

UGANDA

Climate Hazard Assessment – Kamwenge District

April 2026



UK International
Development

Partnership | Progress | Prosperity



Uganda Learning,
Evidence, Accountability,
and Research Network

REACH




Informing
more effective
humanitarian action

Climate Hazards in Uganda’s Refugee-Hosting Districts.

INTRODUCTION

Uganda hosts one of the largest refugee populations in Africa,¹ many of whom live in climate-sensitive landscapes highly vulnerable to the impacts of climate change due to its reliance on rain-fed agriculture, limited adaptive capacity, and high exposure to extreme weather events such as floods, droughts, and prolonged dry spells.² Over recent decades, the country has experienced more frequent and intense climate hazards, undermining livelihoods, food security, health, and infrastructure.^{3,4} Uganda’s climate is characterized by a bimodal rainfall pattern; however, this pattern has become increasingly unpredictable, with delayed onset and erratic distribution of rainfall that disrupts agricultural cycles.⁵

Key National Signals

-  Temperatures have risen by ~1.0–1.5°C over the last five decades, increasing heat stress and evapotranspiration.
-  More erratic rainfall: delayed onset, mid-season dry spells, intense rainfall events
-  Prolonged dry spells and flooding now co-exist as dominant hazards, disrupting agriculture, water access, transport, and shelter

Climate hazards vary across the country, with distinct patterns between the Northern/West Nile and Southwestern regions, highlighting the need for localized analysis. Although both regions are projected to become warmer and wetter by mid-century, the impacts will differ significantly due to variations in baseline conditions, terrain, and livelihood systems.

In the Northern/West Nile region including Yumbe, Koboko, Adjumani, Madi Okollo, Terego, Obongi, and Lamwo, average temperatures are projected to rise from about 25°C to 30°C by mid-century, while annual rainfall increases from roughly 1,138 mm to 1,587 mm. Despite higher rainfall, increased temperatures will accelerate evapotranspiration, leading to greater soil moisture loss and prolonged dry periods

during key agricultural seasons. According to the Multi-Sectoral Needs Assessment (MSNA), conducted by [IMPACT Initiatives](#) in 2024, prolonged dry spells and heavy rains are the hazard types most frequently reported across West Nile and Southwestern regions. With accelerating climate change, they will remain dominant hazards, alongside a growing risk of flash flooding in low-lying and poorly drained areas.⁶

Hazard Type	West Nile	Adjumani	Terego	Koboko	Lamwo	Madi Okollo	Obongi	Yumbe
Drought/ prolonged dry spells	x	31%	39%	40%	46%	31%	36%	46%
Heavy Rains	x	38%	40%	42%	24%	33%	35%	38%
Extreme Temp. Events	x	19%	13%	12%	18%	26%	13%	7%
Flood	x	13%	8%	6%	12%	10%	15%	9%

Table 1: Climate hazards reported in the MSNA, 2024, Northern/West Nile region

In Southwestern Uganda districts, Isingiro, Kamwenge, Kyegegwa, Kiryandongo, and Kikuube, historical temperatures average about **20.3°C** but are projected to rise to around **26°C** by mid-century, marking significant warming. Annual rainfall is also expected to increase from about **842 mm** to roughly **1,372 mm**.

Hazard Type	South west	Kiryandongo	Isingiro	Kamwenge	Kikuube	Kyegegwa
Drought/Prolonged dry spells	x	49%	74%	45%	48%	58%
Heavy Rains	x	30%	17%	28%	25%	25%
Extreme Temp. Events	x	16%	6%	23%	18%	13%
Flood	x	6%	3%	4%	9%	3%

Table 2: Climate hazards reported in the MSNA, 2024, Southwestern region

Across both regions, warmer and wetter conditions do not reduce climate risk. Instead, they increase overlapping hazards, with seasonal droughts, floods, and heat stress occurring in the same districts and seasons. These pressures are especially acute in refugee-hosting areas where land, water, and services are already limited. District-level Climate Hazard Assessments translate national and regional climate trends into local evidence, highlighting key hazards, seasonal risks, and exposures to support targeted planning and resilience for host and refugee communities.

Climate Hazard Assessment – Kamwenge District

CONTEXT & RATIONALE

Kamwenge District is located in the Western Region of Uganda. It is bordered by Kyenjojo to the east, Kabarole to the west, and Mbarara to the south. The district follows a **bimodal rainfall pattern**, characterized by two distinct rainy seasons, occurring from March to May and August to November respectively. The local economy is dominated by agriculture, which serves as the primary source of livelihood and income for the majority of the district's population.⁷ Crops most commonly grown include maize, bananas, cassava, beans, sweet potatoes, coffee and tea. Kamwenge District faces increasing climate variability and environmental degradation that compound existing development challenges. Like much of Western Uganda, the district experiences **erratic rainfall patterns, prolonged dry spells, and periods of intense rains, which undermine agricultural productivity and food security**. Dry seasons often reduce soil moisture and limit crop growth, while heavy rainfall events can damage crops and critical infrastructure and aggravate localized flooding in low-lying areas. Soil fertility is declining as a result of erosion, poor farming practices, and nutrient mining, decreasing overall crop productivity. High soil degradation and acidification are common, with low levels of key nutrients, such as Nitrogen, Phosphorus and Potassium.⁸

Climate projections under the Moderate Socio-economic Path (SSP2-4.5 scenario), which represents a middle of the road development trajectory with moderate emissions and limited climate mitigation, indicate that Kamwenge will become warmer and moderately wetter by mid-century. Mean annual temperatures are projected to rise from **21.2°C to 23.8°C**, while annual rainfall is expected to increase from **1,077 mm to about 1,218 mm**.¹ Despite this increase in rainfall, intensifying heat stress is expected to pose greater risks to rural households and displaced populations.

As of 2026, Kamwenge District hosts **over 106,000 refugees**, living in and around Rwamwanja Refugee Settlement.⁹ The settlement of refugees has **increased pressure on natural resources**, with reliance on wood fuel driving deforestation and rising

¹ SSP2-4.5 refers to a moderate climate change scenario that combines the "Middle-of-the-Road" Shared Socio-economic Pathway (SSP2) with a radiative forcing level of 4.5 W/m² by 2100. It assumes continued socio-economic development along current trends, moderate population growth, and limited but ongoing climate mitigation, resulting in continued warming and increasing climate variability.

demand for farmland intensifying land competition, together increasing vulnerability to climate-related shocks. This analysis therefore seeks to generate evidence-based insights into historical and projected climate trends to inform climate-resilient humanitarian and development programming in Kamwenge District.

By identifying hazard susceptibility, exposure patterns, and future climate risks, the assessment aims to support OPM, UNHCR, WFP, district authorities and humanitarian partners in developing targeted interventions, strengthening disaster preparedness and enhancing resilience within one of Uganda's largest refugee-hosting districts.

Key Messages

- Kamwenge District currently receives **~1,077 mm** of annual rainfall, projected to rise moderately to **~ 1,218 mm** by mid-century under the SSP2-4.5 scenario. However, persistent dry-season deficits and higher evapotranspiration will intensify water stress, especially in areas like Nkomo, Bihanga and Kabambiro.
- Temperatures are projected to **increase by 2.2-2.8°C during the hottest and driest quarters**, increasing the risk of droughts, heat stress and the frequency of very hot days across agricultural and settlement areas
- Droughts remains a dominant hazard, with the Standard Precipitation Index and Vegetation Condition Index (VCI), which capture rainfall deficits and vegetation stress respectively, showing **severe dryness across Biguli, Nkoma, and Bihanga** leading to vegetation stress, reduced crop yields, and limited pasture and water availability.
- **Flood risk is highly localized**, with the greatest concentration of inundation occurring in **river catchments like the Mpanga and Katonga river parts** of the district.

Location and Topography

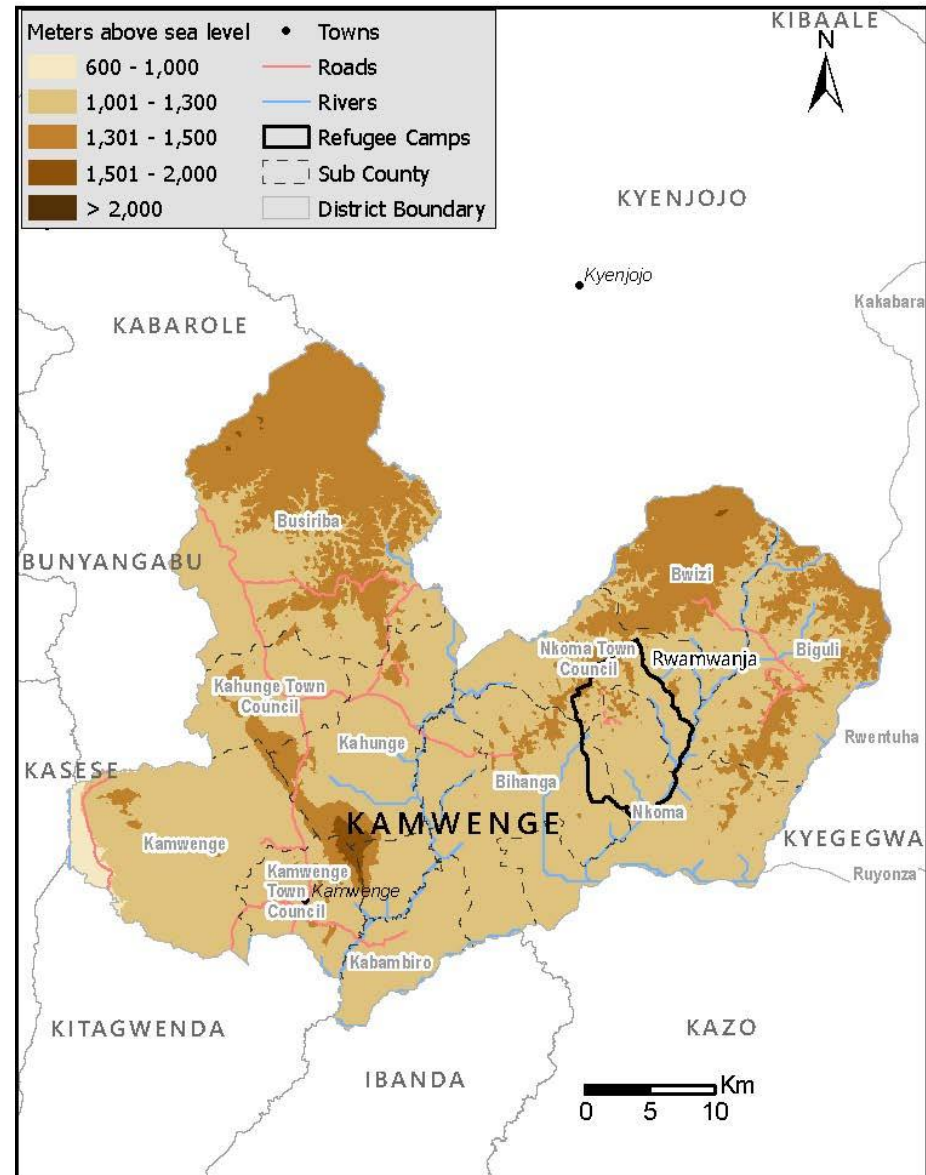
Kamwenge District is located in the Western Region of Uganda, bordering Kabarole to the west, Kyenjojo to the east and north, and Mbarara to the south. It was formed from Kabarole District in 2000 and sits within the Toro Sub-region.

