UGANDA

Climate Hazard Assessment – Koboko District

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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, long dry spell 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 spell	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	Southwest	Kiryandongo	Isingiro	Kamwenge	Kikuube	Kyegegwa
Drought/Prolonged dry spell	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 long dry spells, 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, and exposures to support targeted planning and resilience for host and refugee communities.

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Climate Hazard Assessment – Koboko District

CONTEXT & RATIONALE

Koboko District, located in the West Nile Sub-region region and bordering South Sudan and the Democratic Republic of Congo (DRC), is characterized by a uni-modal rainfall pattern with one distinct rainy season. However, rainfall has become increasingly erratic in recent years. The district experiences frequent dry spells, interspersed with periods of intense rainfall that often lead to localized flooding. These climatic changes adversely affect agricultural production, food security, and water availability.[7, 8] Koboko's low-lying areas and poor drainage infrastructure contribute to seasonal flooding, damaging crops and roads, while prolonged dry periods exacerbate water scarcity and soil degradation.[9] Rainfall patterns have become more unpredictable, with delayed onset, mid-season dry spells and intense rainfall events, particularly affecting sub-counties such as Midia, Northern Division, and Western Division.

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 Koboko will become warmer and moderately wetter by mid-century. Mean annual temperatures are projected to rise from **25°C to 27.5°C**, while annual rainfall is expected to increase from **1,418 mm to about 1,587 mm**.[1] Despite this increase in rainfall, intensifying heat stress is expected to pose greater risks to rural households and displaced populations.[10]

Koboko District hosts over **6,400 refugees** living in Lobule refugee settlement primarily from the neighboring conflict-affected countries, including the DRC and South Sudan. According to Koboko municipality reports, there are about **25,000 self-settled refugees and asylum seekers in the district**. Although Koboko does not host large refugee settlements like neighboring districts, it hosts smaller refugee populations and receives transient refugees due to its border location, which places pressure on local resources and social services. This analysis therefore seeks to generate evidence-based insights into historical and projected climate trends to inform climate-resilient humanitarian and development programming in Koboko District.

By identifying hazard susceptibility, exposure patterns, and future climate hazards, this series of district-level analyses aim to support relevant government authorities and humanitarian/development partners in developing targeted interventions, strengthening disaster preparedness and enhancing resilience in Uganda's refugee - hosting districts.

Key Messages

- Koboko District currently receives ~**1,418 mm** of annual rainfall, projected to rise moderately to ~ **1,587 mm** by mid-century under the SSP2-4.5 scenario. However, greater seasonal variability, prolonged dry spells and higher evapotranspiration are expected to intensify water stress, especially in Lobule Sub-county.

- Temperatures are projected to increase by **2.4-3.0ºC** during the warmest month and driest quarters. This will likely increase the frequency of very hot days, heat stress and seasonal drought, leading to crop productivity, livestock health and water availability.

- Seasonal drought remains a dominant hazard, with the Standard Precipitation Index (SPI) and Vegetation Condition Index (VCI), which capture rainfall deficits and vegetation stress respectively, showing severe dryness, particularly in **Lobule, Ludara and Kuluba Sub counties**, leading to vegetation stress, reduced crop yields, and limited pasture and water availability.

- Flooding affects areas with poor drainage infrastructure, including **Lobule and central urban Koboko.** Intense rainfall events following prolonged dry periods cause soil erosion, damage to crops and shelters, and disruption of roads and community infrastructure, compounding livelihood vulnerabilities.

[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/m^2 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.

Location and Topography

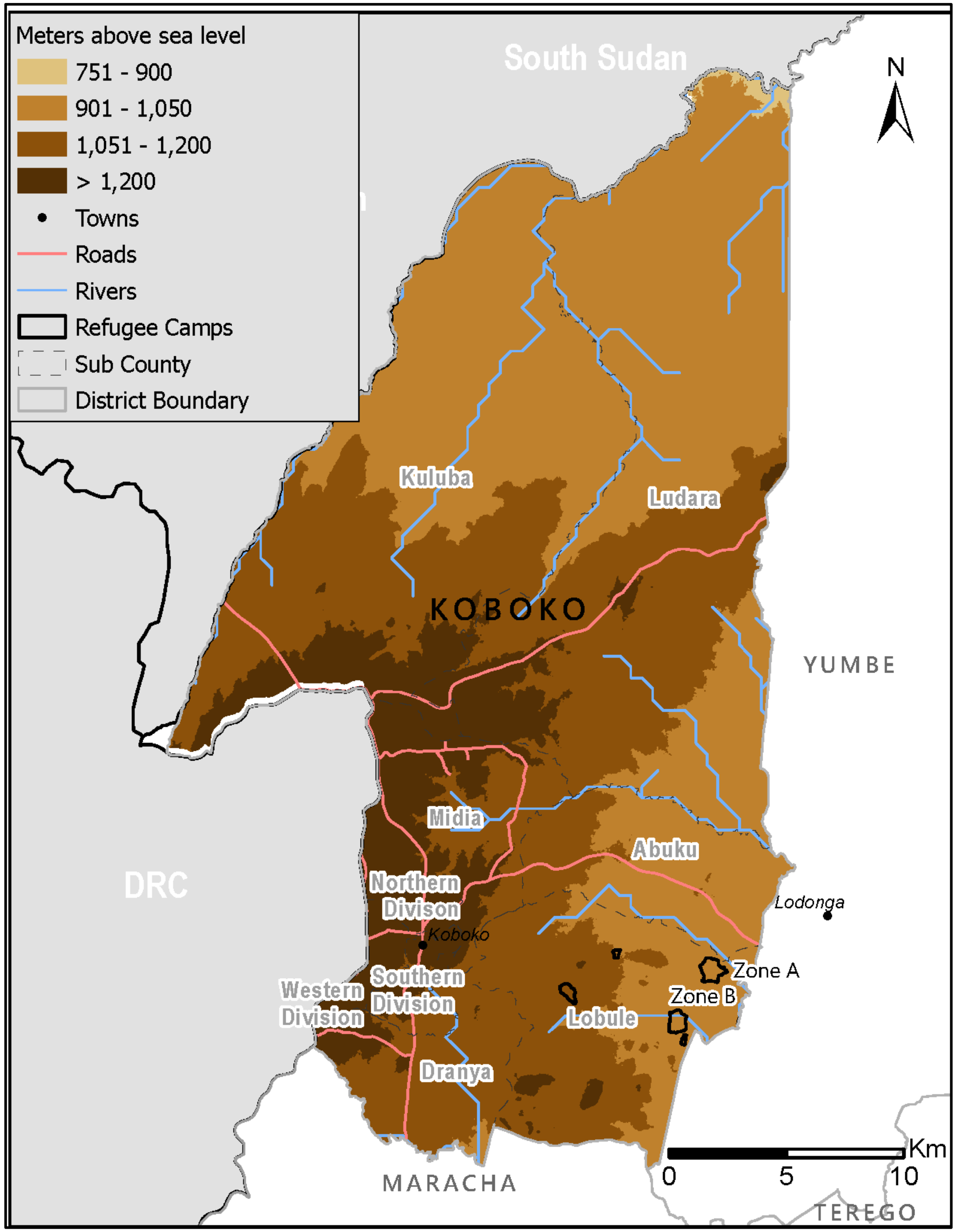
Koboko District is in the extreme northwest corner of Uganda's West Nile Sub-region, bordering South Sudan to the north, the Democratic Republic of Congo (DRC) to the west, Yumbe District to the east and Maracha District to the south. The district's headquarters are in Koboko Town, situated approximately **574km** northwest of Kampala. Koboko occupies a total land area of about **820.8 km^2,** forming part of the tripoint **"Salia Musala,"** where the borders of Uganda, South Sudan, and the DRC converge.[11]

The terrain of Koboko District is predominantly flat with isolated undulating hills and rocky outcrops, especially toward the border areas with South Sudan and the DRC. Elevations across the district generally range from around **1,080 m to 1,300 m** above sea level, with an average elevation near **1,200–1,285 m** in central and populated areas. Hills and rocky features are more pronounced in the western and northern sections, including areas near the Mount Liru ridge, while low-lying plains extend toward the eastern and central parts of the district.[12,13]

This landscape influences local drainage patterns and land use. The gentle slopes and plains support widespread cultivation and settlement but also contribute to areas of shallow drainage and surface water accumulation during intense rainfall, especially in flatter localities. In contrast, the isolated hills and elevated terrains provide slightly better natural drainage and are often preferred for habitation and road networks.

Demographics and Population Distribution

According to the 2024 National Population and Housing Census, Koboko District has a population of over **271,700 people**. This reflects a notable increase from the 2014 census figure of over **208,000** and indicates sustained population growth in the district.[14] The district's population includes a mix of ethnic groups, with the Kakwa community being predominant, alongside the Lugbara and other West Nile sub-regional groups. Christianity and Islam are both widely practiced within the district.[15] Koboko hosts a relatively small formal refugee population compared to the neighboring districts in West Nile. Only **6,400** refugees are hosted in Lobule Settlement as of December 2025.[16] Additionally, municipal and settlement data indicate that a significant number of refugees and asylum seekers are self-settled in Koboko Municipality and surrounding communities, with estimates suggesting over



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

25,000 self-settled refugees and asylum seekers, who make up a substantial portion of the local urban population.[17] These include individuals and families from neighboring South Sudan and the Democratic Republic of the Congo, who have integrated into urban and peri-urban neighborhoods outside formal settlement settings.

