DROUGHT RISK PROFILE FOR KARAMOJA CROSS-BORDER AREA

STRENGTHENING CAPACITY OF IGAD TO INCREASE DROUGHT RESILIENCE IN THE HORN OF AFRICA

PEACE, PROSPERITY AND REGIONAL INTEGRATION

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IGAD Climate Prediction and Applications Centre (ICPAC)

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About ICPAC and the IGAD DRM Unit

The IGAD Climate Prediction and Applications Centre (ICPAC) is a specialized institution of the Intergovernmental Authority on Development (IGAD), based in Nairobi, Kenya, mandated to provide timely climate early warning information and support specific sector applications to enable the region cope with risks associated with climate variability and change including providing climate applications for poverty alleviation, environment management and sustainable development. ICPAC also hosts the **Disaster Risk Management Unit** and the IGAD Food Security, Nutrition and Resilience Analysis Hub (IFRAH).

The specialized IGAD Centre started as a Drought Monitoring Centre (DMC) in 1989, in response to the devastating drought that occurred in eastern Africa in the 1980s. A Protocol that fully integrated the institution into IGAD was signed on 13 April 2007. The Centre serves eight IGAD member countries namely: Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan and Uganda as well as three non-IGAD member countries, namely Burundi, Rwanda and Tanzania.

ICPAC is responsible for climate monitoring, prediction and early warning, applications, climate change, Disaster Risk Management and capacity building for its member countries to cope with extreme climate events and adapt to future climate changes in support of climate sensitive sectors for sustainable development. Furthermore, it is tasked with providing support on disaster risk management within the region, thus strategic for addressing IGAD's climate variability and change and disaster risk management efforts.

The vision of ICPAC is to be a world-class Centre of excellence in climate services for sustainable development in the Greater Horn of Africa. The mission of the Centre is to foster climate services and knowledge to enhance community resilience for prosperity in the Greater Horn of Africa. ICPAC was designated as a World Meteorological Organisation (WMO) Regional Climate Centre (RCC) for eastern Africa in 2016 and also has an observer status with the United Nations Framework Convention on Climate Change (UNFCCC).

ICPAC core values are to:

- Uphold the virtues of integrity, professionalism, teamwork and meritocracy Promote creativity and innovativeness
- Encourage openness and transparency in all dealings and operations Promote social responsibility
- Espouse a strong concern for the preservation and protection of the environment
- Ensure reliable and timely provision of services
- Ensure a regional approach to issues
- Promote the use of all knowledge (including indigenous knowledge)

The objectives of the Centre are to:

- Enhance preparedness and mitigation of climate risks and adaptation to climate change and to strengthen disaster preparedness, mitigation and resilience in the IGAD Region.
- Provide timely climate early warning information and sector specific products for the mitigation of the impacts of climate variability and change;
- Improve the technical capacity of producers and users of climatic information to enhance the input to and use of climate monitoring and forecasting products;
- Develop proactive, timely, broad-based systems of information and product dissemination and feedback, at both sub-regional and national scales through partners;
- Expand the knowledge base within the sub-region in order to facilitate informed decision making on climate risk reduction related issues;
- Maintain quality controlled databases and information systems required for detection and attribution of regional climate hazards and changes; risk/vulnerability assessment, mapping and general support to the national and regional climate risk reduction strategies;
- Monitor, assess, detect and attribute climate change and associated impacts, vulnerability, adaptation and mitigation options;

- Develop relevant tools required to address the regional climate challenges through research and applications in all climate sensitive socio-economic sectors including addressing linkages with other natural and man-made disasters; and

- Network and exchange of information regarding the disasters in the sub-region.

The **IGAD Disaster Risk Management (DRM) Unit** was initiated in 2004 (as a programme), to advance Disaster Risk Reduction (DRR) efforts within the IGAD region. In line with the evolving priorities and global frameworks, the Unit has undergone revisions to align with the four core priorities of the Sendai Framework. These priorities encompass enhancing risk knowledge, fostering effective disaster risk governance, promoting investment in DRR for building resilience, and strengthening preparedness mechanisms.

The overarching objective of the Unit is to reduce the adverse impacts of disasters, particularly minimizing the number of people affected and damage to infrastructure by such events. To achieve this goal, the Unit focuses on the implementation of improved multi-hazard early warning systems, enabling timely and accurate dissemination of critical information to the focal institutions of member states. Through the "Strengthening the Capacity of IGAD to Enhance Drought resilience within the Horn of Africa (SCIDA) III" project and similar initiatives, and partnerships with other donors and partners, the Unit aspires to enhance the disaster response capabilities of Member States and communities in cross-border areas to effectively anticipate, prepare for, and respond to disaster events essentially manage risks before they become disasters. Moreover, the Unit places a strong emphasis on promoting climate-resilient livelihoods across the region, ensuring that vulnerable communities are better equipped to adapt and withstand the challenges posed by a changing climate. By aligning with international frameworks and prioritizing proactive measures, the IGAD DRM Unit is well-positioned to make a tangible difference in disaster risk reduction and community resilience. As it continues to evolve and adapt to emerging challenges, the Unit remains committed to its mission of safeguarding lives, livelihoods, and ecosystems in the face of disasters.

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Acknowledgements

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Executive Summary

The Karamoja cross-border area (defined based on the watershed boundary), encompassing parts of Kenya, Uganda, South Sudan, and Ethiopia, is an area highly prone to climate-induced hazards, with drought emerging as the most prevalent and devastating.

Largely characterized by a uni-modal seasonal rainfall pattern from March to November, the Cross-border Area's rainfall peaks in April and May. However, historical and current drought analysis underscores the chronic and severe impact of prolonged dry spells on the region. These droughts are widespread, persistent, and significantly disrupt the livelihoods of communities largely dependent on pastoralism and rain fed agriculture. Drought events are frequent making communities vulnerable to the compounding effects of recurrent dry seasons and extreme events.

This drought risk profile presents results from analysis of key indicators on drought hazard (aridity, precipitation long-term mean, long-term precipitation index, drought frequency and rainfall coefficient of variability), exposure (population density, land use / land cover and soil organic carbon / soil quality) and vulnerability (market accessibility, Anthropogenic Biomes, and poverty levels).

Analysis of historical rainfall patterns and drought related indicators reveals evidence of drought in the cross-border area of Karamoja severe droughts in 1984, 2000, and 2022, that also highlight both the increasing frequency and duration of droughts in recent decades.

The primary drivers of drought and drought impacts within the Karamoja Cross-border Area are complex and interconnected, stemming from both climatic and socio-economic factors. Climate variability, in combination with land degradation and unsustainable water management practices, intensifies the region's vulnerability.

The drought risk analysis indicates that:

i. Drought hazard index was more dominant (higher) in areas that accounted for higher drought frequency and severity but also received low rainfall and areas that experienced high variability on rainfall.

ii. Drought exposure index is high in areas that experience higher population density and areas with intense livelihood activities.

iii. Drought vulnerability index is associated with high poverty rates (low relative wealth), longer distances to market and areas with high anthropogenic biomes.

Overall, the drought risk index is seen to be higher in central and eastern parts of the cross-border area with the western, southern and northern parts of the cross-border areas falling under the low to medium drought risk.

In conclusion, drought risk as indicated poses a threat to the pastoral and agro-pastoral livelihoods often with devastating impacts on agriculture, livestock, water resources and the environment as a whole. It is expected that if drought continues without robust interventions to mitigate its impacts, it will affect livelihoods, productivity, food security and lead to displacement, conflict and affect peace and security of the communities in the Karamoja cross-border area.

Based on the findings, it is recommended that; the cross-border early warning system for drought be strengthened, preparedness and response plans be developed and operationalized and resources sharing be promoted across the cross-border communities. In addition, there is need to strengthen nature based solutions including ecosystem restoration measures and rangeland management practices to reduce degradation, improve pasture and water availability and also support access to finance, marketing and value addition to increase benefits from crop and livestock

Acronyms

CCI:	Climate Change Initiative
CDI:	Combine Drought Index
CV:	Coefficient of Variability
ESA:	European Space Agency
FAO:	Food and Agriculture Organization
FAPAR:	Fraction of Absorbed Photosynthetically Active Radiation
FEWS NET:	Famine Early Warning Systems Network
FG:	Focussed Group
ICPAC:	IGAD Climate Prediction and Applications Centre
IDDRSI:	IGAD Drought Disaster Resilience and Sustainability Initiative
IFAD:	International Fund for Agricultural Development
JJAS:	June, July, August, September
LTM:	Long Term Mean
MAM:	March, April, May
OND:	October, November, December
PET:	Potential Evapo-transipiration
SCIDA:	Strengthening the Capacity of IGAD for Drought Resilience in the Horn of Africa region
SD:	Standard Deviation
SPI:	Standardized Precipitation Index
UNDP:	United Nations Development Programme
UNICEF:	United Nations International Children Emergency Fund
UNMA:	Uganda National Meteorological Authority
USAID:	United States Aid for International Development
WFP:	World Food Programme
WHO:	World Health Organization
WMO:	World Meteorological Organization

Key Definitions

Coefficient of variation: A statistical measure of the dispersion of data points in a data series around the mean

