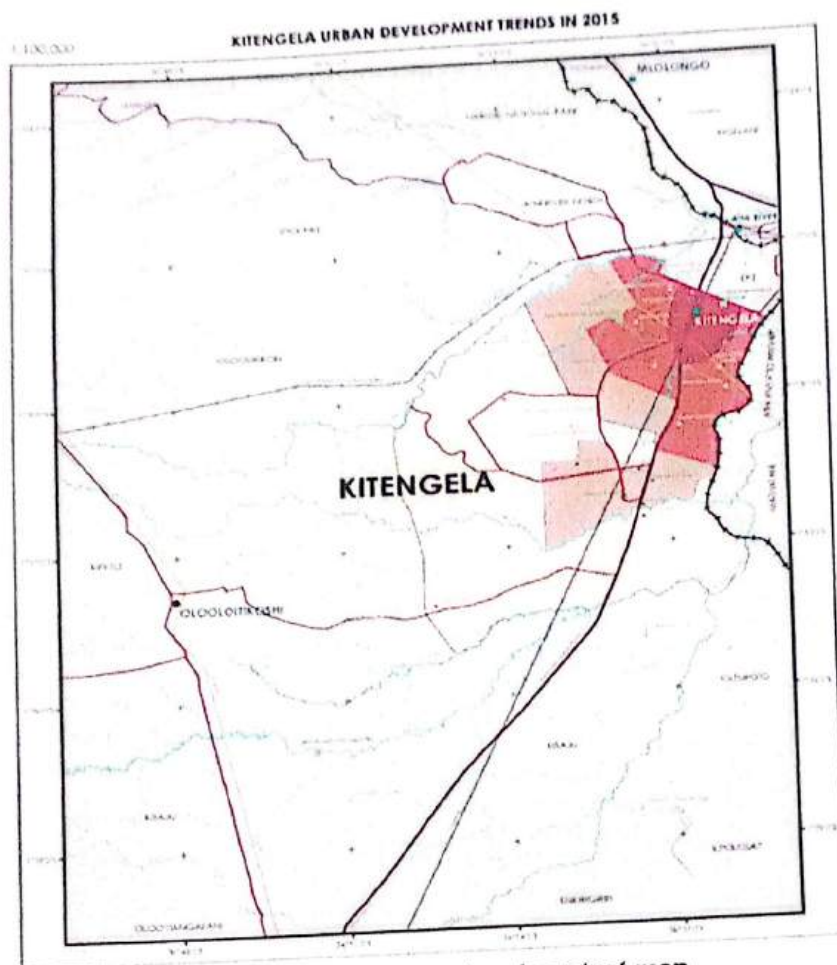


Figure 3: Kitengela Municipality regional context map.

1.2.2. Governance Structure.

Kitengela Municipality was established through the Kitengela Municipal Charter, as approved by the County Assembly of Kajiado and assented to by the Governor of Kajiado County. The establishment of the municipality provides a formal framework for urban governance, planning, and service delivery in response to the area's rapid growth and urbanization. In accordance with the Charter, the Municipal Board is mandated to oversee the management of municipal affairs, including the formulation and implementation of development plans, policies, and programs within Kitengela. **Municipal Board (Section 14):** Comprises 9 to 11 members, appointed competitively by the County Governor and approved by the County Assembly. Members include representatives from professional associations, the private sector, informal sector, and neighborhoods associations

The Charter outlines key objectives that guide the operations of the municipality.

1. Promotion, regulation and provision of the refuse collection and solid waste management services



2. Water and Sanitation
3. Construction and maintenance of Municipal administrative offices and yards.
4. Design, construction and maintenance of Urban Roads and Associated Infrastructure.
5. Construction and Maintenance of Storm water drains and flood control infrastructure within the Municipality.
6. Construction and Maintenance of walkways and other non-motorized transport infrastructure.
7. Design, construction and maintenance of street lighting and floodlights.
8. Construction and maintenance of recreational parks and green spaces.
9. Development and enforcement of municipal plans and development controls.
10. Collecting rates, taxes levies, duties, fees and surcharges on fees.
11. Promotion, regulation and provisions of animal control welfare.
12. Promotion, regulation, and provision of sports and cultural activities.
13. Construction and maintenance of Municipal markets and Abattoirs

The institutional framework for implementing municipal functions in Kitengela is anchored in national legislation, including the County Governments Act, 2012 (as amended) and the Urban Areas and Cities Act, 2019. This framework establishes a clear linkage between the Municipal Board and the County Executive, ensuring coordination in planning, budgeting, and service delivery.

Within this structure, the municipality operates through various technical and administrative units that work closely with relevant departments of the Kajiado County Government. These include departments responsible for urban planning, infrastructure, environment, water and sanitation, public health, and finance. This collaborative approach supports the effective implementation of development plans, routine operations, and climate-responsive initiatives within the municipality.

As Kitengela continues to grow, strengthening governance systems, enhancing institutional capacity, and promoting inclusive participation will be critical to ensuring sustainable urban development and effective climate risk management.



Figure 4. Full-range Minimum Quality Consensusgram.

1. 2. 3. **Transfere-se o conhecimento** (C. unidade 4)

Esmeraldas County has experienced rapid population growth and urbanization in recent years, largely driven by its proximity to Guayaquil and increased rural-urban migration. Urban centers such as Esmeraldas, Chagata Real, and Esmeraldas Town have seen significant expansion, with

Kingville emerging as one of the fastest-growing urban areas in the county. The county's population density remains relatively low compared to highly urbanized counties, but urban growth rates are considerably higher than coastal population growth, reflecting increasing migration into urban and peri-urban areas.

Kisumu Municipality has witnessed substantial population growth due to its strategic location within the Nairobi Metropolitan Region, availability of relatively affordable land, and expanding economic opportunities. The municipality is characterized by a diverse and rapidly growing population comprising formal residential estates, informal settlements, and peri-urban communities. This growth has been fueled by migration from Nairobi and other parts of the country, as people seek affordable housing, employment opportunities, and access to urban services.



The population of Kitengela Municipality is estimated to be significantly higher than previous census figures due to ongoing urban expansion and subdivision of land for residential and commercial use. Population density varies across the municipality, with higher concentrations in built-up areas and lower densities in peripheral zones where agricultural and pastoral activities are still practiced. The population structure is predominantly youthful, with a large proportion of residents engaged in informal employment, small-scale trade, transport services, and emerging industrial activities.

Kitengela serves as a key residential and economic hub, with strong linkages to Nairobi City and neighboring towns such as Athi River, Isinya, and Kajiado. The municipality includes several rapidly developing neighborhoods and informal settlements, where access to basic services such as water, sanitation, waste management, and healthcare remains uneven. These disparities contribute to varying levels of vulnerability among different population groups, particularly low-income households and recent migrants.

The continued population growth and urban expansion in Kitengela present both opportunities and challenges. While growth supports economic development and investment, it also places increasing pressure on infrastructure, land, housing, and essential services. Without adequate planning, this rapid expansion can lead to the proliferation of informal settlements, environmental degradation, and increased exposure to climate-related risks such as flooding, heat stress, and water scarcity.

These dynamics highlight the need for integrated urban planning, inclusive service delivery, and targeted social development strategies to ensure that growth in Kitengela Municipality is sustainable, equitable, and resilient to climate change.

Based on Kajiado County's population growth rate of 1.4 percent, Kitengela Municipality's population is projected to reach approximately 128,648 persons by the year 2030. This Projection highlights the urgent need for proactive urban planning to ensure that infrastructure, housing, and essential services grow in tandem with the population. Strengthening service delivery systems, including water supply, sanitation, transport networks, health facilities, and educational infrastructure, will be critical in supporting the anticipated increase in human capital and maintaining quality of life within the municipality.

This growth trajectory also underscores the importance of integrating climate resilience into all aspects of urban development planning. As the population expands, demand for land and resources will increase, potentially intensifying exposure to climate-related risks such as



flooding, heat stress, and water scarcity. Without adequate planning and investment, these pressures could undermine sustainable development and exacerbate existing inequalities.

The table below presents the municipality's projected population trends.

Table 6: Kitengela Municipality Population.

Division	2019 KPHs			2023 Projections			2027 Projections		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Kitengela	154,433	75,567	78,864	191,319.1	93,614.2	97,698.6	237,010.8	115,971.5	121,031.1
Oloorsirikon	17,439	9,374	8,064	21,603.86	11,612.74	9,989.88	26,763.48	14,386.17	12,375.75
Isinya	14,429	7,300	7,129	17,875.00	9,043.42	8,831.58	22,143.9	11,203.2	10,940.7
Kisaju	7,556	4,041	3,514	9,360.559	5,006.09	4,353.231	11,596.09	6,201.661	5,392.888
Keekonyokie	7,962	3,905	4,057	9,863.521	4,837.61	5,025.912	12,219.197	5,992.958	6,226.228
Kitengela Municipality	201,822	100,187	101,628	250,022.069	124,114.1	125,899.3	309,733.5	153,755.6	155,967.1

1.2.4. Economic Context

Kitengela Municipality has a dynamic and rapidly diversifying economy that continues to evolve from its traditional agro-pastoral base into a mixed urban economy driven by trade, industry, services, and real estate development. Livestock keeping and small-scale agriculture remain important livelihood activities, particularly in the peri-urban areas, where residents engage in dairy farming, horticulture, and subsistence crop production. However, these activities are gradually declining due to ongoing urbanization, land subdivision, and increasing pressure on land use.

The municipality's economy is strongly influenced by its strategic location along the Nairobi-Namanga Highway and its proximity to Nairobi City. This has positioned Kitengela as a key commercial and residential hub within the Nairobi Metropolitan Region. The area hosts a wide range of economic activities, including retail and wholesale trade, supermarkets, petrol stations, restaurants, butcheries, bakeries, construction-related enterprises, and transport services. The growth of shopping centers, malls, and organized retail outlets has further strengthened Kitengela's role as a regional business center.



In recent years, the municipality has also experienced growth in light manufacturing, construction, logistics, and real estate development. These sectors have been driven by increasing demand for housing and commercial space, as well as improved transport connectivity. The expansion of the service sector, particularly banking, hospitality, and education services, has further contributed to economic diversification and employment creation within the municipality.

Despite this growth, the local economy continues to face several challenges. Informal trade dominates a significant portion of economic activity, limiting revenue generation and structured development. In addition, inadequate infrastructure, high cost of utilities, and limited access to affordable credit constrain business expansion, particularly for small and medium enterprises. Environmental pressures, including land degradation, water scarcity, and poor waste management, also pose risks to long-term economic sustainability.

Climate change remains a major threat to Kitengela's economic systems. Increasing temperatures, erratic rainfall, flooding, and prolonged dry spells affect agriculture, disrupt supply chains, damage infrastructure, and increase operational costs for businesses. Informal settlements and small-scale enterprises are particularly vulnerable due to limited adaptive capacity.

Overall, while Kitengela Municipality presents strong economic potential due to its strategic location and rapid urbanization, realizing this potential will require targeted investments in infrastructure, climate resilience, value chain development, and sustainable land use planning to ensure inclusive and long-term economic growth.



Figure 5: Kitengela Municipality Modern Market.

Most of the commercial activities in Kitengela Municipality are concentrated within Kitengela Town and other emerging urban centres across the municipality. Kitengela Town serves as the core business and administrative centre, hosting the highest concentration of formal and informal economic activities.

Formal commercial activities include banking services, transport businesses, SACCOs, wholesale and retail trade, supermarkets, petrol stations, hospitality establishments such as hotels and restaurants, and a growing number of real estate and service-based enterprises. These activities are supported by increasing urban demand and the municipality's strategic location within the Nairobi Metropolitan Region.

In addition to formal enterprises, informal economic activities play a critical role in sustaining livelihoods within the municipality. These include street vending, small retail kiosks, food stalls, and informal service provision. The informal sector remains essential for job creation and local economic resilience, particularly for low-income households and recent migrants who rely on it as a primary source of income.