While refugees represent only a portion of Koboko District's total population, their presence both within and outside formal settlement settings contributes to increased demand for land, water, housing, education and health services. As such, demographic pressures from both nationals and displaced populations shape service delivery dynamics, infrastructure planning and resource allocation across the district.

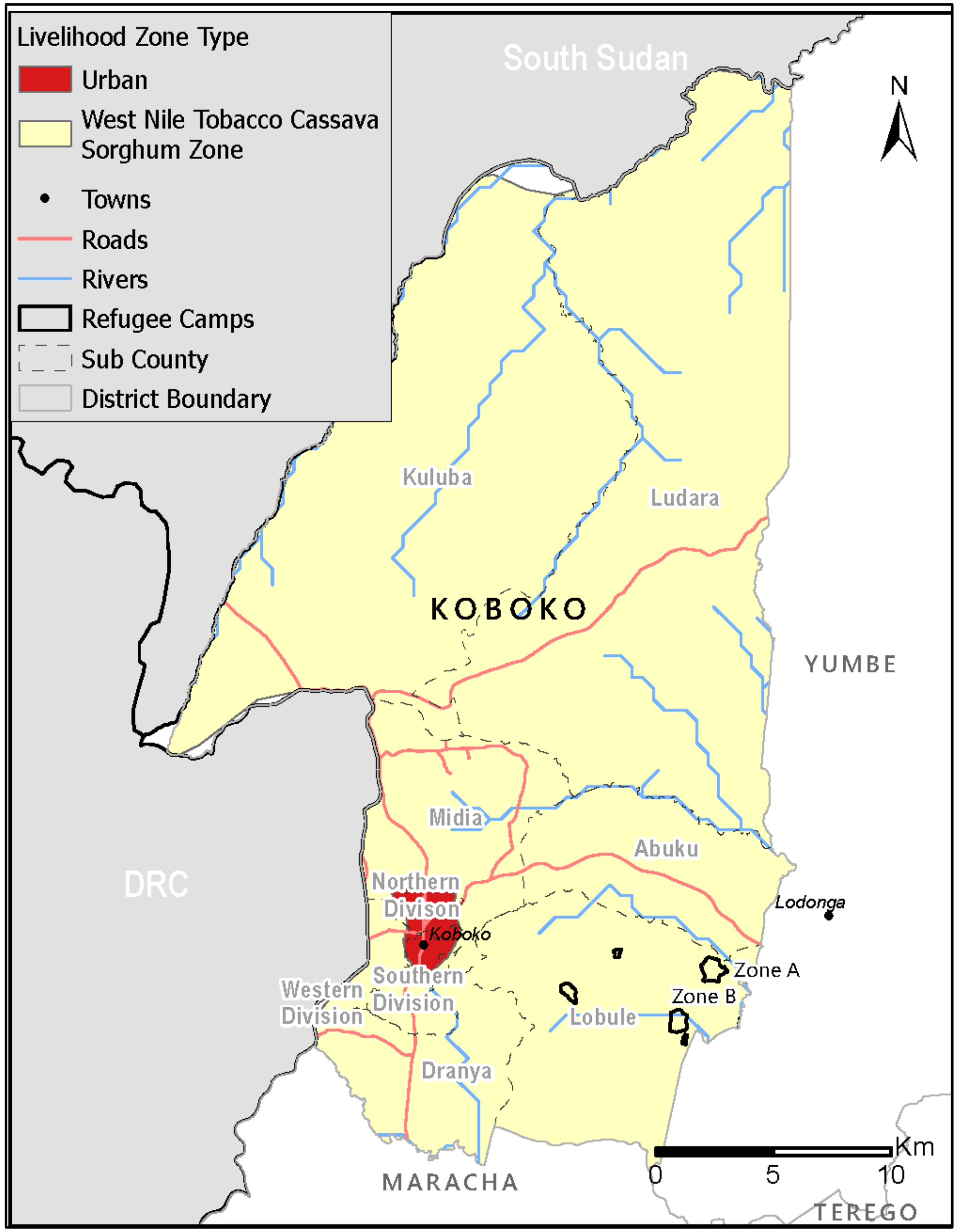
Livelihoods

Koboko District lies in two major livelihood zones**:** the *West Nile Tobacco -cassava-Sorghum Zone*, and the *Urban Zone*. Agriculture is the backbone of Koboko's economy, employing most households. Trade is secondary, supported by the district's strategic location at the border with South Sudan and the Democratic Republic of Congo.[18]

The *West Nile Tobacco-Cassava-Sorghum Zone* is a mixed farming livelihood area, where households rely on tobacco, cassava, and sorghum as their main sources of food and income. Tobacco serves as the primary cash crop, cassava provides a reliable food security buffer due to its drought tolerance, and sorghum is cultivated as a staple cereal. The soil is generally sandy loams and clay loams, moderately fertile but prone to nutrient depletion under continuous cultivation.

The **majority of Koboko District's population** relies on **subsistence agriculture** as their primary source of livelihood. Livestock farming is practiced on a small scale, with households typically rearing goats, poultry, and cattle. However, agricultural productivity is constrained by limited access to markets, largely due to poor road infrastructure. Livelihoods are also highly vulnerable to climatic shocks, such as prolonged dry spelsl, which disrupt planting and harvesting cycles and contribute to food insecurity.[19]

Koboko Town, which occupies the *Urban Livelihood Zone,* is expanding rapidly due to its strategic location at the tri-border point with South Sudan and the Democratic Republic of Congo, increasing demand for housing, infrastructure, and services. Small-



Map 2: Map showing Livelihood Zones in Koboko District.

scale trade, fishing in wetlands, and charcoal production are common. Land-use planning studies highlight the need to balance agricultural expansion with ecosystem conservation.[20]

Environment, Land Use and Land Cover

Koboko District is characterized by **tropical savanah grassland, scattered woodland, wetlands along river valleys and cropland.** These ecosystems provide provisioning services (food, fuelwood, water), regulating services (soil fertility, flood control), and cultural services (traditional practices and livelihoods).

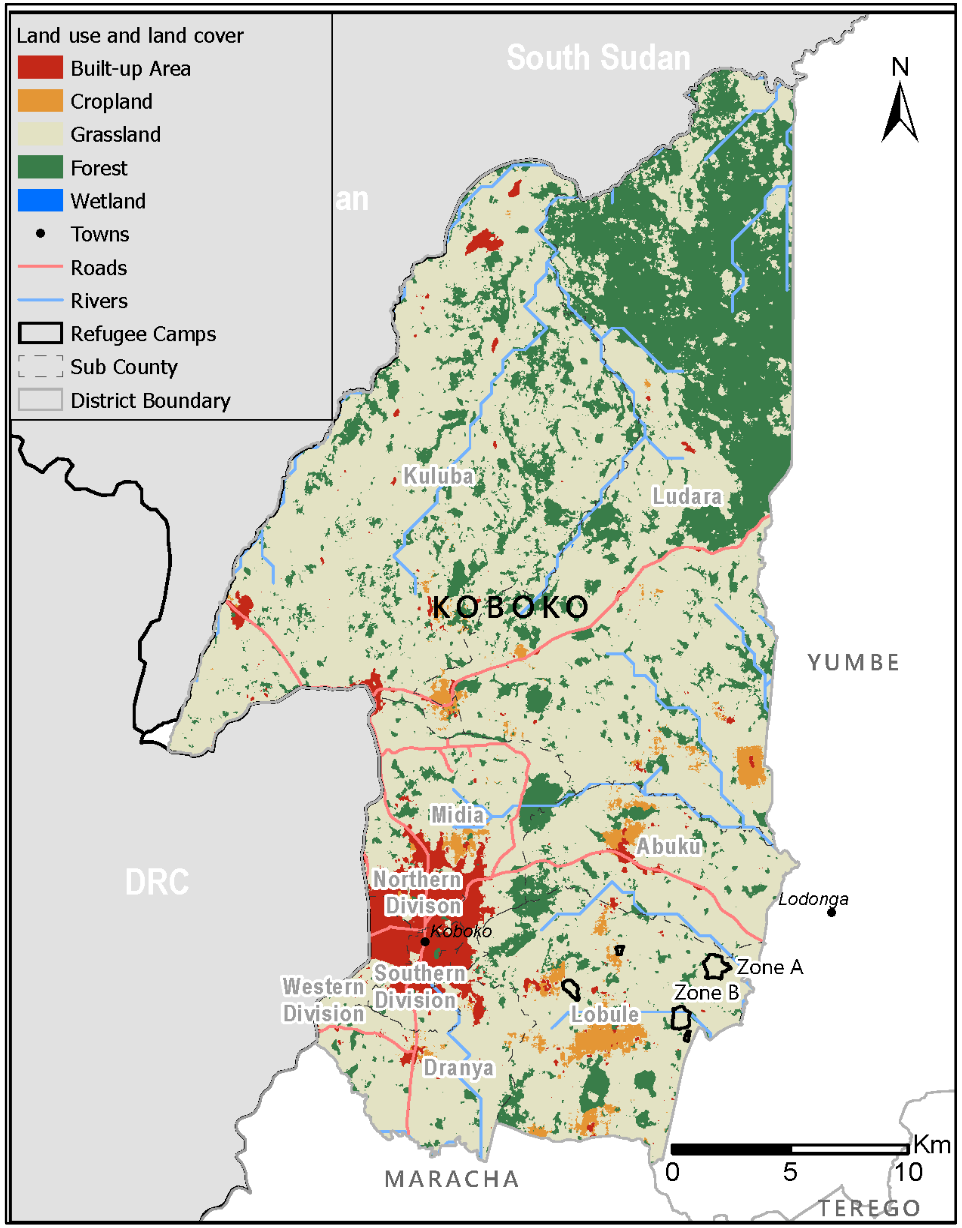
However, the expansion of agricultural land and human settlements has driven deforestation, charcoal production, soil degradation, water scarcity, and waste pollution, leading to the degradation of these ecosystems.[21]

The rapid increase in population from an estimated **208,000 in 2014** to **271,000 in 2024** is largely driven by both host community growth and an influx of refugees and asylum seekers, which has increased demand for fuelwood and construction materials, and agricultural land.