Disaster: A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources

Drought: A prolonged dry period in the natural climate cycle that can occur anywhere in the world. It is typically a slow on-set phenomenon caused by a lack of rainfall

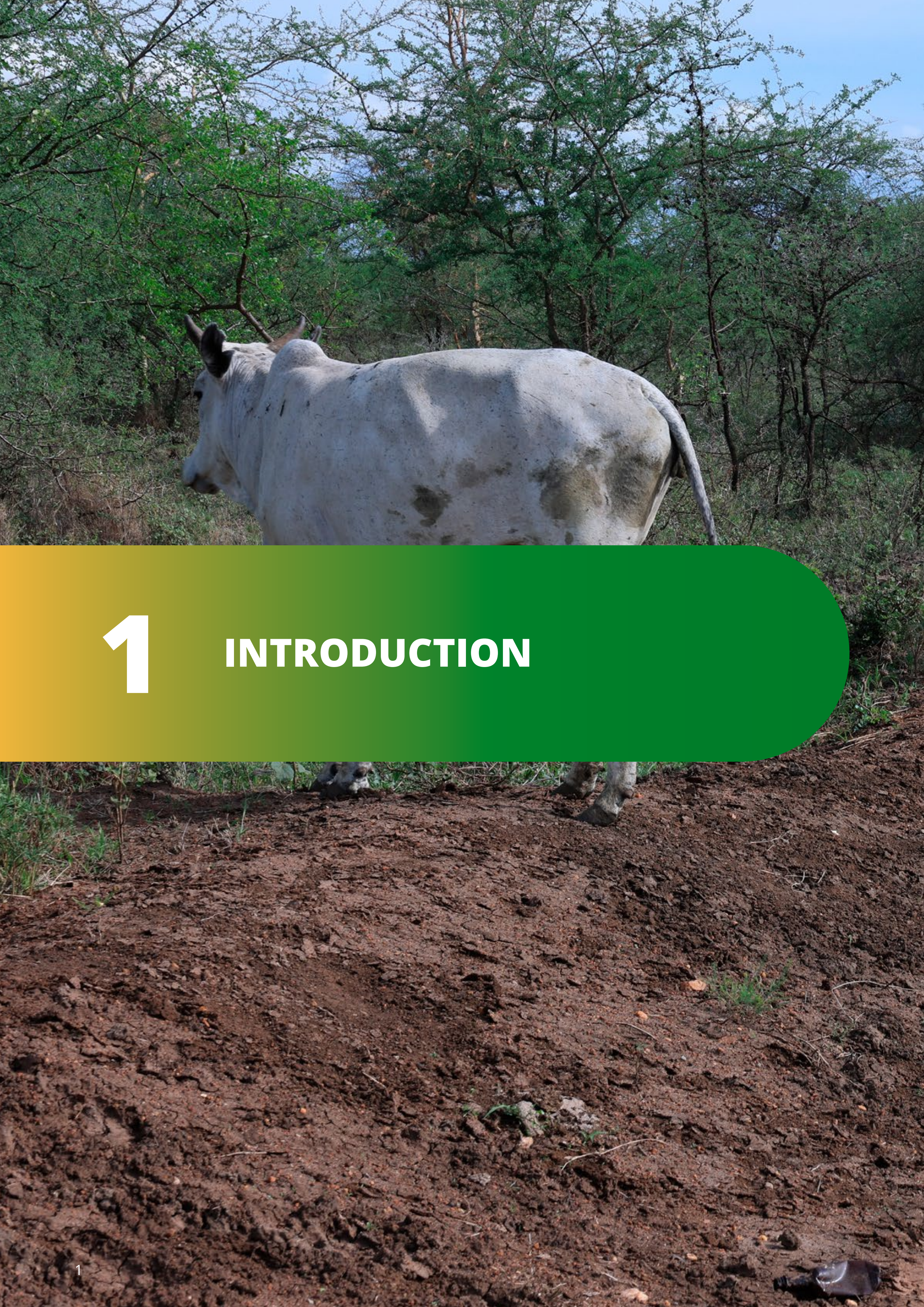
Exposure: The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas

Hazard: A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage

Risk: The combination of the probability of an event and its negative consequences

Standardized Precipitation Index: A drought index that measures how precipitation compares to the average for a given time period

Vulnerability: The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard



1 INTRODUCTION

This section will cover the overview of the Karamoja cross border area, rationale, goal and objectives of the risk profile

1.1 Karamoja Cross-border Area Overview

The "Karamoja cross-border region" also known as "Karamoja Cluster" refers to an area of land that straddles the borders between South-Western Ethiopia, North-Western Kenya, South-Eastern South Sudan, and North-Eastern Uganda (Figure 1). The region is composed of semi-arid savannah, grading into wooded grassland to the north and northwest and semi-arid to the south and southeast. Rainfall is erratic and localized, making crop farming an unreliable subsistence strategy, thus making livestock rearing a better option owing to livestock mobility.

The region has, in the past, experienced a host of challenges, including a persistent drought that has been strongly associated with food insecurity, chronic poverty, protracted competition, displacement and conflicts over livestock and access to pasture and water resources and unwarranted loss of human life, as well as cross-border incursions.

The Karamoja Cross-border Area is home to at least 19 pastoral and agro-pastoral communities (including Bokora, Daasanach, Didinga, Dodoth, Jie, Matheniko, Nyangatom, Ethur, Pian, Pokot, Tepeth, Topotha, and Turkana, Nyangiya, Napore, Mening, Achole, Upe, Iki) who have similar language, cultural practices, and way of life. The development of the Karamoja Cross-border Area is complicated by one of its defining features – the fact that it is a cross-border area: a geographic location that is shared between 4 countries, inhabited by communities that are characterized by their interaction and interconnectedness through various unifying factors (e.g. social, ethnic and linguistic unity; sharing complementary natural resources, livestock movement, infrastructure and trade). These communities experience similar challenges and are often interconnected through, inter alia, natural resource sharing, livestock movement, regional trade and trans-boundary human and animal diseases.

The communities are affected by the challenges of occupying the same space, especially as all of them are vulnerable to various shocks and stresses, such as conflicts, drought, trans-boundary human and animal diseases. These unifying factors, including challenges in water and pasture availability, poor markets and inadequate infrastructure underscore the inextricable linkage of communities with a common destiny whose development cannot be tackled through national programs alone (IDDRSI, 2018).

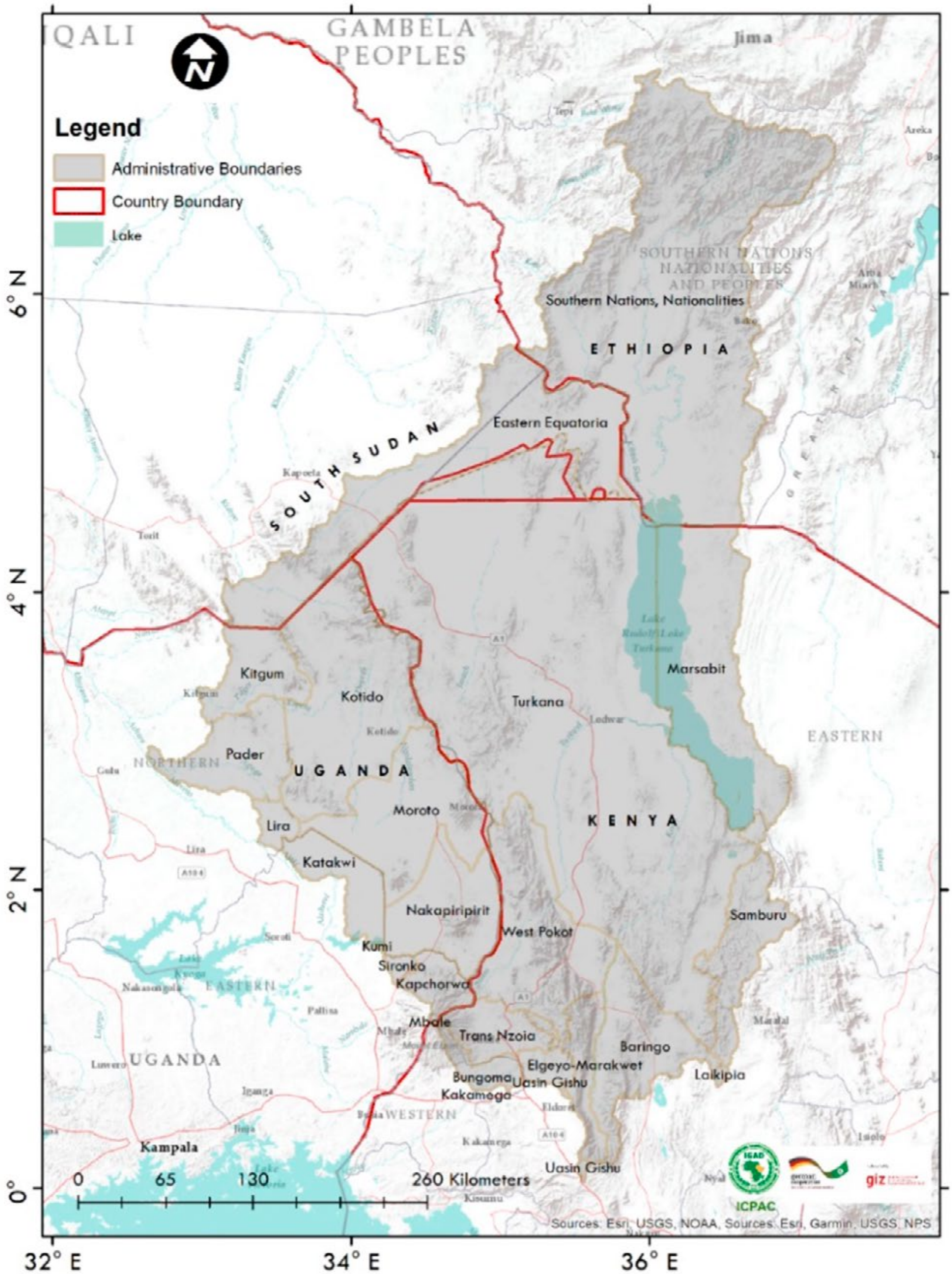


Figure 1: Extent of the Karamoja Cross-border Area

1.2 Rationale of Drought Risk Assessment in Karamoja Cross-border Area

The Karamoja cross border area is susceptible to various natural and human-induced hazards, including droughts, floods, epidemics, landslides, mudslides, rockslides, pests, invasive species and conflicts.