According to *Map 1*, Kamwenge features an **undulating landscape with rolling hills, transitioning into the flat plains of the Great Western Rift Valley**.¹⁰ Topography varies from 1,031 meters to over 1,800 meters above sea level, giving an **average elevation of 1,287 meters**.¹¹ The district's low-lying areas are primarily located in the southwestern part, including sub-counties such as Mahyoro and Kanara.¹² Higher-altitude areas are typically found in the western and northwestern parts bordering Kabarole District. One of the prominent topographic features in the district is Kabuga Hill, which is located approximately 5km from Kamwenge Town and 1,581 meters above seal level.¹³

The district's varied topography directly influences settlement patterns, agricultural land use and water flow during the rainy season. **Higher-lying areas** are often characterized by **dispersed settlements and terrace farming**, while **lower-lying areas** attract **denser settlements and intensive agriculture**.¹⁴ During heavy rains, water flows from higher elevation areas towards lower-lying plains and wetlands, which can lead to runoff with the potential to result in flooding. The risk of this happening is aggravated by widespread wetland degradation and poor land management practices.¹⁵ This underscores the **importance of location-specific planning and risk reduction strategies** to address differential climate sensitivities, including soil moisture deficits, surface runoff and erosion risks across the district.

Demographics and Population Distribution

According to the 2024 National Population and Housing Census, Kamwenge District has a population of **over 337,000 people**.¹⁶ Kamwenge is a predominantly rural district, with the vast majority of residents practicing small-scale agriculture and living outside of urban centres.¹⁷ The most commonly grown crops include bananas, followed by maize, cassava, and sweet potatoes.¹⁸ The district is multi-ethnic, mostly inhabited by the Bakiga, followed by the Bafumbira, the Batooro and the Batagwenda.



Map 1: Map showing the Location and Elevation of Kamwenge District.

Kamwenge is also a **major refugee-hosting area** in Southwest Uganda. The district hosts large refugee population, mainly from the Democratic Republic of Congo, settled in and around Rwamwanja Refugee Settlement. As of early 2026, the refugee population is estimated to be **106,000 people**.¹⁹ Refugees account for a substantial share of the district's total population, significantly increasing population density in settlement-hosting sub-counties.

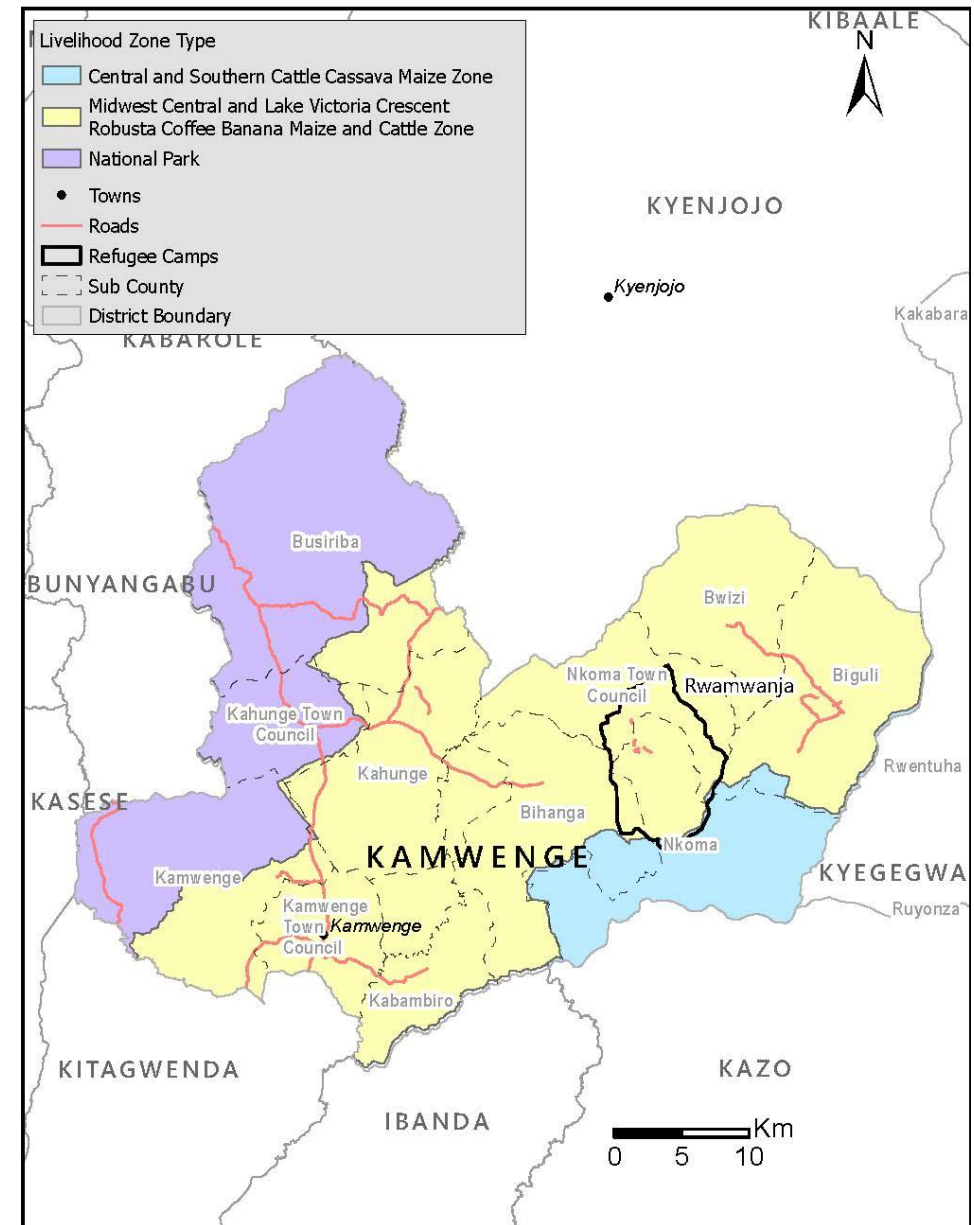
This demographic composition has important implications for district planning and climate hazard management. Both host and refugee populations depend heavily on climate-sensitive natural resources and basic services, including land, water, education, health, and sanitation. The high concentration of people in settlement areas intensifies pressure on land, forests, and water resources, increasing vulnerability to climate-related hazards, such as seasonal droughts, erratic rainfall, and localized flooding.

Livelihoods

Livelihoods in Kamwenge District are primarily **based on smallholder agriculture**, with most households depending on rain-fed farming and livestock keeping for food and income. However, these livelihoods vary across the district's main livelihood zones (see Map 1), which include the *Central and Southern Cattle Cassava Maize Zone*, the *Robusta Coffee Banana Maize and Cattle Zone*, and the *Midwest Central and Lake Victoria Crescent Zone*.²⁰ In much of the district, households **combine crop production particularly cassava, maize, bananas, and coffee with cattle keeping**, forming the foundation of local livelihoods and rural economic activity.

The Rwamwanja Refugee Settlement, located in Nkoma Sub-county in the northeastern part of the district, lies within the *Central and Southern Cattle Cassava Maize livelihood Zone*. As a result, both refugee and host communities in this area mainly rely on rain-fed crop cultivation and livestock rearing, with cassava and maize serving as key staple crops. Environmental conditions play an important role in shaping these livelihood activities. Nkoma Sub-county receives moderate annual rainfall of approximately 1,122–1,317 mm and is situated at elevations ranging from about 1,001–1,300 meters above sea level, with some areas extending to higher elevations. These conditions generally support mixed farming systems but make agricultural productivity highly dependent on seasonal rainfall patterns.

Across the district, **variations in rainfall and elevation influence the distribution**



Map 2: Map showing Livelihood Zones in Kamwenge District.

and productivity of livelihood activities. Sub-counties such as Busiriba and Bwizi receive relatively higher rainfall and are located at higher elevations, conditions that favour crop production and livestock keeping. In contrast, areas such as Kamwenge and Kabambiro receive comparatively lower rainfall, which can limit soil moisture availability and increase vulnerability to rainfall variability. Consequently, many communities remain exposed to climate-related risks, particularly during periods of prolonged dry spells that affect crop performance and pasture availability.

To strengthen resilience, government and development partners are promoting interventions such as **climate-smart agriculture, improved natural resource management, and livelihood diversification.** These efforts aim to enhance agricultural productivity, reduce environmental pressure, and support sustainable livelihoods for both refugee and host communities in Kamwenge District.

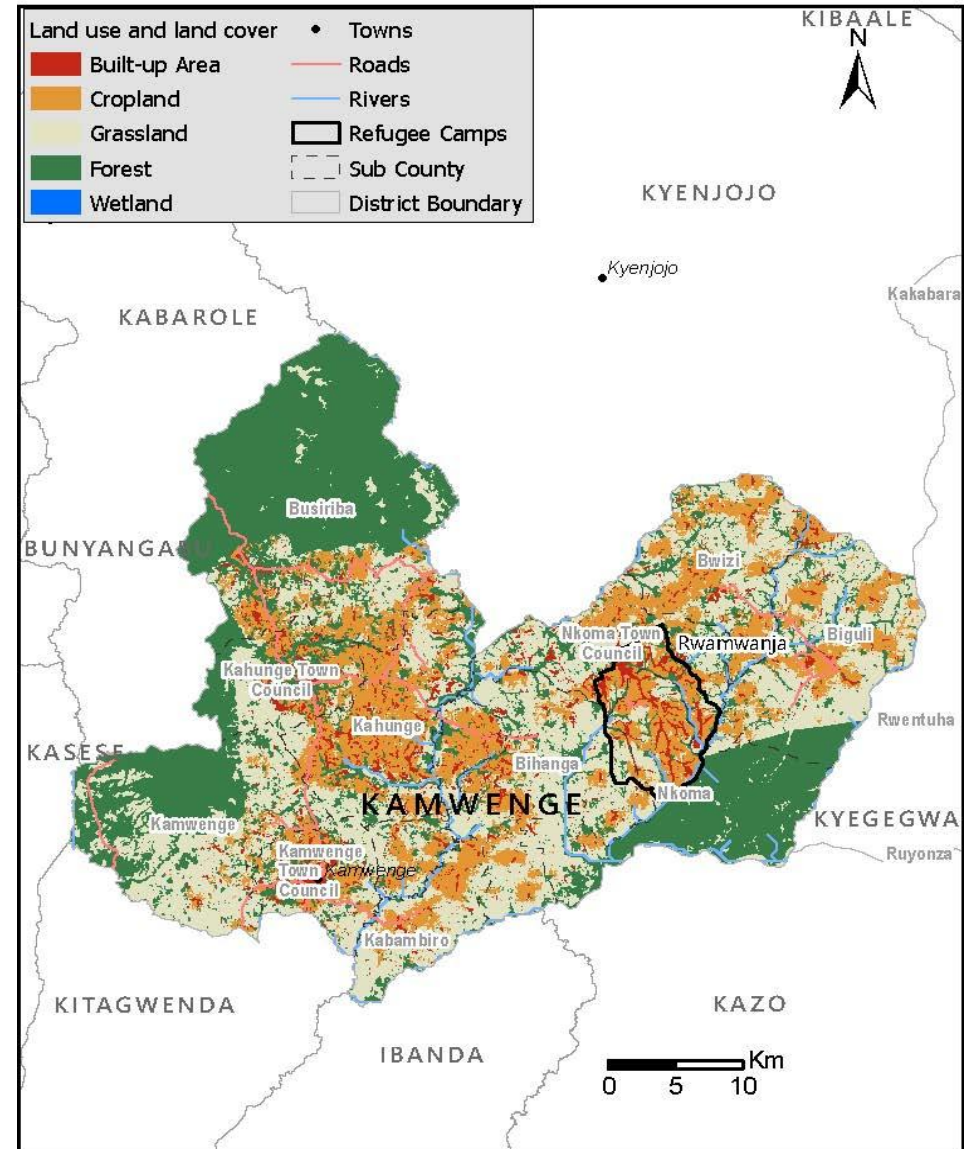
Environment, Land Use and Land Cover

Kamwenge District is characterized by **rolling hills, mid-altitude plains, and scattered forested areas**, with vegetation ranging from grasslands to agricultural land. The district is experiencing increasing environmental pressure driven by expanding agriculture and population growth. Between 2014 and 2024, the population increased from roughly 270,000 to over 337,000, raising demand for land, food, and natural resources. The presence of the Rwamwanja Refugee Settlement has increased further pressure on land and vegetation as both host and refugee communities rely on farming, grazing, and forest resources for their livelihoods.