As shown in *Map 3*, Koboko District's landscape is predominantly composed of grassland, which covers approximately **70.7%** of the total land area. Extensive grassland supports key livelihood activities, such as livestock grazing and seasonal cultivation.

Forestlands **(23.1 %)** stretch across the district and play a vital role in providing fuelwood, timber, and construction poles. They also contribute to soil fertility and erosion control, making them essential for both ecological stability and household energy needs. In addition, they support key livelihood activities, such as livestock grazing and building materials. From 2021 to 2024, Koboko lost the equivalent of **20% forest cover** compared to the year 2000.[22] This loss in forest cover was caused by illegal logging for timber harvesting, charcoal burning, agriculture area expansion and firewood collection.

Built-up areas make up **4.2%** of the district's land cover and include settlements, trading centres, and refugee zones. These areas also host critical infrastructure including schools, health centres, and road networks.



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

Cropland, which makes up **2.1%** of the district's total area, remains crucial for subsistence farming, with crops such as tobacco, sorghum, maize, cassava and groundnuts forming the backbone of household food security and income generation.

Although wetlands and open water bodies cover less than **0.1%** of Koboko District, they are vital for water supply, brick making, dry season farming, and livestock watering. Wetlands are both productive agricultural zones and critical ecological buffers that can sustain communities during climate stress. Upland agricultural lands are at times vulnerable to rainfall variability. Wetlands support fishing and small-scale rice cultivation. Wetlands are threatened by encroachment for agriculture and settlement. This may lead to their pollution through domestic and agricultural waste.

CLIMATE CONTEXT

This section presents an analysis of Koboko 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 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

Koboko District experiences a unimodal rainfall pattern, with the main rainy season extending from March to October, followed by a pronounced dry season from December to February. The long-term average (1981-2024), shown by the dashed line in *Figure 1*, indicates a gradual onset of rain from March, steadily increasing through April and May, and peaking between August and October. The driest months remain January and February, each typically receiving less than 50 mm of rainfall, before rainfall declines again in November and December.

The long-term average also suggests moderate intra-seasonal variability within the rainy season, with relatively lower rainfall around June compared to the peak months of **August-October**. Overall, rainfall is concentrated in the middle of the year, with the highest monthly totals occurring toward the end of the rainy season. Year-to-year variation is evident across the 2022-2024 period, with differences in both rainfall amounts and timing when compared to the historical average. As shown in *Figure 1*, recent observations highlight variability around the long-term mean: For example:

- **2022:** Rainfall was generally below the 1981-2024 average in April, May, June, August, and October. March and July recorded rainfall closer to the long-term mean, while September stood out as one of the wetter months in 2022. The dry season months remained relatively dry, consistent with historical patterns.
- **2023:** Rainfall showed mixed deviations from the long-term average. March, June, October and November were notably more wet than average, while below-average rainfall was observed in February, May, July-September, and December.
- **2024:** Rainfall exhibited stronger departures from the 1981-2024 average. Below-average rainfall was recorded in March to May. In contrast, June to September experienced substantially above-average rainfall, with pronounced peaks in August and September. November rainfall was also above the historical average, while December was markedly drier.

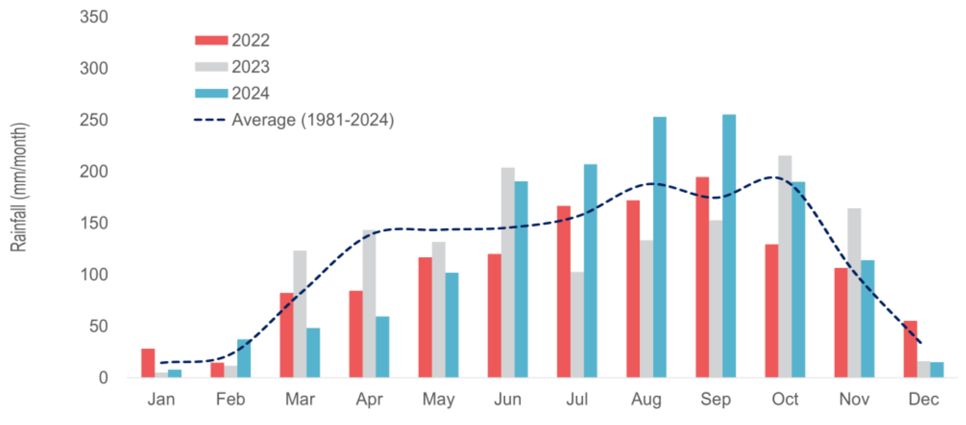


Figure 1: Graph showing Long-Term Average Rainfall (2022-2024) in Koboko District.

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 Nino 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, Koboko is increasingly vulnerable to both seasonal droughts and flooding. Prolonged dry spells, especially during the December-February period, lead to water scarcity, crop stress, and pasture depletion. Conversely, intense rainfall events during the August-October peak can trigger flash floods, crop damage, and disruption of transport and livelihoods.

The dry season is also marked by high temperatures, often exceeding **28°C**, and low humidity, contributing to increased occurrences of seasonal drought and water stress. These conditions are exacerbated by land degradation and limited water infrastructure, affecting domestic use, livestock, and agricultural productivity.[23]

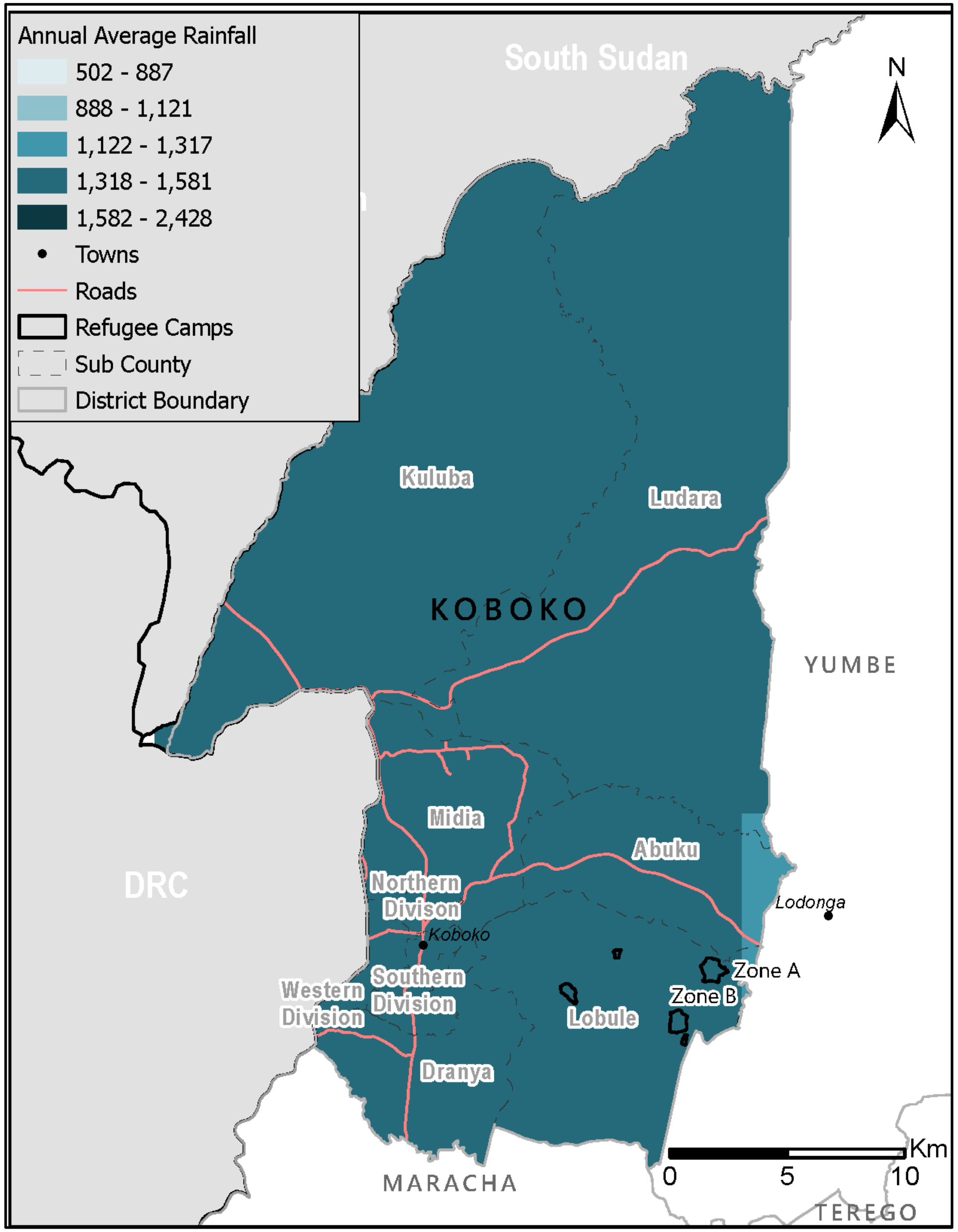
Overall, the increasing variability in rainfall patterns, combined with the district's reliance on rain-fed agriculture, heightens climate hazards for both refugee and host communities. This underscores the urgent need for integrated climate adaptation and resilience strategies to safeguard water availability, food security, and sustainable livelihoods.