The Nairobi–Namanga Highway is a major driver of commercial activity in Kitengela, with numerous business establishments located along its corridor. Traders have established roadside structures commonly referred to as vibandas, which support vibrant micro-enterprise activity and contribute significantly to the local economy. However, these developments also present challenges, including exposure to road traffic accidents due to their proximity to the highway. In addition, the expansion of roadside trading has contributed to land use conflicts, as informal commercial activities often encroach on designated planning zones. This creates tension between formal urban planning regulations and the realities of informal economic survival. Addressing these challenges requires strengthened spatial planning, improved enforcement of zoning regulations, and the provision of designated trading spaces that support both safety and economic inclusion.



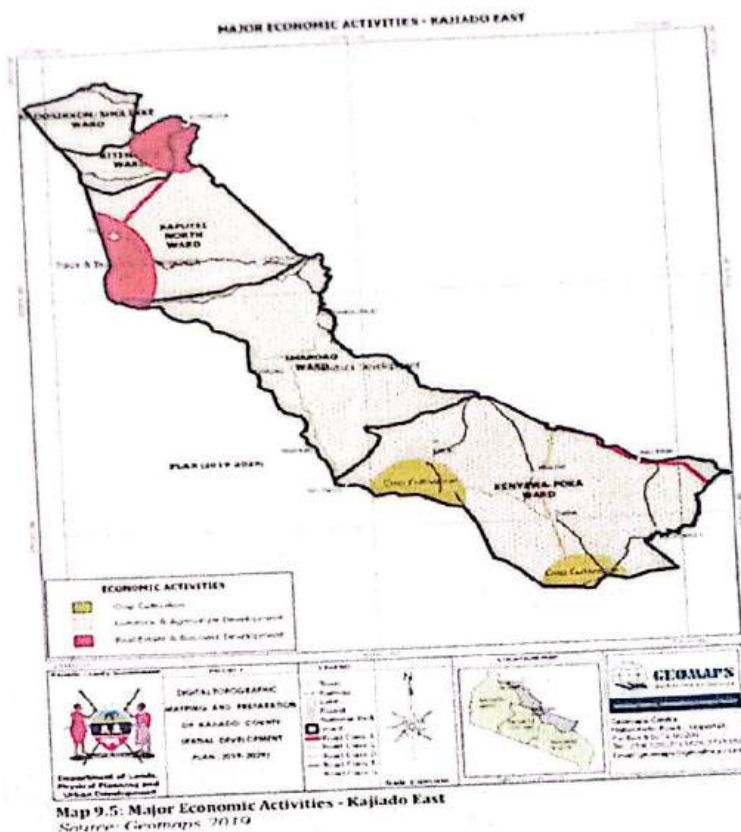


Figure 6: Kitengela Municipality Major Economic Activities.

1.2.5. Land-use Context

The land use pattern in Kitengela Municipality reflects a rapid transition from predominantly rural and agro-pastoral systems to an increasingly urban and peri-urban landscape. Historically, the area was characterized by extensive grazing land and small-scale agriculture. However, ongoing urbanization, population growth, and proximity to Nairobi have significantly transformed land use, making Kitengela one of the fastest urbanizing areas within Kajiado County.

The dominant settlement pattern in the municipality is linear development, largely concentrated along major transport corridors, particularly the Nairobi–Namanga Highway. This corridorbased growth has led to the emergence of Kitengela Town as the primary commercial and administrative centre, alongside other growing nodes within the municipality. These urban centres have evolved into key hubs for economic, social, and administrative activities, serving not only local residents but also surrounding peri-urban and rural communities.



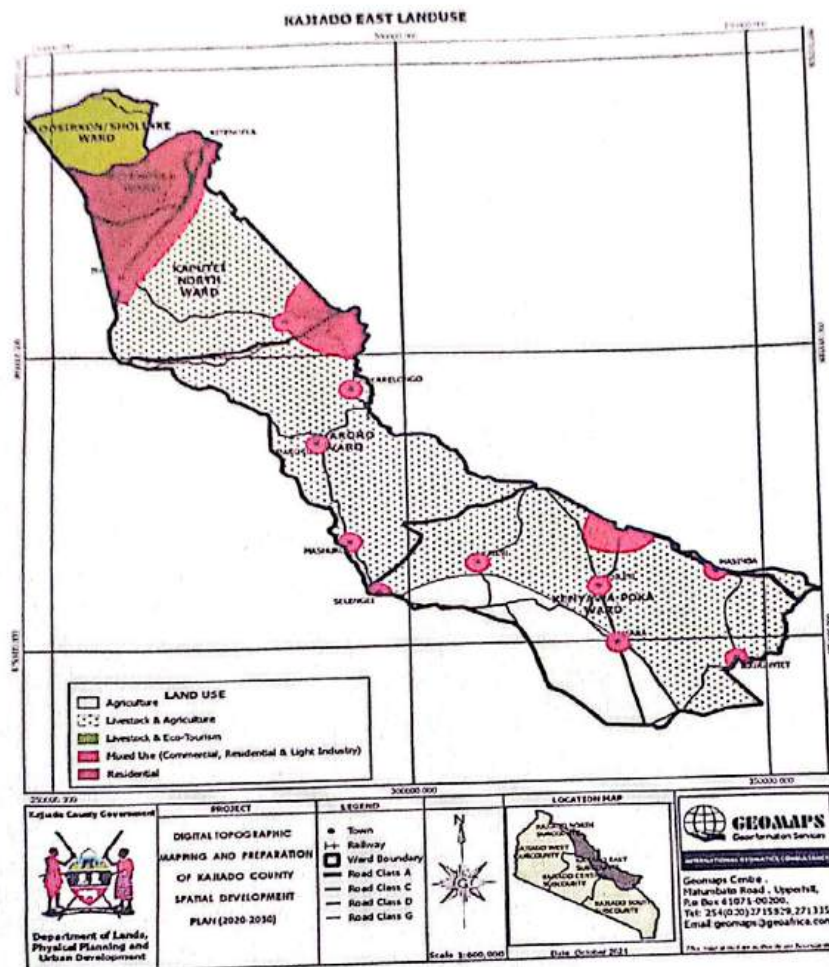
Several factors have contributed to the rapid growth of Kitengela's urban centres. These include the presence of key institutions such as schools, health facilities, administrative offices, and security installations, which have strengthened service delivery and attracted settlement. In addition, the area benefits from its connectivity to major transport infrastructure, including the Standard Gauge Railway network through nearby stations, which enhances mobility and trade. Kitengela also serves as an important stopover point for long-distance transport vehicles operating along the Nairobi–Namanga corridor, further stimulating commercial activity.

The municipality is characterized by a mosaic of land uses, including residential neighborhoods, commercial zones, light industrial areas, institutional facilities, and remaining pockets of agricultural and pastoral land. The expansion of built-up areas has increasingly encroached on former grazing and farming zones, resulting in land fragmentation and changing livelihood patterns. This evolving land use structure plays a central role in shaping infrastructure development, transport networks, and service delivery systems within the municipality.

Urban centres within Kitengela form the backbone of spatial development by acting as nodes of economic and social activity. They influence the distribution of land uses, guide infrastructure investment, and shape zoning and planning decisions. However, rapid and often unplanned growth has also led to challenges such as informal settlements, land use conflicts, strain on infrastructure, and loss of environmentally sensitive areas.

Effective land use planning is therefore essential to ensure sustainable development. Integrating climate considerations into spatial planning will be critical in addressing risks such as flooding, heat stress, and environmental degradation, while also supporting orderly growth, improved service delivery, and the preservation of key ecological areas.





Map 13.6: Proposed Land Use Structure for Kajiado East
Source: Geomaps 2019

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Figure 7: Kitengela Municipality Land use Map.

1.3. Key Stakeholders & Inclusiveness

Stakeholder analysis in Kitengela Municipality was undertaken to identify and understand the roles, interests, and influence of various actors involved in climate change governance and urban development. This process considered institutions, community groups, private sector actors, development partners, and civil society organizations that contribute to planning, implementation, and oversight of municipal functions.



An Influence–Interest Matrix was applied to categorize stakeholders based on their level of influence and interest in climate resilience and urban development processes. This resulted in four categories: high influence–high interest, high influence–low interest, low influence–high interest, and low influence–low interest. Each category requires a tailored engagement approach to ensure meaningful participation and effective collaboration.

High influence–high interest stakeholders, such as the Municipal Board and key county departments, are engaged closely throughout planning and decision-making processes. High influence–low interest stakeholders are regularly consulted to ensure alignment with policy and resource allocation. Low influence–high interest groups, including community-based organizations and informal settlement representatives, are actively involved to ensure inclusivity and local relevance. Low influence–low interest stakeholders are kept informed through structured communication channels.

This inclusive stakeholder engagement approach ensures that climate risk planning in Kitengela Municipality is participatory, transparent, and responsive to the needs of all groups, thereby strengthening ownership, accountability, and the effectiveness of climate resilience interventions.

Table 7: Kitengela Municipality stakeholders mapping.



High Influence – Low Interest • National line ministries • Utility service provider • The media • Development partners: World Bank, commercial banks • Olkejeudo Water and Sanitation Company Limited • Kenya Power • Kenya National Highways Authority • Kenya Urban Roads Authority • Kenya Rural Roads Authority • Civil Society Organizations • Tanathi Water Works Development Agency	High Influence – High Interest • County Executive • National Environment Management Authority • Kitengila Municipal Board • National Drought Management Authority • Kenya Meteorological Department • County Climate Change Steering Committee • Members of county assembly • County Climate Change Unit • County Line Departments
Low Influence – Low Interest • Residents of areas adjacent to the municipality.	Low Influence – High Interest • SMEs • Boda boda operators • Jua kali traders • National research institutions • Neighbourhood associations • Individual farmers • Vulnerable and marginalized groups • PWDs • Widowed households • Women and children • Elderly persons ...



2. Hazard Assessment

Climate risk results from the interaction between hazard, exposure, and vulnerability. Hazard refers to the potential occurrence of climate-related physical events or trends that may cause damage or loss. Exposure describes the presence of people, infrastructure, services, and assets that may be affected by these hazards. Vulnerability refers to the propensity or predisposition of these exposed elements to be adversely affected, based on their sensitivity and capacity to cope.

A climate hazard assessment therefore identifies, evaluates, and prioritizes the physical impacts of climate change such as floods, droughts, heatwaves, and storms on communities, infrastructure, and ecosystems. It determines overall risk by analyzing the interaction between hazard severity, exposure, and vulnerability, and provides a basis for developing targeted adaptation and resilience strategies. This section highlights the key climate hazards affecting Kitengela Municipality and identifies the main risks that should guide local climate action and urban planning.

The climatology of Kitengela Municipality is generally semi-arid, with relatively low and highly variable rainfall, high temperatures, and strong seasonal variability. The area is influenced by the seasonal movement of the Intertropical Convergence Zone (ITCZ), which determines rainfall patterns and contributes to frequent rainfall variability and prolonged dry spells. Average annual rainfall in the broader region is low and unevenly distributed, while evaporation rates are high, leading to persistent water deficits. Mean annual temperatures typically range between 22°C and 28°C, with increasing trends in extreme heat events being observed in recent years.

Rainfall in Kitengela is bimodal, consisting of the long rains occurring between March and May and the short rains occurring between October and December. The short rains are generally more reliable and contribute a larger proportion of annual rainfall, while the long rains are increasingly erratic and less predictable. This variability has significant implications for water availability, agriculture, and urban resilience. Periods of intense rainfall are often followed by prolonged dry spells, creating alternating risks of flooding and drought within short time spans. Based on historical trends and future climate projections, the initial screening process indicates that changes in precipitation patterns and rising temperatures are the most significant climate



drivers of risk in Kitengela Municipality. These changes manifest in the form of flooding, water stress, heat stress, and land degradation processes such as soil erosion and gully formation. Rapid urban expansion, land subdivision, and loss of natural vegetation further intensify these hazards by increasing surface runoff and reducing natural water absorption capacity.