Rainfall and elevation also influence livelihood activities across the district. Areas such as Busiriba and Bwizi receive relatively higher rainfall, while Kamwenge and Kabambiro experience comparatively lower rainfall. Most of the district lies between 1,001 and 1,500 meters above sea level, conditions that support mixed farming systems but make agriculture highly dependent on seasonal rainfall. The Rwamwanja Refugee Settlement in Nkoma Sub-county receives moderate rainfall of about 1,122–1,317 mm annually, supporting crop cultivation and livestock keeping.

Land use reflects the district's strong reliance on natural resources. Forests and grasslands dominate the landscape, covering about 37.62% and 35.81% respectively, while cropland accounts for about 21.81% and built-up areas about 4.74%.

Rwamwanja Refugee Settlement is mainly characterized by cropland and grassland with some built-up areas, highlighting the importance of agriculture and livestock.



Map 3: Map showing Land Use and Land Cover in Kamwenge District. Source: ESRI land cover map.

CLIMATE CONTEXT

This section presents an analysis of Kamwenge’s District’s climate using key indicators. Rainfall and temperatures are examined from both historical records and future climate projections to understand long-term trends and emerging risks associated with these hazards associated with these hazards. The aim is to provide a clear picture of how climate patterns have evolved over time and how they are expected to change in the coming decades, informing both vulnerability profiling and resilience planning.

Rainfall

Kamwenge District typically experiences a **bimodal rainfall pattern**, characterized by two distinct rainy seasons. The primary, heavier rainy season occurs from March to May, **with peak rains normally in April**, while the second season runs from September to November/ December. The **driest months are typically July, and the period from December to February**. July often records the least amount of rain, averaging around 1.4 inches. Consistent with these patterns, the dashed line in *Figure 1* shows the long-term average rainfall (1981-2024) in Kamwenge. Year-to-year variation is evident, with 2022, 2023, and 2024 showing different magnitudes and timing of rainfall, when compared against the historical averages. For example:

- 2022: Rainfall was generally closely following the 1981-2024 average, with slight variations. February, March April recorded totals above the long-term mean, while June, July and September recorded totals below.
- 2023: Rainfall fluctuated around the 1981-2024 average, with July, August, and September experiencing below average precipitation, while November, December and March recorded above-average totals.
- 2024: Rainfall patterns largely followed the 1981-2024 average, with both March and November being outliers. While March was drier than it would be typically, November was significantly wetter than usual, recording above-average precipitation.

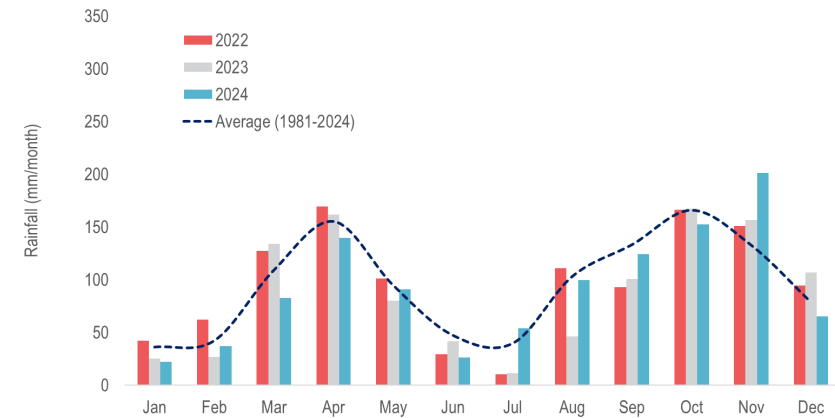


Figure 1: Graph showing Long-term Average Rainfall (2022-2024) in Kamwenge District.

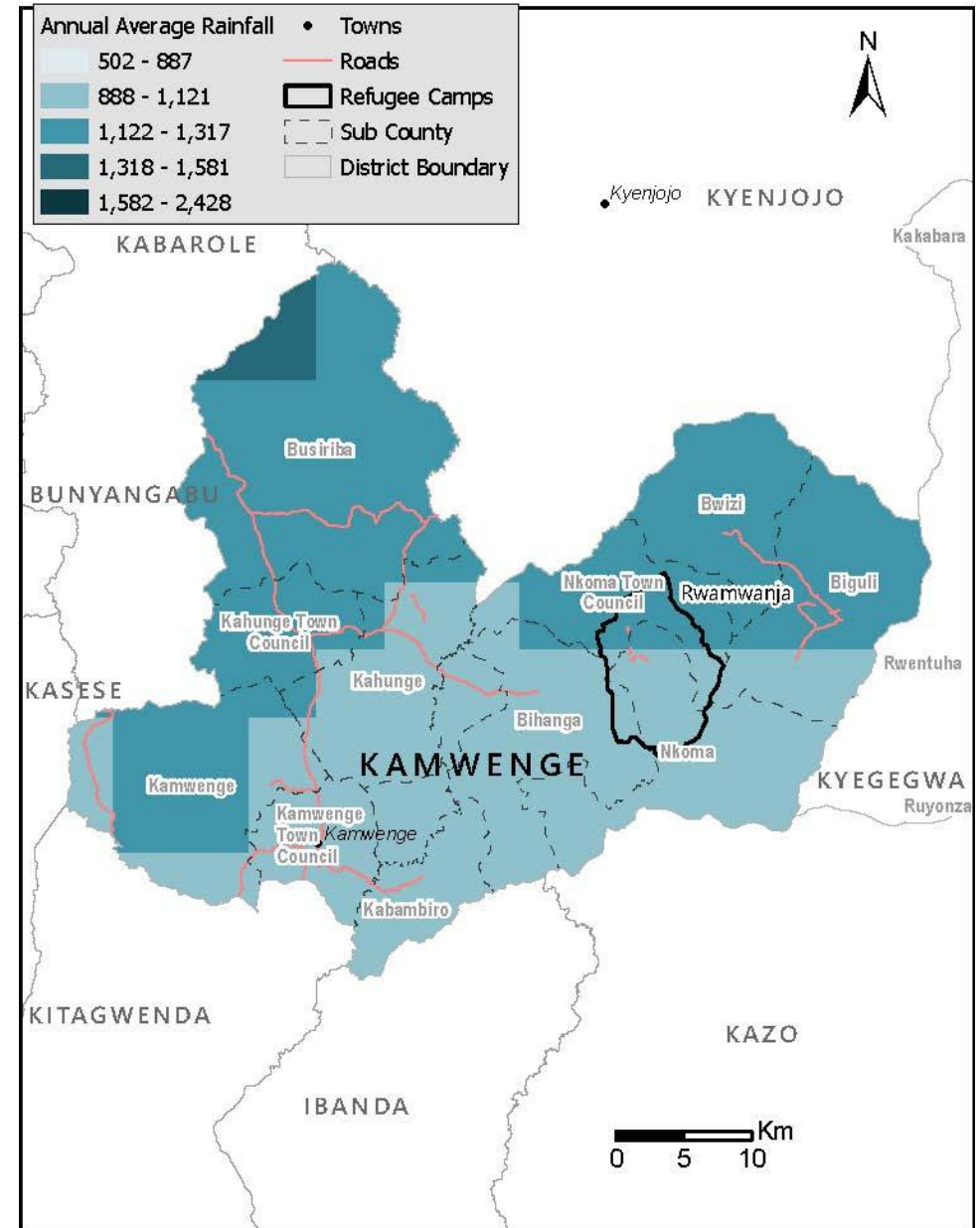
These fluctuations are influenced by climate variability phenomena, such as the El Niño Southern Oscillation (ENSO), which can alter the onset, duration, and intensity of seasonal rains. Historically, the El Niño Southern Oscillation (ENSO) typically occurred in an irregular cycle of two to seven years, with the individual El Niño persisting for 9 to 12 months. In recent decades, greater variability in ENSO timing, intensity and impacts has contributed to less predictable rainfall patterns across the region and as a result, Kamwenge is increasingly vulnerable to both droughts and flooding. Prolonged dry spells, especially during the June-August period, lead to water scarcity, crop stress, and pasture depletion. Conversely, intense rainfall events during the two main rainy seasons (March-May and September-November/December) can trigger flash floods, crop damage, and disruption of transport and livelihoods.

Recent rainfall patterns in Kamwenge District have become **increasingly unreliable and unpredictable, characterized by shifts in traditional rainy seasons and prolonged dry spells.**²¹ This instability includes a mix of erratic, heavy rains causing destruction and unexpected seasonal drought. Furthermore, some areas experience relatively low total precipitation and are drought-prone, particularly within the context of the cattle corridor in the North-East and South, such as Nkoma, Rwizi and Nyabbani Sub-county.

The increasing variability in rainfall patterns combined with the district's reliance and rain-fed agriculture and pastoralism have heightened climate risks for both refugees and host communities. Recurrent extreme weather events have a negative impact on agricultural productivity and livestock, threatening the livelihoods of inhabitants. This underscores the urgent **need for integrated climate adaptation and resilience strategies** to safeguard water availability, food security and sustainable livelihoods.

Map 4 displays the spatial distribution of average annual rainfall across Kamwenge for the period 1981-2024, derived from long-term CHIRPS precipitation data. Kamwenge District straddles the **888-1,121 and 1,318-1,581 mm annual rainfall zones**, with higher elevation areas experiencing more rainfall compared to the lower-lying, drier parts situated along the Eastern escarpment of the Great Western Rift Valley. Rainfall in Kamwenge is **generally considered sufficient for rain-fed agriculture**, with an average of 1,077 mm of well-distributed bimodal rain annually. That said, specific areas within the district tend to receive below-mean precipitation and are drought-prone. Such areas include Biguli Sub-county as well as parts of Mahyoro, Kanara and Ntara.

Similar to trends in neighboring districts, Kamwenge experiences increasingly unreliable and unpredictable rainfall patterns.²² This presents significant challenges to water security, agriculture and rural livelihoods. Seasonal rainfall variability often drives environmental degradation, such as soil erosion, soil nutrient loss and water availability, which in turn disrupts the traditional agricultural calendar, meaning the timing of planting, growing and harvesting. Overall, the increasing variability in rainfall patterns, coupled with the district's reliance on rain-fed agriculture, heightens climate risks for both refugee and host communities. For example, maize, one of the main sources of livelihood in the area, is a highly vulnerable crop: highly sensitive to heat stress and seasonal drought, maize can suffer significant yield losses after 10-14 days without rain during critical periods like tasseling, silking, and grain filling.²³ During early growth stages, plants can usually withstand only 3-5 days of no rainfall. During peak dry season in July, intense sunlight and lack of water can scorch maize plants, with severe cases causing entire fields to wither.



Map 4: Map showing Average Annual Rainfall (1981-2024) of Kamwenge District.

