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COUNTY GOVERNMANT OF MIGORI

AWENDO MUNICIPALITY

URBAN CLIMATE RISK PROFILE

FOR

AWENDO MUNICIPALITY

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Prepared by:
Awendo Municipality
Under the State Department for Housing and Urban Development
Kenya Urban Support Programme Phase II (KUSP II)

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Foreword

Climate change continues to present growing challenges to our urban areas, affecting lives, infrastructure, and the sustainability of municipal development. As urbanization accelerates, municipalities must proactively integrate climate risk considerations into planning and investment decisions. The Urban Climate Risk Profile for Awendo Municipality is an important step toward building a resilient and sustainable future for our communities.

This profile provides an in-depth analysis of the climate-related hazards, vulnerabilities, and exposure within Awendo Municipality and the wider Migori County. It highlights key risks such as flooding, heat stress, and water resource challenges, while also identifying opportunities to strengthen resilience through informed planning, climate-smart infrastructure, and enhanced community awareness.

The preparation of this Urban Climate Risk Profile was undertaken by the Municipality following a two-day Climate Risk Profile Training organized by the State Department for Housing and Urban Development under the Kenya Urban Support Programme Phase II (KUSP II). The training was delivered by the Global Center on Adaptation (GCA) in partnership with the World Bank, the Government of Kenya, and the Council of Governors, held on September 22–23, 2025, in Nairobi, Kenya.

We appreciate the technical guidance and capacity support provided through this collaboration, which has enabled our Municipality to generate data-driven insights for climateresilient urban planning. This document will serve as a critical tool for policymakers, urban planners, and development partners as we align our strategies with Kenya's broader climate adaptation and sustainable urban development goals.

On behalf of the Awendo Municipal Board, I commend the efforts of the Municipal Environment Officer, Mr. Beaky Sunday Kamagy, and the technical team for their commitment in developing this important report. I also acknowledge the support of Migori County Government and all stakeholders who contributed invaluable input to this initiative.

Together, we are laying the foundation for a resilient, inclusive, and sustainable Municipality that can withstand the impact of climate change and ensure the well-being of our municipal residents for generations to come.

Hon. Florence Abich Oile

Chairperson, Awendo Municipal Board

Executive Summary

Table 1. Summary of Pluvial Flooding risks for Awendo 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	Very High	High	Very High

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

Table 2. Summary of Drought risks for Awendo 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 Low	Low	Low	Low	Low
Water & Wastewater Management	Medium	Medium	Very High	High	Very High
Category	**Risk Level**				
	Current	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Solid Waste Management	Low	Low	Medium	Low	Medium

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

Table 3. Summary of Heat Stress/Extreme Heat risks for Awendo Municipality

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

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

Table 4. Summary of Land degradation risks for Awendo Municipality

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

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

Table 5. Summary of Changes in Precipitation Patterns risks for Awendo Municipality

Category	**Risk Level**				
	Current	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Infrastructure & Services					
Storm water Drainage	Low	Low	High	Medium	High
Water & Wastewater Management	Medium	Medium	Very High	High	Very High
Solid Waste Management	Low	Low	High	Medium	High

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

Contents

List of Acronyms

ASAL's	**Arid and Semi-Arid Lands**
CCAP	**County Climate Change Action Plan**
COG	**Council of Governor's**
CSO's	**Civil Society Organizations**
CIDP	**County Integrated Development Plan**
DRR	**Disaster risk reduction**
GCA	**Global Center on Adaptation**
GHG	**Green House Gas**
KUSP	**Kenya Urban Support Programme**
KNBS	**Kenya National Bureau of Statistics**
PWD	**Persons with Disability**
NCCAP	**National Climate Change Action Plan**
NDOC	**National Disaster Operations Centre**
NEMA	**National Environmental Management Authority**
PCRA	**Participatory Climate Risk Assessment**
RCRA	**Rapid climate risk assessment**
UNCED	**United Nations Conference on Environment and Development**
UNFCC	**United Nations Framework Convention on Climate Change**
VMG	**Vulnerable and Marginalized Groups**
VTC	**Vocational Training Centres**
KMTC	**Kenya Medical Training College**

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1. Context

1.1. Objective

This Urban Climate Risk Profile aims to identify, assess, and document the key climate-related risks affecting Awendo Municipality. It seeks to understand the extent and impact of hazards such as flooding, drought, heat stress, Pests and diseases, change in precipitation patterns and land degradation on the Populations, urban systems, infrastructure, and communities. The profile further aims to provide evidence-based insights to guide local planning, enhance climate resilience, and inform the integration of adaptation and mitigation measures into municipal development strategies.

1.2. Urban Context

Awendo Municipality in Migori County, Kenya, is a rapidly urbanizing agricultural town covering approximately 117.2 km2, centered around the sugar industry (SONY) and major nodes like Mariwa and Rapogi market centers. Awendo is equally experiencing rapid, often uncontrolled development and urban decay, requiring strategic planning to manage infrastructure and land use. The town is transitioning with new roads, markets and recreation investments.

- **Location and Geography:** Situated 26km from Migori town, the municipality features low-lying plains and the Awendo Hills. It includes the main urban core, SONY, and nodal centers of Mariwa, Rapogi, and Kokuro.
- **Economic Drivers:** The economy is heavily driven by the sugar industry, supplemented by trade, agricultural processing, and small-scale businesses.
- **Infrastructure and Challenges:** While possessing key services, the town faces issues with uncontrolled development, encroachment of kiosks on road reserves, and inadequate waste management.
- **Development Focus:** Current efforts under the Integrated Strategic Urban Development Plan (ISUDP) include upgrading roads to bitumen standards, improving sanitation, constructing markets, and establishing a public recreational park.

Figure 1; Geographic area

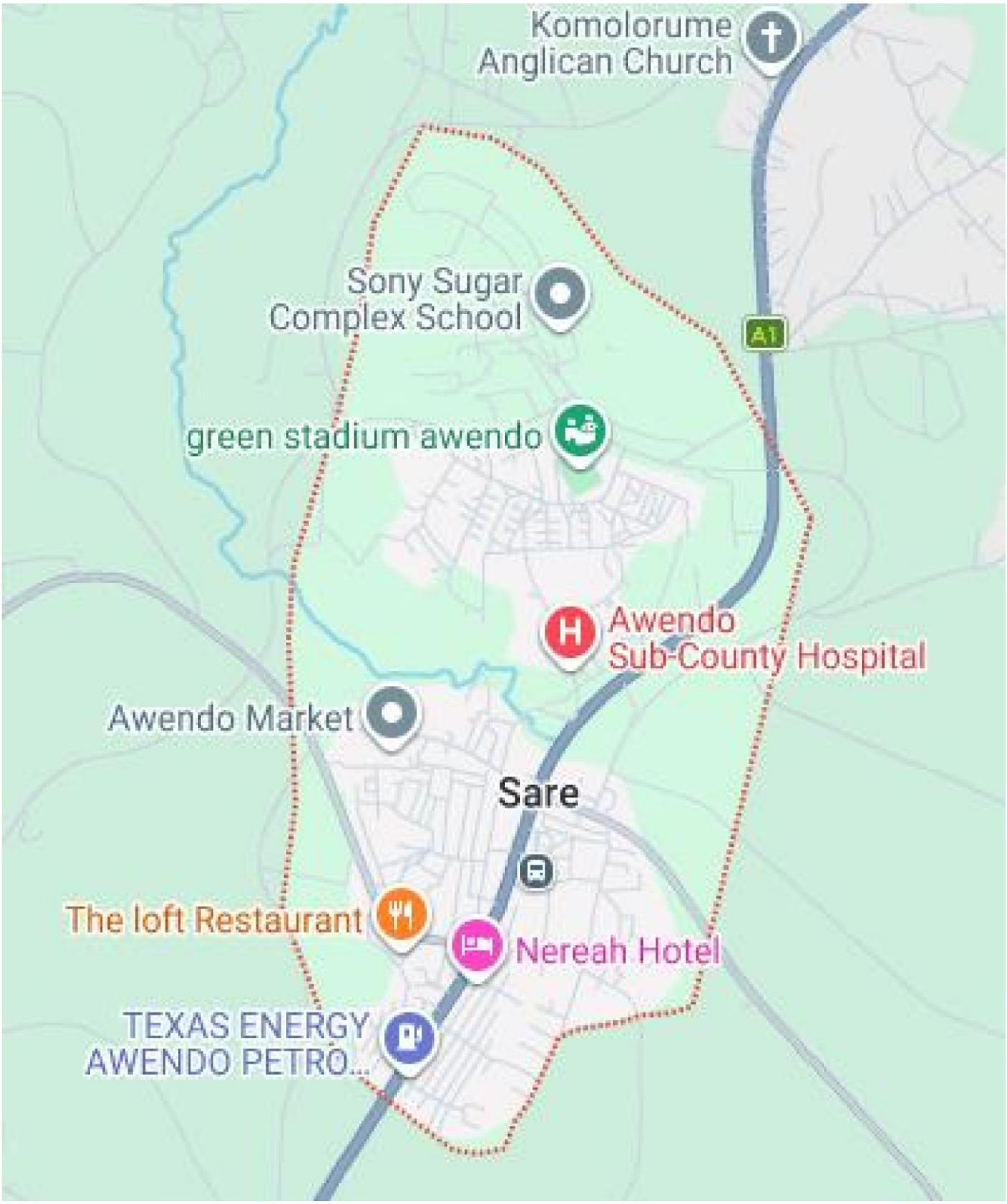
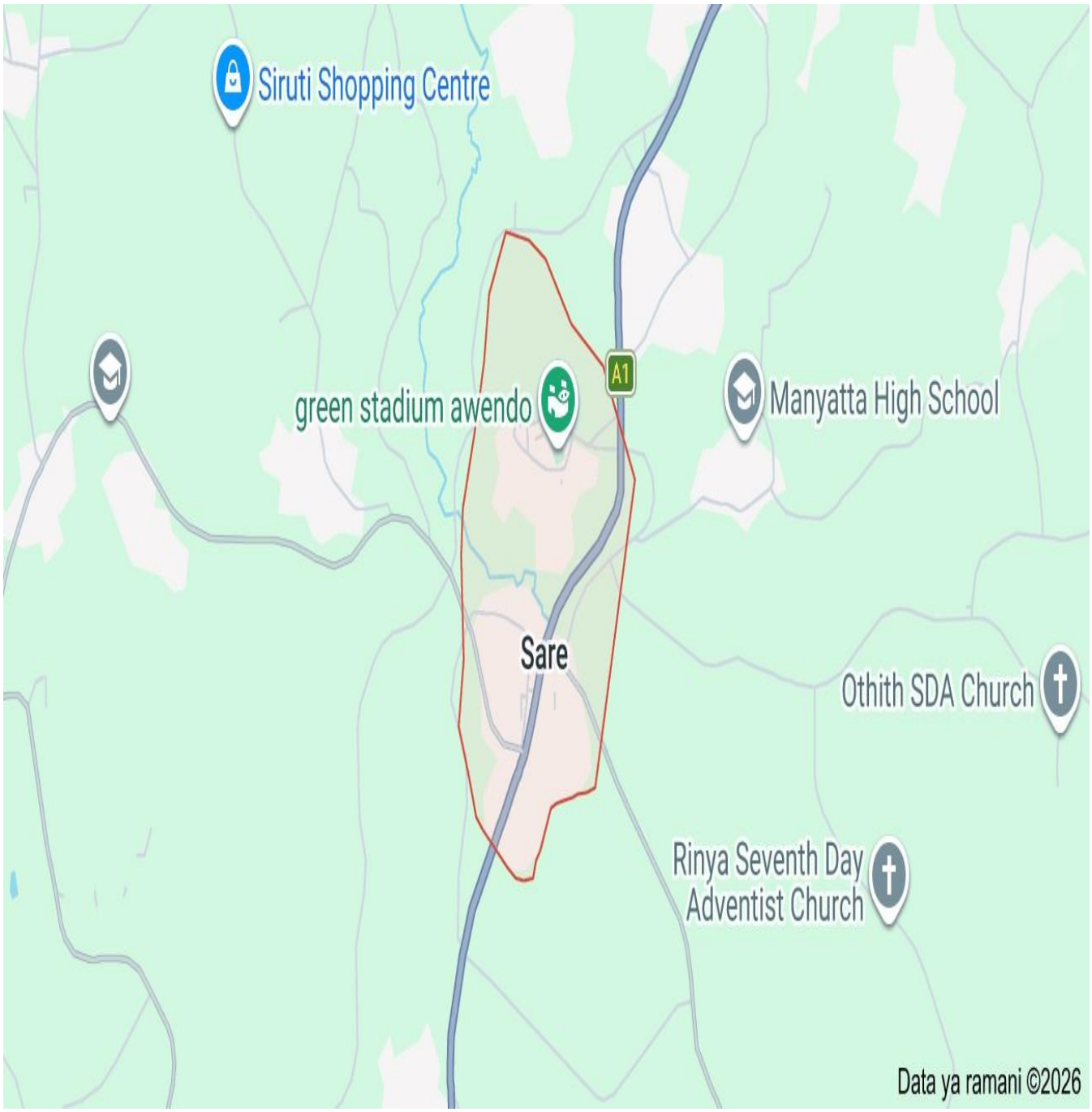