Map 4 displays the spatial distribution of average annual rainfall across Koboko District for the period 1981-2024, derived from long-term CHIRPS precipitation data. Koboko District falls within the **1,122-1,317 mm and 1,318-1,581 mm** annual rainfall zones, indicating moderate to moderately high rainfall conditions across the district. The central and northern parts of Koboko, including **Kuluba and Ludara,** are largely within the with **1,318-1,581 mm rainfall zone, reflecting relatively wetter conditions** compared to the southeastern part of the district. Overall, Koboko receives approximately **1,200-1,500 mm** of rain per year, which is generally sufficient to support rain fed agriculture, pasture regeneration and natural vegetation growth.

Rainfall dynamics in Koboko District are increasingly affected by unpredictable weather patterns, including erratic onset of rains, prolonged dry spells, and intense rainfall events. Local farmers in Lobule Sub-County report that long periods without rain have become more frequent in recent years, disrupting the traditional agricultural calendar that guides planting, crop growth, and harvesting.[24] According to community accounts, rainfall that once supported two distinct cropping seasons (April to June and August to December) is no longer consistent, which leads to crop stress and diminished yields when rains are delayed or erratic, and occasionally causing destructive runoff when heavy rains arrive after a long dry spell.[25]

These changing weather patterns are consistent with broader national observations of increasing climate variability in Uganda, where alternating dry conditions and intense rains have been linked to reduced agricultural productivity and heightened vulnerability for rain-fed households. Such variability complicates farmers' ability to schedule planting and crop management and contributes to water scarcity during extended dry spells.[26]

In Koboko, farmers testify that crops such as maize, beans, ground nuts, and vegetables often suffer when dry conditions persist through critical growth phases. For example, maize planted early in the season, may wither before maturation if rain fails to arrive as expected. Later, heavy rains can damage established gardens and access roads.[27] In 2021, hailstorms destroyed various gardens in Abuku Sub-county in Koboko District.[28]



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

Extended dry periods also affect pasture regeneration and water resources**, reducing forage availability for livestock and increasing distances travelled to find water, which places additional pressure on both host and refugee populations, who depend on mixed crop-livestock systems**. Intense rainfall events, although less frequent, can lead to surface runoff and soil erosion, particularly in areas where vegetation cover has been reduced by land clearance for agriculture and fuelwood. These rainfall patterns, coupled with limited irrigation infrastructure and high reliance on rain-fed agriculture, heighten climate hazards for communities in Koboko, underscoring the need for improved climate information, adaptive agronomic practices, and targeted resilience building.

Temperature challenges exacerbate these issues in Koboko District. Although communities in Koboko are accustomed to generally high temperatures, typical of Northern Uganda, **rising temperatures and increased climate variability** have intensified evapotranspiration, reduced soil moisture retention, and undermined the reliability of rain-fed farming systems across the district's largely subsistence agricultural landscape. **Erratic rainfall patterns** have led to prolonged dry spells, followed by short, intense rain events, making it difficult for smallholder farmers to plan planting and harvesting and contributing to crop losses when rain fails to align with crop water requirements. Local farmers have reported that the **long dry spells often exceed traditional seasonal expectations**, causing crops such as maize and vegetables to wilt or fail before maturity, and have increased pressure on water sources for both crops and domestic use.[29]

Livestock keepers in Koboko also face growing challenges. Water scarcity and reduced pasture availability **during extended hot and dry periods** mean herders travel longer distances in search of grazing, with the potential to result in livestock losses These conditions mirror broader trends across West Nile, where reduced and irregular water availability directly undermines pasture regeneration and livestock productivity.[30]

The recent changes pose specific challenges for refugee-hosting areas in Koboko District, such as the Lobule Refugee Settlement, where both refugees and host farmers depend heavily on rain-fed agriculture with limited access to perennial water sources. When rainfall becomes highly variable and temperatures rise sharply, refugees have fewer alternatives, such as diversified landholdings or livestock reserves, to buffer these shocks, making them more vulnerable than some host community members whose livelihoods may be marginally more diversified.[31]

Overall, it is the increasing variability and rapid shifts in the known climatic patterns that pose growing risks in Koboko District. These shifts influence water availability, crop performance, **pasture regeneration and the reliability of rain-fed farming systems** on which both host and refugee communities depend, compounding pre-existing challenges linked to limited infrastructure, declining soil moisture and overreliance on erratic rainfall.

Temperature

Over the past four decades, Koboko District has experienced a significant rise in temperatures, with an increase of approximately **2.5 to 2.8°C,** a substantial warming trend for a single district. As shown in *Figure 2*, Koboko District exhibits a clear long-term trend from 1981 to 2023, with the most pronounced increases occurring in recent years, suggesting an acceleration in warming and a rising risk of heat related extremes.

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

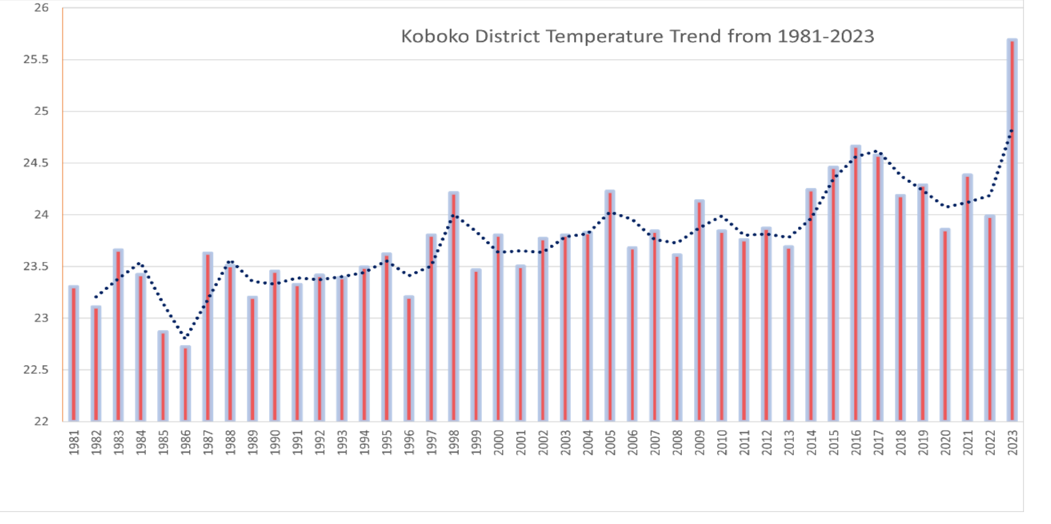


Figure 2: Graph showing the long-term temperature trend (1981-2023).

- **1980s-mid 1990s:** Average annual temperatures remained relatively stable, generally hovering between about **22.7°C and 23.7°C**, with minimal year to year variability and no strong warming trend.
- **Late 1990s-2014**: Average annual temperatures begun to rise gradually with intermittent warmer years reaching to slightly above **24.2°C**. While the overall warming signal was still moderate, this period marks the beginning of a departure from earlier stable conditions.
- **2015 onwards:** A clearer and more sustained warming trend emerges after 2014, accompanied by increased inter-annual variability. Most years during this period record average temperatures above **24.5°C,** with noticeable peaks between 2016-2017.

Following a brief moderation around 2018-2022, temperatures rose sharply again, culminating in an exceptional peak in 2023, which stands out as the warmest year on record. This consistent upward trend highlights the **growing climate stress in the region, with implications for agriculture, water availability, health and overall resilience**.

Seasonal temperature patterns in Koboko District show consistently warmer conditions during the December-March dry and early transition period, when clear skies and high solar radiation drive monthly temperatures above the long-term average. Temperatures decline steadily from April through August, reaching their lowest levels around June-July, before gradually increasing again from September to December.

The long-term monthly temperature average (1981–2024), shown by the dashed line in *Figure 3***,** indicates a single pronounced temperature peak at the beginning of the year (January-February) and a secondary gradual rise toward the end of the year (October-December). Unlike rainfall patterns, temperature variability within the rainy season is relatively limited, with cooler conditions generally prevailing during peak rainfall months.