In recent years, farmers in Kamwenge have faced significant crop failures. While historically a major maize producer, erratic rainfall patterns together with diseases have severely impacted yields.²⁴ The situation is worsened by a lack of adaptation. Although drought-tolerant maize varieties exist, their adoption remains low due to limited access to information, poverty and the prevalence of counterfeit seeds, limiting the mitigation of such crises.²⁵

The recent changes pose **specific challenges for refugee-hosting areas**. Rwamwanja Settlement is highly susceptible to both floods and seasonal droughts due to a combination of climate-related, geographical and human-induced factors. The settlement's rapid expansion and population growth has led to the clearing of trees and vegetation for farming, firewood and building materials, reducing the soil's capacity to absorb water, exacerbating both seasonal drought and floods risks. Inadequate drainage systems and infrastructure further compound these problems. Communities in and around Rwamwanja settlement are extremely sensitive to any deviation from normal rainfall patterns, given the lack of irrigation infrastructure and their dependence on rain-fed agriculture. Overall, refugee communities are more vulnerable than host communities whose livelihoods are distributed across a wider landscape and diversified through larger landholdings and livestock.

The increasing variability and rapid shifts in the known climatic patterns pose growing risks in Kamwenge. These shifts influence water availability, crop performance, pasture regeneration and the reliability of rain-fed farming systems that both host and refugee communities depend upon.

Temperature

Over the past four decades, Kamwenge District has experienced a significant rise in temperatures, with an **increase of approximately 2.2°C to 2.7°C**, a substantial warming trend for a single district. As shown in the graph in Figure 2 the most pronounced rise has occurred in recent years (2014-2023), simultaneously accompanied by greater year-to-year variability in temperatures.

The long-term temperature trend can be summarized as follows:

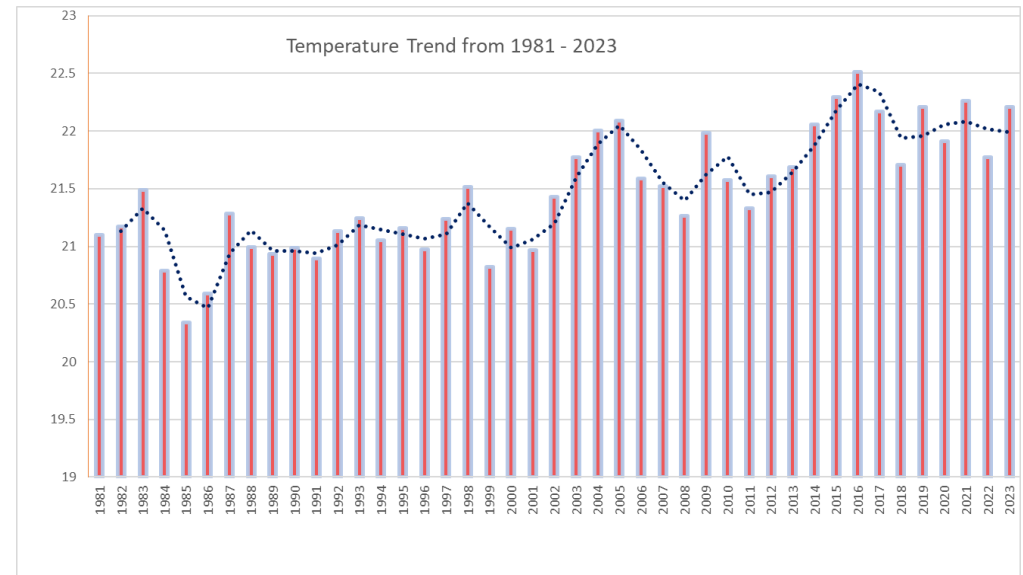


Figure 2: Graph showing the Long-term Temperature Trend (1981-2023) in Kamwenge District.

- 1980s-2002: Average annual temperatures generally ranged between about 20.3°C and 21.5°C, with some year-to-year variability, particularly in the mid-1980s, where temperatures dropped as low as 20.3°C in 1985 from 21.5°C in 1983. That said, overall, there was no warming trend.
- 2003-2013: Average annual temperatures initially rise to 22°C in 2005, before stabilizing between 21.3°C and 22°C. Overall, this period is marked by more year-to-year variability than the previous one.
- 2014 onwards: A clearer warming signal and even greater variability, with most years recording an average annual temperature of over 22°C.

The rise in temperatures coupled with greater variability highlights the growing climate stress in the region, with implications for agriculture, water availability, health and overall resilience.

In Kamwenge, the warmer periods generally coincide with the transition into the rainy seasons. The hottest temperatures typically occur during the drier, sunny periods immediately preceding the two main rainy seasons (March-April and September-November). February is often considered one of the hottest months before the March/April rains start. The graph in *Figure 3* indicates a rise in temperatures, with recent years showing more days where average daily temperatures exceed the long-term mean. This suggests that hotter-than-normal years are becoming more frequent, increasing heat stress on crops, pasture, livestock and water resources. These emerging extremes, coupled with rising seasonal temperatures, highlight Kamwenge's district's growing vulnerability to climate-induced heat stress.

The long-term monthly temperature average (2022-2024), shown by the dashed line in *Figure 3*, indicates temperature increases over the year that coincides with crop flowering (April-June and September/October) and crop germination (March/April and August/September). In Kamwenge, which operates under a bimodal rainfall pattern, crop germination typically occurs at the start of the rainy seasons, while flowering aligns with the peak or tail end of these rains.

The recent monthly temperature trend (2022-2024) can be summarized as follows:

- 2022: Monthly temperature in the crop flowering stage was above normal of the long-term average in May, June and October.
- 2023: Monthly temperature in the crop flowering stage was above normal of the long-term average in May, June, September and October.
- 2024: Monthly temperature in the crop flowering stage was generally above normal of the long-term average, particularly in May, June, September and October.

Above-normal temperatures negatively affect crops at all stages-reducing:

- germination by accelerating metabolism, leading to depletion of energy reserves, impairing starch breakdown and causing poor root development before seedlings establish.
- flowering by hindering pollination, fertilization, and impairing chlorophyll function, thus lowering carbohydrate supply, leading flowers to drop

prematurely.

- seed development by reducing carbohydrate and oil accumulation in seeds, resulting in smaller seeds and thus lowering the seed germination potential of harvested seeds

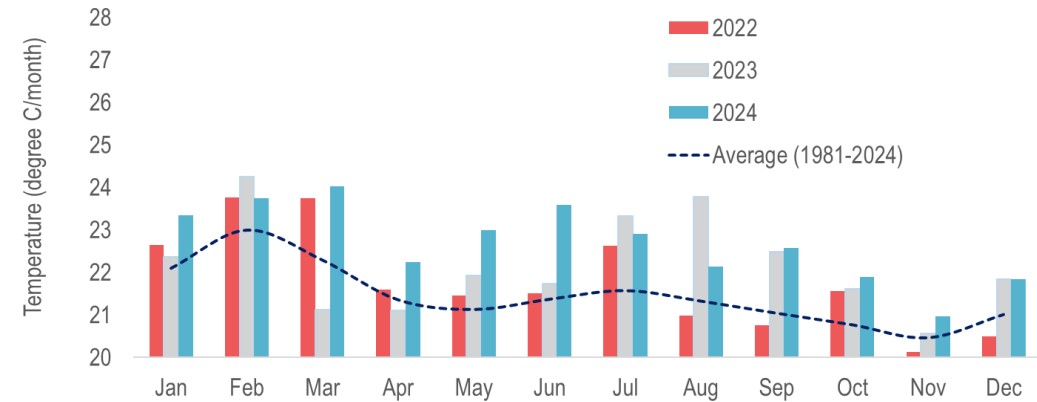


Figure 3: Graph showing Average Annual Temperature (2022-2024) in Kamwenge District.

In short, heat stress is most damaging during flowering and seed development. Farmers might mitigate heat stress effect through adjusted sowing dates, use of heat-tolerant varieties and irrigation scheduling.

CLIMATE CHANGE PROJECTIONS

In this study, bioclimatic variables from WorldClim v2.1, which provide historical high-resolution baseline climate data, such as temperature and precipitation patterns, were compared with future climate projections generated by the UKESM1-0-LL Earth system model under the SSP2-4.5 scenario, a “middle-of-the-road” pathway. Under this scenario, socio-economic development and moderate mitigation policies lead to stabilizing greenhouse gas emissions. This comparison allows researchers to assess how key climatic factors like seasonal rainfall, temperature extremes, and drought indices are expected to shift in coming decades, highlighting potential impacts on ecosystems, agriculture, and water resources under a moderately warming future.

Precipitation changes

(1970-2000 vs 2041-2060)
SSP2-4.5 Moderate Emission Scenario
Annual precipitation changes

+141 mm

Temperature changes

(1970-2000 vs 2041-2060)
SSP2-4.5 Moderate Emission Scenario
Annual Mean Temperature Increase

+2.7 °C

Figure 4: Annual precipitation and temperature changes in Kamwenge District

Temperature

Mean annual temperature is projected to rise from **21.2°C** in the historical baseline to **23.8°C** by **2041-2060**. Both minimum and maximum temperatures show substantial increases. The strongest warming (up to **2.68-2.69°C**) is expected in **Busiriba, Kahunge, Kahunge Town Council and Kamwenge Town Council**.

An increase in mean temperature during both the **warmest months (+2.2°C)** and **driest quarter (+2.8°C)** indicates more intense heatwaves particularly during already dry periods. This combination heightens **heat stress for people, crops and livestock, greater evapotranspiration, and reduced soil-moisture retention**.

An increase in mean temperature during both the **coldest months (+3.1°C)** and **wettest quarters (+2.3°C)** indicates a **general warming across seasons**, including

periods that are typically cooler. This suggests reduced seasonal cooling and more persistent heat throughout the year.

These impacts pose challenges for **crop production, livestock, and human health** particularly in areas with limited vegetation cover, including parts of Nakivale and Oruchinga settlement.

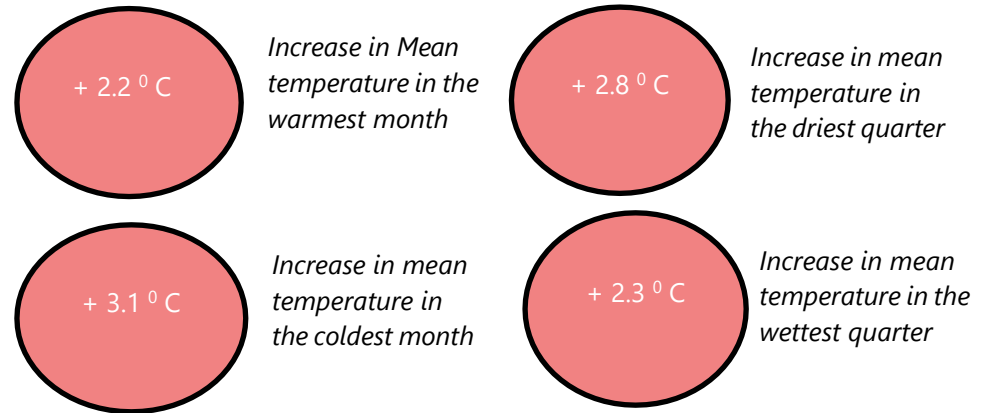


Figure 5: Projected changes in temperature in bioclimatic variables.

Precipitation

Mean annual rainfall is projected to increase from **1,077 mm to 1,218 mm** by mid-century. However, the distribution of rainfall gains is uneven across the district. The largest precipitation increases (**143-156 mm**) are expected in **Busiriba, Kahunge Town Council and Kahunge** while areas such as **Nkoma, Bihanga and Kbambiro** show smaller increases (131-134 mm).