The key climate hazards affecting Kitengela Municipality therefore include heat stress, flooding from extreme rainfall events, prolonged drought and water stress, and land degradation associated with erosion and unregulated land use practices. These hazards are already affecting infrastructure, livelihoods, public health, and ecosystems, with the most severe impacts being experienced in informal settlements and rapidly urbanizing areas.

These risks will form the basis for subsequent analysis and will be integrated into urban planning, infrastructure development, and resilience-building strategies to support sustainable development and climate adaptation within Kitengela Municipality.

2.1. Key Climate Hazards

The following matrix table provides a summary of the key climate hazards that characterize development in Kitengela Municipality.

Table 8: Hazard screening for Kitengela Municipality.

Hazard	Hazard Likely (Y/N)	Significant Impact (Y/N)	High Priority (Y/N)	Key Hazard (Y/N)
Heat Stress				
Average surface temperature increase	Yes	Yes	Yes	Yes
Flooding				
Changes in precipitation patterns	Yes	Yes	Yes	Yes
Pluvial (surface level) flooding, including flash flooding and urban flooding	Yes	Yes	Yes	Yes
Fluvial (river) flooding	Yes	Yes	Yes	Yes
Water Stress				
Drought (meteorological, hydrological)	Yes	Yes	Yes	Yes
Wildfire				
Wildfires & bushfires	Yes	Yes	Yes	Yes

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



2.2. Climate Indicators and Hazard Thresholds

The table below presents selected climate indicators and hazard thresholds relevant to Kitengela Municipality. These indicators are used to assess historical trends and future climate risks across key sectors such as water, infrastructure, health, and livelihoods.

Table 9: Climate indicators and hazard thresholds selected for the assessment.

Key Hazard	Climate Indicator	Data source	Threshold		
			Low	Medium	High
Extreme heat	No. days with heat index > 35°C (Mean)	World Bank Climate Change Knowledge Portal	<5 days / season	5 -15 days / season	>15 days / season
Changes in precipitation patterns	no. days rainfall exceed or fall below the expected intensity	CHIRPS (Climate Hazards Group InfraRed Precipitation with Station data)	< 5%	5% to 15%	> 15%
Fluvial (river) flooding	Flow rate Gauge height Catchment saturation	World Bank Climate Change Knowledge Portal	1-in-100+ years (< 1% annual chance)	1-in-30 to 1-in-100 years (1% - 3.3% annual chance)	< 1-in-30 years (> 3.3% annual chance)
Drought (meteorological, hydrological)	Standard Precipitation Index (SPI) Consecutive dry days (CDD) Standardized Precipitation-Evapotranspiration Index (SPEI)	World Bank Climate Change Knowledge Portal	> -1.0	-1.0 to -1.5	<-1.5
Wildfires & bushfires	Fire Weather Index (FWI)	ThinkHazard!	Low/Very Low	Medium	High/Very High

2.3. Current Hazard Levels and Climate Projections

Kajiado County, where Kitengela Municipality is located, has experienced increasing climate variability over recent decades, with rising temperatures, erratic rainfall patterns, and more



frequent extreme weather events. Historical evidence and community observations indicate that both prolonged dry spells and intense rainfall events are significant hazards in the region. Dry spells are often more severe during the short rains season, with moisture stress periods varying significantly from year to year.

Extreme rainfall and flooding risks are generally moderate but increasingly disruptive in urban and peri-urban areas due to rapid land-use change, expansion of impermeable surfaces, and inadequate stormwater drainage systems. In many cases, even short-duration heavy rainfall events result in localized flooding, particularly in low-lying and informal settlement areas.

Temperature trends in the wider region show a steady increase over time, contributing to rising heat stress across the municipality. Since the early 1980s, mean temperatures have increased, resulting in more frequent hot days and longer periods of thermal discomfort. These changes have direct implications for human health, water demand, livestock productivity, and ecosystem resilience.

Kitengela Municipality, located at an elevation of approximately 1,500–1,600 meters above sea level, experiences a semi-arid climate characterized by relatively high temperatures and bimodal rainfall patterns. The average annual temperature is approximately 24°C to 26°C, with localized variations depending on land cover and urban density. The municipality receives low to moderate rainfall, with long rains occurring between March and May and short rains between October and December. However, rainfall distribution is highly variable both spatially and temporally.

Projected climate scenarios for the period 2021–2065 indicate that Kitengela Municipality will experience increasing temperatures, more frequent heat stress events, and greater rainfall variability. Prolonged dry spells are expected to intensify, particularly during the long rains season, leading to increased water stress and pressure on water supply systems. At the same time, extreme rainfall events are projected to become more intense, increasing the risk of flash floods and surface runoff in urban areas.

Climate projections under both low and high emission scenarios (RCP 2.6 and RCP 8.5) suggest broadly similar trends for the region, indicating that significant climate impacts are already



locked in regardless of future mitigation efforts. This reinforces the urgent need for adaptation measures at the municipal level to build resilience against both current and future climate risks. These findings highlight that heat stress, flooding, water stress, and land degradation processes such as gully erosion are the most significant climate hazards affecting Kitengela Municipality. These hazards are expected to intensify over time and will continue to shape urban development, infrastructure planning, and socio-economic vulnerability if not adequately addressed through integrated climate-resilient planning.

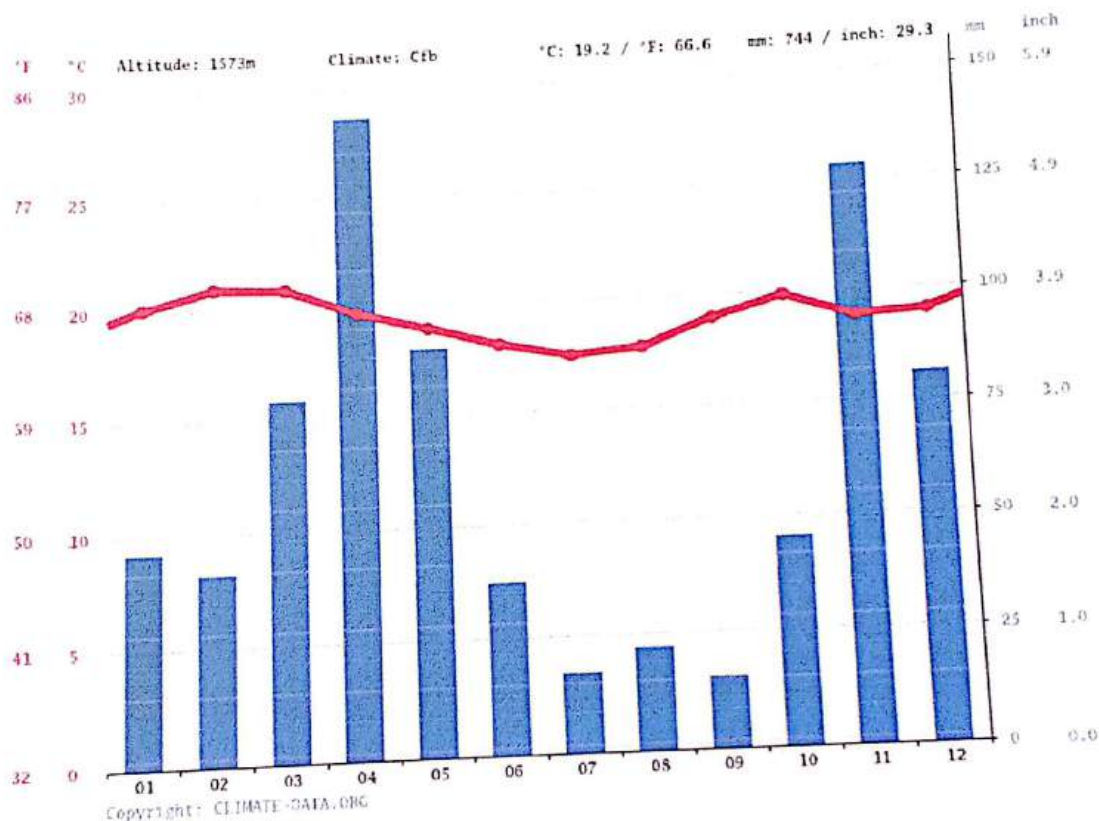


Figure 8: Air Temperature for Kitengela Municipality

The table provides a view of projected mean surface air temperature for Kitengela Municipality up to the year 2100 under five different Shared Socioeconomic Pathway (SSP) scenarios. The projections indicate a consistent warming trend across all scenarios, reflecting the long-term impacts of climate change on local temperatures. Even under the "middle of the road" pathway (SSP2), average temperatures are projected to remain high and may peak above 24°C. Under higher emission scenarios, particularly SSP5-8.5, temperatures are projected to rise further, exceeding 26.4°C.



These projections highlight a clear and sustained increase in thermal stress within the municipality over time. The implications of rising temperatures include increased heat stress on human health, higher demand for water, reduced labour productivity, and added pressure on ecosystems and urban infrastructure. This underscores the importance of integrating heat adaptation measures into urban planning, infrastructure design, and public health strategies in Kitengela Municipality.

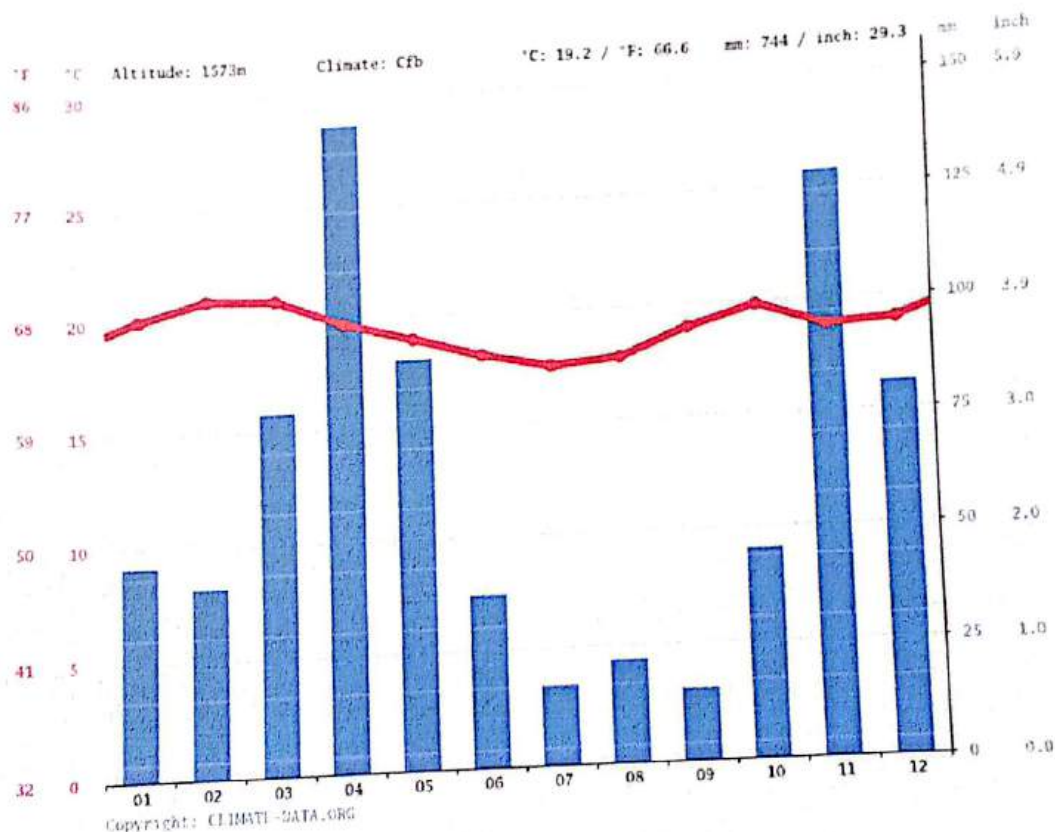


Figure 9: Monthly Precipitation for Kitengela Municipality.