Recent observations (2022-2024) highlight persistent warming relative to the long-term average, particularly during the early months of the year and toward the end of the year:

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

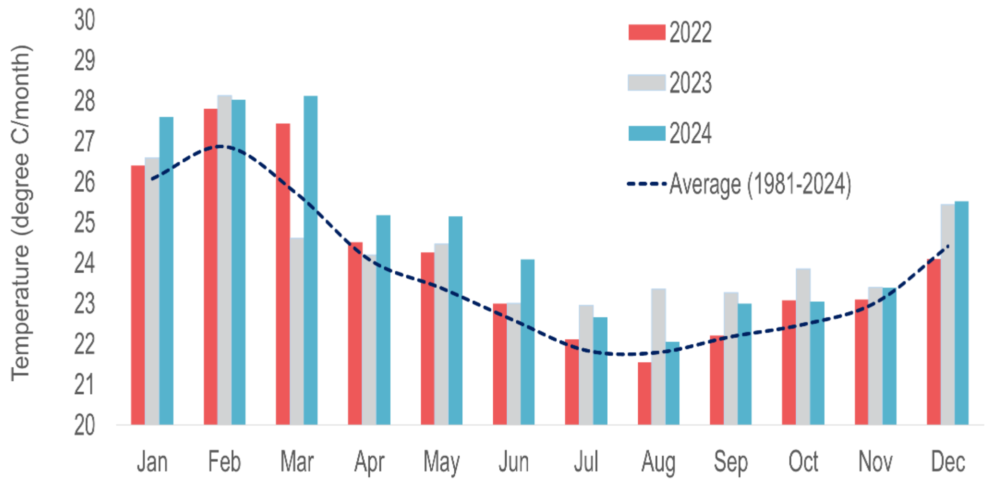


Figure 3: Graph showing average annual temperature (2022-2024) of Koboko District.

- **2022:** Monthly temperature in the crop flowering stage of the first season was above normal of the long-term average in **April-May** while is normal in the second season in **September**.
- **2023:** Temperatures during the first season flowering period were above the long-term average in May, while the second season recorded above average temperatures in August–September, indicating warmer conditions during early crop establishment.
- **2024:** Monthly temperatures during the first season were above the long-term average from April to June, while the second season again experienced above-average temperatures in August–September, reflecting sustained warmth across both growing seasons.

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

Overall, the observed seasonal and intra-seasonal temperature patterns in Koboko District point to increasing heat exposure during key agricultural periods, reinforcing concerns around rising climate-related stress on crops, water resources, and broader livelihood systems.

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, which is considered 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 seasonal 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

+169 mm

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

+2.8 °C

Figure 2: Annual precipitation and temperature changes in Koboko District.

Temperature

The mean annual temperature is projected to rise from **24.9°C** in the historical baseline to **27.7°C** by 2041-2060. Both minimum and maximum temperatures show substantial increases. The strongest warming **(up to 2.77-2.78°C)** is expected in the sub-counties of **Western Division, Dranya, Southern Division and Midia**. Sub-counties such as **Ludara, Northern Division, Abuku and Lobule** are expected to experience slightly smaller increases **(~2.74°C**) but still exceed the districtwide warming trend.

An iIncrease in mean temperature during both the warmest months **(+2.4°C)** and driest quarter **(+3.0°C)** indicates **more intense heatwaves during already dry**

periods. This pattern points to heightened heat stress for people, crops and livestock, greater evapotranspiration, and reduced soil-moisture retention.

At the same time, mean temperatures are projected to rise in the coldest month **(+3.2 °C)** and the wettest quarter **(+2.6 °C),** indicating **pronounced warming during historically cooler and wetter periods**. This suggests **a reduction in seasonal cooling and persistently higher temperatures even during months that are traditionally cooler.**

Together, these trends indicate year-round warming across both dry and wet seasons, with implications for heat exposure, evaporation, and pressure on climate-sensitive systems throughout the year.

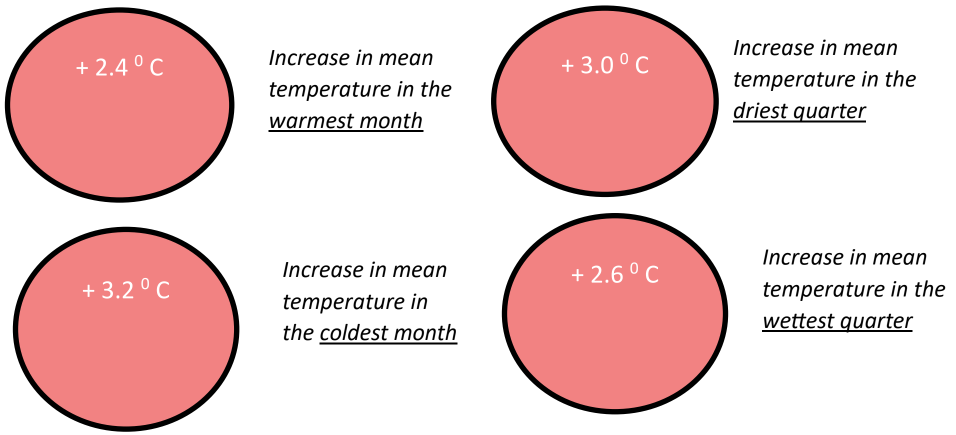


Figure 5: Projected changes in temperature in bioclimatic variables in Koboko District.

Precipitation

Mean annual rainfall is projected to increase from **1,418 mm to 1,587 mm** by mid-century. However, the distribution of rainfall gains is uneven across the district. The largest precipitation increases **(170-175 mm**) are expected in **Northern Division, Midia and Western Division**, while areas such **as Lobule, Kuluba and Abuku** show smaller increases **(167-169 mm).**

An increase in precipitation during both the wettest month **(+44.8 mm)** and the warmest quarter **(+20.0 mm) indicates intensifying rainfall during already wet and hot periods.** This suggests a concentration of rainfall in peak conditions, **increasing the likelihood of heavy rainfall events/floods and pressure on drainage, soils, and infrastructure.**

At the same time, precipitation is projected to increase in the driest month **(+3.4 mm)** and the coldest quarter **(+94.7 mm),** indicating **wetter conditions during periods that were historically drier or cooler**. This points to **a shift in the seasonal distribution of rainfall, with less pronounced dry periods and greater rainfall occurring outside the traditional peak rainy months.**

Together, these patterns indicate both an intensification of peak rainfall and a redistribution of rainfall across the year, reflecting increasing intra-annual variability in precipitation and changing seasonal dynamics.

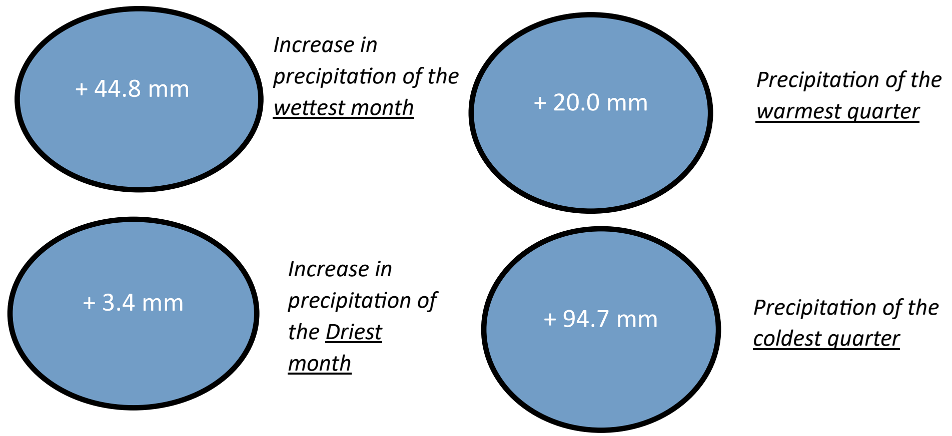


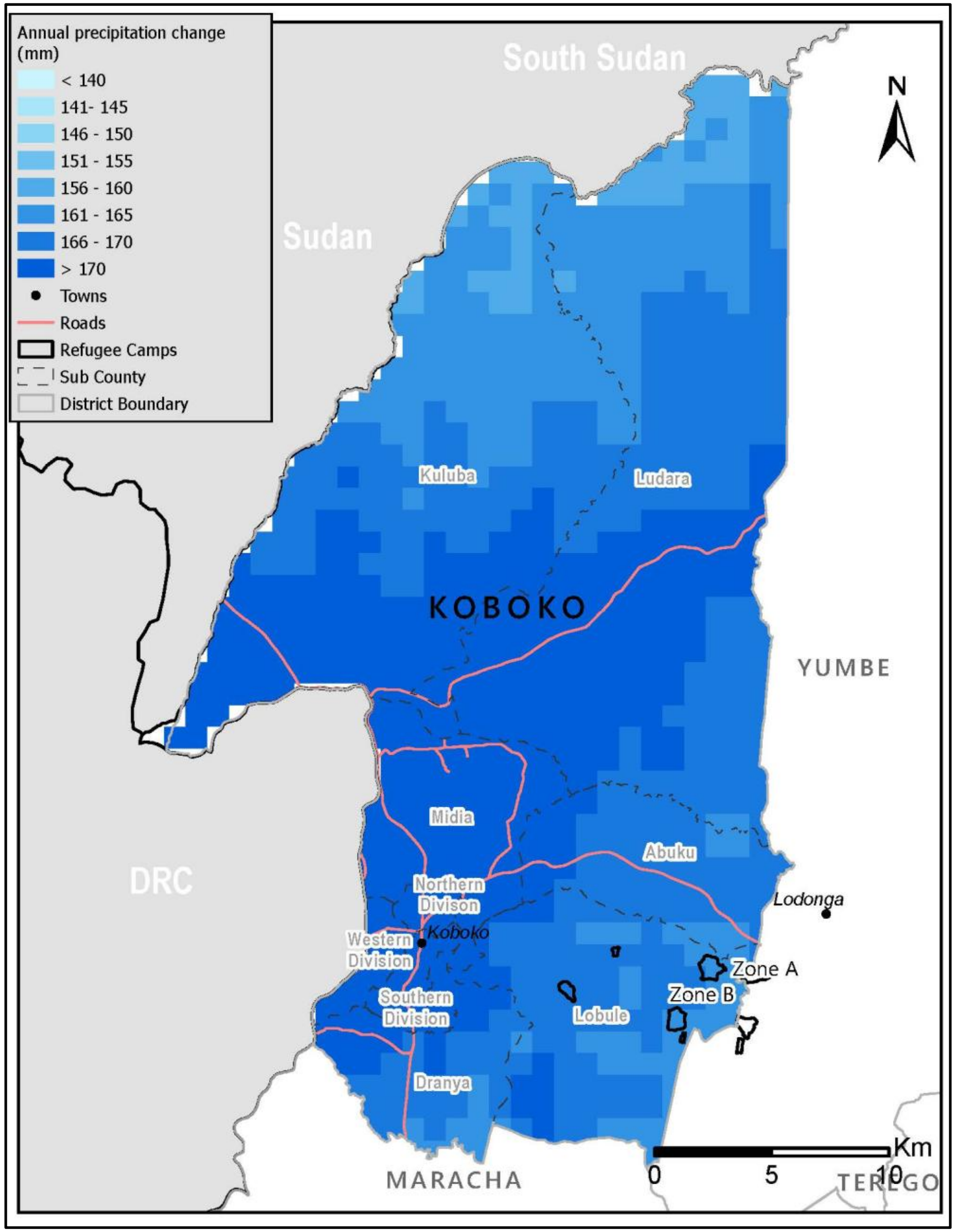
Figure 6: Projected changes in precipitation in bioclimatic variables in Koboko District