Figure 2: Awendo Municipality Basemap



1.2.1. Governance Structure

Administered by the Awendo Municipal Board (operational since 2019), the town is managed under the County Government of Migori to improve service delivery and urban planning.

The municipality's vision focuses on transforming into a green, clean, and sustainable economic zone, addressing past infrastructure deficiencies through structured, participatory planning.

The Municipal Board of Awendo is the primary governing body responsible for oversight, policy guidance, and decision-making on urban development matters. The Municipal Manager serves as the administrative head, coordinating the daily operations and implementation of municipal projects, including climate resilience and environmental sustainability initiatives.

The Climate Risk Profile (CRP) was developed collaboratively under the Kenya Urban Support Programme Phase II (KUSP II), with technical guidance from the State Department for Housing and Urban Development (SDHUD), in partnership with the Global Center on Adaptation (GCA), the World Bank, and the Council of Governors (C.o.G).

At the county level, preparation of the Integrated Development Plan (CIDP) is led by the Department of Finance, Economic Planning, and Development, working in coordination with the Department of Lands, Physical Planning, and Urban Development, and Awendo Municipal Board to ensure that climate resilience priorities identified in the RCRP are integrated into broader development frameworks.

Organogram for Awendo Municipality Responsible for RCRP

National Government

├── State Department for Housing and Urban Development (SDHUD)

│ └── Kenya Urban Support Programme (KUSP II)

│ └── Technical Partners: GCA, World Bank, CoG

│

└── County Government of Awendo

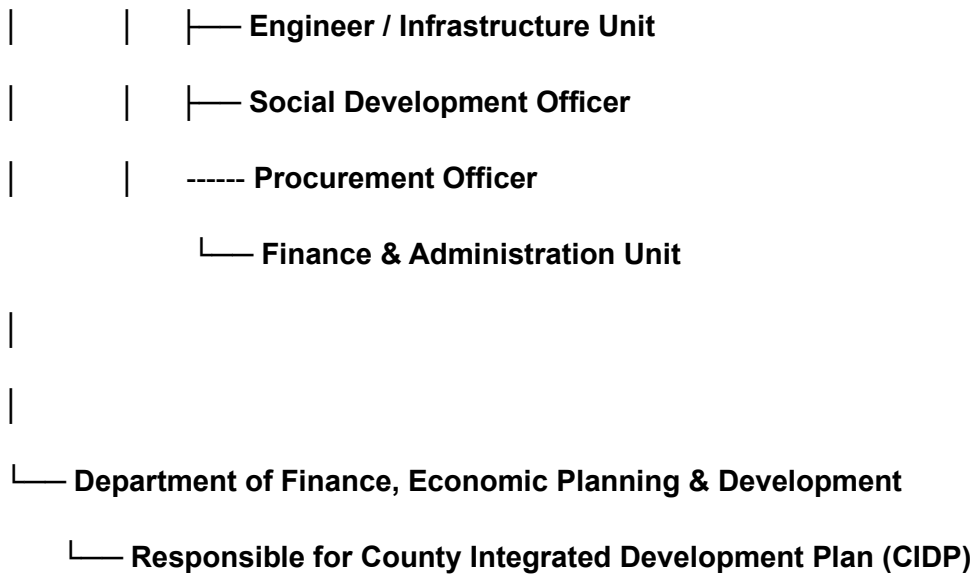
├── Department of Lands, Physical Planning & Urban Development

│ └── Awendo Municipal Board

│ ├── Municipal Manager

│ │ ├── Environment Officer

│ │ ├── Physical Planning Officer



1.2.2. Socio-economic Context

Awendo Municipality in Migori County is a rapidly growing urban center driven primarily by the sugarcane industry, commercial trading, and small-scale enterprises. The socioeconomic context focuses on enhancing infrastructure, such as road networks and market construction (e.g., Rapogi and Ranen markets), promoting investment, and improving public services to foster a "Green, Clean, Safe" environment. Key challenges include improving women-owned businesses' growth, addressing waste management, and reducing reliance on traditional farming.

Key Socio-Economic Aspects

- **Economic Drivers:** The economy heavily relies on the sugar industry (SareAwendo) and associated agricultural supply chains. Trade is a significant contributor, with initiatives to develop modern markets to boost commerce.

- **Infrastructure Development:** Current projects focus on upgrading town roads to bitumen standards, improving waste management, and installing public amenities like boreholes for water supply.
- **Demographic & Social Focus:** The municipality aims for inclusive development, focusing on public participation and providing social services for its residents.
- **Small-Scale Enterprises:** Women-owned businesses are a growing segment, although they face challenges related to knowledge and skills, which hinder growth.
- **Urban Planning:** The municipality is implementing a 5-year Integrated Development Plan (IDeP) to guide urban growth, land use, and service delivery.
- **Social Services:** There is a strong focus on enhancing public health, education, and social protection services.

Awendo is transforming from a solely agricultural-dependent town into a vibrant commercial hub through targeted investment in infrastructure and services.

This rapid demographic growth will intensify the demand for housing, infrastructure, health, and education services, while also heightening exposure to climate-related risks such as flooding, water scarcity, and heat stress.

Ward	Population (2019)	Estimated Population (2030)	Key Characteristics / Notes
Central Sakwa	14,623	33,000	Densely populated, serves as a key commercial and administrative hub for Awendo sub-county headquarters. It is also located along key access roads thus having a moderate risk of flooding. It is also characterized by residential and institutional expansion having the presence of institutions like Sony sugar factory and KMTC Awendo campus.
South Sakwa Ward	17,750	41,000	Rural agricultural ward with potential for future densification. It is also an agricultural area transitioning to peri-urban land use.
North Sakwa	11,768	26,500	Hilly and erosion-prone; largely considered a gold mining zone. It has a sizeable population engaging in agricultural activities and thus is considered a rich agricultural zone.

West Sakwa	10,130	34,000	With the presence of upcoming commercial centers like Dede and Rabondo it is still considered Semi-rural but with a great potential for growth

Note: Population projections assume an average annual growth rate of 3.5%, consistent with urban growth trends observed in southern part of Nyanza province.

The municipality is characterized by a high population density and a youthful demographic with a median age of 23 years. The combined area of central and south sakwa wards which forms a significant portion of the municipality's core, had a 2009 population of approximately 38,807

Demographic Composition

Population

The population development of Awendo as well as related information and services.

Name	Status	Population Census 2009-08-24	Population Census 2019-08-24
Awendo	Municipality	108,913	117,290

Source: Kenya National Bureau of Statistics.

Further information about the population structure:

Males 48%

Females 52%

Gender (C 2019)	
Males	56,348
Females	60,939
Intersex	3

Age Distribution	Males	Females
90+ years	50	83
80-89 years	268	459
70-79 years	703	1036
60-69 years	1397	2052
50-59 years	2060	2567
40-49 years	3923	3913
30-39 years	6403	6984
20-29 years	8258	10371
10-19 years	16600	16744
0-9 years	16684	16727

Age Distribution (C 2019)	
90+ years	133
80-89 years	727
70-79 years	1,739
60-69 years	3,449
50-59 years	4,627
40-49 years	7,836
30-39 years	13,387
20-29 years	18,629
10-19 years	33,344
0-9 years	33,411

Vulnerable groups—particularly women, youth, and persons with disabilities (PWDs)—are disproportionately affected by climate impacts due to limited adaptive capacity and economic marginalization.

Projected Population Growth (2020–2040+)

Year	Estimated Population	Growth (%)
2019	117,290	—
2025	125,400	25.5%
2030	151,000	51%
2040 (Projection)	~200,000	100% increase

Population Density and Urbanization Pattern

Zone Type	Area (km²)	Population Density (people/km²)	Characteristics
Urban Core (Awendo)	25.5	~3,800	High-density residential, institutional, and commercial zones.
Peri-Urban Fringe	20.0	~1,600	Transitional areas with increasing land conversion to residential and mixed use.
Rural Lands	26.0	~900	Predominantly agricultural with dispersed settlement patterns.

Implications for Urban Planning and Climate Resilience

- Increased Pressure on Land and Services: Rapid urban expansion may strain drainage, housing, and waste management systems.
- Rising Exposure to Hazards**:** Population growth in erosion-prone areas like Kanyasrega, Mariwa and Dede increases vulnerability.
- Need for Climate-Sensitive Urban Design: Incorporation of green spaces, improved Stormwater systems, and sustainable housing will be vital.
- Data-driven Planning: Ward-level demographic data should inform infrastructure investments and adaptation priorities in the forthcoming County Integrated Development Plan (CIDP) and Municipal Development Strategy**.**

1.2.3. Economic Context

1. Overview

Awendo Municipality serves as part of the economic and administrative Centre within Migori County, hosting quite a favorable number of Migori County administrative units like the SubCounty headquarters, educational institutions (such as Awendo Kenya medical training college), and an expanding network of small and medium enterprises (SMEs).

The local economy is primarily driven by agriculture, trade, real estate, education, and public administration. However, the economy is increasingly diversifying as urbanization accelerates, particularly in the rapidly growing wards of North Sakwa, Central Sakwa, East Sakwa and West Sakwa wards respectively which continue to attract investment in Education services, construction, hospitality, and transport sectors.

Projected economic growth is expected to average 4.5%–5% per annum through 2030, supported by infrastructure expansion, improved road connectivity, and increased access to finance for SMEs and agribusiness ventures.