Projected cumulative average monthly precipitation is presented in Figure 6. The projections indicate high variability in rainfall distribution across the year, with pronounced seasonal differences and increasing uncertainty in rainfall timing and intensity. For Kitengela Municipality, this variability is particularly significant due to the semi-arid nature of the area and its dependence on rainfall for water supply, ecosystems, and peri-urban livelihoods. Periods of intense rainfall are expected to alternate with prolonged dry spells, increasing the risk of both flooding and water scarcity within short timeframes.

In general, Kitengela Municipality is highly vulnerable to the negative impacts of climate change due to its low to moderate adaptive capacity and increasing exposure driven by rapid



urbanization, land-use change, and pressure on natural resources. The situation is further exacerbated by reliance on climate-sensitive livelihoods in peri-urban areas, including livestock keeping and small-scale agriculture, as well as uneven access to reliable water supply and drainage infrastructure.

Table 10: Current and future hazards levels for Kitengela Municipality

Hazard	Hazard Level				
	Current (Baseline)	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
Extreme heat	Medium	High	High	High	Very High
Changes in precipitation patterns	High	High	High	High	Very High
Fluvial (river) flooding	medium	High	Very high	Very High	Very high
Drought (meteorological, hydrological)	High	High	Very High	Very High	Very High
Wildfires & bushfires	Medium	Medium	High	High	High

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

Table 11: 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 identified climate hazards are currently distributed across the entire Kitengela Municipality, although the intensity and frequency of impacts vary spatially depending on local environmental conditions, land use patterns, and levels of urban development. Areas with high population density, rapidly expanding informal settlements, and limited infrastructure are generally more exposed and vulnerable to multiple overlapping hazards, including flooding, heat stress, and water scarcity

Low-lying areas and locations close to seasonal drainage channels are particularly prone to pluvial flooding during periods of intense rainfall. These areas often experience poor drainage capacity, leading to surface water accumulation and localized flood events that disrupt mobility,



damage property, and affect livelihoods. Conversely, elevated and peri-urban dry zones tend to experience more severe water stress and prolonged dry spells, which negatively affect water availability for domestic use and small-scale agricultural activities.

Heat stress is widespread across the municipality but is more severe in densely built-up zones where vegetation cover is limited and the urban heat island effect is more pronounced. Informal settlements and areas with high concentrations of tin-roof housing are especially affected due to poor thermal regulation and limited access to cooling or adequate water supply.

Looking into the future, climate projections indicate that these hazard impact areas will intensify and expand spatially. Flood-prone zones are expected to experience more frequent and intense flooding events due to increasing rainfall extremes, while dry areas are likely to face worsening water scarcity due to longer dry spells and rising temperatures. Gully erosion hotspots are also expected to expand, particularly in areas undergoing rapid land degradation, unplanned construction, and vegetation loss.

Overall, the spatial distribution of climate hazards in Kitengela Municipality is expected to become more complex over time, reinforcing the need for integrated spatial planning, improved drainage systems, strengthened water resource management, and targeted interventions in the most vulnerable neighborhoods.

3. Exposure & Vulnerability Assessment

Kitengela Municipality is characterized by a tropical savannah climate influenced by local topography and ongoing land-use transformation. Rainfall distribution is highly variable, with higher amounts generally received in relatively elevated and less developed zones, while lower and more degraded areas experience reduced precipitation and increased water stress. The municipality typically experiences two rainy seasons, with long rains occurring in March to May and short rains occurring in October to December. However, rainfall patterns have become increasingly erratic, with growing unpredictability in onset, duration, and intensity.

In recent years, the municipality's vulnerability to climate-related hazards has increased due to rising temperatures and rainfall variability. Extreme temperatures, occasionally reaching up to 35°C and above, are contributing to heightened heat stress, particularly in densely built-up and low-income settlements. The climate has progressively become warmer and drier since the early 2000s, and projections indicate that this trend will continue, with longer and more intense



periods of heat expected in the future. At the same time, rainfall seasons are becoming shorter but more intense, increasing the likelihood of flash floods and surface runoff in vulnerable locations.

Rapid urbanization, population growth, and environmental degradation are significantly amplifying exposure to climate risks within the municipality. Informal settlement expansion, inadequate drainage systems, and limited urban planning enforcement make residents in key commercial and residential zones highly susceptible to flooding events. In addition, deforestation in surrounding areas, vegetation loss, and land degradation are disrupting natural water cycles, reducing groundwater recharge, and contributing to more frequent and severe drought conditions.

Unsustainable practices such as sand harvesting and poor solid waste management further exacerbate environmental degradation, increasing the risk of gully formation and blocking drainage channels. These interacting pressures result in widespread impacts including loss of livelihoods, property damage, water scarcity, reduced agricultural productivity in peri-urban areas, and declining ecosystem health. Ultimately, these climate and non-climate stressors combine to heighten vulnerability across households, infrastructure, and economic systems in Kitengela Municipality, with the most severe effects being felt by low-income and informally settled populations.

3.1. Urban Elements

The inventory of urban elements in Kitengela Municipality identifies the key infrastructure systems, service networks, population groups, and natural assets that are exposed to climaterelated hazards. These elements provide the spatial and functional basis for understanding how climate risks interact with the built environment, socio-economic systems, and ecological resources across the municipality.

Infrastructure and service systems in Kitengela Municipality are characterized by uneven development and limited resilience to climate extremes. Storm water drainage infrastructure exists mainly along major roads and in core urban areas, but remains underdeveloped, fragmented, and poorly maintained in many locations. As a result, the system has limited capacity to manage intense rainfall events, increasing the risk of surface flooding. Water supply is predominantly dependent on groundwater abstraction through boreholes and shallow wells, supplemented by localized supply systems. However, there is no comprehensive sewer network,



and sanitation relies heavily on pit latrines, ventilated improved pit latrines, and septic tanks. Wastewater management is largely decentralized, with limited treatment infrastructure, increasing the risk of contamination during flood events.

Solid waste management systems are also limited, with inadequate collection coverage, poorly managed dumpsites, and a lack of recycling facilities. This contributes to blocked drainage channels and worsening flood conditions during heavy rainfall. Transport infrastructure consists of a combination of tarmacked, gravel, and earth roads, many of which are in fair to poor condition. Public transport is mainly provided by matatus and boda bodas, with limited formal transport terminals and insufficient non-motorized transport infrastructure, increasing vulnerability during extreme weather events.

Energy infrastructure is connected to the national grid, although distribution systems, including power lines and transformers, are vulnerable to disruptions from storms, high winds, and flooding. Street lighting is concentrated in core urban zones, while peri-urban areas remain poorly served. Economic infrastructure is primarily located in key commercial hubs and includes markets, retail centers, livestock trading areas, and emerging industrial zones aligned with county spatial plans.

Social infrastructure includes schools, health facilities, administrative offices, and service centers, though access remains uneven across different parts of the municipality. Emergency response infrastructure such as fire stations and police posts exists but is limited in capacity, and systems for early warning, evacuation planning, and disaster preparedness remain underdeveloped.

Population exposure is a critical component of the urban system. Kitengela Municipality has a rapidly growing urban population, with expanding informal settlements where residents often lack secure land tenure and consistent access to basic services. Vulnerable and marginalized groups include low-income households, women-headed households, children and youth, elderly persons, persons with disabilities, and informal workers. These groups face heightened exposure due to limited adaptive capacity and restricted access to infrastructure and social services.

Natural assets within the municipality include urban green spaces such as parks and landscaped areas, as well as blue infrastructure systems including rivers, seasonal streams, and riparian corridors. Key watercourses such as the Athi River and its tributaries play an important role in



drainage and groundwater recharge, but are increasingly affected by encroachment, pollution, and flow variability. Peri-urban agricultural systems also remain important in outlying areas, although they are highly exposed to drought, heat stress, and land degradation pressures.

Overall, the urban system in Kitengela Municipality reflects rapid urban expansion that has outpaced infrastructure and service provision. This has resulted in increased exposure to climate hazards, particularly flooding, drought, heat stress, and environmental degradation, reinforcing the need for integrated urban planning and climate-resilient infrastructure development.

Table 12: Kitengela Municipality 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	Yes		Along the Namanga Highway and other urban road
	Stormwater storage	N	NO	N/A
	Pumping stations	N	NO	N/A
Water & Wastewater Management	Groundwater abstraction	YES	No	BOREHOLE IN KITENGILA BUS PARK
	Water treatment facilities	N	N	N/A
	Water supply networks	YES	No	OWSCO/Tana Athi
Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Sewer networks	YES		Private sewer system (Kitengela Neighborhood and Tropicana)
	Wastewater treatment facilities	N	N	N/A
Solid Waste Management	Transfer facilities			
	Landfills and dump sites	YES	No	Noonkopir and Isinya dumpsite
	Recycling centers	Yes	No	Takataka in Mali hub and private stations
	Collection fleet	Yes	No	Skipper and a truck for waste collection
Transport and Mobility	Road networks	Yes	No	Road network in Kitengela
	Bridges			



	Public transport networks (rail, bus, mini-bus, etc.)	Yes	NO	Naekena, Nalepo, and Several Bus saccoos
	Transportation terminals	Yes	No	Kitengela Bus Station
	Vehicle depots	NO	NO	N/A
	Non-motorized transport networks	YES	No	Walkways and Pavements along CBD roads and other Road within Kitengela.
	Freight and logistics hubs	No	No	N/A
	Energy power plants	No	No	N/A
Energy	Poles and power lines	Yes	No	Kpl poles and power lines along the major roads
	Transformers and substations	Yes	NO	Transformers and substation opposite Umma Univeristy.
	Streetlighting	Yes	No	Streetlighting along CBD and Namanga Highway.
Economic Infrastructure	Markets	Yes	No	Kitengela new market, Isinya and many other in small centres.
	Businesses and commercial hubs	Yes	No	Within Kitengila town
	Industrial zones/parks and logistics parks	No	No	N/A
Social Infrastructure	Government buildings and service centers	Yes	No	Kitengila Municipality offices, Isinya Sub-county offices.
	Education facilities	Yes	NO	Many Public and Private institution within Kitengila
	Healthcare facilities	Yes	No	Saitoti Level four hospital, Isinya Health centres and many other within Kitengila
	Public spaces	Yes	No	Kitengila Stadium, Isinya play grounds and many other
Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Faith-based buildings	Yes	Yes	Many faith-based churches and Mosques within Kitengila
	Cultural and heritage assets	Yes	No	Manyatta sites
	Fire stations	Yes		Fire engine in Kitengea Municipality
	Police stations	Yes	No	Kitengila and Isinya Police Station
Emergency Services				