Implications

The combination of rising temperatures, changes in dry-season rainfall, and moderate increases in annual precipitation creates a complex climate hazard profile for Koboko District. Increased evapotranspiration may reduce the benefits of higher annual rainfall, limiting improvements in soil moisture and water availability. **Areas with fragile/limited vegetation cover such as Ludara and Kuluba Sub-counties are likely to face rising exposure to heat stress, seasonal drought and water scarcity.**

Northern sub-counties in Koboko, which already experience drier conditions, may face heightened vulnerability to climate-related shocks compared to the Southern sub-counties that receive 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 UNFCCC[32] and the IPCC Sixth Assessment Report[33], 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 Koboko 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.



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

SEASONAL DROUGHT HAZARD ASSESSMENT

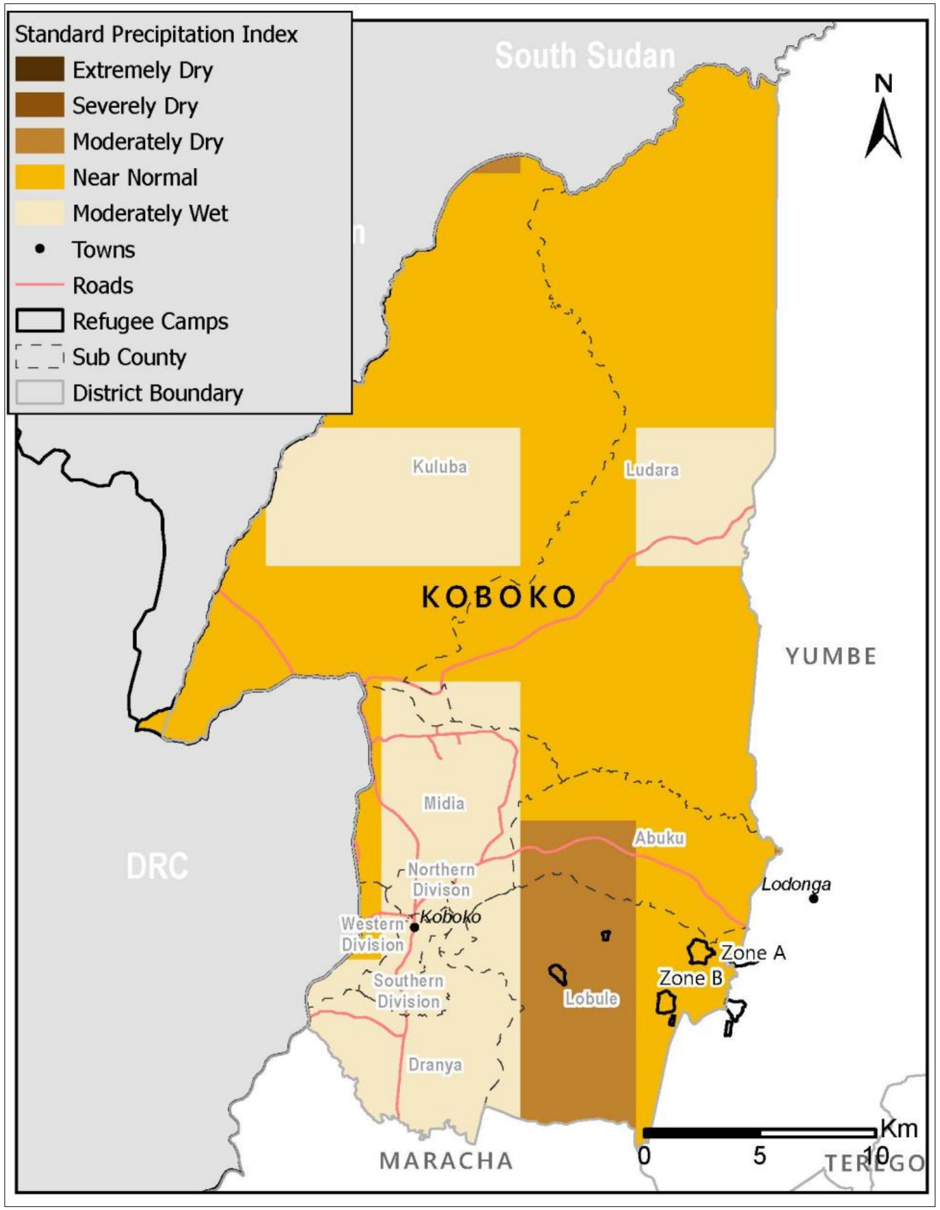
Koboko District has been experiencing notable climate changes, unpredictable rainfall, prolonged dry spells and rising temperatures. These conditions have severely affected the first planting season, undermining agricultural production and household livelihoods in this largely rain-fed farming system.[34] Both host and refugee communities, including those in Lobule Settlement, experience recurrent meteorological droughts (periods of significantly below-average rainfall) and vegetation droughts (when crops and natural vegetation show stress due to lack of moisture). These conditions disrupt planting seasons, reduce yields, and intensify food insecurity.[35]

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 NDVI[2] 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 seasonal drought occurrence and severity.

The **effects were** pronounced in **2023**, when severe seasonal drought conditions hit Lobule Sub-county, resulting in **crop failure, water shortages, and heightened humanitarian needs**. While agencies such as WFP, UNHCR, and other partners provided emergency assistance, limited resources and logistical constraints underscored the district's urgent need for sustained investment in seasonal drought preparedness, climate-resilient livelihoods, and long-term adaptation measures.[36]

SPI Findings

The *Standardized Precipitation Index (SPI)* analysis shows that March-May 2024 was a critical month for measuring seasonal drought because it coincides with the flowering season for first season crops. In Koboko District, much of the area experiences **near normal to moderately wet rainfall. Only Lobule Sub-county, where the refugee settlement is located, experienced moderately dry precipitation.**



Map 6: Map showing the SPI Index.

[2] NDVI stands for the Normalized Difference Vegetation Index.

This moderately dry condition, as shown in *Map 6*, indicates substantial **impacts on soil moisture availability, crop performance, rangeland conditions, and water access, particularly in areas overlapping with Lobule Refugee Settlement, where livelihood systems are already highly sensitive to rainfall variability**