2. Sectoral Contribution to the Local Economy

Sector	Current Contribution (2024)	Projected Contribution (2030)	Key Drivers and Challenges
Agriculture	40%	32%	Sugarcane, declining share due to urban expansion; vulnerable to erratic rainfall and land degradation.
Trade and Commerce (SMEs)	22%	27%	Growth in retail, hardware, and agricultural-input enterprises; digital platforms expanding market access.
Public Administration & Education	15%	16%	Driven by Kenya Medical Training College Awendo Campus, Marindi polytechnic, Siruti technical and vocational college and county government offices; stable employment source.
Real Estate & Construction	10%	15%	Rapid growth in residential and mixeduse developments; driven by demand for urban housing.
Transport and Logistics	7%	6%	Sustained by improved road networks; impacted by fuel costs and infrastructure pressure.

Hospitality & Services	6%	8%	Expanding tourism, accommodation, and restaurant services; boosted by local conferences and student population.

2. Employment by Sector (2025)

Sector	Share of Employment (%)
Agriculture	55%
Trade & SMEs	18%
Public Sector & Education	12%
Construction & Real Estate	8%
Transport	4%
Hospitality/Other Services	3%

Observation:

- Employment remains heavily dependent on agriculture and informal trade.
- The service sector and construction are expected to grow fastest over the next decade, creating new urban jobs but also increasing environmental pressures.

3. Key Economic Zones and Growth Corridors

Zone / Centre	Economic Role	Key Characteristics
Awendo Town	Commercial & Institutional Hub	Hosts major retail outlets, banks, government offices, and educational institutions.
Sony area	Agricultural Production Zone	Sugarcane growing and mixed land use. The presence of South Nyanza Sugar Company (SONY) also serves as a major industrial pillar in the region.

Ranen Centre	Peri-urban Development Corridor	Rapid residential expansion and Agri-based trade.

4. Projected Economic Growth (2020–2030)

Year	Municipal GDP Estimate (Ksh Billion)	Growth Rate (%)	Main Drivers
2020	27.8	–	Agriculture, retail, and government services
2024	33.6	4.8	Construction, SMEs, education, real estate
2027	40.2	5.0	Infrastructure development and service growth
2030	47.5	5.2	Diversification and urban expansion

5. Income and Poverty Indicators

Indicator	Value (2024)	Projected (2030)	Comment
Average Monthly Income	KSh 18,500	KSh 25,000	Increase due to urban employment growth.
Poverty Rate	28%	18%	Expected decline due to job creation and SME support.
Informal-Sector Employment	65%	58%	Gradual formalization as municipal regulation improves.
Unemployment Rate	10%	7%	Reduced through youth-focused training and enterprise funding.

7. Major Challenges Impacting the Local Economy

- Climate Risks: Erratic rainfall patterns disrupt agriculture, transport, and market activities. Occasional landslides/Land drifts due to uncontrolled gold mining activities have also resulted in family loss of breadwinner lives hence poverty.
- Urban Sprawl**:** Conversion of fertile agricultural land to real estate reduces productivity.
- Waste and Infrastructure Strain**:** Poor solid waste management and inadequate drainage affect business operations.

- Energy and Water Supply**:** Fluctuations in power and water reliability hinder industrial growth.
- Access to Finance**:** Small enterprises still face limited access to affordable credit.

Awendo Municipality's economy is on a positive trajectory, transitioning from a largely Agrobased economy to a diversified urban economy with strong potential in ventures like trade, real estate, and service sectors. Strategic urban planning, infrastructure investment, and climate-smart development policies will be crucial to sustain growth and enhance resilience against climate-related disruptions.

5.1.1. Land-use Context

1. Overview

The municipality's economy is transitioning from a primarily agricultural base toward a more diversified urban economy characterized by growth in trade, real estate, construction, education, and public administration. This transformation, however, is occurring within the context of increasing climate-related risks such as floods, landslides due to mining activities prolonged droughts, and land degradation that affect productivity and urban infrastructure.

2. Economic Structure and Sectoral Contribution

Agriculture remains the mainstay of the local economy, contributing well about 40% or more of municipal output in 2024, though its share is expected to decline to 32% by 2030 as other sectors expand. Trade and SMEs are emerging as the fastest-growing contributors, supported by youth entrepreneurship, infrastructure development, and expanding markets.

Public administration, education, and health services are major formal employers, while real estate and construction are rapidly growing due to rising housing demand. The hospitality and services sector are also expanding, driven by the increasing number of students from the mushrooming colleges and Vocational Training Centers, civil servants, and conferences held within the peripheries of the Municipality area.

6. Sectoral Contribution Table

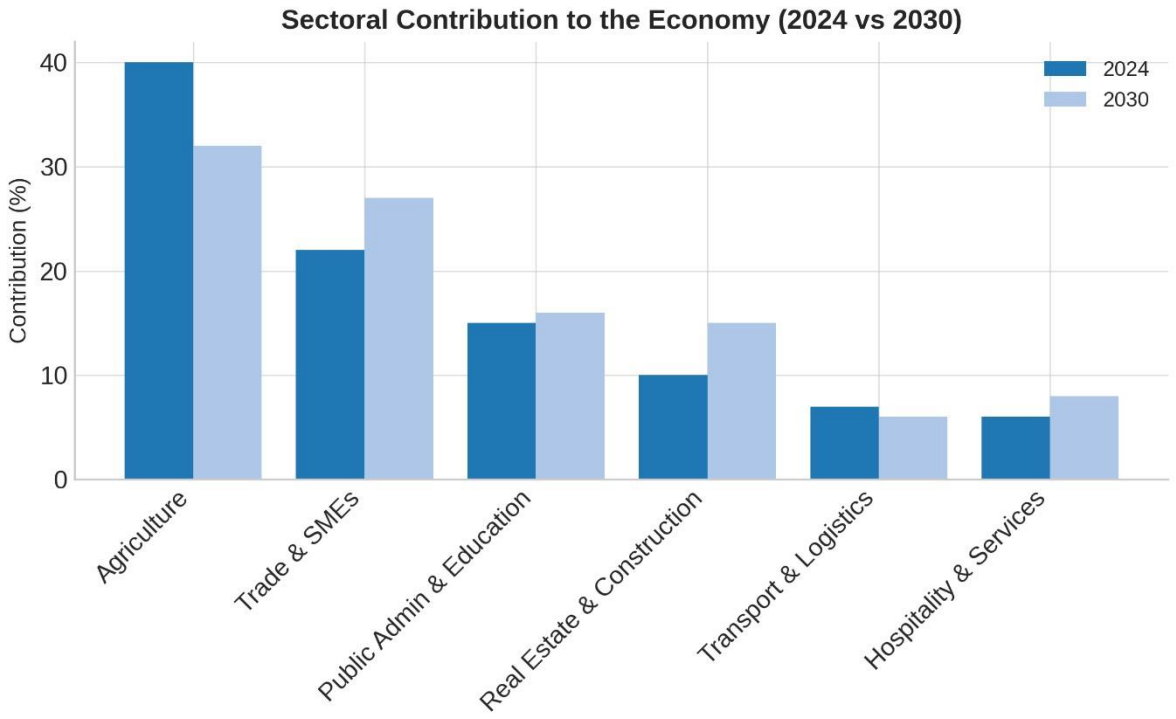


Figure 3: Sectoral Contribution to the Economy (2024 vs 2030)

Sector	Current Contribution (2024)	Projected Contribution (2030)	Key Observations
Agriculture	40%	32%	Still dominant but affected by climate variability and land conversion.
Trade & SMEs	22%	27%	Growing due to expanding urban markets.
Public Admin & Education	15%	16%	Stable; supported by public service and education sectors.
Real Estate & Construction	10%	15%	Fastest growing; driven by housing and urban infrastructure projects.
Transport & Logistics	7%	6%	Influenced by fuel prices and urban mobility challenges.
Hospitality & Services	6%	8%	Increasing with tourism and institutional visitors.

4. Economic Growth Trends

Between 2020 and 2030, the municipal GDP is projected to grow from KSh 17.8 billion to KSh 37.5 billion, averaging about 5% annual growth. This growth is expected to be fueled by infrastructure investments, SME expansion, and continued urbanization.

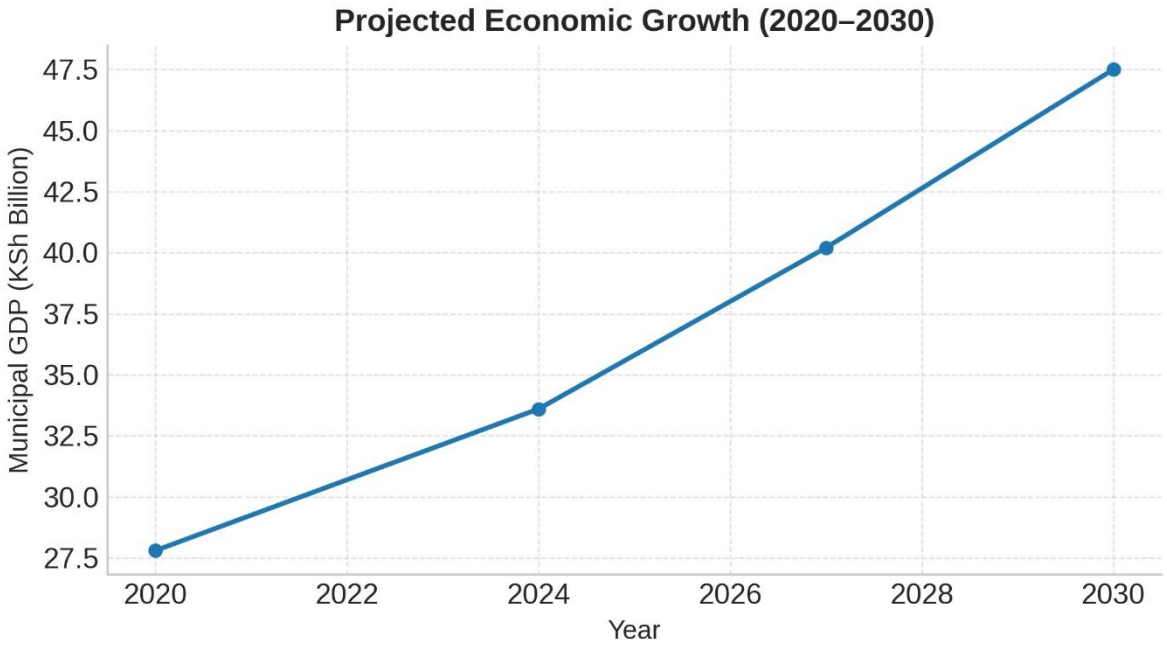


Figure 4: Projected Economic Growth (2020-2030)

5. Employment Profile

The labor market in Awendo Municipality remains largely informal, with over 55% of residents engaged in agriculture and 18% in trade and small-scale enterprises. The share of construction, services, and public employment continues to rise, providing a growing number of formal jobs.