Understanding the risks associated with these hazards is crucial for implementing effective mitigation and preparedness measures. By comprehensively understanding disaster risk, interventions can be designed to protect the lives and livelihoods of the population in the Karamoja Cross-border Area. This includes measures to minimize the loss of human life, prevent injuries, and safeguard essential infrastructure and livelihood assets.

The region may have some interventions in development initiatives such as infrastructure development, healthcare, and education. Effective disaster risk management ensures that these gains are not compromised by disasters and that development efforts remain sustainable over the long term. Environmental degradation and climate change exacerbate the risk of disasters in the Cross-border Area. Managing disaster risk involves protecting natural resources, such as forests, pasture/browse and water sources, which are essential for the well-being of communities and ecosystems.

By understanding the drivers of vulnerability and exposure, tailored interventions can be developed to enhance the resilience of communities in the Cross-border Area. This includes building local capacities, strengthening social networks, and promoting adaptive strategies to cope with and recover from disasters. Proactive risk management can reduce the need for emergency response and humanitarian assistance in the aftermath of disasters. By investing in preparedness and prevention, the human and financial costs associated with disaster response can be minimized.

Disaster risk management is integral to communities and livelihoods support and sustainable development efforts in the Cross-border Area. By integrating risk reduction considerations into development planning and decision-making processes, development initiatives can be more resilient and less prone to disruption by disasters. The Sendai Framework for Disaster Risk Reduction, adopted by the United Nations, emphasizes the importance of understanding and managing disaster risk at all levels. By aligning with global commitments, efforts to address disaster risk in the Karamoja Cross-border Area can benefit from international support and cooperation.

1.3 Goal and Objectives of the Drought Disaster Risk Profile

The objective of the report / profile is to increase understanding of the various components of drought risk and provide policy recommendations for responding to the identified risks. Specific objectives include;

(i) Examine rainfall characteristics and occurrence of drought in the cross-border area

(ii) Examine social and bio-physical characteristics (hazard, exposure and vulnerability) related to drought risk in the cross-border area

(iii) Develop a drought risk profile for Karamoja cross-border area

2 DATA AND METHODOLOGY FOR DROUGHT DISASTER RISK ASSESSMENT

This section covers description of data sources and methodologies used for drought risk assessment as well as an explanation of techniques and statistical analyses.

2.1 Data

Data of historical drought events and their respective impacts are important in ensuring that the defined thresholds are adapted to localized conditions of the region of interest. In some cases, systematic data records in readily accessible databases are available. Such data sources include EM-DAT and DesInvetar. These are global databases of disaster impact developed to provide systematic, homogeneous, and compatible data on impacts of various disasters. These two databases were analyzed for historical drought impact data for the Karamoja Cross-border Area. The data records, however, like for most areas of Africa, were scarce and incomplete. The records from these global databases are presented in Table 1.

Table 1: Data and indicators used across hazard, exposure and vulnerability.

Risk Component	Indicator / Data	Data source	Time period	Resolution	Source / Citation
Hazard Component	Rainfall – SPI	CHIRPS	1991-2013	5km	Omay et al., 2023
	Rainfall – Long Term Mean	CHIRPS	1991-2013	5km	Omay et al., 2023
	Rainfall - variability	CHIRPS	1991-2013	5km	Omay et al., 2023
	Rainfall - Trend	CHIRPS	1991-2013	5km	Omay et al., 2023
	Temperature	CHIRTS	1991- 2023	5km	
	Evapo-transpiration	TERA Climate		1km	
	Aridity Index	Multiple	2000	1km	(Trabucco & Zomer, 2019)
Exposure Component	Soil Organic Carbon (Soil Quality)	ISRIC	1960-01-01	250m	(Hengl et al., 2017)
	Population density	WorldPop	2000-2020	1km	WorldPop, University of Southampton, Highfield
	Land-use/ land cover	ESA CCI	2021	10m	ESA WorldCover project, 2021
Vulnerability Component	Land Degradation	Multiple	2022	100m	GMES & Africa RCMRD Consortium
	Water bodies	Sentinel	2015-2023	10m	DEA
	Poverty levels	Relative wealth Index	2021	30m	Meta
	Market accessibility (Travel time to major cities/towns; 2021)	Multiple	2015	Approx 1km	(Weiss et al., 2018)
	Anthropogenic Biomes version 2 (2000)	Multiple	2000	Approx 90Km	(Ellis et al., 2010)

To complement the data from the global databases, through a co-development process, historical drought events-impact data based on local knowledge from community representatives was collected. The importance of integrating local perspective of events-impacts is to ensure inclusivity and adaptation of thresholds to local nuances of the Karamoja region. This was particularly important in Karamoja as the conventional WMO SPI thresholds for drought classification do not capture years considered drought years in Karamoja. It is important to adapt thresholds to local conditions, otherwise there is a risk of overestimating or underestimating disaster impacts (ICPAC, WFP, UNMA (2024)).

A drought disaster happens when a drought impacts on a population or community whose capacity is inadequate to withstand or cope with its adverse effects, resulting in damages, loss and disruption in community/society functioning. Both primary and secondary sources were used for this assessment. In Karamoja, interviews were conducted with community focus groups (FGs). The first meeting was held in June 2024 in Moroto, Uganda, and the second in Kitale in October 2024, field work activities were conducted in May 2024.

2.2 Methodology

The cross-border drought risk under this assessment was undertaken along three major considerations. The drought hazard index, the drought exposure index and the drought vulnerability index.

The assessment has been informed by an extensive analysis of climate data considering long-term rainfall mean, trend, coefficient of variability, aridity index and Standardized Precipitation Index (SPI). Standardized Precipitation Index (SPI) is the most used indicator worldwide for detecting and characterizing meteorological droughts. The SPI indicator measures precipitation anomalies at a given location, based on a comparison of observed total precipitation amounts for an accumulation period of interest (e.g. 1, 3, 12, 48 months), with the long-term historic rainfall record for that period. The historical record is fitted to a probability distribution, which is then transformed into a normal distribution such that the mean SPI value for that location and period is zero. For any given region, increasingly severe rainfall deficits (i.e., meteorological droughts) are indicated as SPI decreases below -1.0, while increasingly severe excess rainfall are indicated as SPI increases above 1.0. Because SPI values are in units of standard deviation from the long-term mean, the indicator can be used to compare precipitation anomalies for any geographic location and for any number of timescales.

The Aridity Index is the average water available in the soil, defined as the ratio between mean annual precipitation (P) and mean annual evapo-transpiration (ETP). Potential Evapo-transpiration (PET) is a measure of the ability of the atmosphere to remove water through Evapo-transpiration (ET) processes.

Thus, it is expressed as rainfall divided by vegetation water demand (aggregated on annual basis). Under this formulation, Aridity Index values increase for more humid conditions, and decrease with more arid conditions. It is a critical environmental factor affecting the evolution of natural vegetation and therefore rain erosivity by considering rainfall and air temperature.

Considering the importance of land cover as an input in climate modelling, land cover data was retrieved from the European Space Agency Climate Change Initiative Land Cover. The 2021 ESA CCI Landcover classes include Agriculture, Forest, Grassland, Wetland, Settlement and Other lands.

Drought disaster risk mapping and management requires an understanding of hazard, exposure and vulnerability (Vogt et al., 2018). Therefore, this section aims at assessing, analyzing and understanding drought disaster risk in Karamoja cross-border areas of Kenya, Uganda, Ethiopia and South Sudan. This assessment adopted the definition of drought risk as defined by Cardona et al, 2012; UNISDR, 2015 and has been used in Ahmadalipour, 2019; Carrao et al., 2016 and Vogt et al., 2018 as shown in Equation 1.

Drought Risk = f(Exposure*Hazard/Vulnerability)

Eq. 1

A number of indicators for drought hazard (extent, frequency, intensity, severity); exposure; vulnerability and adaptive capacity have been assessed individually and were combined using GIS tools to infer drought risk. The analysis focuses on observed (1991-2023) risk in the cross-border area.