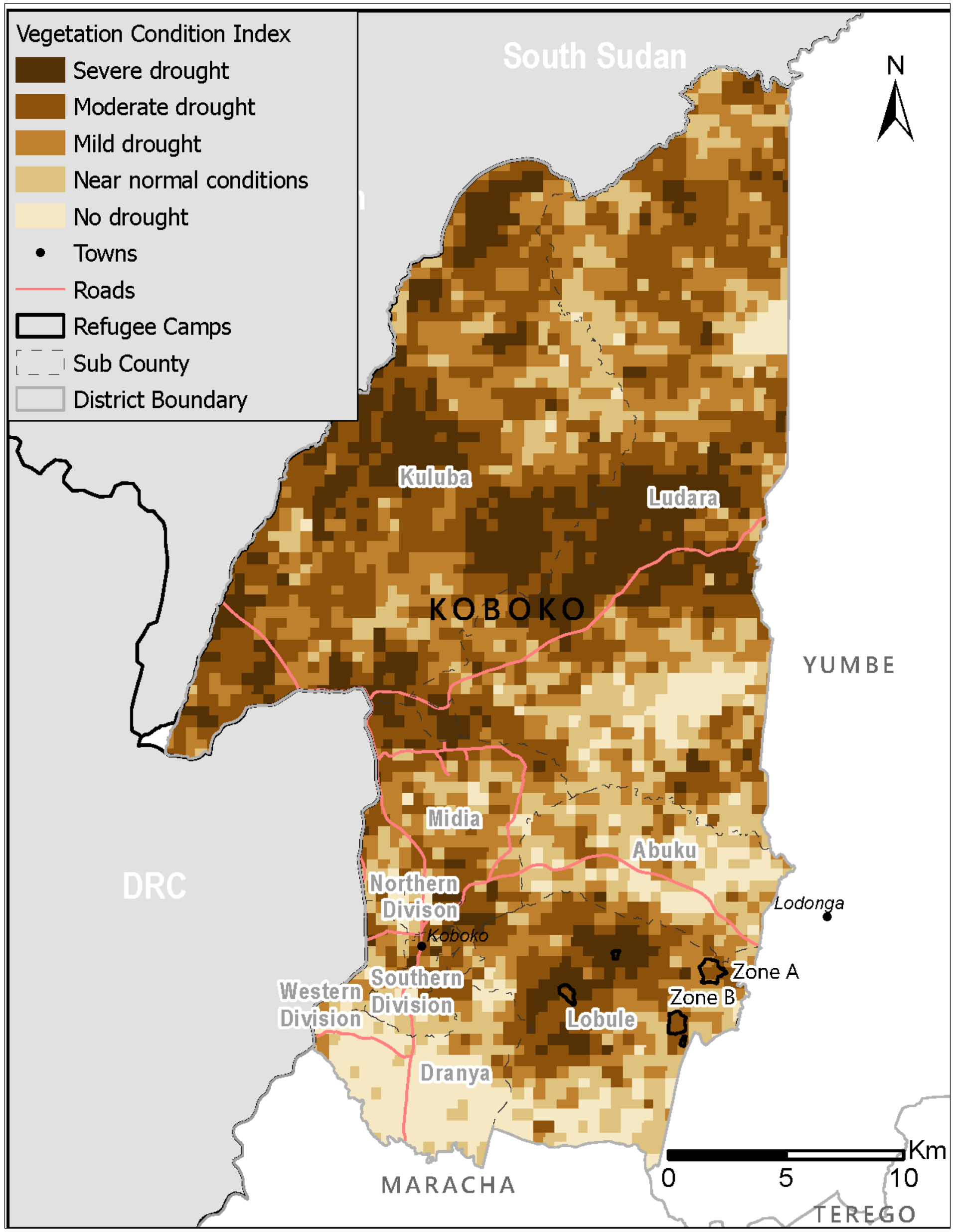
VCI Findings

The *Vegetation Condition Index (VCI)* results confirm widespread vegetation stress across Koboko District in March-May 2024, corresponding closely with the SPI-detected rainfall deficits. Grasslands provide the clearest and most reliable signal of seasonal drought severity because they are shallow-rooted and are highly sensitive to rainfall variability. Croplands come next, depending on crop type and seasonal calendar timing shifts. Forests mask short-term drought because they have deeper root systems and higher biomass, and built-up areas give misleading signals because of bare surfaces and less green vegetation.

The **most affected sub-counties Ludara, Kuluba and Lobule show moderate to severe vegetation seasonal drought, represented by the darker brown tone** (*Map 7*).

Lobule sub-county, which experienced moderately dry precipitation *(Map 6)* and contains cropland and grassland areas *(Map 3*), reflects true vegetation conditions of severe seasonal drought. In contrast, **Ludara and Kuluba sub-counties, with near-normal precipitation and limited cropland, may not be considered as critically affected.** The *VCI Map* around Lobule Refugee Settlement demonstrates a notable intensification of vegetation drought, consistent with the spatial distribution of rainfall deficits.

Overall, the findings illustrate that **vegetation health across much of the district was significantly constrained during this period, affecting both croplands and grazing areas crucial for household food security and livelihoods**.



Map 7: Map showing the VCI index.

Implications

The combined SPI and VCI findings reveal that Koboko District is experiencing seasonal drought conditions that extend beyond short-term rainfall deficits with far-reaching implications across agriculture, food security, water resources, public health and socio-economic stability. The simultaneous occurrence of severe SPI dryness and low VCI values in Lobule, Ludara and Kuluba Sub counties indicates that these areas face acute vulnerability during short-term rainfall deficits.

These climatic stressors have real-world consequences. In 2021, unreliable rainfall patterns and short dry spells during critical planting windows hindered crop production for farmers in the Koboko District, reducing expectations for good yields.[37]

Local reporting from the wider West Nile Sub-region (of which Koboko District is part) also documented dry spells that **have withered staple crops like maize, beans, groundnuts, and cassava before maturity,** with farmers describing unpredictable rainfall as a major constraint on production and harvest outcomes.[38] These observed agricultural challenges reflect the link between SPI and VCI signals and reduced agricultural output, food availability, and livelihood resilience in both host and refugee communities.

The impacts extend across several livelihood dimensions. **Reduced soil moisture and weakened vegetation cover directly undermine crop yields, pasture availability, and water resources, heightening food insecurity, reducing household incomes** for both host and refugee communities. Vegetation loss also **exacerbates soil erosion and land degradation, weakening the district's overall ecological resilience to future shocks.** These conditions place **additional pressure on settlement areas, where higher population density and limited natural resource buffers magnify** seasonal drought impacts**.**

Water scarcity, driven by seasonal drought, also has broader implications for **household welfare and public health**. Reduced household water availability can **compromise hygiene, sanitation, and domestic use, leading to higher risks of water-related diseases and stress on community health systems.** Seasonal drought conditions **also increase the incidence of dust and air quality problems**, which can exacerbate **respiratory illnesses, particularly among vulnerable groups such as children and the elderly.**[39]

Photo 1: Several Women in Koboko District are Spending Sleepless Nights at Water Points. Photo Credit: Warom Felix Okollo

During a prolonged dry spell reported by the Daily Monitor (Updated in 2021), **Koboko District** experienced an acute water crisis as boreholes and wells dried up due to extended rainfall deficits. Households were forced to walk up to **four kilometers** to access water, and long queues formed at the few remaining functional sources. The cost of a **20-litre jerrycan** reportedly rose to about **UGX 1,500**, increasing the financial burden on already vulnerable families. Women and children were disproportionately affected, often spending long hours or even nights at water points. The dry spell not only limited access to safe drinking water but also heightened risks of poor hygiene and water-related illnesses. The crisis highlighted Koboko's vulnerability to prolonged dry conditions and underscored the need for strengthened **water infrastructure, seasonal drought preparedness, and climate-resilient planning** in the district.

Source: Monitor UG- Acute water crisis hits Koboko District

From a preparedness standpoint, the findings emphasize **the need for early warning systems, climate-smart agriculture, water harvesting and storage, and strengthened natural resource management. Integrating SPI and VCI monitoring into district-level disaster risk management frameworks can enhance evidence-based planning, support timely alerts during emerging seasonal drought episodes, and improve resource allocation for both immediate response and long-term climate resilience** across Koboko District.

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.[40] The score rank of the thirteen indicators was summed and ranked into three level of risk.

1. Distance to Permanent water ranked from higher risk to lower risk at 100 meters, 250 meters, 500 meters, and 750 meters.[41]

2. Elevation above sea level ranked from higher risk to lower risk at 600 meters, 700 meters, 800 meters, and 1000 meters.[42]

3. Slope of the area in degrees ranked from higher risk to lower risk at 2, 5, 10, 15.[43]

4. Landcover ranked from higher risk to lower risk as built-up, cropland (include water, flooded vegetation), grassland, shrub and forest.[44]

5. Topographic Position Index ranked from higher risk to lower risk at -8, -6, -4, -2, 0.

6. Normalized Difference Vegetation Index ranked from higher risk to lower risk at 0.2, 0.4, 0.6, 0.8[45]

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.[46]

9. Rainfall Intensity as average maximum annual rainfall ranked from higher risk to lower risk at 33 mm, 31 mm, 29 mm, 27 mm.[47]

10. Monthly Number of Days with Rainfall ranked from higher risk to lower risk at 13 days, 10 days, 7 days, 3 days.[48]

11. Frequency of -days with continuous Rainfall ranked from higher risk to lower risk at 2, 1.2, 0.8, 0.4.[49]

12. Height Above Nearest Drainage (HAND) ranked from higher risk to lower risk at 2 meters, 5 meters, 10 meters, 20 meters.[50]

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).[51]