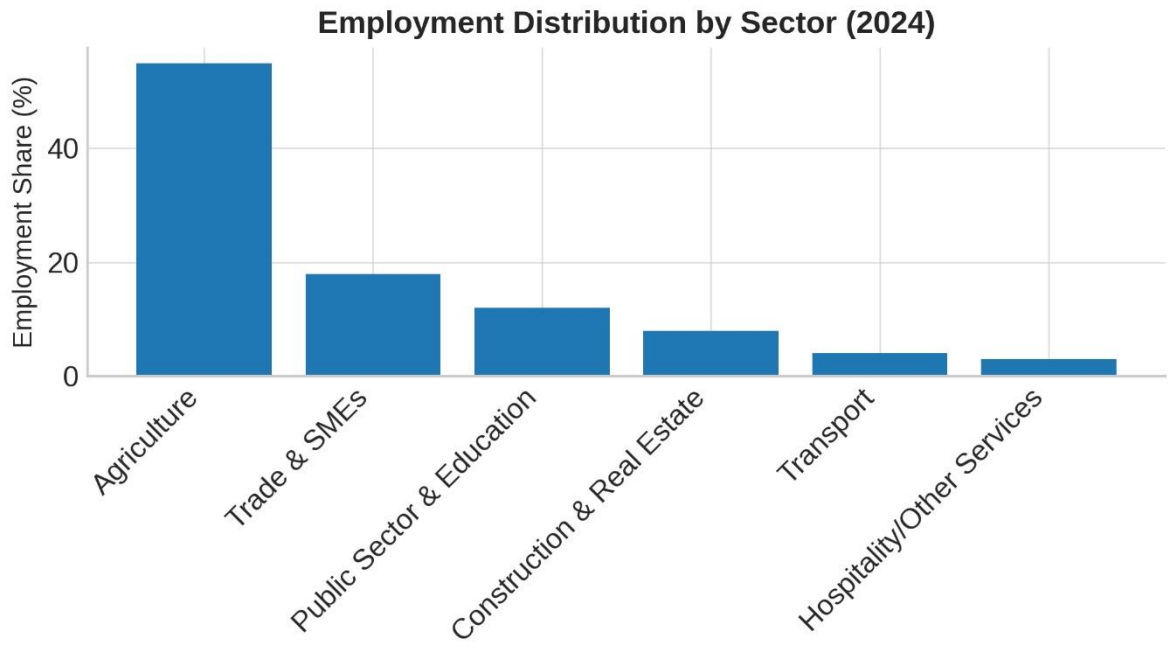


Figure 5: Employment Distribution by Sector (2024)

6.Fig 6. Economic Zones and Growth Corridors

The municipality comprises of distinct economic zones that play complementary roles in growth and service delivery:

Zone / Area	Economic Function	Remarks
AwendoTown	Commercial, Administrative, Educational, and Health Hub, Emerging Industrial/Light Manufacturing';	Hosts real estate, retail, financial institutions, hospitals, and polytechnics.
Uriri Town	Administrative, Educational & Service Center	Rapid real estate growth, Schools & Vocational Training Colleges
Ranen/Rapogi Centers	Agricultural High Potential Zone	Upcoming commercial zone although sometimes vulnerable to rainfall changes. Potential for value addition and logistics facilities.
Dede and Mariwa Centers	Peri-urban Growth Corridors	Experiencing rapid residential and mixed-use expansion.

Key Economic Challenges

- **Climate Risks:** Unpredictable rainfall and flooding threaten agricultural yields and market access.
- **Urban Sprawl:** Conversion of fertile land to real estate reduces food production.
- **Infrastructure Pressure:** Poor drainage, traffic congestion, and waste mismanagement constrain economic efficiency.
- **Energy and Water Supply Instability:** Affects SMEs and light industries.
- **Limited Financial Access:** Especially for youth and women-led enterprises.

Awendo Municipality is poised for steady economic transformation over the next decade. By 2030, it is projected to evolve into a vibrant secondary urban hub that balances growth with environmental sustainability. Strategic urban planning, investment in infrastructure, and integration of climate resilience into municipal development plans will be vital in ensuring inclusive and sustainable growth.

6.1. Key Stakeholders & Inclusiveness

The stakeholders relevant for the RCRA are mapped according to their:

Influence -the extent to which stakeholders can shape the RCRA process and outcomes, **Interest -**to the degree to which they are likely to be involved in the assessment and findings.

This will guide the approach through which they could be involved in the RCRA, and subsequent planning processes.

It emphasizes multi-stakeholder engagement to ensure that climate risk identification, assessment, and prioritization reflect local realities and community needs. The process promotes inclusivity, transparency, and ownership across different governance levels — from the municipal board to community-based organizations and technical experts.

Stakeholders are engaged through consultative meetings, data validation workshops, field assessments, and participatory mapping sessions. Their inputs guide the identification of vulnerabilities, prioritization of sectors for adaptation, and validation of the final risk profile.

High	**High Influence – Low Interest** • National Treasury and Planning (Indirect through KUSP II) • Private Developers and Major Investors	**High Influence – High Interest** • Municipal Board of Awendo • Global Center on Adaptation (GCA), World Bank, Council of Governors (CoG) • Municipal Manager & Technical Team • County Department of Lands, Physical Planning & Urban Development • State Department for Housing & Urban Development (SDHUD)
	Low Influence – Low Interest • General Residents not directly engaged in urban development • Informal sector groups (casual workers, micro vendors)	**Low Influence – High Interest** • Community Representatives (Youth, Women, PWDs, Farmers, Traders) • Civil Society Organizations (CSOs), NGOs • Local Business Associations

Low High

Figure 6: Multi-Stakeholder workshop identifying key hazards within Awendo Municipality

7. Hazard Assessment

The Hazard Assessment provides a systematic analysis of the natural and human-induced hazards that affect Awendo Municipality. Situated within Kenya's Nyanza region, the municipality's terrain which is characterized by, plains, and undulating slopes that creates varying exposure levels to geophysical and climatic threats.

While the area does not experience large-scale natural disasters such as earthquakes or volcanic eruptions, it faces a range of localized but recurrent hazards that have significant implications for infrastructure, livelihoods, public health, and environmental sustainability. These hazards arise from the interaction of physical geography, land-use practices, and changing climate patterns.

The assessment identifies and categorizes the municipality's hazards into three main groups:

1. **Geophysical Hazards** – including occasional landslides from uncontrolled mines, soil erosion, and localized instability caused by slope gradients, deforestation, and unregulated construction.
2. **Hydro-Meteorological Hazards** – such as erratic rainfall, flooding, drought, and heat stress, which are becoming more frequent due to climate variability.
3. **Environmental Hazards** – driven by rapid urbanization, poor waste management, water pollution, deforestation, and biodiversity loss.

The purpose of this hazard assessment is to:

- Identify key hazards affecting the municipality and their underlying causes.
- Evaluate their frequency, intensity, and spatial extent.
- Determine the level of risk and vulnerability across different sectors and locations.
- Provide a foundation for developing adaptation and mitigation measures to strengthen climate resilience.

This assessment draws on field observations, stakeholder consultations, and secondary data from relevant government agencies and climate studies. The findings highlight the urgent need for integrated land-use planning, improved infrastructure, and community-based adaptation initiatives to reduce exposure and enhance urban resilience.

7.1. Key Climate Hazards

Table 6. Hazard screening for Awendo Municipality

Hazard	Hazard Likely (Y/N)	Significant Impact (Y/N)	High Priority (Y/N)	Key Hazard (Y/N)
Heat Stress				
Average surface temperature increase	**Y**	**Y**	**N**	**Y**

Average ocean temperature increase	**N**	**N**	**N**	**N**
Extreme heat	**Y**	**Y**	**Y**	**Y**
Marine heatwaves	**N**	**N**	**N**	**N**
Cold Stress				
Average surface temperature during winter	**N**	**N**	**N**	**N**
Extreme cold (e.g., cold spells, frost)	**N**	**N**	**N**	**N**
Snowfall and ice storms	**N**	**N**	**N**	**N**
Flooding				
Changes in precipitation patterns	**Y**	**Y**	**Y**	**Y**
Pluvial (surface level) flooding, including flash flooding and urban flooding	**Y**	**Y**	**Y**	**Y**
Fluvial (river) flooding	**Y**	**N**	**N**	**N**
Sea level rise	**N**	**N**	**N**	**N**
Coastal flooding, including storm surges	**N**	**N**	**N**	**N**
Waterlogging	**Y**	**N**	**N**	**N**
Water Stress				
Drought (meteorological, hydrological)	**Y**	**Y**	**Y**	**Y**
Groundwater salinization	**Y**	**Y**	**Y**	**Y**
Saline intrusion	**N**	**N**	**N**	**N**
Wildfire				
Wildfires & bushfires	**N**	**N**	**N**	**N**
Storms				
Extreme wind	**N**	**N**	**N**	**N**
Tropical cyclones	**N**	**N**	**N**	**N**
Sand and dust storms	**N**	**N**	**N**	**N**
Hailstorms	**N**	**N**	**N**	**N**
Mass Movement				
Landslides	**Y**	**N**	**N**	**Y**
Coastal erosion	**N**	**N**	**N**	**N**
Gully erosion	**N**	**N**	**N**	**N**
Marine Conditions				
Ocean acidification	**N**	**N**	**N**	**N**
Geophysical*				
Subsidence	**N**	**N**	**N**	**N**
Earthquakes	**N**	**N**	**N**	**N**
Volcanos	**N**	**N**	**N**	**N**

* 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.

7.2. Climate Indicators and Hazard Thresholds

Table 7. Climate indicators and hazard thresholds selected for the assessment

Key Hazard	Climate Indicator	Data Source	Thresholds		
			Low	Medium	High
Pluvial Flooding	Number of days with precipitation > 50 mm	• World Bank Climate Change Knowledge Portal / Kenya Meteorological Department	< 3 days/year	3 – 6 days/year	> 6 days/year
Drought	Standardized Precipitation–Evapotranspiration Index (SPEI)	• SPEI Database / Kenya Meteorological Department	> -1.0	-1.0 to -1.5	< -1.5
Heat Stress / Extreme Urban Heat	Number of days with heat index > 35°C (mean)	• World Bank Climate Change Knowledge Portal / IPCC Data Portal	< 5 days/season	5 – 15 days/season	> 15 days/season
Land Degradation	Normalized Difference Vegetation Index (NDVI) anomaly or soil erosion rate	• FAO Global Land Degradation Information System / SERVIR East Africa	NDVI > 0.5 (stable)	NDVI 0.3–0.5 (moderate degradation)	NDVI < 0.3 (severe degradation)

Changes in Precipitation Patterns	Coefficient of Variation (CV) of seasonal rainfall	World Bank Climate Change Knowledge Portal / Kenya Meteorological Department	CV < 15% (stable rainfall)	CV 15–25% (moderate variability)	CV > 25% (high variability)

7.3. Current Hazard Levels and Climate Projections

Table 8. Current and future hazards levels for Awendo Municipality

Hazard	Current (Baseline)	2050 SSP2–4.5	2050 SSP5–8.5	2100 SSP2–4.5	2100 SSP5–8.5
Pluvial Flooding	**Medium** – Frequent flash floods during long rains, drainage overflow in low-lying areas (Manyatta, & Lower kuja).	**High** – ↑ Intense rainfall (>50 mm/day) events expected to double; 20–30% increase in flood days.	**Very High** – Heavy rainfall events become more extreme; urban flooding more frequent and widespread.	**High** – Sustained increase in rainfall intensity; moderate adaptation may reduce severity.	**Very High** – Severe pluvial flooding becomes chronic in unplanned and poorly drained areas.
Drought	**Medium** – Periodic dry spells during short rains affecting crops and water supply.	**High** – Longer dry periods; seasonal water scarcity increases by 20–25%.	**Very High** – Severe droughts likely every 2–3 years; water stress rises sharply.	**High** – Persistent rainfall deficits; reduced soil moisture affecting agriculture.	**Very High** – Multi-year droughts and water crises likely; ecosystem and livelihood stress.