	Telecommunications networks	Yes	No	Safaricom and Airtel boosters.
	Early warning systems	N	N	N/A
	Disaster management centers and shelters	YES	N	Kenya Red Cross Society, National Drought Management Authority (NDMA)
	Evacuation routes	Yes	N	Services lane along Nairobi-Namanga Highway and other roads network
Populations				
Urban Residents	Population	Yes	N	206,000 people as per the Kenya population and Housing Censes 2019
	Households	Yes		All household within Kitengila residential areas
Informal Settlement Residents	Population living in informal settlements	Yes		Kyoembe, Noonkopir, Lucky base , Kimalat and Majengo in Isinya
	Households lacking land tenure	Yes	N	Common in informal areas such as Kimalat, Noonkopir outskirts and parts of Isinya, where many residents occupy land without formal title deeds, increasing risk of eviction and limiting infrastructure investment.
	Households / residents lacking access to basic services	Yes	N	Informal settlements experience limited access to piped water, sewer systems, drainage, and solid waste management.
Vulnerable and Marginalized Groups	Low-income households	Yes	N	Large proportion of residents depend on informal employment and small-scale businesses, making them highly vulnerable to economic and climate shocks
	Women-headed households	Yes	N	Increasing in peri-urban Kitengila
Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Children and youth	Yes	N	Number of youth are facing unemployment and are



				exposure to environmental health risks
	Elderly persons	Yes	N	Limited social protection and mobility challenges make elderly residents vulnerable during floods and heat stress
	People with disabilities (PWD)	Yes	N	Often excluded from planning and emergency response systems; face barriers in accessing infrastructure and services
	Homeless populations	Yes	N	Though relatively small, includes street families and displaced persons within trading centres and transport corridors
	Unemployed or precariously employed workers	Yes	N	Rely on casual labor with unstable incomes and low resilience to shocks
	Seasonal workers / migrant laborers	Yes	N	Mostly attracted by construction and industrial growth in Kitengela; often live in temporary housing with limited services
	Nomadic groups in periurban areas	Yes	N	Maasai pastoralists in periurban zones of Kitengela and Isinya affected by shrinking grazing land, urban expansion and climate variability.
	Urban refugees and migrants	Yes	N	Mostly in settlement areas
	Minority ethnic groups in urban areas	N	N	N/A
Natural Assets				
Urban Green Infrastructure	Urban parks and gardens	N	N	N/A
	Green corridors	N	N	N/A
	Street landscaping	N	N	N/A
	Urban forests and forest reserves	N	N	N/A
Urban Blue Infrastructure	Natural wetlands	N	N	N/A
	Rivers	Yes	No	Noonkopir River
	Riparian zones			



	Lakes, ponds and reservoirs	N	N	N/A
Category	Subcategory	Included in the RCRA (Y/N)	Available in GIS format (Y/N)	Description
	Coastal ecosystems	N	N	N/A
	Urban agriculture	N	N	N/A
Peri-urban and Agricultural Systems	Peri-urban agriculture	Yes	No	
	Agroforestry systems	No	No	n/a
	Forests and forest reserves	No	No	No
	Protected areas and national parks	No	No	n/a
	Savannahs and rangelands	Yes	No	Kaputie rangeland

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

Kitengela Municipality is exposed to multiple climate hazards including heat stress, flooding, prolonged dry spells, and land degradation processes such as gully erosion. The interaction between these hazards and the municipality's urban systems, population distribution, and environmental assets determines the overall level of vulnerability and the severity of impacts experienced across different sectors.

Infrastructure and service systems are highly exposed to climate variability due to their limited adaptive capacity. Storm water drainage systems are particularly vulnerable to pluvial flooding because of insufficient coverage, poor maintenance, and limited design capacity to handle high intensity rainfall events. During extreme precipitation, drainage networks are easily overwhelmed, resulting in surface flooding, road damage, and disruption of transport services. Water supply systems are also highly exposed to prolonged dry spells, as the municipality relies heavily on groundwater abstraction from boreholes and shallow wells. Reduced recharge rates during drought periods lead to declining water availability, increased abstraction costs, and heightened competition among users.

Sanitation and wastewater systems are similarly vulnerable, particularly in informal settlements where reliance on pit latrines and septic tanks increases the risk of contamination during floods. Overflowing sanitation systems contribute to public health risks, especially during periods of heavy rainfall. Solid waste management challenges further amplify vulnerability by blocking



drainage channels, increasing flood intensity, and contributing to environmental pollution. Energy infrastructure, while generally more resilient, is still exposed to disruptions from storms, high winds, and flooding, particularly through damage to distribution lines and transformers.

Transport systems are highly sensitive to both flooding and extreme rainfall events. Poor road conditions, combined with inadequate drainage, lead to road washouts, reduced accessibility, and increased travel times. This has direct economic impacts, particularly for traders, commuters, and transport operators. Non-motorized transport users and boda boda operators are especially vulnerable due to limited protective infrastructure and high exposure to hazardous road conditions during extreme weather.

Population exposure is unevenly distributed across the municipality, with informal settlements and low-income communities experiencing the highest levels of vulnerability. These populations are often located in high-risk zones such as flood-prone areas, poorly drained lowlands, and environmentally degraded land. Heat stress disproportionately affects these groups due to inadequate housing materials, limited access to cooling, and restricted access to reliable water supplies. During flood events, these communities face higher risks of displacement, property loss, and livelihood disruption.

Vulnerable and marginalized groups including women-headed households, children, the elderly, persons with disabilities, and informal workers face compounded risks due to limited adaptive capacity and reduced access to services. These groups are less able to recover from climate shocks, making them more susceptible to long-term socioeconomic impacts such as poverty deepening and food insecurity.

Natural assets in Kitengela Municipality are also highly exposed to climate hazards. Rivers, riparian zones, and seasonal waterways are increasingly affected by altered flow regimes, pollution, and encroachment. During heavy rainfall, these systems experience flash flooding and erosion, while prolonged dry spells reduce base flows and water availability. Urban green spaces are exposed to heat stress and water scarcity, leading to vegetation loss and reduced ecosystem services such as cooling and storm water regulation. Peri-urban agricultural systems are among the most vulnerable assets, with high sensitivity to both drought and extreme rainfall, resulting in reduced crop yields, loss of livestock productivity, and increased food insecurity.

Overall, the exposure and vulnerability assessment shows that climate hazards in Kitengela Municipality have widespread and interconnected impacts across infrastructure, population



groups, and natural systems. The most severe impacts are concentrated among informal settlements, low-income households, and peri-urban agricultural areas, where limited infrastructure and adaptive capacity significantly amplify climate risks.

Table 13: 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.
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.

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 14: Impact Matrix

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



TABLE 15: Exposure, Vulnerability, and Impacts of Hazards on Urban Elements
Hazard: Extreme Heat

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	Channels exposed to drying, cracking and reduced functionality during prolonged heat Increased sedimentation and blockage due to dry conditions and poor maintenance	Medium	Sensitivity: - Poorly designed and unlined drains easily degrade under heat stress - Informal settlements lack proper drainage infrastructure Adaptive Capacity: - Routine maintenance and enforcement - Urban drainage upgrade	medium	medium
Water & Wastewater Management	- Water sources reduced recharge during heat periods - Increased water demand due to high temperature - Wastewater system face drying and inefficiencies	High	Sensitivity: - Heavy reliance on borehole and water vendors - Inadequate sewer systems; many use septic tanks Adaptive Capacity: - Increase water storage infrastructure - Increase private and county efforts in water supply expansion	High	High
Solid Waste Management	- Decomposition of water leading to foul odors and health risks - Increased risk of waste burning and fire outbreak during hot seasons ...	High	Sensitivity: - Inadequate waste collection in informal areas - Open dumping practices common Adaptive Capacity: - Increase waste management infrastructure - Growing private sector involvement	High	High



Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Transport and Mobility	- Road surface soften and deteriorate under high temperature - Increased dust on unpaved roads e.g Kimalat, Noonkopir outskirts - Public transport exposed to heat stress	Medium	Sensitivity: - Many roads are unpaved or poorly maintained - High dependence on informal transport systems Adaptive Capacity: - Ongoing road upgrade along Nairobi/Namanga - Increased climate-resilient road design	Medium	High
Energy	- Increased electricity demand for cooling - Solar systems exposed to high heat - Power lines and transformer prone to heating	Medium	Sensitivity: - Frequent power fluctuations in peri-urban area - High reliance on electricity and charcoal Adaptive Capacity: - Adoption of solar energy in homes and institution - Private sector investment in backup generators and alternatives solutions.	Medium	High
Economic Infrastructure	- Rapid urbanization increasing pressure on markets and business facilities - Climate-related disruption affecting supply chains and trade - Informal sector highly exposed to shocks (Heat,)	Medium	Sensitivity: - SMEs and informal businesses are highly sensitive to climate and economic shocks - Business operations affected by poor infrastructure and high temperatures Adaptive Capacity: - Proximity to Nairobi provides market opportunities - Growing private investment in infrastructure and real estates	Medium	Medium
Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level



Social Infrastructure	• Overstretched health facilities • Inadequate recreational facilities • Water scarcity and sanitation challenges	Medium	Sensitivity: • Low-income communities highly vulnerable to poor services • Health risks increase during heat waves and drought Adaptive Capacity: • Presence of both public and private schools • Community initiatives and NGO support in some area	Medium	Medium
		Medium	Sensitivity: • High population density increases emergency incidents • Insufficient equipment and manpower Adaptive Capacity: • Presence of police stations and health emergency • Community response efforts improving	Medium	Medium
Populations					
Urban Residents	• High exposure in densely built urban areas with concrete surfaces, • Limited vegetation •	Medium	Sensitivity: • Children, elderly, outdoor workers more affected than others Adaptive Capacity: • Access to electricity fans, healthcare, water and better housing	Medium	High
		Medium	Sensitivity: • Children, elderly, outdoor workers more affected than others Adaptive Capacity: • Access to electricity fans, healthcare, water and better housing	Medium	High
Informal Settlement Residents	• Severe heat stress and heatstroke • Dehydration and water scarcity stress • Reduced livelihood productivity • Higher mortality risk during heatwaves	Medium			



Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Vulnerable and Marginalized Groups	• Very high especially for those living in working outdoors or poorly ventilated shelters • Lack access to safe housing, healthcare access and resources	High	Sensitivity: • Children, elderly, outdoor workers more affected than others Adaptive Capacity: • Provision of healthcare facilities and social protection	High	High
Natural Assets					
Urban Green Infrastructure	• Trees stressed, reduced cooling.	Medium	Sensitivity: • Limited irrigation, high heat stress. Adaptive Capacity: • Some community planting programs.	Medium	High
Urban Blue Infrastructure	• High evaporation of water	Low	Sensitivity: • Drying up of water bodies Adaptive Capacity: • Improve management of water resources	Medium	Medium
Peri-urban and Agricultural Systems	• Water stress in field farms	Medium	Sensitivity: • Limited food production Adaptive Capacity: • Climate smart agriculture initiatives	Medium	High

Table 1: Exposure, Vulnerability, and Impacts of changes in precipitation on Urban Elements

Hazard: Changes in precipitation patterns

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
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Infrastructure & Services				
Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Impact Level
Stormwater Drainage	High exposure to increased rainfall intensity and runoff in urban areas with impervious surfaces	High	Sensitivity: - Inadequate drainage systems, poor maintenance, blocked drains, informal settlements in flood zones. Adaptive Capacity: - Improve storm drainage systems	High
Water & Wastewater Management	Flooding and drought variability	High	Sensitivity: - Aging infrastructure, leakage, poor storm water-sewer separation, limited treatment capacity. Adaptive Capacity: - Improve Water and waste water management systems	High
Solid Waste Management	Floodwater interaction with waste systems	Medium	Sensitivity: - Poor collection, illegal dumping, lack of engineered landfills Adaptive Capacity: - Provision of waste collection equipment and maintenance of dumpsite	High
Transport and Mobility	Roads exposed to flooding and erosion	High	Sensitivity: - Poor drainage design, unpaved roads, weak maintenance Adaptive Capacity: - Maintenance and upgrading of road systems	High



Energy	• Storms and hydrological variability	Medium	Sensitivity: • Dependence on hydropower, exposed transmission lines Adaptive Capacity: • Some redundancies.	Medium	Medium
Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Economic Infrastructure	• Flooding and access disruption	Medium	Sensitivity: • Poor siting, weak building standards • Business interruption, loss of income, property damage Adaptive Capacity: • Early warning system	Medium	High
Social Infrastructure	• Flood and storm damage	Medium	Sensitivity: • Weak construction, overcrowding, poor drainage Adaptive Capacity: • Provision adequate social amenities	Medium	High
Emergency Services	• Increased disaster events.	Medium	Sensitivity: • Limited equipment, poor access roads, weak early warning Adaptive Capacity: • Provision of required equipment	Medium	Medium
Populations					
Urban Residents	• Urban properties and infrastructure will be exposed to rainfall	High	Sensitivity: • Unplanned urban development Adaptive Capacity: • Improve on urban planning	High	High
Informal Settlement		High	Sensitivity:	High	High



Residents	• Flooding affecting the livelihood of informal settlements		• Properties destruction and loss of live		
			Adaptive Capacity: • Very low		
Vulnerable and Marginalized Groups	• High exposure on flood and health risk		Sensitivity: • Loss of live and properties		
			Adaptive Capacity: • Very low		
Natural Assets					
Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Urban Green Infrastructure	• Destruction of vegetation by flood	Medium	Sensitivity: • Limited irrigation and plant diversity. Adaptive Capacity: • Community inclusion	High	High
Urban Blue Infrastructure	• Flooding of water points	High	Sensitivity: • Destruction of water sources Adaptive Capacity: • Improve water structure systems	High	High
Peri-urban and Agricultural Systems	• Crops and soil erosion from heavy rains	High	Sensitivity: • Shallow soils, poor drainage Adaptive Capacity: • Partial water management practices.	High	High

Table 17. Exposure, Vulnerability, and Impacts of fluvial flooding (River on Urban Elements).