The hazard component has undertaken analysis on the rainfall conditions using standardized precipitation index (SPI), rainfall totals and aridity index. Data has been analyzed for the period 1991-2023 and case study years that were characterized by drought including 2022. Primarily blended data based on both observation and satellite data rainfall data from Climate Hazards Center InfraRed Precipitation with Station data (CHIRPS) data set (Omay et al., 2023) prepared at ICPAC has been used.

Measures of exposure can include the number of people or types of assets in an area. The exposure component analyzed data on land-use land cover, population density, water bodies, and vegetation / rangeland characteristics.

To assess vulnerability indicators, a field survey was conducted covering local actors and community's representative in Kenya and Uganda regions of the Cross-border Area. This focused on key aspects covering availability of early warning systems, access to early warning information, livelihoods and other factors that define vulnerability and adaptive capacity of households and communities. In addition, other indicators presented in Table 1 have been used for studying the spatial extent and spread of the vulnerability / adaptive capacity factors. The vulnerability levels are adopted from previous studies (UNDP, 2021) as shown in Table 2.

Table 2: Categories of vulnerability

Range	Vulnerability Level
≤ 0.20	Very low
0.20 - 0.40	Low
0.40 - 0.60	Moderate
0.60 - 0.80	High
≥0.80	Very high

Source: *UNDP (2021)*

To assess drought disaster risk, the three components (Table 1) have used following a detailed analysis of;

- Meteorological data to identify rainfall and drought patterns, frequency and trends.
- Agricultural impact assessments, focusing on crop yield reductions and soil moisture deficits.
- Hydrological assessments (e.g., river flow, groundwater levels, reservoir capacities).
- Socioeconomic impacts, including effects on water supply, health, and local economies

The relevant layers have been combined using GIS tools to indicate different levels of risks across the cross-border area.

3 RESULTS ON HAZARD COMPONENT OF DROUGHT DISASTER RISK

Source: Adobe Stock

3.1 Annual Climate and Aridity Characteristics of Karamoja Cross-border Area

Much of the Karamoja Cross-border Area is characterized by harsh arid and semi-arid conditions receiving annual rainfall of 500 mm or less (Table 2 and Figure 2). Rainfall is seasonal and highly erratic in timing, intensity, and distribution (Egeru et al., 2014; Omay et al., 2022; Omay et al., 2023). Consequently, periods of acute seasonal hardships result from annual and longer-term drought cycles within the Karamoja Cross-border Area.

The livestock keeping communities living in the Cross-border Area are careful managers that have evolved a range of strategies to enable them to adapt to, rather than change or damage, the environment in which they live. They have made deliberate efforts to develop sophisticated mechanisms to cope with the elevated level of risks inherent to this marginal environment.

These strategies include seasonal mobility, split herd management, keeping several livestock species and supplementing feeds supplies and income with small scale rain-fed sorghum cultivation, fishing, trading, and fruit gathering. Consequently, systems of natural resource management and social organization have evolved among the Karamoja Cross-border Area communities and are based on common land tenure, to use efficiently the resources available for livestock herding. For instance, in the traditional set up, it was possible to mitigate natural and human-caused threats to pastoral livelihoods with a considerable degree of success (Darlington Akabwai, 2019; Nakalembe, 2018).

Table 3: Summary of climate parameters including Rainfall (mm) and air temperature (°C).

1991-2020	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall	15.8	20.0	66.8	107.2	97.5	68.9	80.1	80.2	54.9	73.6	60.8	32.3	758.2
Maximum Temperature	32.5	33.8	33.3	31.8	31.0	30.0	29.3	29.7	30.9	31.2	31.0	31.6	31.4
Minimum Temperature	18.5	19.4	20.4	20.7	20.7	20.0	19.7	19.8	20.1	20.4	19.4	18.4	19.8

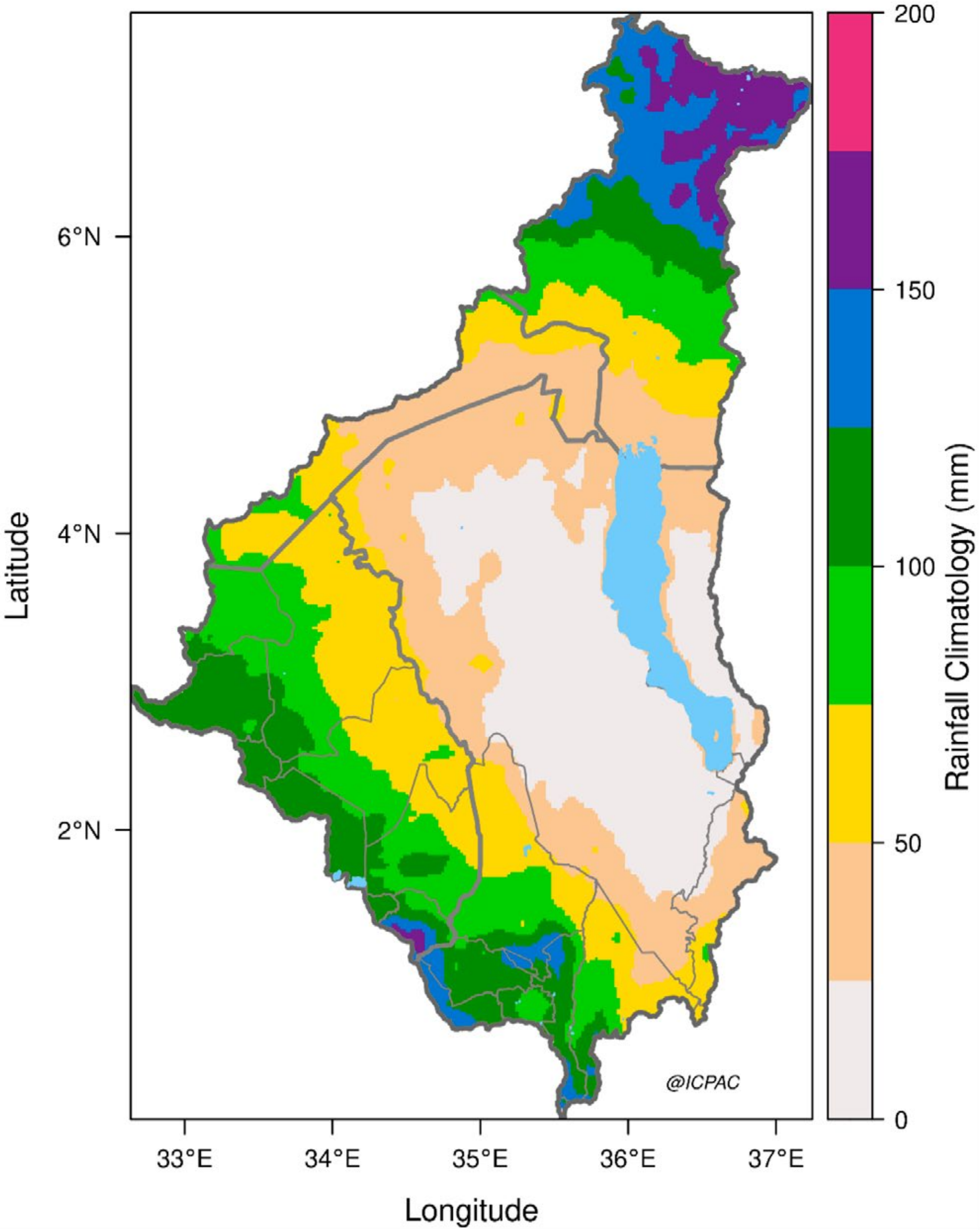


Figure 2: The long-term mean (LTM) annual rainfall distribution for the Karamoja Cross-border Area for the period 1991 – 2020.

Annual precipitation (rainfall) trend has been depicted under Figure 3 while the coefficient of variability is depicted in Figure 4. The results (Figure 3) predominantly show increasing rainfall trends, especially in central and northeastern regions, indicated by green shades, though these trends are statistically significant (p-value < 0.05) only in limited areas.