Heat Stress / Extreme Urban Heat	**Medium** - Temperatures average 18.7°C, with ~5–10 heat days > 35°C per season.	**High** – +1.5°C increase; heat index > 35°C for 15–20 days/season.	**Very High** – +2°C to +2.5°C rise; heat waves more intense and prolonged.	**High** – +2.5°C average increase; significant heat island amplification in urban cores.	**Very High** – +3°C to +4°C; extreme heat becomes a major urban hazard affecting health and productivity.
Land Degradation	**Medium** – Soil erosion, deforestation, and poor landuse practices increasing.	**High** – Accelerated erosion on slopes; declining soil fertility.	**Very High** – Strong link with drought and deforestation; reduced vegetation cover.	**High** – Land restoration possible but pressure from urbanization persists.	**Very High** – Irreversible degradation in unmanaged zones; reduced agricultural productivity.

Table 9. 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

7.4. Current and Future Hazard Impact Areas

8. Exposure & Vulnerability Assessment

The exposure and vulnerability assessment for Awendo Municipality examines how various urban elements including infrastructure, services, populations, and natural assets are affected by climate and environmental hazards**.** This analysis identifies which assets are most exposed

to flooding, drought, heat stress, and land degradation, and evaluates their capacity to adapt or recover from these impacts.

The result prioritizes investment and adaptation planning to enhance urban resilience, protect livelihoods, and guide sustainable land use**.**

8.1. Urban Elements

Table 10. Urban elements inventory

Category
Infrastructure & Services
Stormwater Drainage
Water & Wastewater Management
Solid Waste Management
Transport and Mobility
Energy
Economic Infrastructure
Populations
Urban Residents

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

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

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

Table 11. 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 12. Impact Matrix

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

Table 13. Exposure, Vulnerability, and Impacts of Pluvial Flooding on Urban Elements

Hazard: Pluvial flooding

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	• Urban drainage channels (Awendo) are undersized, informal open drains present; low-lying pockets (Sony, Manyatta, Rapogi and Uriri areas) collect runoff and backflow. Frequent blockage by solid waste reduces conveyance capacity.	**High**	**Sensitivity:** Major — drains are shallow/undersized, and many roads drain into low points. **Adaptive Capacity:** • Low — limited municipal maintenance budget, few retention ponds, no large stormwater storage.	**High**	**Catastrophic**
Water & Wastewater Management	• Piped networks in cores; many periurban areas depend on boreholes and septic systems. Flooding overwhelms soak-away pits,	**Medium**	• **Sensitivity:** Medium — partial piped/sanitation exists but many systems are informal (septic/pits) that are vulnerable to inundation.	**Medium**	**Moderate**

			Adaptive Capacity: • Low–Medium — some institutional management (MIWASCO) but limited treatment and flood-resilient infrastructure.		

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Solid Waste Management	• Main dumpsite (Lichota Area) located in low area; open dumping and poor collection lead to blocked drains and increased surface water contamination during floods.	**High**	• **Sensitivity:** High — unlined dumps and informal burning increase contamination risk when inundated. **Adaptive Capacity:** • Low — irregular collection fleet, informal recycling; limited engineered transfer stations.	**High**	**Catastrophic**
Transport and Mobility	• Urban roads and some rural access roads become impassable during	**Medium**	• **Sensitivity:** High — key arterial and feeder roads cross low points.	**Medium**	**Moderate**

	pluvial events; small bridges over Sare river and Kuja near Kanyasrega subject to scouring. Key pedestrian routes flood (no continuous nonmotorized infrastructure).		**Adaptive Capacity:** • Low — maintenance is reactive; limited alternative routes and weak design standards for drainage capacity.		
Energy	• Overhead power lines & utility poles run through peri-urban slopes; substations located in accessible	**Medium**	• **Sensitivity:** Medium — poles can be undermined by erosion; substations tolerate some water but prolonged inundation risks service outages.	**Medium**	**Moderate**

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
	urban nodes that can be surrounded by flood water.		**Adaptive Capacity:** • Medium — Kenya Power maintains networks but localized resilience measures are limited.		
Economic Infrastructure	• Awendo markets, shops and commercial premises concentrated in	**High**	• **Sensitivity:** High — businesses suffer stock losses, supply chain interruption.	**High**	**Catastrophic**

	CBDs and market yards that flood, disrupt trade and minimize access		**Adaptive Capacity:** • Low–Medium — some insurance/stock shifting for larger businesses, but most SMEs are informal with little buffer.		
Social Infrastructure	• Schools, health centres (Awendo Level 4), and government offices in town centers are reachable but roads to them flood at times; some facilities sit in moderate-low ground.	**Medium**	• **Sensitivity:** Medium — critical services affected by access loss rather than total asset loss. **Adaptive Capacity:** • Medium — institutions have contingency practices but limited formal flood proofing.	**Medium**	**Moderate**

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Emergency Services	• Single fire station in Migori town and police posts; limited amphibious	**Medium**	• **Sensitivity:** High — response time hindered by flooded roads.	**High**	**Major**

	response and no dedicated local early warning for pluvial events. Shelters are informal (churches, schools).		**Adaptive Capacity:** • Low — limited resources, no mapped evacuation routes or dedicated shelters.		
Populations					
Urban Residents	• Majority live in formal and peri-urban neighborhoods; many households in low points face periodic inundation; population density rising (urbanization).	**Medium**	• **Sensitivity:** Medium — property damage and health risk when flooded. **Adaptive Capacity:** • Medium — some households can cope (savings, kin networks) but many cannot.	**Medium**	**Moderate**
Informal Settlement Residents	• High concentration of informal housing in low-lying Jiudendi & Athiko areas of Awendo Municipality	**High**	• **Sensitivity:** Very High — lightweight housing, no sanitation, high exposure to water contamination and displacement.	**High**	**Catastrophic**

Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**

	with poor drainage and insecure land tenure; limited access to services.		**Adaptive Capacity:** • Very Low — low income, limited options to relocate.		
Vulnerable and Marginalized Groups	• Tend to live in lower quality housing and have weaker mobility/resources to evacuate or protect assets.	**High**	• **Sensitivity:** Very High — health & livelihood impacts disproportionate; evacuation access limited. **Adaptive Capacity:** • Very Low — limited savings, social protection coverage.	**High**	**Catastrophic**
Natural Assets					
Urban Green Infrastructure	• Street trees, small parks and riparian vegetation are sparse/fragmented; green cover provides limited attenuation of runoff.	**Medium**	• **Sensitivity:** Medium — degraded green cover reduces infiltration. **Adaptive Capacity:** • Low–Medium — potential to expand green infrastructure but constrained by land pressure	**Medium**	**Moderate**
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**

Urban Blue Infrastructure	• Sare and Kuja rivers have narrowed riparian zones in places; overflow during intense storms causes local inundation and contamination.	**High**	• **Sensitivity:** High — river channels modified and banks vulnerable to erosion. **Adaptive Capacity:** • Low — limited riverbank restoration or buffer enforcement.	**High**	**Catastrophic**
Peri-urban and Agricultural Systems	• Low-lying farm plots and roadside plots receive runoff; soils already erode on slopes and terraces; agricultural drains often fail under heavy surface flows.	**Medium**	• **Sensitivity:** Medium — crop damage, soil loss. **Adaptive Capacity:** • Low–Medium — traditional terraces exist but severely stressed; limited investment in retention structures.	**Medium**	**Moderate**

Table 14. Exposure, Vulnerability, and Impacts of Drought on Urban Elements

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

Stormwater Drainage	• Stormwater systems provide little buffering for dry-season water supply; retention basins are absent so no drought storage.	**Medium**	• **Sensitivity:** Medium — limited role in drought adaptation. **Adaptive capacity:** **Adaptive Capacity:** • Low — lack of multifunctional storage.	**Medium**	**Moderate**
Water & Wastewater Management	• Municipal piped network in cores supplemented by boreholes; many peri-urban and rural households depend on shallow wells and springs. Reduced recharge lowers borehole yields; some springs and shallow wells historically dry up during prolonged dry spells.	**Medium**	• **Sensitivity:** High — water infrastructure reliant on surface/groundwater recharge. **Adaptive capacity:** **Adaptive Capacity:** Medium — KIRIWASCO provides management but limited storage/resilience (few reservoirs/treated surface storage).	**High**	**Major**
Solid Waste Management	• Reduced water can increase concentration of wastes in informal	**Low**	• **Sensitivity:** Low. **Adaptive capacity:**	**Low**	**Insignificant**

Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**

	dumps; however direct drought exposure is low.		**Adaptive Capacity:** • Low — service disruptions possible due to resource constraints.		
Transport and Mobility	• Roads and bridges not directly watersupply dependent; drought reduces river flows (less scouring) but also increases dust and road surface deterioration.	**Low**	• **Sensitivity:** Low–Medium. **Adaptive Capacity:** • Medium — routine maintenance possible but costs rise.	**Low**	**Insignificant**
Energy	• Small-scale energy users (pumped water supply, pumps for irrigation) see increased demand from borehole pumping; higher diesel/electricity costs.	**Medium**	• **Sensitivity:** Medium — increased energy demand for water supply and irrigation; grid reliability affects pumps. **Adaptive Capacity:** • Medium — some institutional capacity to manage but limited backup.	**Medium**	**Moderate**
Economic Infrastructure	• Markets, Agro-processing units and agribusiness (tree nurseries, sugarcane seedling preparation) rely	**High**	• **Sensitivity:** High — agricultural value chains sensitive to yield loss and water scarcity.	**High**	**Catastrophic**

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
	on steady water supply; irrigation systems limited.		**Adaptive Capacity:** • Medium — some larger farms have irrigation or better access to credit; smallholders are less resilient.		
Social Infrastructure	• Schools and hospitals need reliable water for sanitation and hygiene; limited on-site storage increases risk of service disruption.	**High**	• **Sensitivity:** High — critical services impacted by lack of water for sanitation and clinical needs. **Adaptive Capacity:** • Medium — can implement rationing but limited reserves.…	**High**	**Catastrophic**
Emergency Services	• Firefighting and health response require water; drought reduces available water sources and complicates response.	**Medium**	• **Sensitivity:** Medium — emergency effectiveness compromised. **Adaptive Capacity:** • Low — no dedicated drought contingency water reserves	**Medium**	**Moderate**
Populations					

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Urban Residents	• Urban households rely heavily on piped water from MIWASCO and community boreholes; drought reduces yields and increases rationing. • High dependence on river-fed water treatment works; reduced river flows during drought directly affect urban water availability.	**High**	**Sensitivity:** • High — limited on-site water storage in most rental units and flats. • High — rising population density increases demand during shortages. **Adaptive Capacity:** **Medium** — some households purchase water from vendors or stores in small tanks; affordability is limited for low-income households.	**High**	**Catastrophic**
Informal Settlement Residents	• Dependence on shallow wells, springs, informal water vendors and communal taps, many of which dry during prolonged droughts. • Located in areas without formal water infrastructure; water scarcity	**High**	**Sensitivity:** • **Very High** — limited sanitation, poor drainage, and overcrowding increase health risks when water is scarce. • **High** — limited financial capacity to buy vendor water during drought.	**High**	**Catastrophic (for prolonged drought)**