Hazard: fluvial flooding (River)



Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	• Erosion and siltation	Medium	Sensitivity: • Limited capacity and blockage	Medium	Medium
			Adaptive Capacity: • Improvements in critical areas		
	• Risk of sewerage overflow	Medium	Sensitivity: • Contamination of water sources	Medium	Medium

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Urban Green Infrastructure	• Loss of urban vegetation	Medium	Sensitivity: • erosion	Medium	Medium
			Adaptive Capacity: • Partial afforestation		
Urban Blue Infrastructure	• Infrastructure Damage	Medium	Sensitivity: • Flood prone	Medium	Medium



Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Water & Wastewater Management			Adaptive Capacity: • Eliminate unplanned flood signs		
Emergency Waste Services Management	Flooded roads limit response Garbage washout	Medium	Sensitivity: • Limited Mobility/resources Adaptive Capacity: • Contamination of water sources • Improved drainage infrastructure	Medium	Medium
Populations					
Urbanity Residents	Infrastructure damage	Medium	Sensitivity: • Low lying roads Adaptive Capacity: • Flood prone areas Adaptive Capacity: • Alternative routes and maintenance Sensitivity: • Moderate preparedness	Medium	Medium
Energy Informal Settlement Residents	Distribution lines disruption Population Displacement	Medium	Sensitivity: • Low lying substation/Weak power lines Housing infrastructure in riparian lines Adaptive Capacity: • Backup systems Sensitivity: • Moderate preparedness	Medium	Medium
Economic Vulnerable and Marginalized Groups	Shops and market flooding Waterborne diseases	medium	Sensitivity: • Low lying commercial centres Adaptive Capacity: • Limited insurance and floodproofing Sensitivity: • Minimal preparedness	Medium	Medium
Social Infrastructure	Flooding of schools and hospitals		• Limited flood protection		



Natural Assets			
Peri-urban and Agricultural Systems	• Food security	Medium	Adaptive Capacity:
			• Partial retention measures
			Sensitivity:
			• Low lying farms
			Adaptive Capacity:
			• Moderate flood adaptation measures
		Medium	Medium

Table 18: Exposure, Vulnerability, and Impacts of Drought (meteorological, hydrological) on Urban Elements

Hazard: Drought (meteorological, hydrological)

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	• Reduced rainfall lowers runoff	Medium	Sensitivity:	High	High
			• Systems designed for peak flows may clog with sediments		
			Adaptive Capacity:		
			• Moderate if maintenance exists		
Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Water & Wastewater Management	• Reduced water availability	Medium	Sensitivity:	High	High
			• High dependence on water sources		
			Adaptive Capacity:		
			• Limited in areas with poor infrastructure.		



Solid Waste Management	• Dry conditions	High	Sensitivity: • Waste accumulation increases fire risk	High	High
			Adaptive Capacity: • Low in informal areas		
Transport and Mobility	• Dusty and degraded roads.	High	Sensitivity: • Unpaved roads highly affected	High	High
			Adaptive Capacity: • Moderate with maintenance.		
Energy	• Reduced hydropower generation	High	Sensitivity: • High reliance on water.	High	High
			Adaptive Capacity: • Moderate with diversification		
Economic Infrastructure	• Reduced productivity	Medium	Sensitivity: • Water-dependent industries	Medium	Medium
			Adaptive Capacity: • Limited for small businesses		
Social Infrastructure	• Water shortages	High	Sensitivity: • Schools and hospitals affected	High	High
			Adaptive Capacity: • Limited.		
Emergency Services	• Increased drought emergencies	Medium	Sensitivity: • Limited resources.	High	High
			Adaptive Capacity: • Moderate		
		High	Sensitivity: • Moderate.	High	High



Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
			Adaptive Capacity: • Varies		
Informal Settlement Residents	• Severe water shortages	High	Sensitivity: • Very High	High	High
			Adaptive Capacity: • Low		
Vulnerable and Marginalized Groups	• Very High	High	Sensitivity: • Very high	High	High
			Adaptive Capacity: • Low		
Natural Assets					
Urban Green Infrastructure	• Reduced water supply	High	Sensitivity: • High	High	High
			Adaptive Capacity: • Low		
Urban Blue Infrastructure	• Reduced rainfall	High	Sensitivity: • High	High	High
			Adaptive Capacity: • Limited irrigation.		
Peri-urban and Agricultural Systems	• Reduced rainfall.	High	Sensitivity: • High	High	High
			Adaptive Capacity: • Limited irrigation		



Table 19: Exposure, Vulnerability, and Impacts of Wildfires & bushfires on Urban Elements
Hazard Wildfires & bushfires

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	Fires reduce vegetation cover leading to increased runoff and sedimentation.	Medium	Sensitivity: - High due to clogging by ash and debris Adaptive Capacity: - Low to moderate due to limited maintenance systems	Medium	Medium
Water & Wastewater Management	Ash contamination affects water sources	Medium	Sensitivity: - High due to reliance on surface and shallow groundwater Adaptive Capacity: - Low in informal areas	Medium	Medium
Solid Waste Management	Destruction of properties increase volumes of waste	Medium	Sensitivity: - High due properties destruction Adaptive Capacity: - Low	Medium	Medium
Transport and Mobility	Fires damage roads and reduce visibility	High	Sensitivity: - High due to limited alternative routes Adaptive Capacity: - Moderate	High	High
Energy	Power lines and installations at risk	High	Sensitivity: High due to above-ground systems	High	High



Economic Infrastructure	Businesses and assets exposed to fire.	High	Adaptive Capacity: Moderate	High	High
			Sensitivity: High especially SMEs		
			Adaptive Capacity: Low		
Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Social Infrastructure	Schools and health facilities exposed		Sensitivity: High	High	High
			Adaptive Capacity: Low		
Emergency Services	Increased demand during fires	High	Sensitivity: High due to limited resources	High	High
			Adaptive Capacity: Moderate		
Populations					
Urban Residents	Increased chances of fire risk	High	Sensitivity: High due to high population	High	High
			Adaptive Capacity: Low		
Informal Settlement Residents	Increase of fire outbreak	High	Sensitivity: Informal setup susceptible for fire	High	High
			Adaptive Capacity: Low		
Vulnerable and Marginalized Groups	Low capability to response to fire	High	Sensitivity: Elderly, young and people living with disability	High	High



Natural Assets				Adaptive Capacity: • More awareness	
Urban Green Infrastructure	• Vegetation are high risk fire	High		Sensitivity: • High Adaptive Capacity: • Low	High
Urban Blue Infrastructure	• Minor exposure to fire.	Low		Sensitivity: • Low Adaptive Capacity: • High	Medium
Category	Exposure (Description)	Exposure Level	Vulnerability Level	Impact Level	
Peri-urban and Agricultural Systems	• Prone to fire outbreak	High	High	Sensitivity: • High Adaptive Capacity: • Low	High



4. Climate Risk Assessment

Kitengela Municipality faces increasing and complex risks associated with climate change, driven by rapid urbanization, population growth, and continuous in-migration into the area. These dynamics have led to the expansion of settlements into environmentally sensitive and ecologically fragile zones, which are more exposed to climate-related hazards such as flooding, heat stress, prolonged dry spells, and land degradation. In addition, a significant proportion of new urban residents have limited financial capacity and adaptive resources, reducing their ability to recover from climate-induced shocks and disasters.

As urbanization continues, the importance of climate risk assessment and resilience planning across Kitengela Municipality becomes increasingly critical. A structured risk assessment process supports the identification of key hazards, estimation of their likelihood and severity, and evaluation of potential impacts on different sectors and population groups. This includes economic losses, damage to infrastructure and services, disruption of social systems, and adverse public health outcomes.

The risk assessment framework therefore provides a basis for prioritizing interventions by highlighting where risks are highest and where adaptive capacity is lowest. It also helps guide the allocation of resources toward the most vulnerable systems and communities, ensuring that adaptation efforts are both targeted and cost-effective. By integrating risk information into planning and decision-making processes, the municipality can better reduce exposure, strengthen resilience, and improve long-term sustainability in the face of a changing climate.

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 20. 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	Medium	High
	Insignificant		Very Low	Low	Low

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

Table 21. 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

Urban elements in Kitengela Municipality are currently experiencing varying levels of climate risk depending on their location, design, and level of service provision. These risks are expected to intensify in the future under both moderate and high emission scenarios, particularly due to increasing temperatures, more frequent extreme rainfall events, and longer dry spells. The interaction between these hazards and existing infrastructure, population distribution, and ecological systems determines the overall risk profile of the municipality.

Infrastructure and service systems are among the most climate-sensitive urban elements. Storm water drainage systems currently face high risk from pluvial flooding, and this risk is expected to remain high or increase in the future due to more intense rainfall events and continued urban expansion. Under both SSP2-4.5 and SSP5-8.5 scenarios, drainage systems are likely to be overwhelmed more frequently, resulting in increased surface flooding, road damage, and



disruption of essential services. Water supply systems face increasing risk from prolonged dry spells and rising temperatures, which reduce groundwater recharge and increase demand. This is expected to place additional pressure on boreholes and shallow wells, increasing the likelihood of water shortages in both mid- and long-term scenarios.

Sanitation and wastewater systems are currently highly vulnerable and are expected to remain at high risk in the future. Increased flooding events will continue to overwhelm pit latrines and septic systems, particularly in informal settlements, leading to contamination of surface and groundwater sources. Solid waste management systems also face persistent risk due to inadequate infrastructure and poor service coverage. Future increases in extreme rainfall will likely worsen drainage blockage and waste dispersal, further amplifying flood impacts. Transport infrastructure is exposed to both flooding and heat stress. Road networks currently experience moderate to high levels of disruption during heavy rainfall, and this risk is expected to increase under future climate scenarios. Poor road conditions combined with more frequent extreme weather events will likely lead to higher maintenance costs, reduced accessibility, and increased economic losses. Energy infrastructure is moderately exposed to climate risks, particularly through storm-related damage to distribution networks, with risks expected to increase under higher intensity storm scenarios.

Population groups face differentiated and increasing levels of climate risk. Informal settlements and low-income households currently experience high levels of exposure to flooding, heat stress, and water scarcity. These risks are projected to intensify under both mid-century and end-century climate scenarios due to worsening environmental conditions and continued settlement expansion into high-risk areas. Vulnerable groups including women-headed households, children, the elderly, persons with disabilities, and informal workers are expected to remain at consistently high risk due to limited adaptive capacity and constrained access to essential services.

Natural assets such as rivers, wetlands, and urban green spaces are also at risk. River systems are expected to experience increased flow variability, with more intense flooding during rainy seasons and reduced base flows during dry periods. This will affect water availability, ecosystem health, and groundwater recharge. Urban green spaces face increasing risk from heat stress and water scarcity, leading to reduced vegetation cover and loss of ecosystem services such as cooling and flood regulation. Peri-urban agricultural systems are projected to remain



among the most vulnerable assets, with high risk under all future scenarios due to combined exposure to drought, heat stress, and extreme rainfall events.