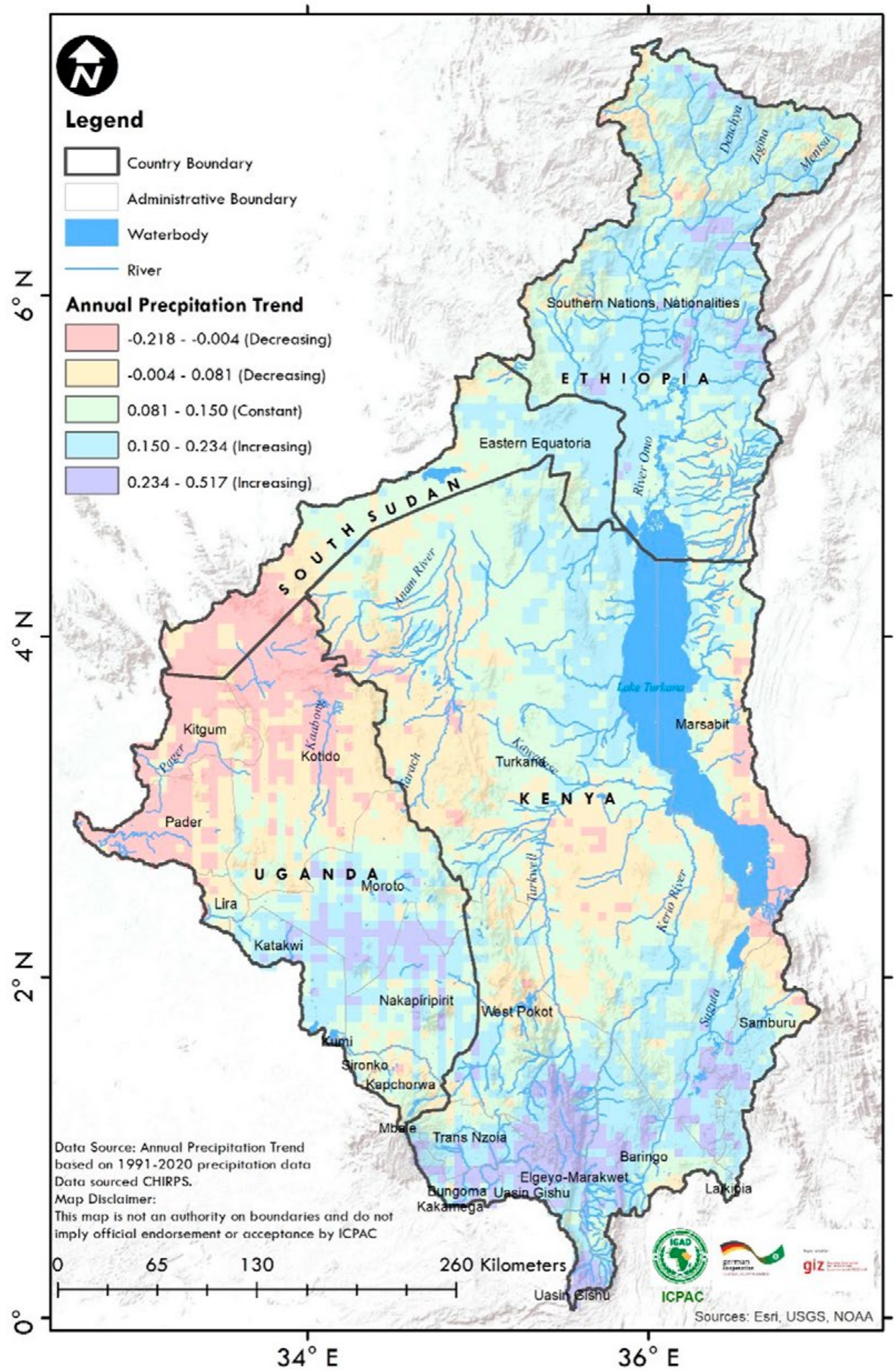


Figure 3: The long-term annual rainfall trend for the Karamoja Cross-border Area for the period 1991 – 2020

Further, results present mixed signals in seasonal rainfall trends with both increasing and decreasing rainfall in different areas, particularly central regions of the Cross-border Area, but with limited statistically significant changes. These observations highlight the importance for understanding long-term rainfall changes and informing resource management in the Cross-border Area. The Western part of the Karamoja cross-border area experiences low rainfall variability compared to the central, northeastern and eastern parts of the cross-border area that experience high rainfall variability (Figure 4).

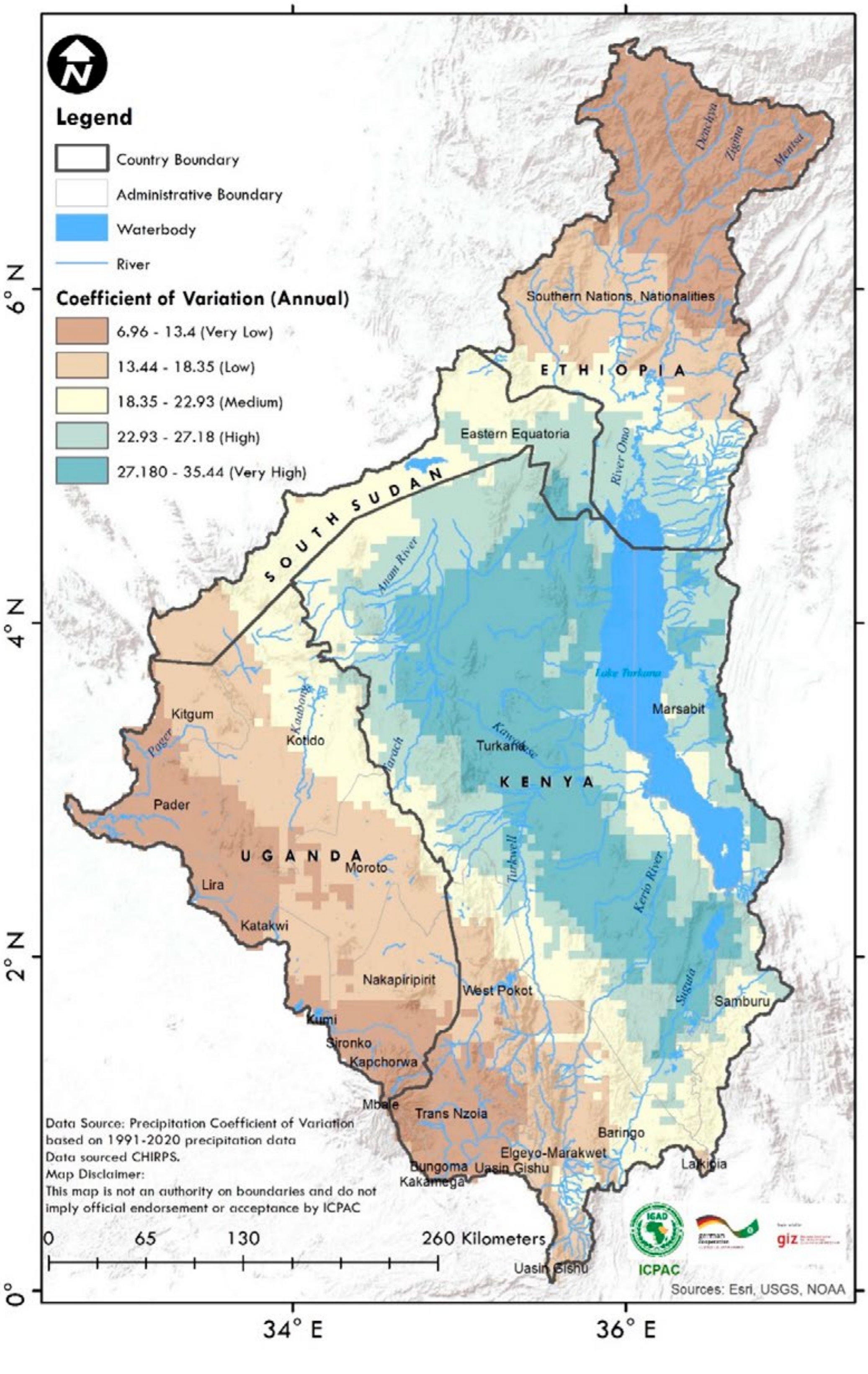


Figure 4: Annual coefficient of variation (CV) of rainfall for the Karamoja Cross-border Area from 1991 to 2020

The aridity index (Figure 5) classifies the Karamoja Cross-border Area into four different aridity zones. The northeastern most parts are marked in gray, indicating humid conditions, while light yellow areas represent regions with dry sub-humid conditions, mainly in the northeastern and Southern parts. The central region, dominated by orange, indicates arid conditions, and the light brown areas in the central to southern regions denote semi-arid conditions. Comparing the two maps (Figure 2 and Figure 5), the northeastern region, which has the highest rainfall, corresponds with humid and dry sub-humid zones, suggesting a strong correlation between high rainfall and lower aridity.