An Increase in precipitation of the **wettest month (+9.8 mm)** and **coldest quarter (+74.0 mm)** indicates intensifying rainfall during already wet and cold periods. This may lead to more frequent and intense floods, waterlogging, with potential impacts on agriculture, settlements and access to services.

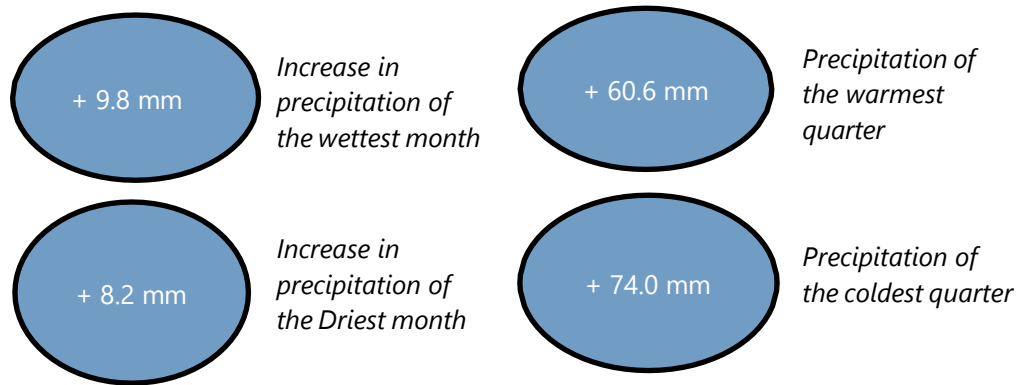
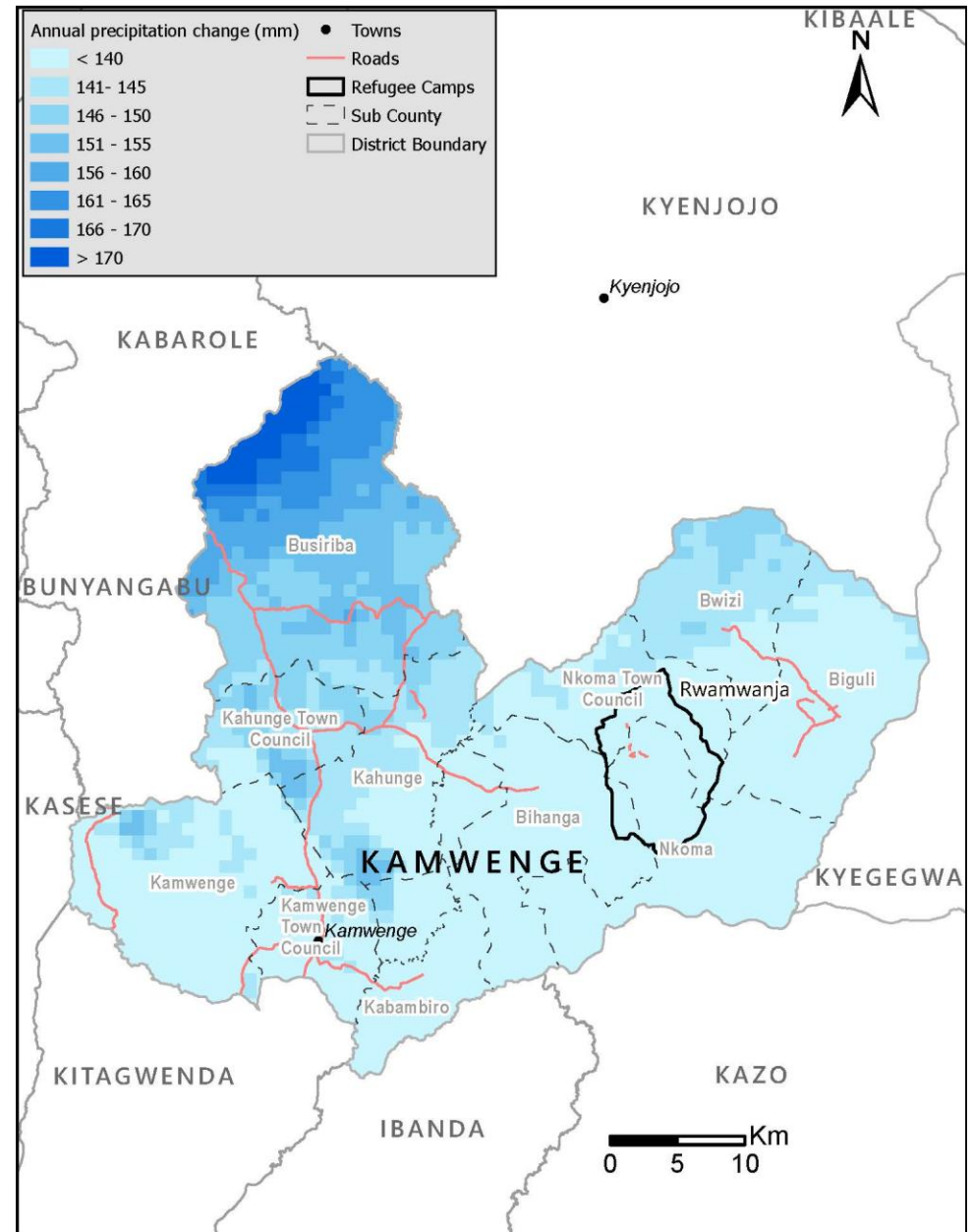


Figure 6: Projected changes in precipitation in bioclimatic variables

An increase in precipitation during the **driest month (+8.2 mm)** and the **warmest quarter (+60.6 mm)** indicates a **shift toward wetter conditions outside the traditional rainy season**, suggesting more evenly distributed rainfall across the year. This means dry-season water scarcity will persist, even under wetter annual conditions. This change **reflects increasing seasonal variability, with implications for agricultural planning, water management, and flood risk during periods that were previously drier or hotter.**



Map 5: Map showing Projected Precipitation Changes from the Baseline (1970-2000) to the Near Future (2041-2060).

Rainfall seasonality also remains largely unchanged, continuing Kamwenge District's dependence on two distinct rainy seasons. That said, these seasons become increasingly unpredictable in their timing and intensity.

Implications

The combination of rising temperatures, changes in dry-season rainfall, and moderate increases in annual precipitation creates a complex climate-hazard profile for Kamwenge District. **Increased evapotranspiration may reduce the benefits of higher annual rainfall, limiting improvements in soil moisture and water availability.** Areas with fragile vegetation cover or high settlement density such as certain zones within Rwamwanja Refugee Settlement are likely to face rising exposure to heat stress, seasonal drought and water scarcity.

North-eastern and southern Kamwenge, which already experiences drier conditions, may face heightened vulnerability to climate-related shocks compared to the rest of the district which receives larger rainfall gains. These shifts have significant implications for agriculture, livestock production, water systems, and community resilience.

These projections align closely with broader national and East African climate patterns. According to the Uganda Third National Communication to the UNFCCC²⁶ and the IPCC Sixth Assessment Report²⁷, temperatures across Uganda are expected to rise by 1.5-2.5°C by mid-century, while rainfall is projected to increase with greater variability and intensity. The projected warming and rainfall changes observed in Kamwenge District fall within these ranges, indicating that the district is experiencing climate shifts consistent with regional trends.

This comparison reinforces the need for targeted adaptation measures, as increased rainfall intensity, elevated flood risk, and intensified heat stress may further affect agriculture, water resources, and overall livelihood resilience.

SEASONAL DROUGHT HAZARD ASSESSMENT

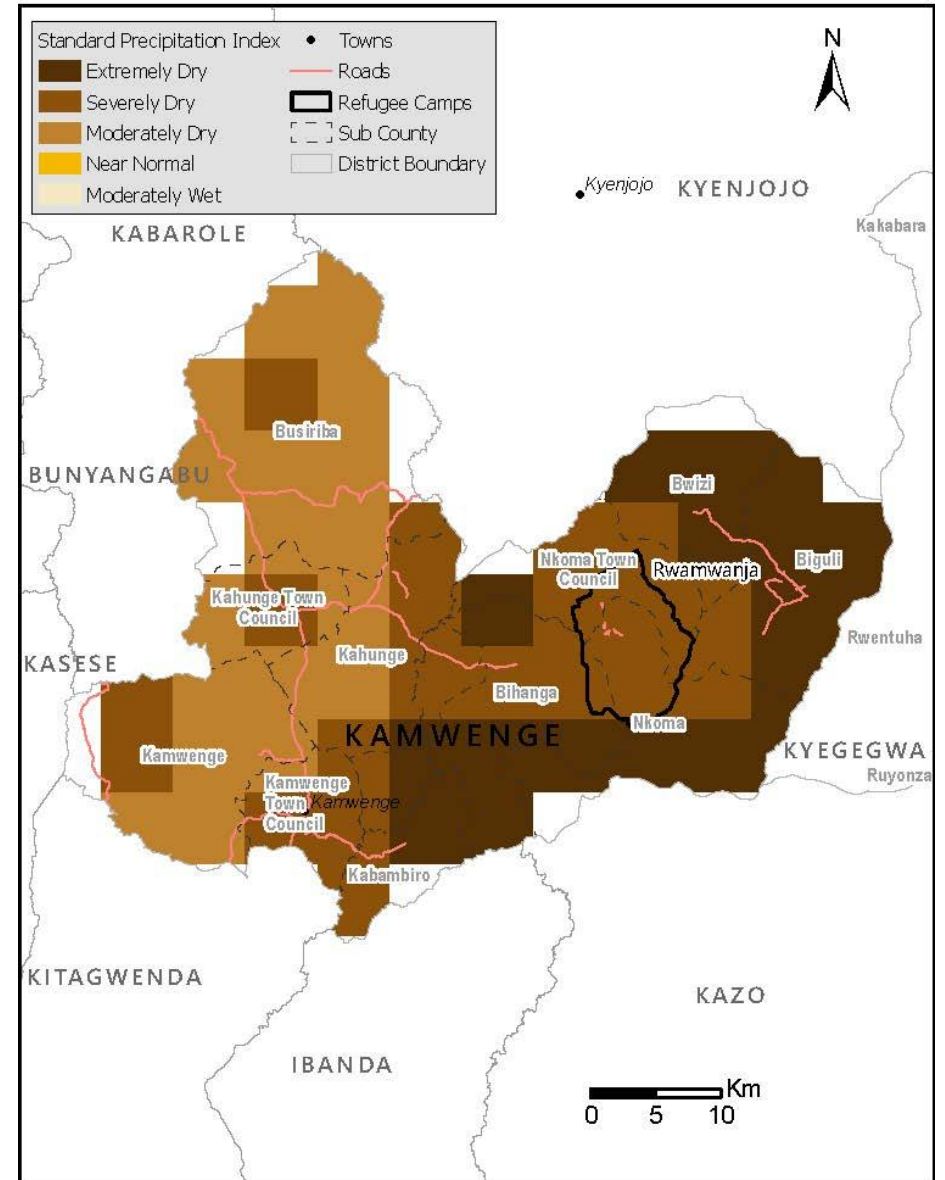
Kamwenge District is increasingly **vulnerable to seasonal drought and erratic weather**, as rainfall patterns have become less predictable and more variable, undermining the reliability of rain-fed agriculture. This climatic variability, compounded by human pressures such as deforestation, wetland degradation, and expanding agricultural land, has resulted in prolonged dry spells, crop and pasture stress, and reduced harvests, threatening food security for rural households and smallholder farmers, particularly in sub-counties such as **Biguli, Nkoma, and Bihanga**. Local studies and reports indicate that shifting rainfall patterns and rising temperatures are intensifying these challenges, constraining agricultural productivity and heightening the vulnerability of households that depend on farming as their primary livelihood.²⁸

This analysis applies the *Standardized Precipitation Index (SPI)*, a precipitation-based indicator that measures precipitation/rainfall anomalies by comparing observed rainfall to historical averages and the *Vegetation Condition Index (VCI)*, an NDVI² based indicator that shows crop biomass and vegetation health responses to precipitation anomalies/moisture stress. Together, these indices capture both meteorological drought conditions and their impact on vegetation, providing an integrated understanding of drought occurrence and severity.