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level

	immediately raises costs and burden on women/youth for collection.		**Adaptive Capacity:** • **Low** — minimal water storage, low incomes, limited resilience infrastructure, and often no formal connection to MIWASCO networks.		
Vulnerable and Marginalized Groups	• Typically live in areas with poor service coverage or depend on communal water sources that dry faster. • Disproportionately affected by rising water prices during scarcity.	**High**	**Sensitivity:** • Very High — infant care, elderly care, disability needs heightened dependence on reliable water. • High — marginalized groups often lack capacity to queue for water or purchase emergency supplies. **Adaptive Capacity:** • **Low** — limited income, limited access to climate-information, and fewer safety nets.	**High**	**Catastrophic**
Natural Assets					

Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**

Urban Green Infrastructure	• Drought causes die-off of trees, drying of parks and urban vegetation decline. • Urban heat island effect worsens as vegetation loses moisture.	**Medium**	**Sensitivity:** • Drought causes die-off of trees, drying of parks and urban vegetation decline. • Urban heat island effect worsens as vegetation loses moisture. **Adaptive Capacity:** • **Medium** — county can support replanting and watering, but budget and water constraints limit action.	**Medium**	**Moderate**
Urban Blue Infrastructure	• River flows (e.g. River Sare & River Kuja) significantly drop during drought; wetlands and springs shrink or dry completely. • Urban runoff and pollution intensify due to low water volume.	**High**	**Sensitivity:** • High — heavy dependence on consistent river flow for domestic supply and municipal treatment works. • Wetlands are already degraded by agriculture and urban expansion. **Adaptive Capacity:** • **Low/Medium**— limited wetland protection, siltation control, or regulated abstraction.	**High**	**Catastrophic**

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Peri-urban and Agricultural Systems	• Heavily reliant on rainfall and shallow groundwater; drought sharply reduces yields (coffee, tea, vegetables). • Competition for water between agriculture and domestic use increases.	**High**	**Sensitivity:** • Very High — crops like vegetables, bananas, and dairy systems are extremely water-sensitive. • Heavy reliance on seasonal rivers that nearly dry during severe droughts. **Adaptive Capacity:** • **Medium/Low** — few farmers have irrigation; adoption of drip irrigation and water-efficient systems is slowly growing.	**High**	**Catastrophic (if drought is prolonged)**

Table 15. Exposure, Vulnerability, and Impacts of Heat Stress on Urban Elements

Hazard: Heat Stress

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	• Heat stress accelerates evaporation, drying drains and sediment traps, increasing accumulation of debris. • Concrete surfaces expand and crack under prolonged high temperatures.	**Medium**	**Sensitivity:** • **Medium** — drains deteriorate faster under thermal stress. **Adaptive Capacity:** • **Medium** — maintenance possible but may be irregular; limited shading/vegetation reduces resilience.	**Medium**	**Moderate**
Water & Wastewater Management	Higher temperatures increase evaporation in water pans and reduce surface water reliability.	**Medium**	**Sensitivity:** • **High** — demand spikes outstrip storage; pipes and treatment systems degrade faster under heat.	**High**	**Major**

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level

	Increased water demand (cooling, sanitation) stresses municipal supply systems.		**Adaptive Capacity:** • **Medium** — KIRIWASCO can ration and optimize supply, but limited storage capacity remains a constraint.		
Solid Waste Management	• High temperatures accelerate decomposition and odor emissions from dumpsites. Increased risk of spontaneous fires at informal dumpsites.	**Medium**	**Sensitivity:** • **Medium** — waste handling becomes more hazardous; public health risks rise. **Adaptive Capacity:** • Low — informal dumpsites lack firecontrol and monitoring systems.	**Medium**	**Moderate**
Transport and Mobility	Extreme heat softens asphalt surfaces, causing rutting; dust increases on unpaved roads.	**Medium**	**Sensitivity:** • **Medium** — roads degrade faster; heat affects public transport reliability.	**Medium**	**Moderate**

Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**

	• Pedestrian mobility reduces, especially for elderly and vulnerable groups.		**Adaptive Capacity:** • **Medium** — routine maintenance possible but costly.		
Energy	• Increased cooling demand (fan use, refrigeration, cold storage) drives up electricity consumption. • Heat affects transformer efficiency and increases chances of power outages.	**High**	**Sensitivity:** • **High** — increased demand stresses the grid, especially in urban centres. **Adaptive Capacity:** • **Medium** — KPLC system adjustments possible but limited redundancy.	**High**	**Catastrophic**
Economic Infrastructure	• Heat affects productivity of markets, shops, agro-processors, and informal businesses. • Post-harvest losses increase due to faster spoilage.	**High**	**Sensitivity:** • Heat affects productivity of markets, shops, agro-processors, and informal businesses. • Post-harvest losses increase due to faster spoilage.	**High**	**Catastrophic**

Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**

	•		**Adaptive Capacity:** • **Medium** — some businesses adopt refrigeration, but high energy costs limit access.		
Social Infrastructure	• High indoor temperatures reduce learning capacity and increase heatrelated illnesses. • Hospitals face increased caseloads for dehydration and heat exhaustion.	**High**	**Sensitivity:** • **High** — buildings poorly ventilated; few have cooling systems. **Adaptive Capacity:** • **Medium** — can adopt shading, ventilation strategies but limited funding.	**High**	**Catastrophic**
Emergency Services	• Fire risk and heat-related medical emergencies increase; staff performance may drop in extreme heat.	**Medium**	**Sensitivity:** • Medium— emergency operations directly affected by high temperatures.	**High**	**Major**

Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**

			Adaptive Capacity: • **Medium** — response capacity exists but is strained during heatwaves.		
Populations					
Urban Residents	• High temperatures increase discomfort, indoor overheating, and energy bills for cooling. • Heat stress worsens in dense settlements with limited tree cover.	**High**	**Sensitivity:** • **High** — many homes lack ventilation, insulation, or shading. **Adaptive Capacity:** • **Medium** — some can afford fans or cooling, but energy prices limit uptake.	**High**	**Catastrophic**
Informal Settlement Residents	• Corrugated iron-sheet houses trap heat, making indoor conditions extremely high. • Little vegetation or shaded areas; limited access to cooling.	**High**	**Sensitivity:** • **Very High** — poor housing materials, overcrowding, and lack of water worsen heat stress. **Adaptive Capacity:** • **Low** — low incomes and lack of cooling infrastructure.	**High**	**Catastrophic**

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Vulnerable and Marginalized Groups	• Infants and elderly at greatest risk; heat stress worsens chronic illness. • Limited mobility increases difficulty accessing cool areas.	**High**	**Sensitivity:** • **Very High** — physiological susceptibility to overheating. **Adaptive Capacity:** • **Low** — depend on caretakers and access to cooling or water. …	**High**	**Catastrophic**
Natural Assets					
Urban Green Infrastructure	• Parks, trees, and green belts dry quickly; canopy cover reduces. • Increased risk of vegetation die-off.	**High**	**Sensitivity:** • **High** — species sensitive to moisture loss. **Adaptive Capacity:** • **Medium** — county watering programs exist but limited in scale.	**High**	**Catastrophic**
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**

Urban Blue Infrastructure	• Higher temperatures accelerate water loss and reduce oxygen levels, affecting ecosystems. • Reduced flow worsens pollution concentration.	**High**	**Sensitivity:** • **High** — aquatic ecosystems fragile under heat. **Adaptive Capacity:** • **Medium** — poor protection of riparian areas; limited restoration programmes.	**High**	**Catastrophic**
Peri-urban and Agricultural Systems	• Heat reduces crop yields (vegetables, bananas, Sugarcane). • Livestock experience heat stress reducing productivity.	**High**	**Sensitivity:** • **Very High** — many crops are temperature sensitive; heat increases irrigation demand. **Adaptive Capacity:** • **Low** — limited irrigation access; smallholder farmers lack cooling sheds.	**High**	**Catastrophic**

Table 16. Exposure, Vulnerability, and Impacts of Land Degradation on Urban Elements

Hazard: Land Degradation

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Infrastructure & Services					
Stormwater Drainage	• Land degradation increases soil erosion and siltation, blocking drains, culverts and outlets; upstream catchment degradation increases sediment load into urban drainage.	**Medium**	**Sensitivity:** • **Medium** — system dependent on stable soils. **Adaptive Capacity:** • Low — limited desilting equipment and irregular maintenance.	**Medium**	**Moderate**
Water & Wastewater Management	• Catchment degradation reduces surface water reliability and increases turbidity, raising treatment costs; siltation of intakes and spring sources.	**High**	**Sensitivity:** • **High** — treatment stressed by sedimentheavy water. **Adaptive Capacity:** • Medium — some treatment adjustment possible but limited redundancy.	**High**	**Catastrophic**

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Solid Waste Management	• Land degradation creates informal dumping zones and erosion exposes buried waste, though overall exposure remains low.	**Medium**	**Sensitivity:** • **Low**— exposed waste increases environmental risks. **Adaptive Capacity:** • Low — poor site management and limited equipment.	**Low**	**Minor**
Transport and Mobility	• Road shoulders erode; unpaved roads degrade faster under runoff; gullies affect access routes.	**Medium**	**Sensitivity:** • **Medium** — transport corridors sensitive to soil instability. **Adaptive Capacity:** • **Medium** — maintenance possible but expensive.	**Medium**	**Moderate**
Energy	• Soil instability undermines electricity poles, small substations and distribution lines.	**Low**	**Sensitivity:** • Low — overall network resilient.	**Low**	**Insignificant**

			Adaptive Capacity: • Medium — routine repairs possible.		

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Economic Infrastructure	• Agricultural processing, local markets, and agri-business depend on productive land—declining soil fertility disrupts value chains.	**High**	**Sensitivity:** • **High** — strong dependence on land productivity. **Adaptive Capacity:** • **Medium** — larger enterprises can invest in conservation; smallholders cannot.	**High**	**Catastrophic**
Social Infrastructure	• Schools/health facilities in peri-urban areas affected by erosion of compounds and access roads.	**Medium**	**Sensitivity:** • Medium — disruptions to sanitation and accessibility. **Adaptive Capacity:** • Medium — local repairs possible but funding limited.	**Medium**	**Moderate**

Emergency Services	• Land degradation limits access routes for fire engines and ambulances, especially in steep or rural areas.	**Medium**	**Sensitivity:** • **Medium** — response times affected by degraded roads.	**Medium**	**Moderate**

Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
			Adaptive Capacity: • **Medium** — rerouting possible but delays increase.		
Populations					
Urban Residents	• Households on steep slopes, riverbanks and informal settlements exposed to erosion, unstable soils and gully formation.	**High**	**Sensitivity:** • **High** — informal settlements lack stabilization and drainage. **Adaptive Capacity:** • **Low** — limited resources for soil conservation.	**High**	**Catastrophic**
Informal Settlement Residents	• More likely to settle on degraded marginal lands with poor infrastructure.	**Medium**	**Sensitivity:** • **High** — limited relocation options.	**High**	**Major**

			Adaptive Capacity: • **High** —financial constraints restrict adaptation.		

Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
Vulnerable and Marginalized Groups	• Direct exposure to soil fertility decline, gully formation and reduced yields.	**Medium**	**Sensitivity:** • **High**— financial constraints restrict adaptation. **Adaptive Capacity:** • High — degradation increases workload and reduces resource availability.	**High**	**Major**
Natural Assets					
Urban Green Infrastructure	• High exposure to deforestation, soil erosion and surface runoff.	**High**	**Sensitivity:** • High — vegetation loss accelerates degradation loops.	**High**	**Catastrophic**

			Adaptive Capacity: • Medium — reforestation possible but slow.		
Urban Blue Infrastructure	• Exposed to siltation, reduced water quality and unstable banks from erosion.	**High**	**Sensitivity:** • **High** — aquatic ecosystems rapidly degrade.	**High**	**Catastrophic**
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
			Adaptive Capacity: • **Medium** — restoration achievable with strong management.		
Peri-urban and Agricultural Systems	• Directly exposed to erosion, nutrient depletion and gully formation.	**High**	**Sensitivity:** • **Very High** — primary asset affected. **Adaptive Capacity:** • **Low** — natural recovery slow without intervention.	**High**	**Catastrophic**

Table 17. Exposure, Vulnerability, and Impacts of Change in Precipitation Patterns on Urban Elements

Hazard: Change in Precipitation Patterns

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

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Stormwater Drainage	• Drainage systems exposed to intense rainfall events leading to overflow, siltation, and blockages; prolonged dry spells reduce system functionality due to sediment accumulation.	**High**	**Sensitivity:** • High — infrastructure not designed for current rainfall extremes. **Adaptive Capacity:** • Medium — limited upgrades, desilting irregular.	**Medium**	**Major**

Water & Wastewater Management	• Water supply and wastewater systems exposed to fluctuating rainfall affecting groundwater recharge, surface water quality, and wastewater overflow during storms.	**High**	**Sensitivity:** • High — turbidity spikes overwhelm treatment; wastewater plants affected by stormwater infiltration. **Adaptive Capacity:** • Medium — some operational flexibility but infrastructure constraints remain.	**High**	**Catastrophic**
Solid Waste Management	• Dumpsites exposed to leachate increases during heavy rainfall; waste washed into waterways; disruption of collection during extreme weather.	**Medium**	**Sensitivity:** • Medium — poor containment increases environmental risks.	**Medium**	**Moderate**

Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
			Adaptive Capacity: • Low — few engineered disposal sites and limited drainage controls.		
Transport and Mobility	• Roads and bridges exposed to flooding, erosion, and pavement weakening during heavy rains; dry spells lead to dust and surface cracking.	**High**	**Sensitivity:** • High — erosion and washouts common during storms.	**Medium**	**Major**

			Adaptive Capacity: • Medium — maintenance possible but reactive and underfunded.		
Energy	• Energy distribution infrastructure exposed to storm-related disruptions (lightning, wind, erosion); rainfall variability affects systems reliant on steady water supply.	**Medium**	**Sensitivity:** • Medium — outages increase with storm intensity. **Adaptive Capacity:** • Medium — restoration capacity exists but challenges persist.	**Medium**	**Moderate**

Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
Economic Infrastructure	• Markets, agro-processing and SMEs exposed to disruptions in supply chains, reduced access, and water-related operational challenges.	**High**	**Sensitivity:** • High — dependent on consistent water availability and functional access roads.	**High**	**Catastrophic**

			Adaptive Capacity: • Medium — some private actors adapt, but small enterprises vulnerable.		
Social Infrastructure	• Schools, hospitals and social facilities exposed to flooding, roof leaks, and sanitation challenges during irregular rains.	**Medium**	**Sensitivity:** • High — essential services require stable water and infrastructure conditions.	**High**	**Major**
			Adaptive Capacity: • Medium — some facilities have basic storage, but structural resilience is limited.		
Emergency Services	• Emergency operations exposed to access difficulties during storms; communication and mobility disrupted by road flooding or washouts.	**High**	**Sensitivity:** • Medium — response heavily dependent on road network and weather.	**Medium**	**Major**

Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**

			Adaptive Capacity: • Medium — alternative routing possible but limited.		
Populations					
Urban Residents	• Exposed to flash floods, drainage overflows, water shortages during dry spells, and health risks from water contamination.	**Medium**	**Sensitivity:** • Medium — reliant on municipal systems with limited redundancy. **Adaptive Capacity:** • Medium — can adopt household coping measures depending on income.	**High**	**Major**
Informal Settlement Residents	• Highly exposed to flooding, runoff, contamination of drinking water, and storm-related hazards due to marginal settlement locations.	**High**	**Sensitivity:** • High — poor housing, inadequate drainage, and overcrowding. **Adaptive Capacity:** • Low — limited financial and institutional support.	**High**	**Catastrophic**

Category	Exposure (Description)	Exposure Level	Vulnerability (Description)	Vulnerability Level	Impact Level
Vulnerable and Marginalized Groups	• Children, elderly, PWDs, and low-income households are exposed to health hazards, mobility constraints, and service disruptions.	**High**	**Sensitivity:** • High — disproportionate impact from water shortages and extreme rainfall. **Adaptive Capacity:** • Low- limited ability to relocate or reinforce homes.	**Medium**	**Major**
Natural Assets					
Urban Green Infrastructure	• Trees, parks, and landscaped areas exposed to drought stress, soil erosion, and storm damage from intense rains.	**Medium**	**Sensitivity:** • Medium — vegetation quickly affected by rainfall extremes. **Adaptive Capacity:** • Low — limited irrigation and management resources.	**High**	**Major**

Urban Blue Infrastructure	• Rivers, streams, and wetlands are exposed to fluctuating water levels, sedimentation, and pollution during erratic rainfall events.	**High**	**Sensitivity:** • High — ecosystems easily destabilized by runoff and pollutant loads.	**Medium**	**Major**
Category	**Exposure (Description)**	**Exposure Level**	**Vulnerability (Description)**	**Vulnerability Level**	**Impact Level**
			Adaptive Capacity: • Medium — restoration possible but requires sustained effort.		
Peri-urban and Agricultural Systems	• Farms and peri-urban land exposed to irregular rains affecting planting seasons, crop yields, and increasing erosion.	**High**	**Sensitivity:** • High — rainfall-dependent cropping systems highly impacted.	**High**	**Catastrophic**
			Adaptive Capacity: • Medium — irrigation limited; smallholder farmers vulnerable.		

9. Climate Risk Assessment

The Climate Risk Assessment evaluates the combined effects of hazard exposure, vulnerability, and adaptive capacity to determine the overall level of climate risk facing Awendo Municipality. It integrates scientific data, stakeholder insights, and spatial analysis to identify which sectors, populations, and assets are most at risk from climate-induced events such as flooding, drought, heat stress, land degradation etc. This assessment provides a critical foundation for prioritizing resilience actions, informing planning decisions, and guiding sustainable investments that safeguard the municipality's people, economy, and environment against the growing impacts of climate change.

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 18. Risk matrix***

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

For this Urban Climate Risk Profile, risk levels should be interpreted based on the table below.
Table 19. 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.

9.1. Current and Future Climate Risks on Urban Elements

Table 1. Summary of Pluvial Flooding risks for Awendo Municipality

	Time Horizon & Climate Scenario	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
	Hazard Level					
Categories	**Impact**	**Risk Levels**				
		Current	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Infrastructure & Services						
Stormwater Drainage	Moderate	Medium	Medium	High	Medium	High
Water & Wastewater Management	Moderate	Medium	High	High	High	High
Solid Waste Management	Moderate	Medium	Medium	High	Medium	High
Transport and Mobility	Major	High	High	High	High	High
Energy	Moderate	Medium	Medium	High	Medium	High
Economic Infrastructure	Major	High	High	High	High	High
Social Infrastructure	Major	High	High	High	High	High
Emergency Services	Moderate	Medium	High	High	High	High
Populations						
Urban Residents	Major	Medium	High	High	High	High
Informal Settlement Residents	Catastrophic	High	High	High	High	High
Vulnerable and Marginalized Groups	Major	Medium	High	High	High	High
Natural Assets						
Urban Green Infrastructure	Major	Medium	High	High	High	High

Urban Blue Infrastructure	Major	High	High	High	High	High
Peri-urban and Agricultural Systems	Major	High	High	High	High	High

Table 2. Summary of Drought risks for Awendo Municipality

	Time Horizon & Climate Scenario	Current	2050 SSP2-4.5	2050 SSP5-8.5	2100 SSP2-4.5	2100 SSP5-8.5
	Hazard Level					
Categories	**Impact**	**Risk Levels**				
		Current	**2050 SSP2-4.5**	**2050 SSP5-8.5**	**2100 SSP2-4.5**	**2100 SSP5-8.5**
Infrastructure & Services						
Stormwater Drainage	Minor	Low	Medium	Medium	Medium	Medium
Water & Wastewater Management	Major	High	High	High	High	High
Solid Waste Management	Minor	Medium	Medium	High	Medium	High
Transport and Mobility	Moderate	Medium	High	High	High	High
Energy	Moderate	Medium	High	High	High	High
Economic Infrastructure	Major	High	High	High	High	High
Social Infrastructure	Major	High	High	High	High	High
Emergency Services	Moderate	Medium	High	High	High	High
Populations						
Urban Residents	Major	High	High	High	High	High
Informal Settlement Residents	Major	High	High	High	High	High
Vulnerable and Marginalized Groups	Major	High	High	High	High	High
Natural Assets						

Urban Green Infrastructure	Major	High	High	High	High	High
Urban Blue Infrastructure	Major	High	High	High	High	High
Peri-urban and Agricultural Systems	Major	High	High	High	High	High

Table 3. Summary of Heat Stress/Extreme Heat risks for Awendo Municipality

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

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

Table 4. Summary of Land Degradation risks for Awendo Municipality

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

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

Table 5. Summary of Changes in Precipitation risks for Awendo Municipality

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

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

9.2. Climate Risk Hotspots

Awendo Municipality sits in the Centre of Migori County, ranging from municipal lowlands through rolling peri-urban agricultural lands up toward the southern foothills of Awendo hills. Climate risks are not evenly distributed**:** urban cores, low-lying drainage corridors and riparian strips, peri-urban farms and steep slopes each face different dominant hazards. Migori County PCRA and County Climate Action Plan highlight flooding (pluvial & fluvial) and drought/ water scarcity as primary threats, with heat stress**,** land degradation (erosion/siltation) as important cross-cutting concerns.

1) **Awendo Municipal urban wards (Central Sakwa, West Sakwa, North Sakwa, South Sakwa) flooding, heat, service stress**

- **Pluvial / flash flooding and drainage failure**: the densest urban blocks - municipal centre, market areas and low sections adjacent to roadside drains and natural drainage lines - have the highest exposure to short, intense rainfall events and blocked drains**.** The municipal spatial plan and PCRA show that poor/undersized stormwater systems and clogging by solid waste are common causes of urban inundation. These problems are concentrated where older development and informal infill have reduced natural drainage corridors.
- **Heat stress** is strongest in densely built areas with low tree canopy and high imperviousness (market centers, densely built residential blocks). The county-level

heat trends in the CCAP and national guidance indicate rising frequency of extreme heat days, which concentrates health and productivity impacts in the urban core.

- **Service vulnerability** (water, wastewater, energy) is highest where on-site storage is limited (many rental flats and smaller commercial premises) and the municipal network has limited redundancy — meaning shortfalls during droughts or when sources are contaminated after storms.

Policy note: these wards should be prioritized for drain upgrading, solid waste control at markets, and urban greening / shading interventions.