Overall, future climate risk in Kitengela Municipality is expected to become more frequent, more intense, and more spatially widespread. Without targeted adaptation measures, the most severe impacts will continue to be concentrated in informal settlements, infrastructure-deficient areas, and peri-urban zones, reinforcing existing patterns of vulnerability and inequality.

Table 22: Summary of Extreme Heat risks for The Municipality of Kitengela

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

KITENGELA MUNICIPALITY

Date:

APPROVE

Q. 801100, KAJI



Natural Assets
Urban Green
Urban Blue Medium
Infrastructure
Peri-urban and
Agricultural Systems

Infrastructure
Medium High High High

Populations

Medium Medium High High High
High High

Table 23: Summary of Changes in Precipitation Patterns risks for The Municipality of Kajiado

Kajiado

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



Peri-urban and Agricultural Systems	High	Very High	Very High	Very High	Very High	Very High
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Table 24: Summary of Fluvial Flooding risks for The Municipality of Kitengela

Table 24: Summary of Fluvial Flooding risks for The Municipality of Klerksburg						
Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP2-8.5
Infrastructure & Services						
Stormwater Drainage	Medium	Medium	Medium	High	High	High
Water & Wastewater Management	Medium	Medium	Medium	High	High	High
Solid Waste Management	Medium	Medium	Medium	High	High	High
Transport and Mobility	Medium	Medium	Medium	High	High	High
Energy	Medium	Medium	Medium	High	High	High
Economic Infrastructure	Medium	Medium	Medium	High	High	High
Social Infrastructure	Medium	Medium	Medium	High	High	High
Emergency Services	Medium	Medium	Medium	High	High	High
Populations						
Urban Residents	Medium	Medium	Medium	High	High	High
Informal Settlement Residents	High	High	High	High	High	High
Vulnerable and Marginalized Groups	High	High	High	High	High	High
Natural Assets						
Urban Green Infrastructure	Medium	Medium	Medium	High	High	High
Urban Blue Infrastructure	Medium	Medium	Medium	High	High	High
Peri-urban and Agricultural Systems	Medium	Medium	Medium	High	High	High

Table 25: Summary of Drought risks for The Municipality of Kitengela

Categories	Impact	Risk Levels				
		Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP2-8.5
Infrastructure & Services						
Stormwater Drainage	Medium	Medium	High	High	High	Very High



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

Table 26: Summary of Wildfires & Bushfires risks for The Municipality of Kitengela

Categories	Impact	Risk				
		Levels				
		Current	2050 SSP2- 4.5	2050 SSP5-8.5	2100 SSP2- 4.5	2100 SSP5- 8.5
Infrastructure & Services						
Storm water Drainage	Medium	Medium	Medium	High	High	High
Water & Wastewater Management	Medium	Medium	Medium	High	High	High
Solid Waste Management	Medium	Medium	Medium	High	High	High
Transport and Mobility	Medium	Medium	Medium	High	High	High
Energy	Medium	Medium	Medium	High	High	High
Economic Infrastructure	Medium	Medium	Medium	High	High	High



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

4.2. Climate Risk Hotspots

Climate risks in Kitengela Municipality vary significantly across different wards and sublocations, reflecting differences in topography, land use, infrastructure provision, and levels of urban development. This spatial variation in risk has important implications for planning, as it highlights the need for targeted and location-specific adaptation interventions rather than uniform municipality-wide responses.

Low-lying areas and locations adjacent to seasonal rivers and drainage channels represent key flood risk hotspots. These areas are particularly exposed to pluvial flooding during periods of intense rainfall due to poor drainage capacity, encroachment into riparian zones, and increased surface runoff from expanding built-up areas. Informal settlements located within these zones are especially vulnerable, experiencing recurrent flooding, property damage, and disruption of livelihoods during heavy rainfall events.

Elevated and peri-urban areas, on the other hand, tend to experience higher levels of water stress and prolonged dry spells. These areas are often more dependent on boreholes and shallow wells, which are highly sensitive to declining groundwater recharge during extended dry periods. As a result, households and small-scale users in these zones face periodic water shortages, increased water costs, and reduced resilience during drought conditions.

Heat stress hotspots are generally concentrated in densely built-up urban areas, particularly in commercial centers and informal settlements where vegetation cover is limited and building materials such as iron sheets and concrete contribute to the urban heat island effect. These areas



experience higher daytime temperatures and reduced nighttime cooling, increasing risks to public health, labor productivity, and general well-being.

Areas undergoing rapid land-use change and environmental degradation are emerging as gully erosion hotspots. These include locations affected by uncontrolled sand harvesting, deforestation, and poorly planned construction activities. In such areas, exposed soils combined with intense rainfall events accelerate erosion processes, leading to land degradation, infrastructure damage, and increased sedimentation in drainage systems and waterways.

Overall, the distribution of climate risk hotspots in Kitengela Municipality is strongly influenced by physical geography and patterns of urban expansion. Downstream and low-lying areas are more prone to flooding, while upland and peri-urban zones are more exposed to drought and water stress. Densely built urban cores face heightened heat stress, and environmentally degraded areas are increasingly affected by erosion. This spatial pattern underscores the importance of integrating climate risk mapping into land use planning, infrastructure investment, and service delivery to ensure that interventions are appropriately targeted to the most vulnerable locations.



HAZARDS/RISK FOR KAJIADO EAST SUB-COUNTY

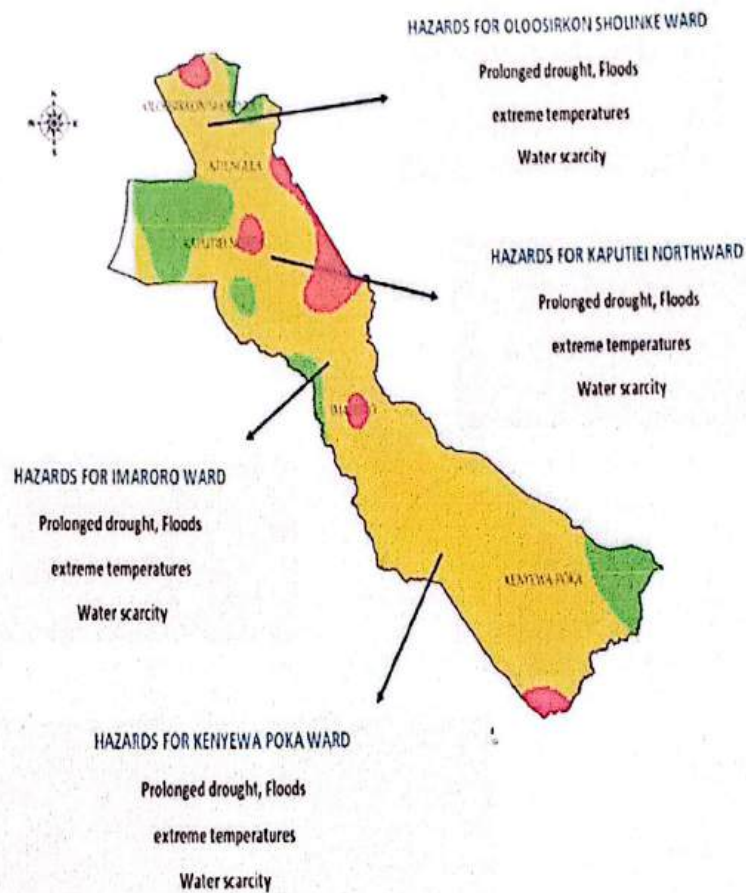


Figure 10: Kitengela Municipality hazard hotspot areas.

5. What's Next?

5.1. Key Findings

Kitengela Municipality, located within Kajiado County and part of the rapidly growing Nairobi Metropolitan Area, is experiencing increasing climate-related risks driven by both environmental and socio-economic pressures. The following are the key findings from the climate risk profile:

Increasing Climate Hazards



Kitengela is highly exposed to recurrent droughts, erratic rainfall, and flash floods. Changes in rainfall patterns influenced by the Inter-Tropical Convergence Zone have resulted in prolonged dry spells followed by intense rainfall events, leading to water scarcity and flood damage.

High Vulnerability Due to Rapid Urbanization

Rapid population growth and unplanned urban expansion have increased vulnerability, particularly in informal settlements. Poor drainage systems, encroachment on riparian land, and inadequate infrastructure exacerbate flood risks and environmental degradation.

Water Stress and Resource Competition

Despite proximity to Nairobi, Kitengela faces chronic water shortages. Over-reliance on boreholes has led to declining groundwater levels and quality concerns. Climate variability further strains already limited water resources.

Livelihood Sensitivity

Local livelihoods especially livestock keeping and small-scale trade—are highly climate-sensitive. Drought conditions reduce pasture availability, affecting income and food security, while floods disrupt transport and business activities.

Weak Climate-Resilient Infrastructure

Infrastructure such as roads, drainage systems, and waste management facilities is not adequately designed to withstand extreme weather events. This increases the cost of maintenance and disaster recovery.

Environmental Degradation

Land subdivision, sand harvesting, and loss of vegetation cover have reduced the natural ecosystem's ability to buffer climate impacts. This contributes to soil erosion, reduced water retention, and increased flood intensity.

Institutional and Governance Gaps

Although frameworks like the National Environment Management Authority and policies such as the National Climate Change Action Plan exist, implementation at the municipal level remains weak due to limited technical capacity, funding constraints, and coordination challenges.

Limited Community Awareness and Preparedness

Public awareness of climate risks and disaster preparedness is still low. Early warning systems are underutilized despite support from agencies such as the Kenya Meteorological Department.



Opportunities for Climate Resilience

- Adoption of climate-smart urban planning
- Investment in sustainable water supply systems
- Strengthening public-private partnerships (PPP)
- Leveraging programs like locally led climate action initiatives
- Enhancing ecosystem restoration (tree planting, riparian protection)

Table 27: Summary of climate risks affecting urban elements for The Municipality of Kitengela

Category	List of Key Hazards		
	Current	Mid-term (2050)	Long-term (2100)
Infrastructure & Services			
Stormwater Drainage	Flooding (High)	Flooding (Very High)	Flooding (Very High)
Water & Wastewater Management	Drought (High)	Drought (Very High)	Drought (Very High)
Solid Waste Management	N/A	N/A	N/A
Transport and Mobility	Flooding (High), Heat (Medium)	Flooding (Very High), Heat (High)	Flooding (Very High), Heat (Very High)
Energy	Heat (Medium), Fire (Medium)	Heat (High), Fire (High)	Heat (Very High), Fire (High)
Economic Infrastructure	Flooding (Medium)	Flooding (High)	Flooding (High)
Social Infrastructure	Flooding (High), Heat (Medium)	Flooding (Very High), Heat (High)	Flooding (Very High), Heat (Very High)
Emergency Services	Flooding (Medium)	Flooding (High)	Flooding (High)
Populations			
Category	List of Key Hazards		
	Current	Mid-term (2050)	Long-term (2100)
Urban Residents	Heat (Medium), Flooding (Medium)	Heat (High), Flooding (High)	Heat (Very High), Flooding (Very High)



Informal Settlement Residents	Flooding (High), Fire (Medium)	Flooding (Very High), Fire (High)	Flooding (Very High), Fire (High)
Vulnerable and Marginalized Groups	Heat (Medium), Drought (Medium)	Heat (High), Drought (High)	Heat (Very High), Drought (Very High)
Natural Assets			
Urban Green Infrastructure	Heat stress (Medium)	Heat stress (High)	Heat stress (High)
Urban Blue Infrastructure	Flooding (Medium)	Flooding (High)	Flooding (High)
Peri-urban and Agricultural Systems	Drought (High), Fire (Medium)	Drought (Very High), Fire (High)	Drought (Very High), Fire (High)

5.2. Climate Adaptation and Resilience Solutions

Building on the identified risks, Kitengela Municipality (within Kajiado County) requires integrated, locally appropriate, and scalable adaptation solutions aligned with national frameworks such as the National Climate Change Action Plan and implemented through institutions like the National Environment Management Authority.