Prolonged dry conditions in Kamwenge District have caused **water shortages and stress on crops and pastures, threatening local livelihoods**. Communities face acute water scarcity, often shared with livestock, increasing health and food security risks. Limited resources highlight the need for long-term investment in seasonal drought preparedness, climate-resilient agriculture, and improved water management.²⁹

SPI Findings

Kamwenge District is experiencing significant moisture stress, with **most sub counties falling under extremely dry and severely dry conditions** according to the Standard Precipitation Index (SPI) (see Map 6). Sub-counties such as Buhanda, Kamwenge Town Council, Nkoma, Biguli, Bihanga, and Nkoma Town Council are predominantly classified as extremely dry, indicating serious rainfall deficits that can negatively affect soil moisture, crop growth, pasture availability, and water resources. Other areas, including



Map 6: Map showing the SPI Index

² NDVI stands for the Normalized Difference Vegetation Index.
13

Bwizi and Kahunge Town Council, are categorized as severely dry, suggesting continued moisture stress though slightly less intense

The Rwamwanja Refugee Settlement, located in Nkoma Sub-county, also falls within the extremely dry category. This highlights increased vulnerability for both refugee and host communities who rely heavily on rain-fed agriculture and livestock keeping for their livelihoods. Prolonged dry conditions in these areas can reduce crop yields, limit pasture regeneration, and constrain water availability.

The SPI pattern indicates **widespread seasonal drought conditions across Kamwenge District**, increasing pressure on agricultural production and natural resources. These findings emphasize the need for targeted interventions such as improved water management, climate-resilient agricultural practices, and strengthened seasonal drought preparedness to support sustainable livelihoods and resilience across the district

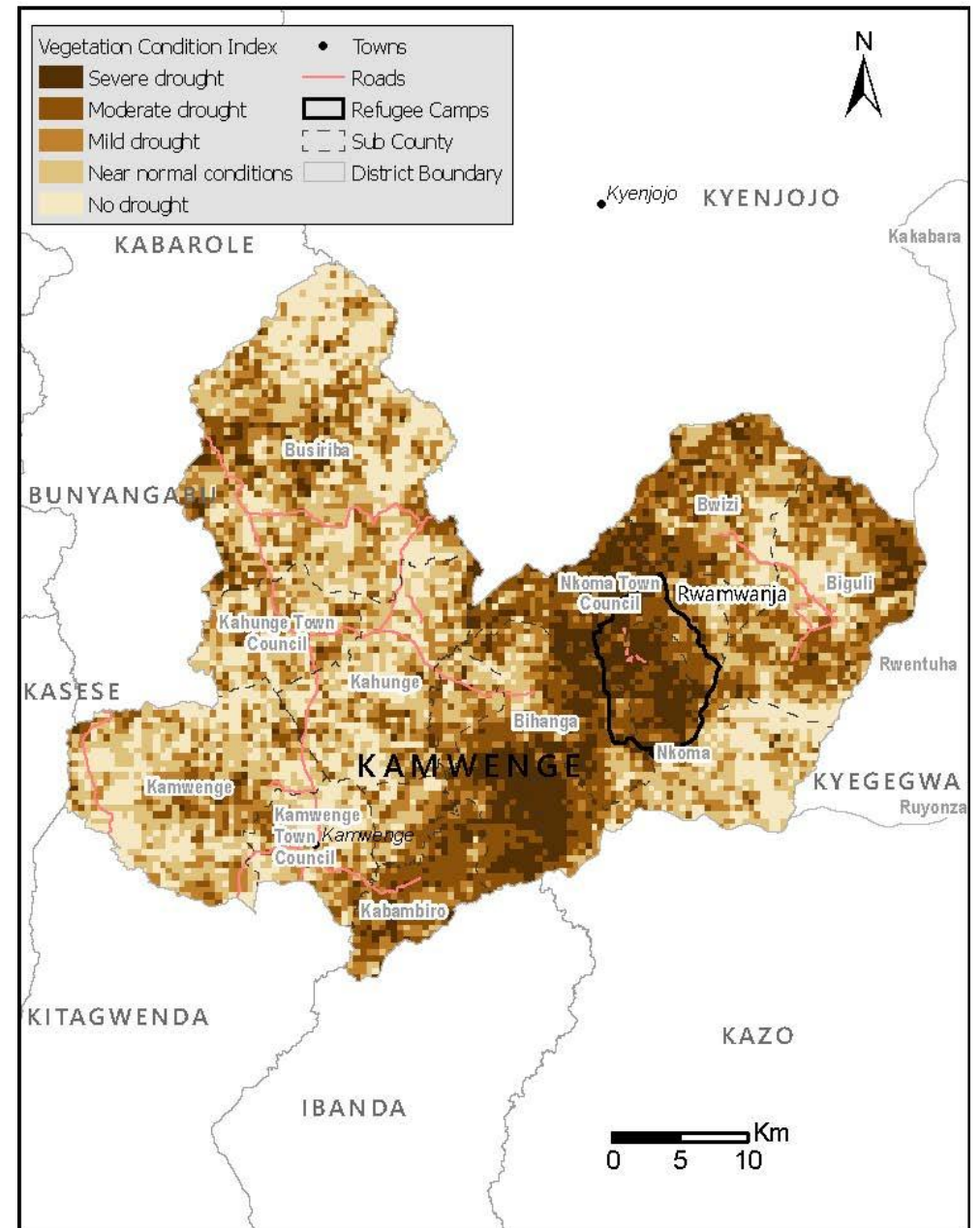
VCI Findings

The *Vegetation Condition Index (VCI)* results indicate **widespread vegetation stress across Kamwenge District**, corresponding closely with SPI-detected rainfall deficits. Grasslands provide the clearest signal of drought severity because they are shallow-rooted and highly sensitive to rainfall variability. Croplands show varying stress depending on crop type, seasonal planting schedules, and land management practices, while forests buffer short-term drought due to deeper root systems and higher biomass. Built-up areas give less reliable signals because of limited vegetation cover.

The most affected areas, including Nkoma Sub-county and the Rwamwanja Refugee Settlement, show severe vegetation drought, represented by the darker brown tones on the map (see Map 7). These areas combine moderate rainfall, mid-altitude elevation, and intensive land use, including cropland and grassland, which together reduce soil moisture, limit vegetation growth, and contribute to very poor vegetation health, declining pasture availability, and early signs of crop stress.

Meanwhile, higher-elevation and more forested areas, such as Bwizi, Biguli, and Buhanda Sub-counties, show moderate to mild vegetation stress, indicating better environmental performance. Higher rainfall and extensive forest cover help sustain vegetation, although cropland expansion and human activity continue to exert pressure.

The VCI map demonstrates a clear gradient of **vegetation drought from the heavily stressed central-eastern and mid-altitude zones to the moderately affected**



Map 7: Map showing the VCI Index

northwest and highland areas

The findings illustrate that vegetation health across much of Kamwenge District was significantly constrained during this period, particularly in areas with intensive land use and settlements. These conditions have important implications for croplands, grazing areas, and the livelihoods and food security of both refugee and host communities, especially within the Rwamwanja Refugee Settlement.

Implications

The combined SPI and VCI analyses for Kamwenge District highlight the significant impact of seasonal drought on both vegetation and livelihoods. Central-eastern areas, particularly Nkoma Subcounty and the Rwamwanja Refugee Settlement, exhibit severe SPI dryness and pronounced vegetation stress, indicating that these communities are particularly vulnerable during periods of rainfall deficit. This pattern reflects broader observations that Kamwenge experiences unreliable rainfall and increased occurrences of dry spells, which local assessments identify as contributing to crop failures and livelihood stress across sub-counties such as Biguli, Nkoma, and Bihanga

In 2023, erratic rainfall and extended dry periods during key agricultural seasons disrupted crop growth and reduced soil moisture availability, with many farmers reporting below-average yields for staple crops such as maize, cassava, and beans. These conditions directly mirror the combined SPI and VCI findings, resulting in lower food availability, diminished household incomes, and weakened resilience among both host and refugee communities.

The implications extend beyond crop production. Reduced soil moisture, degraded vegetation cover, and increased pressure on pasture and water resources undermine the district's ability to absorb future climatic shocks. This pressure is especially pronounced in settlement areas, where high population density and limited access to natural resources amplify the effects of seasonal drought. These findings point to an urgent need for interventions in Kamwenge focused on climate-smart agriculture, sustainable water management and natural resource restoration. To strengthen resilience and food security for both refugee and host populations.

From a preparedness and response perspective, the findings highlight the **need for early warning systems, climate-smart farming, water harvesting and sustainable natural resource management** in Kamwenge. Integrating SPI and VCI monitoring into planning can support timely alerts, evidence-based decisions, and better allocation of resources, particularly in Nkoma Subcounty and the

Rwamwanja Refugee Settlement, where drought poses high risks to both host and refugee livelihoods.



Photo 1: Dry spell in Kamwenge, Business focus Photo Credit; Taddewo William Senyonyi

In June 2025, farmers in Kamwenge District and neighboring central western Uganda districts experienced intermittent showers and thunderstorms, marking the gradual establishment of the first rainfall season. Rainfall remained unpredictable, affecting crops like maize, beans, and coffee, while limited irrigation options made planting challenging. Agricultural experts recommended soil testing, proper fertilizer use, and crop insurance to reduce risks. Rainfall is expected to stabilize by mid-June in most districts, with near-normal to slightly above-normal totals anticipated for the season.

Source: [Dry Spell To Run Up to Mid-August Over Most Parts of Uganda As Detailed Breakdown Of Forecast By District Revealed »](#)

FLOOD HAZARD ASSESSMENT

Flood susceptibility refers to how likely an area, community, or system is to experience harmful impacts from flooding, based on physical, environmental, and socio-economic factors. Several factors determine how an area exposure to flood is ranked from low to high. These factors include hydrological (e.g. intensity and duration of rainfall), geographical (proximity to rivers, soil type, and topography), land use and community livelihood types.