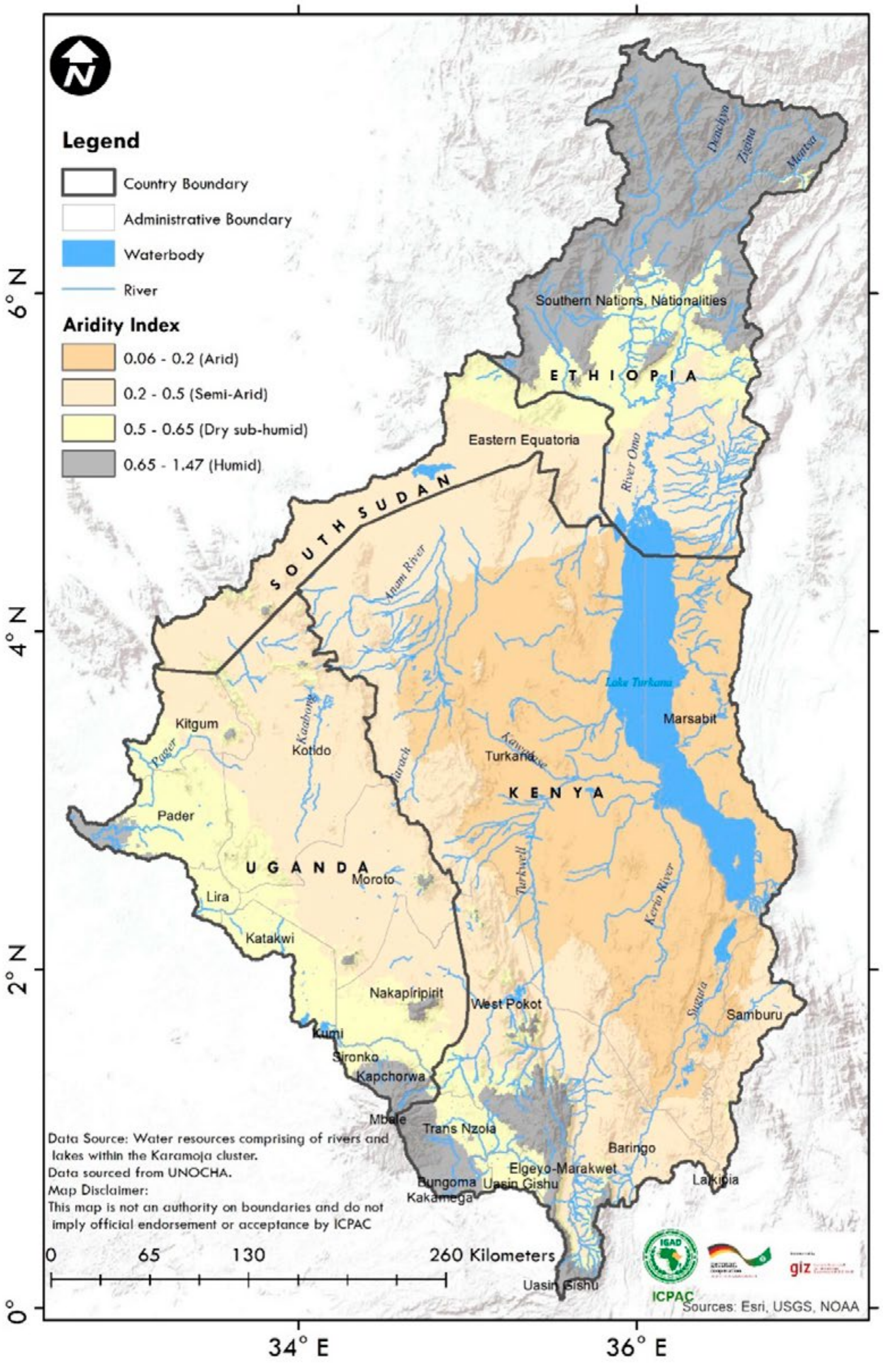


Figure 5: The aridity index of the Karamoja Cross-border Area, classifying the region into different aridity zones

In contrast, the central and southern regions with lower rainfall levels are classified as semi-arid and arid, highlighting the relationship between low rainfall and higher aridity. This distribution impacts agricultural and rangeland practices, water resource management, and the overall livelihood of communities within the Karamoja Cross-border Area, with wetter regions being more suitable for agriculture and drier regions requiring specific interventions for water conservation and drought management practices.

3.2 Seasonal Rainfall Characteristics

3.2.1 Seasonal Rainfall Climatology of Karamoja Cross-border Area

The climatological distribution of rainfall for Karamoja Cross-border Area for the period 1991 - 2020 has been analyzed using boxplot. A boxplot effectively illustrates the variability and central tendency of monthly rainfall, highlighting both typical patterns and extreme events (Figure 6). In this figure, January and February are the months with relatively low rainfall with a mean value of 17.9 mm.

The spread is narrow with some outliers indicating occasional higher rainfall events (Figure 6). The rainfall starts increasing in March with a mean of 67.2 mm and a larger spread, indicating more variability.

The months of April to October show the highest rainfall amounts with a mean generally between 107.3 mm and 73.9 mm. The spread of data is also the highest during these months, suggesting significant variability and presence of many outliers indicating extreme rainfall events. Rainfall starts decreasing from November with a mean of 60.9 mm with significant outliers. December has a mean rainfall of 32.3 mm with a narrow spread similar to January and February but still contains some outliers.

The graph also shows a clear uni-modal seasonal rainfall pattern (March - November) with peak rainfall occurring in April and May. The drier months are December, January, and February, showing much lower rainfall amounts and lesser variability. The presence of outliers in almost every month, especially from April to November, indicates that there are occasional extreme rainfall events which deviate significantly from the average values, but their frequency is low as observed in Figure 5.

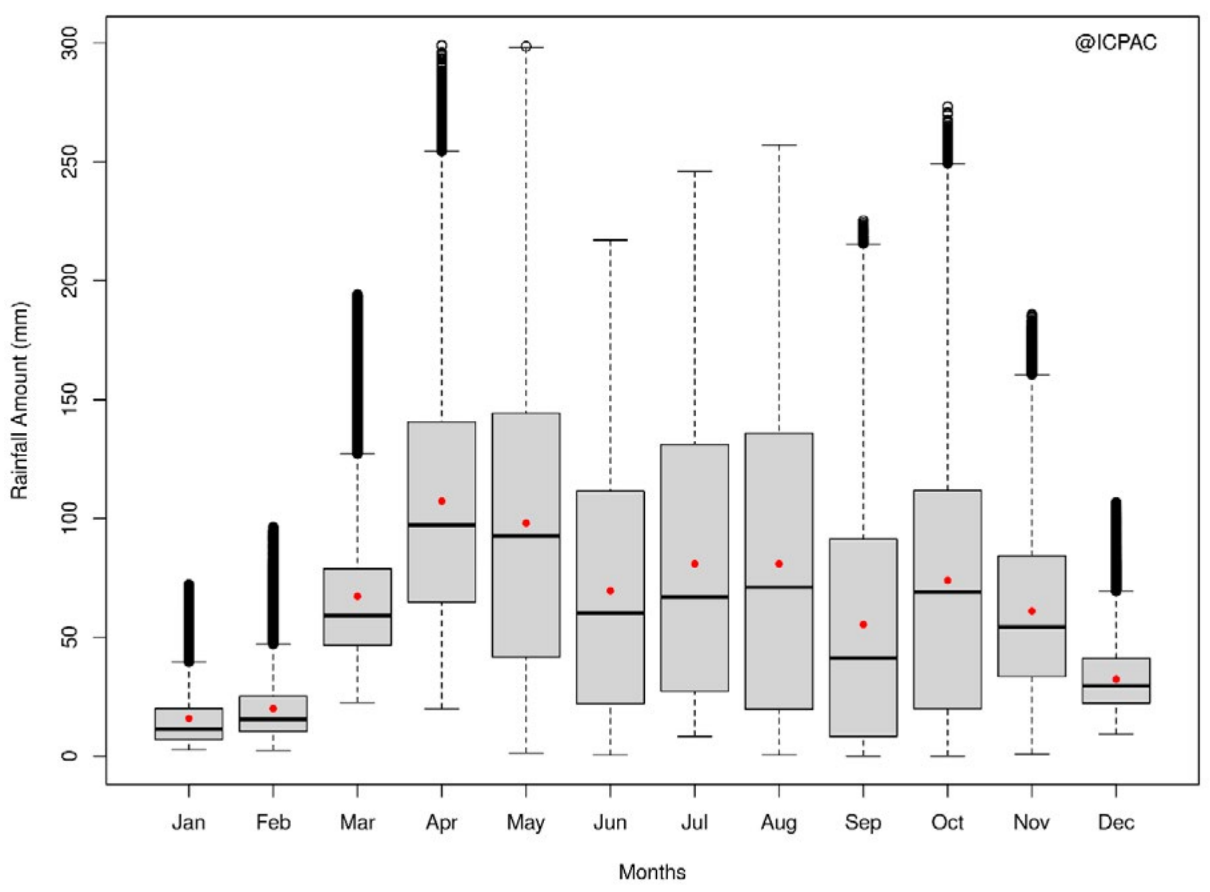


Figure 6: The variability and central tendency of monthly rainfall for the period 1991-2020, highlighting both typical patterns and extreme events [red dots are the mean values].

The monthly long-term mean (1991-2020) rainfall maps for the Karamoja Cross-border Area (shown in Figure 33A under Annex) illustrate distinct seasonal patterns. From December to February, the region experiences minimal rainfall, mostly below 50 mm, indicating a dry season.

Rainfall begins to increase in March, with significant amounts from April to June, peaking with over 100 mm in many areas, especially in the north and west. April and May represent the peak rainy season, with extensive regions receiving over 150 mm. Rainfall gradually decreases in September and October, transitioning to the dry season by November, where most areas receive less than 100 mm. This seasonal variation highlights the north's consistently higher rainfall.

3.2.1.1 Seasonal Mean Rainfall Patterns

The seasonal mean rainfall for the Karamoja Cross-border Area from 1991 to 2020 (Figure 7) illustrates distinct spatial and temporal rainfall patterns across all the seasons i.e. MAM, JJAS, and OND. During MAM season, the northeastern and western regions receive the highest rainfall, exceeding 150 mm, with a gradual decrease towards the central and eastern areas, which receive less than 50 mm (Figure 7).