5.2.1 Climate-Resilient Urban Planning and Land Use Management • Enforce zoning

regulations to prevent settlement in flood-prone and riparian areas.

- Integrate climate risk considerations into municipal spatial plans and County Integrated Development Plans (CIDPs).
- Promote compact, planned urban growth to reduce environmental degradation.

Local relevance: Rapid urban expansion in Kitengela has increased flood vulnerability and land degradation.

5.2.2 Sustainable Water Resource Management • Promote rainwater harvesting

systems at household, institutional, and commercial levels.

- Develop and rehabilitate water storage infrastructure (e.g., community water pans, tanks).
- Regulate borehole drilling and encourage groundwater recharge initiatives.
- Enhance water quality monitoring in collaboration with Kenya Meteorological Department and water agencies.

Local relevance: Addresses chronic water shortages and declining groundwater levels.

5.2.3 Climate-Smart Agriculture and Livelihood Diversification

- Promote drought-tolerant crops and livestock breeds through institutions like Kenya Agricultural and Livestock Research Organization.



- Encourage alternative livelihoods such as agribusiness, eco-tourism, and small-scale enterprises.
- Support pasture management and fodder storage systems.

Local relevance: Enhances resilience of peri-urban and pastoral communities in Kitengela.

5.2.4 Flood Risk Management and Stormwater Infrastructure.

- Upgrade drainage systems to handle increased rainfall intensity.
- Restore and protect natural drainage channels and wetlands.
- Introduce **nature-based solutions** such as green infrastructure (permeable pavements, urban green spaces).

Local relevance: Reduces impacts of flash floods common during heavy rains.

5.2.5 Ecosystem Restoration and Environmental Conservation.

- Promote afforestation and reforestation in partnership with Kenya Forest Service.
- Protect riparian zones and wetlands from encroachment.
- Regulate sand harvesting and land degradation activities.

Local relevance: Restores natural buffers that reduce climate risks like flooding and drought.

5.2.6 Climate-Resilient Infrastructure Development. • Design and construct roads, drainage, and buildings to withstand extreme weather events.

- Incorporate climate risk assessments in all infrastructure projects.
- Promote use of durable, locally available construction materials.

Local relevance: Reduces economic losses and improves service delivery during climate shocks.

5.2.7 Strengthening Disaster Risk Management (DRM) Systems. •

Establish and operationalize local disaster response units.

- Enhance early warning systems in collaboration with National Drought Management Authority.
- Develop community-based disaster preparedness and response plans.

Local relevance: Improves preparedness for droughts, floods, and other climate hazards.

5.2.8 Institutional Capacity Building and Governance. • Strengthen coordination

between county departments, municipality, and national agencies.

- Build technical capacity for climate risk assessment and planning.
- Enhance enforcement of environmental regulations by National Environment Management Authority.



Local relevance: Addresses gaps in implementation and governance.

5.2.9 Community Awareness and Public Participation.

- Conduct climate awareness campaigns and training programs.
- Promote community participation in planning and decision-making.
- Support local climate action groups and youth initiatives.

Local relevance: Empowers communities to adopt sustainable practices and improve resilience.

5.2.10 Climate Financing and Partnerships

- Leverage funding from national programs and international partners.
- Promote **Public-Private Partnerships (PPP)** for climate-resilient infrastructure.
- Utilize programs such as locally led climate action initiatives (e.g., FLLoCA).

Local relevance: Ensures sustainable financing for adaptation interventions.



Table 28: Climate adaptation and resilience solutions recommended for Kitengela Municipality.

Category	Recommended Solutions		
	Immediate	Mid-term	Long-term
Infrastructure & Services			
Stormwater Drainage	• Clear and maintain drains • Construct temporary retention ponds	• Upgrade drainage networks • Integrate flood-resilient road designs	• Build permanent retention ponds and flood storage systems • Expand climate-resilient infrastructure in hotspots
Water & Wastewater Management	• Protect boreholes and storage tanks • Promote water conservation	• Expand storage capacity and diversify water sources • Smart water monitoring systems	• Climate-resilient water treatment and distribution • Groundwater recharge programs
Solid Waste Management	• Community clean-up campaigns • Waste segregation awareness	• Construct flood-resilient waste collection points	• Integrate waste-to-energy solutions in urban planning
Transport and Mobility	• Repair and maintain critical roads • Temporary flood barriers	• Upgrade roads and bridges to climate-resilient standards • Develop alternative evacuation routes	• Climate-proof transport network • Public transport infrastructure adaptation
Energy	• Inspect and maintain substations • Fire prevention measures	• Distributed solar microgrids • Reinforce energy distribution	• Climate-resilient energy infrastructure • Expand renewable energy backup systems
Economic Infrastructure	• Conduct vulnerability audits • Temporary flood mitigation	• Elevate and retrofit high-risk structures • Business continuity plans	• Integrate climate risk into all urban development projects
Social Infrastructure	• Emergency water and cooling centers • Staff training for heat/flood	• Upgrade hospitals and schools with resilient designs • Backup water and energy	• Integrate climate adaptation into all social infrastructure projects
Emergency Services	• Equip emergency teams for heat/flood/fire • Community drills	• Expand disaster management centers • Early warning systems	• Institutionalize climate-smart emergency services and response



Urban Residents	- Heat awareness campaigns - Evacuation drills	Community cooling centers • Water distribution	- Integrate adaptation into urban planning - Vulnerability mapping
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Recommended Solutions			
Category	Immediate	Mid-term	Long-term
Informal Settlement Residents	- Flood response planning - Fire safety awareness	- Flood-resilient housing upgrades - Shaded communal areas	- Relocation planning for high-risk areas - Infrastructure formalization
Vulnerable and Marginalized Groups	- Targeted assistance programs - Health support	- Adaptive livelihood programs - Heat/drought shelters	- Social safety nets - Long-term community-based adaptation
Natural Assets			
Urban Green Infrastructure	- Tree planting campaigns - Green shading for public spaces	- Expand urban parks - Drought-resistant landscaping	- Integrate urban green corridors - Ecosystem-based adaptation planning
Urban Blue Infrastructure	- Maintain rivers and small reservoirs - Prevent illegal encroachment	- Construct retention ponds and buffer zones - Wetland restoration	- Integrated urban water management - Floodplain protection
Peri-urban and Agricultural Systems	- Promote drought-tolerant crops - Firebreaks	- Climate-smart agriculture - Irrigation infrastructure	- Agroforestry and ecosystem restoration - Water storage expansion



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- Kenya Meteorological Department. *Climate Data and Seasonal Forecasts*.
- Ministry of Agriculture Livestock Fisheries and Cooperatives. *Climate Risk Profile Data Sets (2016–2021)*.
- Kajiado County Government. *County Integrated Development Plan (CIDP)*.
- Kajiado County Government. *County Climate Change Action Plan (if available)*.
- National Environment Management Authority. *Environmental Impact Assessment and Audit Reports*.

Annex: Historical Hazard Events.

Kitengela Municipality, located in Kajiado County, has experienced a range of recurrent climate-related hazard events over the years. While site-specific historical records for



Kitengela are limited, county-level and national datasets provide reliable evidence of hazard trends affecting the municipality due to its proximity to Nairobi and similar ecological conditions.

Table 29: Key Historical Hazard Events Affecting Kitengela and Environs

Year / Period	Hazard Type	Description of Event	Impacts in Kitengela / Kajiado Context
1980s (Historical baseline)	Severe drought	One of the longest drought periods recorded in the region	Massive livestock losses, water scarcity, and livelihood disruptions
2016–2017	El Niño-related floods	Above-normal rainfall across Kenya leading to flooding in urban and periurban areas	Localized flooding, infrastructure damage, and displacement
2019–2020	Prolonged drought	Below-average rainfall seasons across Kenya	Reduced pasture, water shortages, and declining livestock productivity
2020–2022	Extreme multiyear drought	Three consecutive years of failed rains in Kajiado County	Up to 70% livestock losses and severe crop failure; water crisis intensified
2023	Erratic rainfall & heat stress	Irregular rainfall patterns and rising temperatures	Increased water demand, reduced agricultural productivity
2024 (March–May)	Severe floods (El Niño / long rains)	Heavy rainfall caused widespread flooding across Kenya, including areas near Kitengela	Homes flooded, roads damaged, and emergency rescues conducted in Kitengela
2025	Erratic rainfall patterns	Late onset and uneven distribution of rains affecting agriculture	Crop stress, reduced yields, and increased vulnerability
2026 (ongoing trends)	Intensifying drought & flood cycles	Alternating drought and flood events linked to climate variability	Livelihood losses, resource conflicts, and increased vulnerability in Kajiado

Key Observations from Historical Trends

Increasing Frequency of Drought

- Drought is the most dominant hazard in Kitengela and the wider Kajiado region.
- Recent droughts (2020–2022) were among the worst in 40 years, causing extensive livestock deaths and economic losses.



Emerging Pattern of Flood Events

- Traditionally semi-arid, the area is now experiencing more frequent flash floods, especially during intense rainfall seasons.
- The 2024 floods demonstrated increasing vulnerability of peri-urban areas like Kitengela due to poor drainage and rapid urbanization.

Climate Variability and Extremes

- Climate trends show alternating cycles of drought and heavy rainfall, rather than stable seasonal patterns.
- This variability is consistent with national observations of increasing extreme weather events in Kenya.

Socio-Economic Impacts • Livelihoods (pastoralism, small-scale trade) are highly affected by these hazards.

- Drought leads to livestock mortality and food insecurity, while floods damage infrastructure and disrupt businesses.

Link to Environmental Degradation

- Land subdivision, deforestation, and poor land-use practices have exacerbated hazard impacts, especially flooding and drought severity

Annex: Data Sources

The table below presents key data sources, the type of data used, and the relevant section/page of the climate risk profile where each dataset is applied. These sources are drawn from Kenyan national institutions and Kajiado County-level documents, which are standard for localized climate risk assessments.

TABLE 30: Data Sources.

Profile Section / Page	Data Used	Data Source
Baseline Information	Population, demographics, urban growth trends	Kenya National Bureau of Statistics (KNBS Census Reports)
Climate Overview	Rainfall patterns, temperature trends, seasonal forecasts	Kenya Meteorological Department (KMD Climate Reports & Data)
Historical Hazard Events	Records of droughts, floods, and extreme weather events	Kenya Meteorological Department; National Drought Management Authority (NDMA Reports)



Hazard Mapping	Drought indices (SPI, VCI), flood-prone zones	National Drought Management Authority; Kenya Meteorological Department
Water Resources	Groundwater levels, borehole data, water demand/supply	Kajiado County Water Department; Water Resources Authority
Land Use and Urban Development	Land subdivision, zoning, spatial growth patterns	Kajiado County Government (CIDP & Spatial Plans)
Environmental Status	Vegetation cover, land degradation, EIA reports	National Environment Management Authority (NEMA Reports)
Agriculture and Livelihoods	Crop production, livestock data, climate impacts	Kenya Agricultural and Livestock Research Organization (KALRO); Ministry of Agriculture
Disaster Risk and Vulnerability	Community vulnerability, disaster response data	National Disaster Management Unit; National Drought Management Authority
Socio-economic Data	Income levels, poverty indices, employment	Kenya National Bureau of Statistics
Infrastructure	Roads, drainage systems, housing data	Kajiado County Government; Kenya Urban Roads Authority
Policy and Institutional Framework	Climate policies, adaptation frameworks	Government of Kenya (NCCAP, NAP); National Environment Management Authority
Climate Projections	Future climate scenarios, risk modelling	Kenya Meteorological Department; World Bank Climate Data
Community Perceptions	Local knowledge, stakeholder consultations, participatory assessments	Public participation forums; Kajiado County stakeholder reports
Early Warning Systems	Weather alerts, drought early warning bulletins	Kenya Meteorological Department; National Drought Management Authority