For this assessment thirteen indicators were analysed by ranking into five score levels to flood risk. The score rank of the thirteen indicators was summed and ranked into three levels of risk.³⁰

1. Distance to Permanent water ranked from higher risk to lower risk at 100 meters, 250 meters, 500 meters, and 750 meters.³¹
2. Elevation above sea level ranked from higher risk to lower risk at 600 meters, 700 meters, 800 meters, and 1000 meters.³²
3. Slope of the area in degrees ranked from higher risk to lower risk at 2, 5, 10, 15.³³
4. Landcover from higher risk to lower risk as built-up, cropland (include water, flooded vegetation), grassland, shrub and forest.³³
5. Topographic Position Index ranked from higher risk to lower risk at -8, -6, -4, -2, 0.
6. Normalized Difference Vegetation Index (NDVI) ranked from higher risk to lower risk at 0.2, 0.4, 0.6, 0.8.³⁴
7. Normalized Difference Water Index (NDWI) ranked from higher risk to lower risk at 0.6, 0.2, -0.2, -0.6.
8. Flood Return period ranked from higher risk to lower risk at 10 years, 20 years, 50 years, 100 years, 200 years.³⁵
9. Rainfall Intensity as average maximum annual rainfall ranked from

higher risk to lower risk at 33 mm, 31 mm, 29 mm, 27 mm.³⁶

10. Monthly Number of Days with Rainfall ranked from higher risk to lower risk at 13 days, 10 days, 7 days, 3 days.³⁷
11. Frequency of -days with continuous Rainfall ranked from higher risk to lower risk at 2, 1.2, 0.8, 0.4.³⁸
12. Height Above Nearest Drainage (HAND) ranked from higher risk to lower risk at 2 meters, 5 meters, 10 meters, 20 meters.³⁹
13. Soil texture ranked from higher risk to lower risk with (clay, clay loam, silty loam), (silty clay, silty clay loam), (sandy clay, sandy clay loam), (loam, sandy loam), (loamy sand, sand).⁴⁰

Flood susceptibility mapping relies on integrating multiple environmental, hydrological, and climatic indicators to assess risk levels. Recent literature emphasizes that parameters such as proximity to water bodies, elevation, slope, land cover, vegetation indices, and rainfall characteristics are critical determinants of flood vulnerability. Studies highlight that areas closer to permanent water sources, with low elevation and gentle slopes, are more prone to inundation. Similarly, built-up and cropland land covers tend to amplify flood risk due to reduced infiltration capacity, while vegetation indices (NDVI, NDWI) provide insights into soil moisture and vegetation health, which influence runoff and water retention. The inclusion of topographic indices like HAND and TPI further refines susceptibility mapping by capturing micro-topographic variations that affect drainage and water accumulation

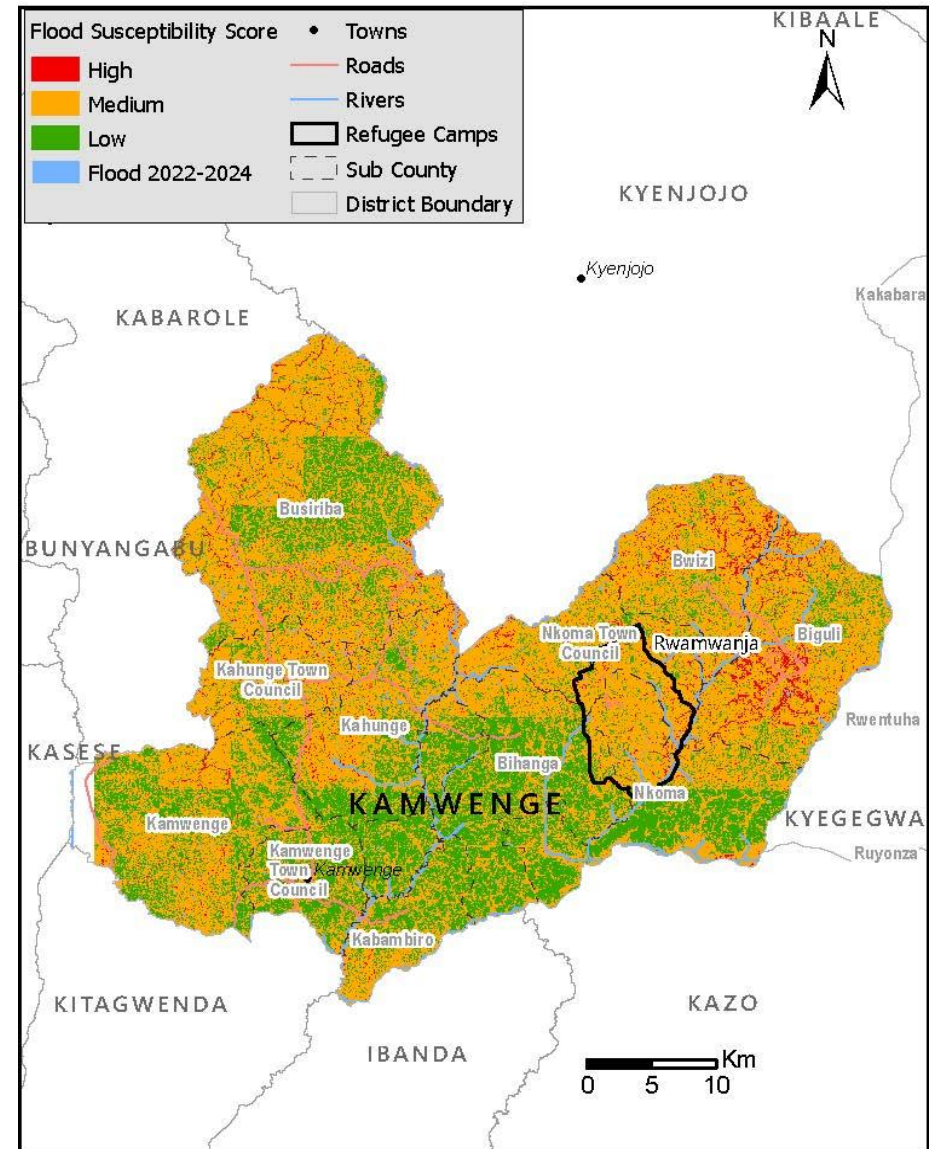
Hydro-climatic indicators such as rainfall intensity, frequency of continuous rainfall days, and flood return periods are equally vital in flood risk assessment. Literature shows that extreme rainfall events, particularly when sustained over consecutive days, significantly increase flood hazards. Soil texture also plays a crucial role, with clay-rich soils exhibiting lower infiltration rates and higher runoff potential compared to sandy soils. Integrating these thirteen indicators into a composite scoring system aligns with established frameworks that rank susceptibility into multiple risk levels. Such multi-criteria approaches are widely recommended because they capture the complex interplay between terrain, hydrology, and climate, thereby improving the accuracy of flood hazard mapping and supporting disaster risk reduction strategies

Findings

Several geographic and infrastructural factors exacerbate flood risks in the district. Kamwenge District has predominantly flat terrain with clayey soils. Insufficient drainage infrastructure limits water infiltration and increases surface runoff, particularly in low-lying areas and along seasonal streams and permanent rivers. District-wide hazard profiles and contingency plans highlight floods as one of the risks.⁴¹

Satellite-based assessments reveal **that 3.4% of Kamwenge District fall into high-risk flood areas**. Its hilly terrain with deep valleys makes it prone to flash floods and landslides. Although Biguli, Nkoma, Kahunge Town Council and Kamwenge can be categorized as sub-counties with high flood risk according to *Map 8*, there were no flood incidents in the last four years. That said, **Kahunge is the sub-county that has experienced floods**.⁴² Its vulnerability stems from upstream runoff from areas of Kabarole, and flood-prone river catchments like the Katonga rivers. Within refugee settlements in Kamwenge, Rwamwanja is susceptible to flooding due to its proximity to its location in low-lying areas near the Mpanga River catchment. These zones are situated on sloping terrain that accumulates runoff during peak rainfall periods, resulting in repeated damage to shelters, latrines and access roads. Such events disrupt humanitarian operations and pose significant public health risks, including water contamination.

The flood susceptibility analysis for Kamwenge District (2022-2024) in *Map 8* shows that flooding is **mostly flash flooded and localized, with the greatest concentration of inundation occurring in river catchments like the Mpanga and Katonga rivers parts of the district**.



Map 8: Map of Kamwenge District showing Flood Susceptibility (2022-2024).

Risk on Cropland and Settlement

The land cover analysis revealed that grassland covers 35.8%, forest 37.6%, built-up areas 4.7% and cropland 21.8%. 4.2% of cropland falls within the high-risk flood zone, while at least 5.7% of built-up areas are within the high-risk flood zone. Built-up areas seem to emerge as the most affected by flooding when measured in terms of the area inundated compared to cropland. However, these estimates represent district-wide averages. Therefore, they conceal substantial spatial concentration of impacts at the local level.

The *Land Use and Landcover Map (Map 3)* shows that cropland cells are more evenly distributed within the district, falling within low- to high-risk flood zones, pointing to exposure for households cultivating around floodplains and poorly drained depressions. For households in flood-prone areas, localized flash flooding events can result in crop damage, delayed planting, and yield losses, likely to contribute to income losses and seasonal food insecurity. Built-up areas which overlap with the cropland around Rwamwanja Refugee Settlement are within medium to high flood risk zones.

The flooding trend corresponds with periods of above-average rainfall and seasonal river overflow, implying a strong link between climatic variability and local hydrological responses. Additionally, expanding settlement and land use changes, especially around refugee-hosting areas, have contributed to reduced infiltration and increased runoff, thereby contributing to flood occurrence.

Flood Impacts

Flooding in Kamwenge District has had **multidimensional socio-economic and environmental impacts**. That said, flooding is highly localized, primarily affecting the low-lying areas near the Mpanga River catchment. In these areas, recurrent inundations have led to damage of crops and agricultural land, disrupting food production and household income for both host and refugee communities. Access roads and footpaths in flood-prone areas become impassable during heavy rainfall,⁴³ causing drowning,⁴⁴ affecting mobility and access to markets, schools, and health facilities. Floods have also contaminated water sources and damaged sanitation facilities, increasing the risk of waterborne diseases.



Photo 2: Bridge Collapse in Kamwenge District in April 2025. Photo credit: Nile Post UG.

In April 2025, Residents and local leaders in Kamwenge District are urgently calling for intervention following the collapse of the Kyitabashegu community access bridge, which was swept away by heavy floods.

Most flash floods occur during the March-May and September-November rainy seasons, often leading to fatalities, displacement, and the destruction of infrastructure and crops.

Source: [Kamwenge Leaders Sound Alarm Over Collapsed Bridge](#)

Environmentally, repeated flooding contributes to soil erosion, sedimentation of streams, and loss of vegetation cover, which further degrade the natural drainage systems and exacerbate future flood risk. Socially, households in persistently flooded areas often face temporary displacement, loss of shelter, and heightened vulnerability

due to inadequate infrastructure and limited adaptive capacity. These cumulative impacts underline the **urgent need for integrated flood management, infrastructure improvement, and community-based adaptation strategies to enhance resilience in flood-affected areas in Kamwenge District.**

Conclusion

The findings of this geospatial analysis highlight the substantial influence of climate-related hazards on both refugee and host communities in Kamwenge District. Over the assessment period, the district has experienced seasonal drought conditions and recurrent localized flooding, which together **pose major risks to agricultural productivity, cattle farming, water availability, and settlement infrastructure.** The SPI and VCI analyses reveal widespread vegetation stress and rainfall deficits while flood mapping indicates high exposure in low-lying sub-counties catchments **along the Mpanga and Katonga rivers.** These findings underscore the growing climate vulnerability of Kamwenge District, emphasizing the need for targeted adaptation measures including improved water resource management, resilient agricultural practices, and settlement planning to safeguard livelihoods and enhance resilience for both refugee and host populations.

Methodology Overview

The climate hazard assessment for Kamwenge District used a combined geospatial, remote-sensing, and climate-modelling approach integrating historical baselines, future projections, and hazard-specific analyses. Historical climate conditions (1970-2000) were derived from WorldClim v2.1 using BIO1 (Annual Mean Temperature) and BIO12 (Annual Precipitation), clipped to the district and summarised through spatial and statistical analysis. Future projections for 2041-2060 were obtained from the UKESM1-0-LL model⁴⁵ under the SSP2-4.5 scenario, processed using the same bioclimatic variables to ensure comparability with the historical baseline.⁴⁶

Drought assessment followed UN-SPIDER protocols⁴⁷, using SPI calculated in Google Earth Engine (GEE)⁴⁸⁴⁹ from CHIRPS rainfall data⁵⁰ (2014-2024) and VCI derived from NDVI time-series to measure vegetation stress. Agricultural and rangeland areas were manually delineated to improve spatial accuracy, and VCI classification followed Kogan (1995) standards.⁵¹ Outputs were visualized and analysed in ArcGIS.