In the JJAS season, rainfall intensifies, particularly in the northeastern part, where it surpasses 175 mm, while the central and southern areas see increased rainfall ranging from 0 to 175 mm. The OND period shows reduced rainfall compared to JJAS, with the northeastern regions receiving around 75 to 150 mm, and the central and southern parts experiencing 0 to 100 mm. These maps highlight the peak rainy season in MAM and the transitional rainfall periods in JJAS and OND, crucial for pastoralism and water resource management in the region.

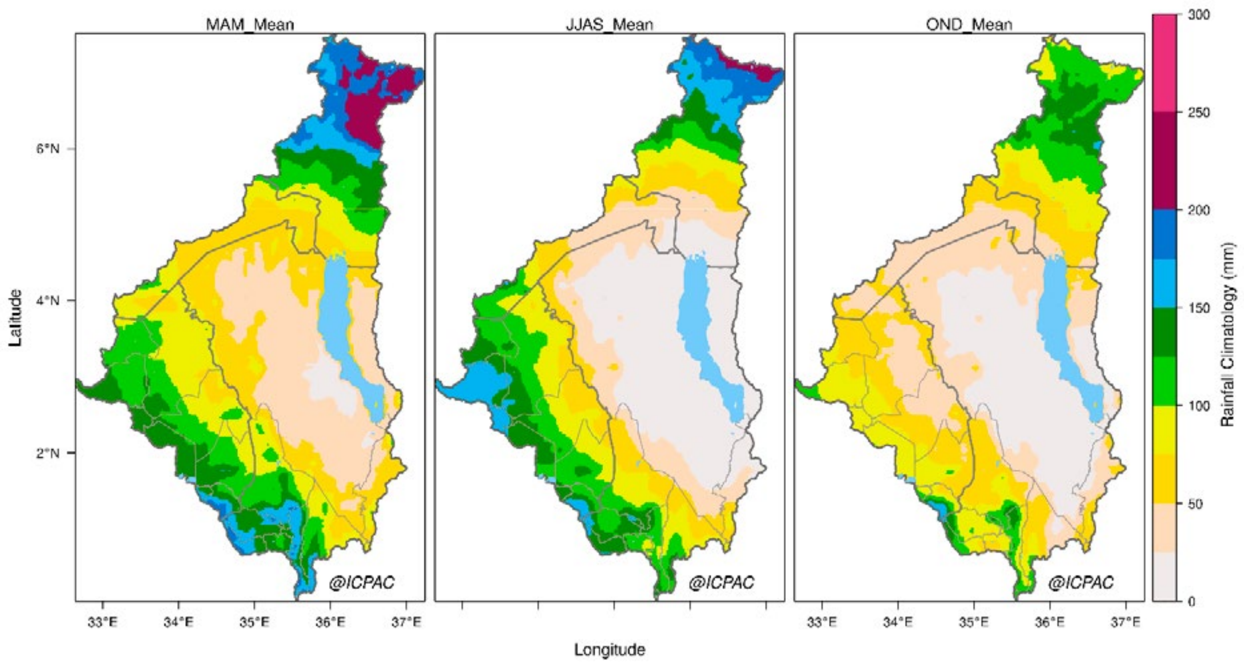


Figure 7: Seasonal mean rainfall maps for the Karamoja Cross-border Area from 1991 to 2020.

3.2.1.2 Seasonal Rainfall Variability

The seasonal coefficient of variation (CV) for the Karamoja Cross-border Area (Figure 8) from 1991 to 2020 reveals significant insights into rainfall variability across three key seasons: March-May (MAM), June-September (JJAS), and October-December (OND). The CV maps show that rainfall variability is moderate during MAM (30-60%) and JJAS (30-60%), with central regions experiencing higher variability.

The OND season exhibits the highest relative variability, particularly in central and northeastern areas, with CV exceeding 60%. The SD maps indicate moderate absolute variability during MAM, with higher values (10-40%) in northeastern and central parts. JJA shows more stable rainfall patterns with SD values mostly between 10-30%, while OND displays higher absolute variability in the northeastern regions. These findings highlight the peak and transitional rainfall periods, essential for effective agricultural planning and water resource management in the Karamoja Cross-border Area.

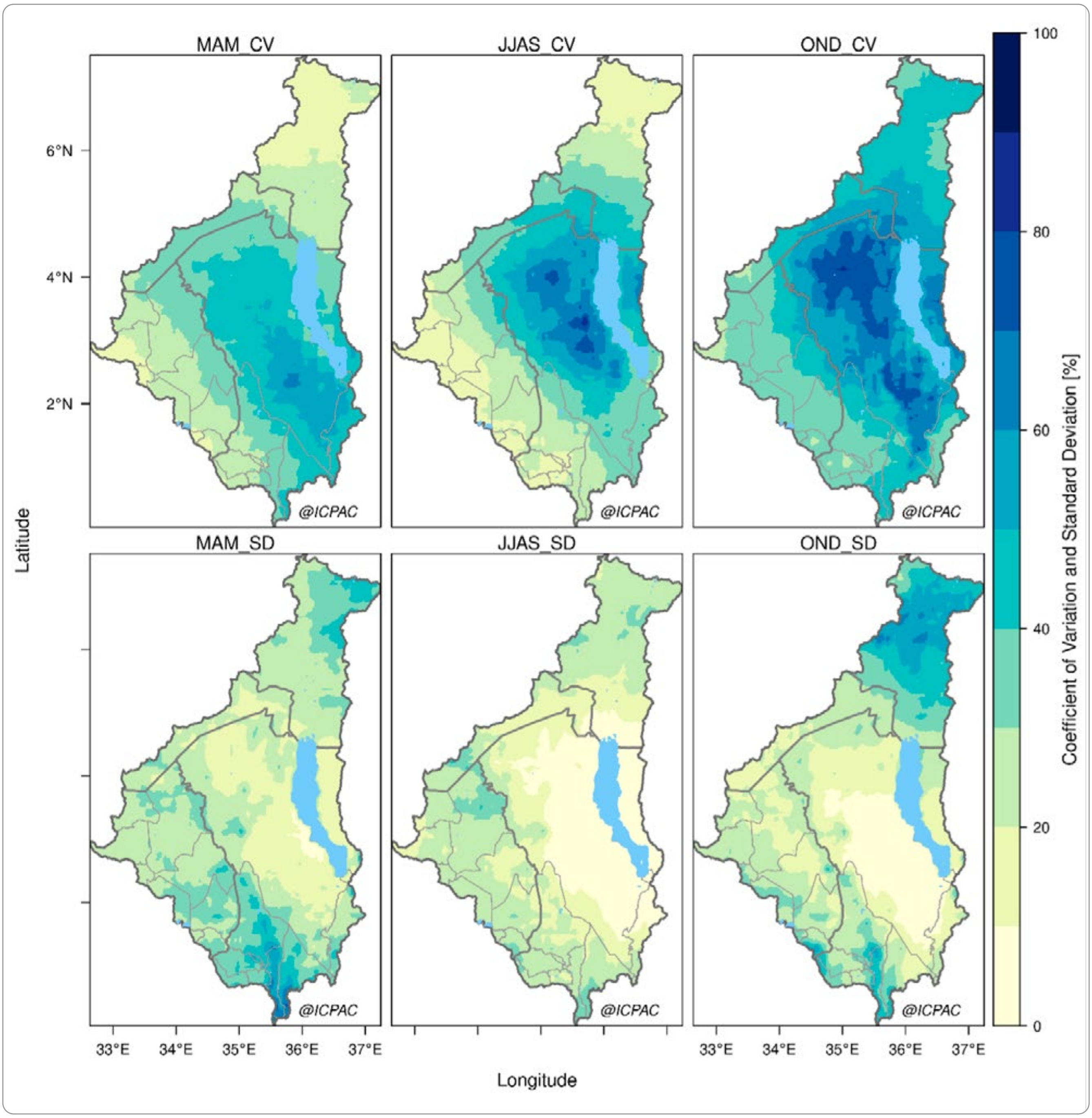


Figure 8: Seasonal coefficient of variation (CV) of rainfall for the Karamoja Cross-border Area from 1991 to 2020, covering the periods March-May (MAM), June-August (JJA), and October-December (OND)

3.3. Observed Drought Characteristics

3.3.1 Historical Drought Frequency, Severity

Figure 9 – 10 show long-term patterns in rainfall anomalies associated with drought severity based on the standardized precipitation index (SPI) averaged over Karamoja cross-border area. Figure 9 shows 1-Month SPI (Nakalembe, 2018) patterns indicating that drought events have become more frequent in the recent past. On the other hand, Figure 10 presents 3-Month SPI (Nakalembe, 2018) indicating prolonged rainfall deficit in recent years. This pattern of SPI is concerning, and close attention needs to be paid to the trends to ensure impacts do nt cause grave damage to livelihoods and activities.