2) Edges and peri-urban fringe (urban expansion zones / peri-urban farms surrounding

the core) drought impact on water supply, agricultural losses, land degradation

- **Water scarcity & drought exposure:** peri-urban producers and smallholder plots that supply vegetables, coffee/tea seedlings and dairy to the municipality are highly sensitive to declining rainfall or longer dry spells — reductions in groundwater recharge reduce yields and raise competition for borehole water. The PCRA and CCAP identify peri-urban agriculture as a hotspot for drought impacts and economic losses.
- **Land degradation and erosion** are evident on steeper slopes and in areas undergoing unchecked construction or informal cultivation; erosion increases sediment loads into drainage, reducing stormwater conveyance capacity and raising treatment costs for water utilities. The municipal spatial plan maps peri-urban open spaces and the hills where erosion risk is concentrated.

Policy note: prioritize water-harvesting, small-scale irrigation (drip), soil conservation and riparian restoration in peri-urban wards and planned expansion zones.

3) Riparian corridors, wetlands and small rivers that cross the municipality (urban blue

infrastructure) flooding, pollution, and ecosystem loss

- River and stream corridors that bisect the urban area (the municipal plan highlights local streams/drainage channels) are focal points for both **pluvial / fluvial flooding** and water quality deterioration after intense storms (wash-off and leachate from dumpsites). Siltation from upstream erosion reduces channel capacity and shifts flood footprints.

Policy note: protect riparian buffers, restrain development on floodplains, and upgrade culverts/bridges where maps show repeated overtopping.

4) Informal settlements and low-income neighborhood's — highest vulnerability to multiple hazards

- These settlements (many located along marginal land, drainage lines or low plots near markets) face compound risks: flooding, sanitation failure during floods, contaminated water supplies, heat exposure in metal-roof dwellings, and low adaptive capacity (limited storage and finance). The PCRA explicitly highlights informal settlements as disproportionately affected.

Policy note: prioritize targeted early-warning, localized stormwater clearance, emergency water provision and social protection measures for these wards.

- On steeper slopes leading up from the municipality, intense rainfall can trigger slope instability and gully formation; deforestation/land-use change increase this risk. While landslides are more spatially limited, their impacts are severe where access roads and scattered settlements sit on unstable slopes. The county plans identify hillside restoration and forest conservation as climate priorities.

10. What's Next?

10.1. Key Findings

Table n1. Summary of climate risks affecting urban elements for Awendo Municipality

Category	List of Key Hazards		
	Current	**Mid-term (2050)**	**Long-term (2100)**
Infrastructure & Services			
Stormwater Drainage	Urban flooding blocked drains	Flush floods, public health risk	Permanent loss of natural drainage pathways

Water & Wastewater Management	Discharge of untreated sewage, seasonal water shortages	Infrastructure stress from extreme weather, higher river pollution	Chronic water scarcity, long term ground water contamination
Solid Waste Management	Blocked storm water due to plastic waste, Increased contamination of water sources	Extreme weather intensity and disease risk	Chronic flooding, landfill relocation and methane emissions
Transport and Mobility	Traffic disruptions during storms, potholes from intense rainfall	Damage to culverts and bridges raising maintenance cost	Costly infrastructure, Chronic flooding
Energy	Flooding, Heatwaves/high temperatures	Increased rainfall variability, Soil erosion	Chronic water scarcity, Population growth and urban expansion
Economic Infrastructure	Droughts, erosion, Heat	Water stress, erosion	Systematic failures, Cyclic extremes

Category	**List of Key Hazards**		
	Current	**Mid-term (2050)**	**Long-term (2100)**
Social Infrastructure	Flooding, Water scarcity	Droughts, Health hazards	Structural degradation, Chronic water shortage
Emergency Services	Disease outbreaks, Power outages, Heat waves, Flooding and Heavy rains	Water scarcity, Population displacement	Chronic water shortage, Extreme heat and Infrastructural collapse
Populations			

Urban Residents	Flooding, Water scarcity and Air pollution	Food insecurity, Vector and infectious disease expansion	Chronic water shortages, Infrastructure failure impacts, Persistent air quality degradation
Informal Settlement Residents	Poor water quality, Storm damage, Flooding	Water scarcity, Erosion, Waste accumulation	Health crisis, Chronic water stress and Environmental degradation
Vulnerable and Marginalized Groups	Heat waves and extreme temperatures, Flooding and Water logging, Food insecurity	Chronic water scarcity, Health vulnerabilities, Education disruptions	Chronic poverty, Collapse in food systems, Mental health impacts and Social instability
Natural Assets			
Urban Green Infrastructure	Heat waves and extreme temperatures, heavy rainfall and flooding, strong winds	Prolonged droughts and loss of biodiversity	Permanent loss of green cover, altered hydrology and ecosystem collapse
Urban Blue Infrastructure	Heavy rainfall and flush floods, water contamination	Prolonged droughts	Chronic water scarcity
Category	**List of Key Hazards**		
	Current	**Mid-term (2050)**	**Long-term (2100)**
Peri-urban and Agricultural Systems	Loss of topsoil fertility, prolonged droughts	Reduced agricultural productivity, increased livestock vector-bone diseases	Chronic food insecurity and severe land degradation

10.2. Climate Adaptation and Resilience Solutions

Table n. **Climate adaptation and resilience solutions recommended for Awendo Municipality**

Category	Recommended Solutions		
	Immediate	**Mid-term**	**Long-term**
Infrastructure & Services			
Stormwater Drainage	• Desilt and unblock all existing storm water drains, culverts and manhole • Remove solid waste, silt and illegal obstructions	• Drainage system upgrading • Construct water retention and detention points.	• Develop an integrated urban storm water management system (IUSWMS) • Implement upstream soil and water conservation measures to reduce run-off entering the town
Water & Wastewater Management	• Promote household and institutional rainwater harvesting using surface and underground tanks • Identification and stoppage of illegal wastewater discharge into open drains, rivers and open lands.	• Drill and equip climate resilient boreholes • Upgrade treatment plants to handle viable water quality during adversaries like floods	• Protect and restore water catchment areas and riparian zones upstream of Awendo area • Construct or upgrade centralized wastewater treatment plants for climate resilient standards

Solid Waste Management	• Operational and service measures – clear waste from drainage channels, road reserves and flood prone areas • Dumpsite and disposal risk control – improve drainage around existing dumpsites to prevent flooding. • Restrict waste disposal during extreme rainfall events where necessary.	• Infrastructure improvement: upgrade waste collection equipment i.e. covered waste trucks and skip bins • Waste reduction and segregation; introduce waste segregation at source. • Support recycling initiatives for plastics, paper and metal	• Integrated and circular waste systems – develop a sanitary landfill or controlled disposal facility designed for extreme rainfall • Climate smart waste treatment. Scale up composting facilities to reduce organic waste and methane emissions • Introducing Waste to Energy where feasible

Category	**Recommended Solutions**		
	Immediate	**Mid-term**	**Long-term**
Transport and Mobility	• Road and drainage maintenance; desilt and clear roadside drains, culverts and bridges during and after rainy seasons. • Non-motorized Transport protection (NMT) – Clear foot paths and pedestrian crossings. Improve street lighting for safety during extreme weather events.	• Climate resilient road designs; upgrade roads using climate resilient standards. Replace undersized culverts and bridges with larger climate resilient structures Mobility and traffic management; design • safer bus stops and loading zones that are flood resilient	• Green and low mobility; Expand nonmotorized transport networks • Smart and digital solutions; implement smart traffic and asset management system
Energy	• Protection of critical energy infrastructure; protect transformers and power meters from flooding through elevation and fencing • Emergency power and preparedness; provide backup generators or solar power systems for critical facilities.	• Climate resilient energy infrastructure; expand solar powered systems for street lighting, water pumping and public buildings • Diversity of energy sources; promote decentralized renewable energy sources (solar, mini-grids, rooftop pvc)	• Integrated and smart energy systems; introduce smart grids and digital monitoring systems for efficient energy management • Renewable energy transition; promote public-private partnership for large scale renewable projects

Economic Infrastructure	• Enforce land-use regulations to prevent construction on riparian reserves • Routine maintenance of infrastructure to prevent climate related deterioration	• Expand and modernize stormwater management systems • Integrate climate risk considerations into municipal planning, budgeting and infrastructure designs.	• Develop and implement a climate resilient infrastructure masterplan • Promote low-carbon and climate smart infrastructure (Green buildings, renewable energy hub)
Social Infrastructure	• Conduct rapid climate risk assessments on social facilities • Raise community awareness on climate related health and safety risks	• Upgrade schools and health facilities using climate-resilient designs. • Train teachers, health workers and facility managers on climate risk management	• Develop and implement a climateresilient social infrastructure strategy aligned with municipal policies • Relocate or redesign social facilities located on high risk zones

Category	**Recommended Solutions**		
	Immediate	**Mid-term**	**Long-term**
Emergency Services	• Conduct rapid climate risk and capacity assessments for emergency service facilities and equipment's Identify • and map climate hazard hotspots and high-risk communities	• Upgrade fire stations, ambulance centre and emergency operation centre • Develop incident command systems and standard operation procedures for climate emergencies	• Develop and implement a climate resilient service master plan Establish • permanent well-equipped Emergency Operation Centres (EOP)
Populations			
Urban Residents	• Provide early warning systems for floods and storms through radio and SMS • Promote solid waste management and drainage maintenance.	• Enhance access to clean water and sanitation for all urban residents • Establish community-based disaster response teams trained in first aid and emergency evacuation	• Integrate urban planning with social resilience strategies (safe roads, access to health services, schools) Ensure • inclusive governance and decision making

Informal Settlement Residents	• Conduct rapid vulnerability and risk assessment in informal settlements • Clear blocked drains and debris to reduce flooding risk	• Improve water, sanitation and drainage system • Upgrade housing structure with climateresilient materials	• Relocate or upgrade informal settlements in high-risk areas • Inclusive planning and social protection
Vulnerable and Marginalized Groups	• Conduct rapid vulnerability assessments to identify marginalized households and high-risk communities • Promote access to clean water, sanitation and health care services	• Strengthen access to climate resilient housing for low income and marginalized groups • Promote inclusive health and social services with outreach programs for women, children, elderly and persons with disability	• Establish long-term livelihood programs and social protection mechanisms for marginalized groups • Relocate or upgrade settlements in high-risk zones with social safeguards for vulnerable residents
Natural Assets			
Category	**Recommended Solutions**		
	Immediate	**Mid-term**	**Long-term**
Urban Green Infrastructure	• Maintain and protect existing urban trees, parks and vegetated areas • Establish temporary green interventions such as potted plants, green barriers and rooftop gardens	• Expand urban parks, green corridors and street trees to enhance urban cooling and flood mitigation Integrate • green infrastructure into drainage systems	• Establish permanent green corridors and protect urban forests • Promote nature-based solutions to compliment grey infrastructure like wetlands
Urban Blue Infrastructure	• Clear illegal encroachments and dumping along water course Conduct • rapid assessment of water bodies and drainage systems to identify vulnerabilities	• Upgrade and expand storm water management systems • Improve urban water storage and distribution systems for drought resilience	• …Promote nature-based solutions for urban water management, including urban wetlands • Integrate innovative water management technologies (smart drainage, sensors, real-time monitoring)

Peri-urban and Agricultural Systems	• Water and soil protection; promote mulching, minimum tillage and cover cropping to retain soil moisture • Livestock resilience; promote strategic destocking during prolonged drought periods	• Water management and irrigation; develop small-scale climate resilient irrigation system • Market and value chain resilience; improve rural-urban feeder roads to ensure market access during extreme weather	• Integrate landscape and food systems; implement integrated landscape management linking urban, peri-urban and rural systems • Climate-resilient food systems; encourage re-use of treated wastewater for irrigation.