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

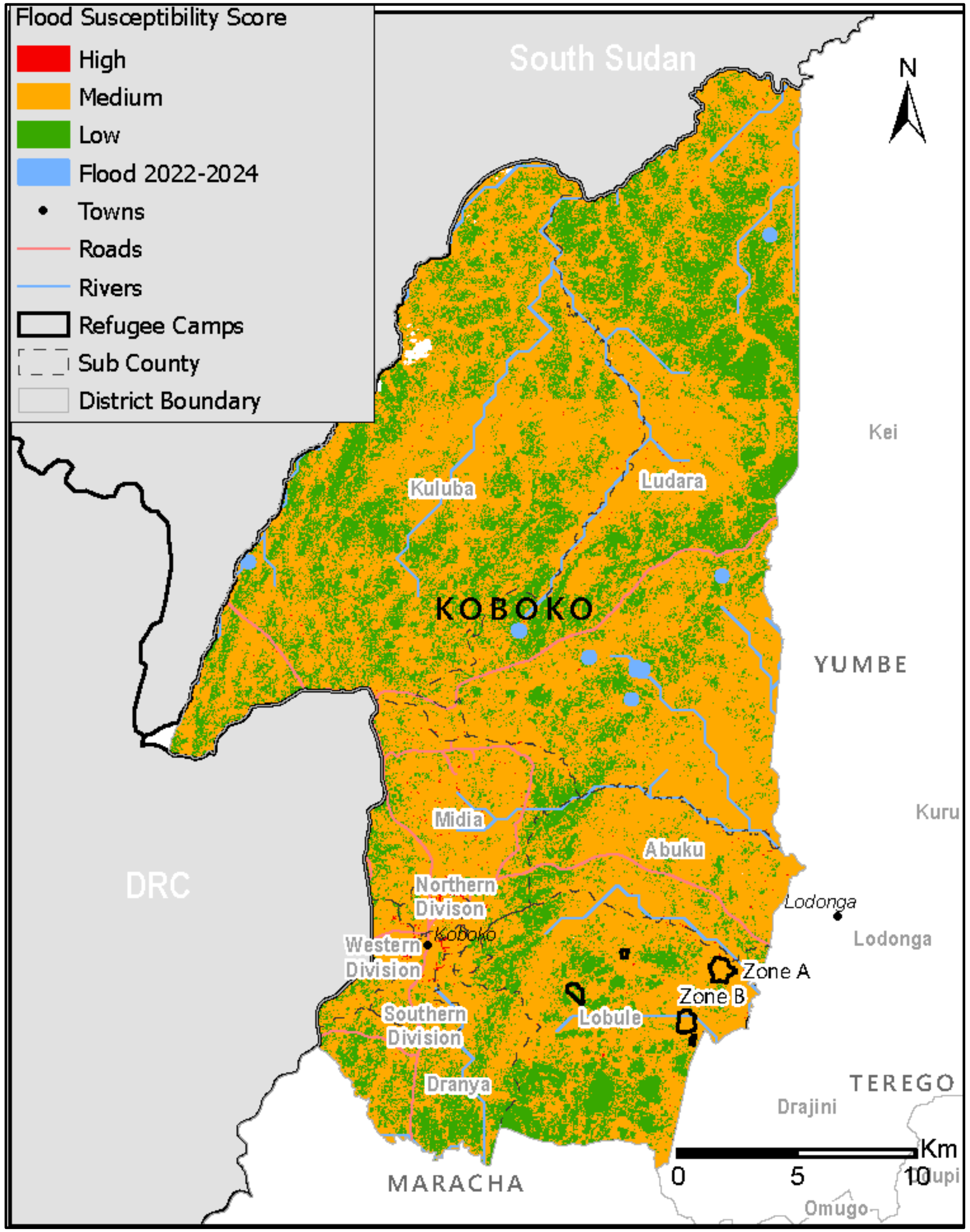
Hydro-climatic indicators such as rainfall intensity, frequency of continuous rainfall days, and flood return periods are equally vital in flood risk assessment. Literature shows that extreme rainfall events, particularly when sustained over consecutive days, significantly increase flood hazards. Soil 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 hazards in the district. Koboko's landscape is a mix of flat plains and hills sloping towards the east, unstable clayey soils in slopy areas, and insufficient drainage infrastructure, increasing surface runoff, particularly in low-lying areas and along seasonal streams.

Satellite-based assessments reveal that less than **5% of Koboko District falls within high-risk flood areas**. Midia, Western, Southern and Northern division sub-counties around Koboko Town are **areas with higher risk for flash floods,** which has led to significant gully erosion, especially on the eastern hillside of Koboko Town, where gullies can reach depths of up to 9 meters.[52] Abuku and Lobule Sub-counties face a **higher risk of riverine flooding** due to their low elevation, proximity to rivers and limited forest cover. Within the Lobule Refugee Settlement, Zones A and B are particularly susceptible to flooding due to their closeness to Atu River and lower elevation compared to the western parts of the district. These zones are situated on terrain that accumulates runoff during peak rainfall periods, resulting in damage to shelters, latrines, and access roads. Such events disrupt humanitarian operations and pose significant public health risks, including water contamination.[53]

Flood recurrence is strongest in areas aligned with seasonal river channels, low-lying plains, and poorly drained terrain, highlighting the influence of local topography and hydrological pathways. **Recurrent flooding around Kochi River (**Catchment covers 1640 km² across Koboko, Yumbe, and Moyo districts; originates in Koboko and Yumbe, flows to lowlands in Moyo**)** suggests limited natural drainage capacity, potential siltation of watercourses, and increasing surface runoff linked to land cover modification, including vegetation clearance and the expansion of built-up areas within the broader catchment.[54] These conditions reduce infiltration and increase the likelihood of rapid accumulation of surface water following intense rainfall events.



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

Risk on Cropland and Settlement

The land cover analysis revealed that **grassland covers 70.6%, forest 23.1%, built-up areas 4.2%, while cropland only covers 2.1 %.** Less **than 19% of cropland falls within the low-risk flood zone,** while less **than 8% of built-up areas are within the low-risk flood zone**. Built-up areas emerge as the most affected by flooding when measured in terms of area inundated compared to cropland. However, these estimates represent district-wide averages and therefore conceal substantial spatial concentration of impacts at local levels.

The *Land Use and Landcover Map* (*Map 3)* shows that most cropland areas are located around Koboko Town and in the southeastern parts of the district, largely falling within low- to medium-risk flood zones. This indicates that households cultivating in and around floodplains and poorly drained depressions remain exposed to flooding. For these households, 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 cropland around Koboko Town and Lobule Refugee Settlement, are within the range of low- to high-risk flood zones.

Overall, the findings indicate that flood risk in Koboko is spatially concentrated in specific terrain and soil types and closely linked to settlement patterns.[55] Urban expansion occurred without a structured and adequate plan to manage stormwater, leaving the concentrated runoff to carve out large gullies. Effective flood risk management will require targeted interventions around the Kochi Catchment Area. These interventions could include planting of trees, buffer zone demarcations, improved drainage infrastructure, and strengthened alternatives for income-generating activities like **apiary (beekeeping), aquaculture (fish farming), and fruit farming**. Integrating flood hazard information and unstable soil management **to reduce landslides** into land-use planning and settlement management is essential for reducing vulnerability, particularly in flood-affected sections of the Lobule Refugee Settlement.[56]

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 amplifying flood related landslide.

Flood Impacts

Flooding in Koboko District has had multidimensional socio-economic and environmental impacts. Flash flood and hailstones inundation has led to damage of crops and agricultural land, disrupting food production and household income for both host and refugee communities.[57] **Access roads and footpaths in flood-prone areas become impassable during heavy rainfall, affecting mobility and access to markets, schools, and health facilities**.[58] **Floods have also killed livestock, contaminated water sources and damaged sanitation facilities, increasing the risk of waterborne diseases particularly within the built up areas affected by landslides**.[59]

Photo 2: Pupils stranded at Apa Bridge in Koboko District after it was submerged following a heavy downpour. Photo Credit: Peter Aligo

Heavy rainfall events in Koboko District have also resulted in notable **flood-related losses**, as reported by the Daily Monitor. Following intense rains, **504 livestock were killed** in parts of the district, highlighting how flash flooding and waterlogging directly affect agricultural assets and household livelihoods in low-lying farming areas. Such flood impacts in Koboko underscore how extreme rainfall events often associated with climate variability. Damage property and livestock, disrupting economic activities and contributing to loss of income for households dependent on agriculture and animal husbandry.

Source: Monitor UG – Landslides, floods – govt should be proactive

Photo 3: Some farmers whose photos were destroyed by hailstorms. Photo credit: Rashul Adidi

In September 2021, a severe storm accompanied by hailstones and strong winds struck **Koboko District**, destroying more than **330 acres of crops** in **Lobule Sub-county**. Affected crops included maize, cassava, sorghum, simsim, beans, groundnuts, cabbage, watermelon, and sweet potatoes. Refugee farmers in Lobule settlement were particularly affected, with both mature and newly planted crops damaged. **Villages such as Atu River A and B, Kotoro, and Melioko recorded substantial losses.** The destruction undermined household food reserves and income from planned sales. The event illustrates how extreme weather hazards pose serious risks to rain-fed livelihoods in Koboko.

Source: Monitor UG - Koboko, Yumbe farmers in tears after hailstones destroy crops

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 flooded areas often face temporary displacement, loss of shelter, and heightened vulnerability due to inadequate infrastructure and limited adaptive capacity**. These impacts underline the urgent need for integrated flood management, infrastructure improvement, and community-based adaptation strategies to enhance resilience in Koboko District.

Conclusion

The findings of this geospatial analysis highlight the influence of climate-related hazards on both refugee and host communities in Koboko District. Over the assessment period, the district has experienced **seasonal drought conditions and localized flooding, which together pose major risks to agricultural productivity, water availability, and settlement infrastructure.** The SPI and VCI analyses **reveal spatially spread vegetation stress and rainfall deficits controlled by elevation and landcover type, especially during the 2023 first-season crop flowering, while flood mapping indicates high exposure in low-lying sub-counties, such as Koboko Town, Abuku, and in Lobule Zones A and B.** These findings underscore the need for climate vulnerability of Koboko District, **with 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 risk assessment for Koboko 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 model[60] under the SSP2-4.5 scenario, processed using the same bioclimatic variables to ensure comparability with the historical baseline.[61]

Seasonal drought assessment followed UN-SPIDER protocols[62], using SPI calculated in Google Earth Engine (GEE)[63,64] from CHIRPS rainfall data[65] (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.[66] 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.[67] 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 Lobule refugee settlement in Koboko 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 seasonal 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 Koboko (WorldClim ≈ 25.7°C for 1970-2000, ERA5-Land ≈ 24.7°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 25-26°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.[6869]

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.[70]

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.[71]

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.[72]

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[73]

Exposure: The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas.[74]

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.[75]

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).[76]

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.

Endnote

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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).

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