Flood mapping was conducted using Sentinel-1 SAR imagery processed in GEE to identify inundation for 2022-2024.⁵² Annual flood layers were imported into ArcGIS, where raster summation generated a districtwide flood-frequency map. Together, the historical and projected climate datasets, SPI-VCI drought indicators, and multi-year flood mapping provide an integrated picture of climate hazards affecting both host communities and the Rwamwanja Refugee Settlement in Kamwenge District.

Limitations

The assessment primarily relied on remote-sensing and global climate datasets, which, while widely used, may not fully capture localized micro-climatic variations or ground-level conditions affecting vulnerability. Community-level vulnerability indicators such as coping capacity, water access constraints, and infrastructure fragility were not systematically integrated due to limited available data. Field verification of drought and flood extents was not conducted, though the satellite image processing followed established and validated UN-SPIDER protocols.

Further background information can be found in the [Climate Risk Profiles for Refugee-Hosting Districts in Uganda Terms of Reference \(TOR\)](#).

Note on Data Sources

Historical climate estimates in this report use both WorldClim (1970-2000 climatology) and ERA5-Land (1981-2024 reanalysis). These datasets use different observational networks, spatial resolutions and interpolation/assimilation methods and consequently report slightly different estimates of mean annual temperature for Kamwenge (WorldClim $\approx 25.7^{\circ}\text{C}$ for 1970-2000, ERA5-Land $\approx 24.7^{\circ}\text{C}$ for early 1980s-2000). These differences are within the expected uncertainty range for gridded climate datasets and do not affect the overall interpretation of a warm tropical baseline and a clear recent warming trend. All historical temperatures in this report should therefore be understood as approximate values in the mid-20s (around $25\text{-}26^{\circ}\text{C}$) rather than exact point estimates.

To view/access the Climate Hazard Analyses for any of the following districts:

- Adjumani District
- Koboko District
- Yumbe District
- Terego District
- Madi Okollo District
- Lamwo District
- Obongi District
- Kyegegwa District
- Kiryandongo District
- Kamwenge District
- Kikuube District
- Isingiro District

Kindly click this link below to explore the full series available on the Resource Centre: [Resource Centre | Impact](#)

Definitions

Hazards: A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation.⁵³

Flood: The overflow of water onto land that is normally dry, resulting from the temporary inundation of areas due to factors such as intense or prolonged rainfall, river overflow, surface runoff, or failure of water control structures. Floods can vary in scale and duration and may cause damage to infrastructure, livelihoods, ecosystems, and human health.⁵⁴

Flood Susceptibility: The likelihood of flooding occurring in an area based on physical, environmental, and climatic factors such as topography, rainfall intensity, and proximity to water bodies.⁵⁵

Seasonal Drought: A temporary period of below-average rainfall within a specific season, resulting in soil moisture deficits and vegetation stress, particularly during critical agricultural periods.⁵⁶

Meteorological Drought: A period of abnormally dry weather sufficiently prolonged to cause a serious hydrological imbalance, typically defined by a lack of precipitation relative to the long-term average.⁵⁷

Exposure: The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas.⁵⁸

Risk: The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity.⁵⁹

Water Stress: Water stress occurs when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use. Water stress causes deterioration of freshwater resources in terms of quantity (aquifer over-exploitation, dry rivers) and quality (eutrophication, organic matter pollution, saline intrusion).⁶⁰

Disclaimer

This report provides an evidence-based overview of climate trends, hazards, and projected impacts in Uganda's refugee-hosting districts to support informed planning and decision-making. The analysis draws on historical climate datasets, remote sensing products, and modeled projections, all of which are subject to inherent uncertainties, assumptions, and methodological limitations.

The drought assessment presented in this report focuses primarily on seasonal drought conditions, using indicators such as the Standardized Precipitation Index (SPI) and the Vegetation Condition Index (VCI). These indicators capture short- to medium-term rainfall deficits and vegetation stress within specific seasons and should not be interpreted as representing long-term or permanent drought conditions.

Accordingly, the findings should be considered indicative rather than definitive, particularly at localized scales, where microclimatic variability, environmental conditions, and socio-economic factors may differ. While every effort has been made to ensure data accuracy, this report does not replace site-specific assessments or field verification.

The views expressed herein do not necessarily reflect those of any government, organization, or funding partner. This report should not be used as the sole basis for policy, investment, or operational decisions without further contextual analysis and validation.

Users are encouraged to complement these findings with local knowledge, stakeholder consultation, and additional data sources when designing interventions or resilience strategies.

In case of questions, feedback, or requests for tailored, area-specific remote-sensing products, kindly contact uganda@reach-initiative.org.

Endnotes

- 1 [UNHCR, Refugee Response Portal - Uganda](#)
- 2 [UNCDF, Uganda–Climate Risk and Vulnerability Assessment](#)
- 3 [Ministry of Water and Environment \(MWE\). \(2015\). *Uganda's National Climate Change Policy*. Government of Uganda.](#)
- 4 [World Bank. \(2021\). *Climate risk country profile: Uganda*. Washington, DC: World Bank Group.](#)
- 5 [Uganda National Meteorological Authority \(UNMA\). \(2024, July 24\). *UNMA explains unreliable rains, urges farmers to harvest water*.](#)
- 6 [REACH UGA 2024-MSNA-Report July-2025.pdf](#)
- 7 [Uganda Invest. Kamwenge District. Investment Profile](#)
- 8 [Agroforestry And Soil-Water Conservation In Kamwenge District, Western Uganda: A Case Study Of Kahunge Town Council](#)
- 9 [UNHCR Uganda. Refugees and nationals by district.](#)
- 10 [Kamwenge DLG. Five-Year Development Plan.](#)
- 11 [Kamwenge topographic map, elevation, terrain](#)
- 12 [Kamwenge District HRV Profile.pdf](#)
- 13 [Kamwenge District HRV Profile.pdf](#)
- 14 [Influence of Population Growth on Land Use in Uganda. A Case Study of Biguli Subcounty Kamwenge District](#)
- 15 [Experts offer solutions as floods ravage country - Uganda | Relief Web](#)
- 16 [UBOS - National-Population-and-Housing-Census-2024-Final-Report.pdf](#)
- 17 [District Profile - Kamwenge District](#)
- 18 [Uganda Invest. Kamwenge District. Investment Profile](#)
- 19 [UNHCR Uganda. Refugees and nationals by district.](#)
- 20 [FEWS NET- Livelihood mapping and zoning exercise: Uganda, 2010](#)
- 21 [Long-term climate change and anthropogenic activities together with regional water resources and agricultural productivity in Uganda using Google Earth Engine - ScienceDirect](#)
- 22 [Full article: Repercussions of rainfall and river flow trends under a changing climate on local communities' livelihood strategies in Southern Tanzania](#)
- 23 [Vulnerability of crop yields to variations in growing season precipitation in Uganda | Discover Applied Sciences | Springer Nature Link](#)
- 24 <https://irbackend.bsu.ac.ug/server/api/core/bitstreams/4c58a8f7-c2c1-4f12-8b45-fed79dcdff99/content>
- 25 [A meta-analysis of factors affecting the adoption of drought-tolerant maize varieties \(DTMV\) in sub-Saharan Africa - ScienceDirect](#)
- 26 [United Nations Framework Convention on Climate Change \(UNFCCC\) – Third National Communication of Uganda to the UNFCCC. Kampala: Government of Uganda](#)
- 27 [Intergovernmental Panel on Climate Change \(IPCC\). \(2021\). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the IPCC*. Cambridge University Press.](#)
- 28 [Kamwenge District Local Government. Kamwenge District Disaster Profile: Climate hazards and vulnerability report. National Emergency Coordination and Operations Centre \(NECOC\), Uganda. \(2024\).](#)
- 29 [Kamwenge District Local Government. Kamwenge District Disaster Profile: Climate hazards and vulnerability report. National Emergency Coordination and Operations Centre \(NECOC\), Uganda. \(2024\).](#)
- 30 [MDPI - Flood Risk Mapping by Remote Sensing Data and Random Forest Technique](#)
- 31 [European Commission - Global Surface Water Explorer, updated data for 2021](#)
- 32 [NASA Shuttle Radar Topography Mission Global 1 arc second V003 – NASA Earth data](#)
- 33 [NASA Shuttle Radar Topography Mission Global 1 arc second V003 – NASA Earth data](#)
- 34 [World Resources Institute - Research for People & Planet](#)
- 35 [sentinel.esa.int](#)

ABOUT REACH

REACH Initiative facilitates the development of information tools and products that enhance the capacity of aid actors to make evidence-based decisions in emergency, recovery and development contexts. The methodologies used by REACH include primary data collection and in-depth analysis, and all activities are conducted through inter-agency aid coordination mechanisms. REACH is a joint initiative of IMPACT Initiatives, ACTED and the United Nations Institute for Training and Research - Operational Satellite Applications Programme (UNITAR-UNOSAT).

- 36 [European Commission - Joint Research Centre Data Catalogue - Global river flood hazard maps](#)
- 37 [CHIRPS: Rainfall Estimates from Rain Gauge and Satellite Observations – UC Santa Barbara](#)
- 38 [CHIRPS: Rainfall Estimates from Rain Gauge and Satellite Observations – UC Santa Barbara](#)
- 39 [CHIRPS: Rainfall Estimates from Rain Gauge and Satellite Observations – UC Santa Barbara](#)
- 40 [Yamazaki Lab – Global Hydrodynamics Lab](#)
- 41 [DCP BOOK FINAL backup 3](#)
- 42 [Floods kill two in Kamwenge district](#)
- 43 [Kamwenge Leaders Sound Alarm Over Collapsed Bridge, Urge Urgent Action](#)
- 44 [Floods kill two in Kamwenge district](#)
- 45 [RMetS – Evaluation of precipitation simulations in CMIP6 models over Uganda](#)
- 46 [Berio Fortini et al Bioclimatic variables dataset for baseline and future climate scenarios for climate change studies in Hawai'i | U.S. Geological Survey](#)
- 47 [UN-SPIDER - Standardized Precipitation Index \(SPI\) in Google Earth Engine](#)
- 48 [UN-Spider Agriculture Drought Monitoring and Hazard Assessment](#)
- 49 [World Meteorological Organization \(WMO\). \(2012\). Standardized Precipitation Index user guide \(WMO-No. 1090\). Geneva: WMO.](#)
- 50 [CHIRPS Daily: Climate Hazards Center InfraRed Precipitation With Station Data \(Version 2.0 Final\)](#)
- 51 [Kogan, F. N. \(1995\). Application of vegetation index and brightness temperature for drought detection. Advances in Space Research, 15\(11\), 91–100.](#)
- 52 [UN-Spider Flood Mapping Methodology](#)
- 53 [United Nations General Assembly Resolution A/71/644, \(UNGA, 2016\).](#)
- 54 [UNDRR-Disaster risk reduction terminologies,2017](#)
- 55 [MDPI-Flood Susceptibility Assessment for Improving the Resilience Capacity of Railway Infrastructure Networks,2024](#)
- 56 [MDPI-A General Overview of the Risk-Reduction Strategies for Floods and Droughts,2020](#)
- 57 [NDMC-Types of Drought,2026](#)
- 58 [United Nations General Assembly Resolution A/71/644, \(UNGA, 2016\).](#)
- 59 [United Nations General Assembly Resolution A/71/644, \(UNGA, 2016\).](#)
- 60 [European Environment Agency, Glossary Definitions, Water Stress](#)