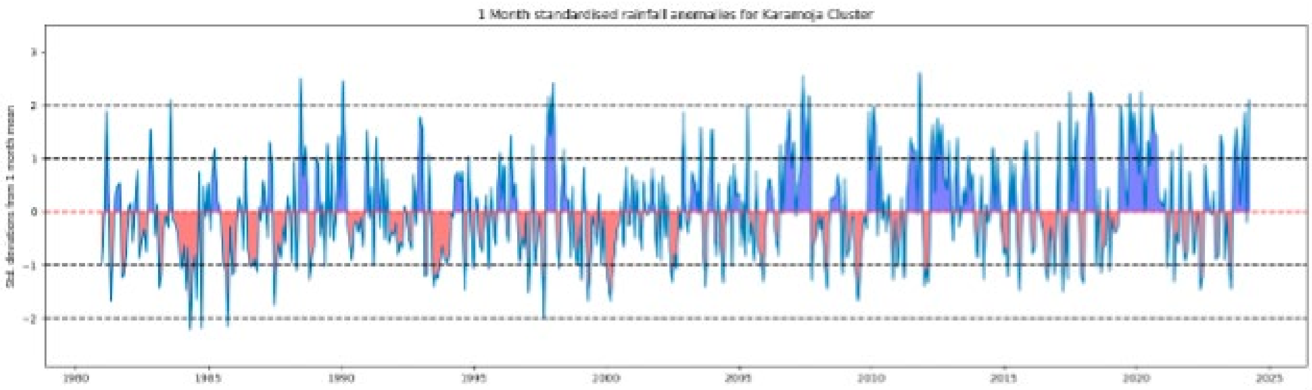


Figure 9: Timeseries of 1 – Month Standardized Precipitation Index (SPI) in Karamoja Cross-border Area

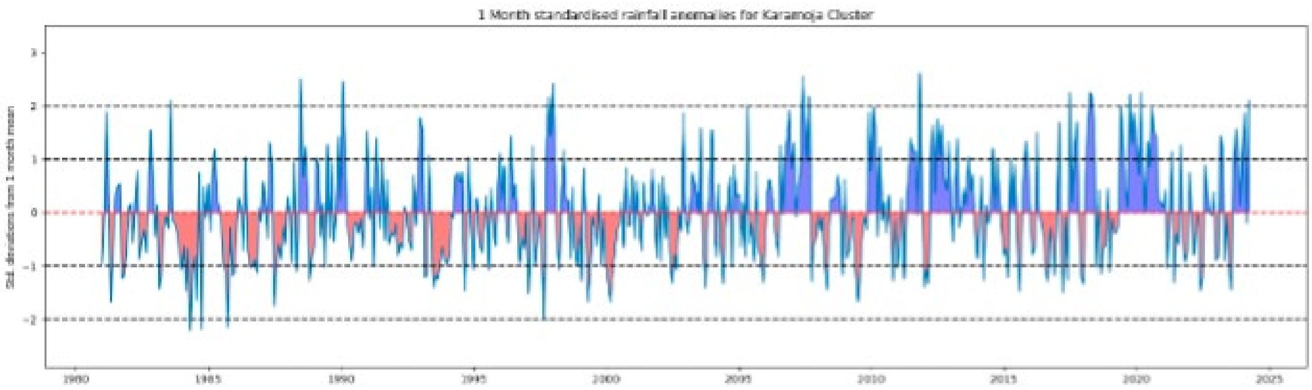


Figure 10: Timeseries of 3 – Month Standardized Precipitation Index (SPI) in Karamoja Cross-border Area

3.3.2 Spatial Drought for Selected Events

The Standardized Precipitation Index (SPI)1 is a measure used to quantify precipitation deficit over a specific period, with negative values indicating dry conditions and positive values indicating wet conditions.

The SPI maps for the Karamoja Cross-border Area during the selected major droughts events i.e. 1984, 2000 (Figure 12), and 2022 (Figure 11), provide a comprehensive view of the severity and spatial distribution of drought conditions across these three distinct years.

The 1984 SPI (Figure 39A) shows persistent and severe drought conditions throughout the year. From January to April, the region experienced significant negative SPI values (ranging from -2 to -4), indicating severe dry conditions, especially in the central and northeastern areas. This trend continued with little respite through May to August, with SPI values remaining low, and into the final quarter of the year, showing slight improvements but still largely negative SPI values.

The year 2000 also witnessed severe drought conditions, as evidenced by the SPI maps in Figure 12. From January to July, much of the region showed negative SPI values, indicating moderate to severe dry conditions. This trend intensified from April to June, with more areas reflecting severe drought (SPI values between -2 and -4).

By the end of the year, from September to December, some regions showed slight improvement, with SPI values closer to zero, but overall, the region didn't recover fully. In 2022, the SPI maps similarly reflect widespread dry conditions across the Karamoja Cross-border Area (Figure 11). From January to August, the central, northeastern, and western areas experienced moderate drought, with negative SPI values indicating dry conditions. The severity increased from May to August, where the SPI values in several areas dropped to between -2 and -4, particularly in the western regions. However, the last quarter of the year, from September to December, showed some improvement, with several areas exhibiting near-neutral SPI values, suggesting a slight easing of drought conditions.

Across the three years, 1984 (Figure 39A), 2000 (Figure 12), and 2022 (Figure 11), the SPI maps consistently show the Karamoja Cross-border Area experiencing severe drought conditions, particularly in the central and northeastern regions. Each year follows a pattern of severe dry conditions in the early months, intensifying in the middle of the year, with some signs of improvement towards the end of the year.

These recurring drought conditions highlight the region's vulnerability to prolonged dry periods, underscoring the need for effective drought monitoring, water management, Rangeland management and adaptive agricultural practices to mitigate the impacts of such climatic events.

Over the years (1991-2020), there has been more severe droughts in the eastern and southern part of the Cross-border Area. Moderately, severe droughts are experienced in the North-West part. Less severe droughts occurred in the Northeastern part of the Cross-border Area. Figure 13 shows the most recent drought event for December 2022 while Figure 14 indicates drought frequency across the different parts of the Karamoja cross-border area over the long-term period.

Combining the different drought indicators including annual mean rainfall, trend, coefficient of variation and drought frequency yielded the drought hazard spatial patterns shown in Figure 16. Results show very high to high drought hazard index in areas of central, and eastern parts of the cross-border area (areas of low to lowest rainfall) while medium, low and very low index is depicted in western, northeastern and Southern parts of the cross-border area (Figure 15).


Source: Adobe Stock

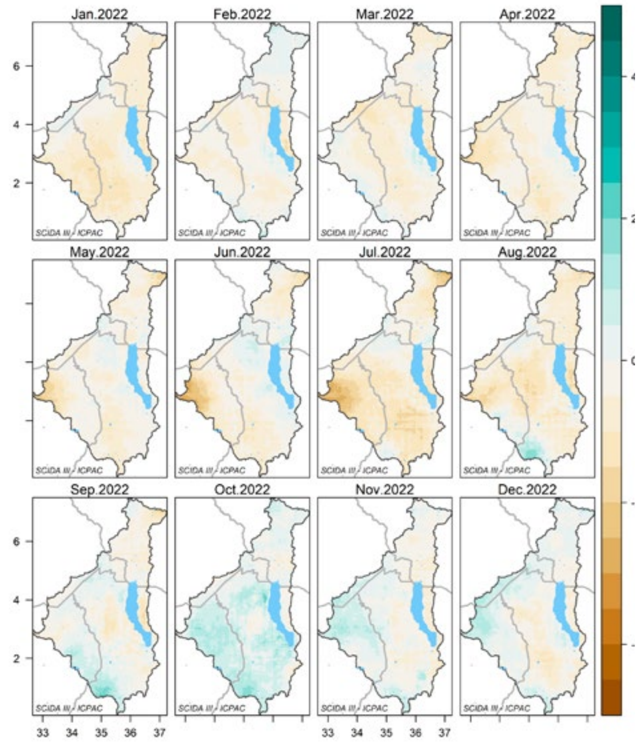


Figure 11: The Standardized Precipitation Index (SPI) maps for the Karamoja Cross-border Area during the drought of 2022.

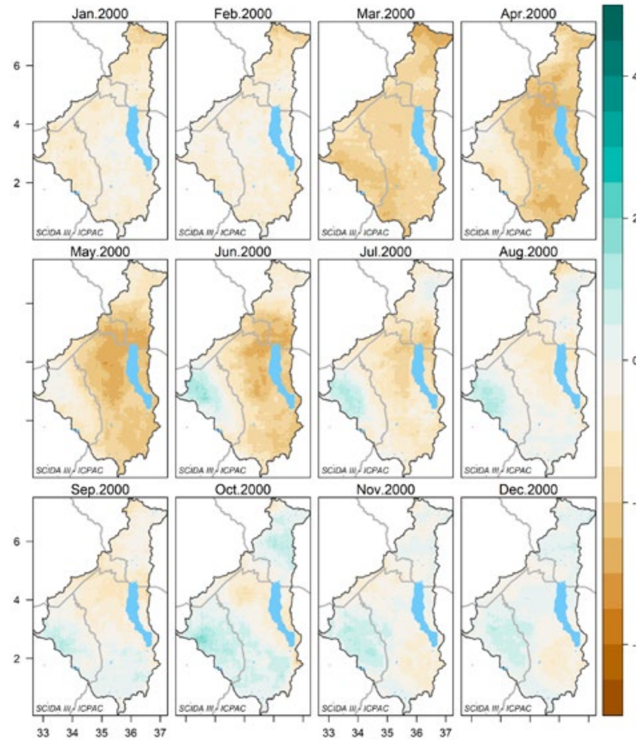


Figure 12: The Standardized Precipitation Index (SPI) maps for the Karamoja Cross-border Area during the drought of 2000

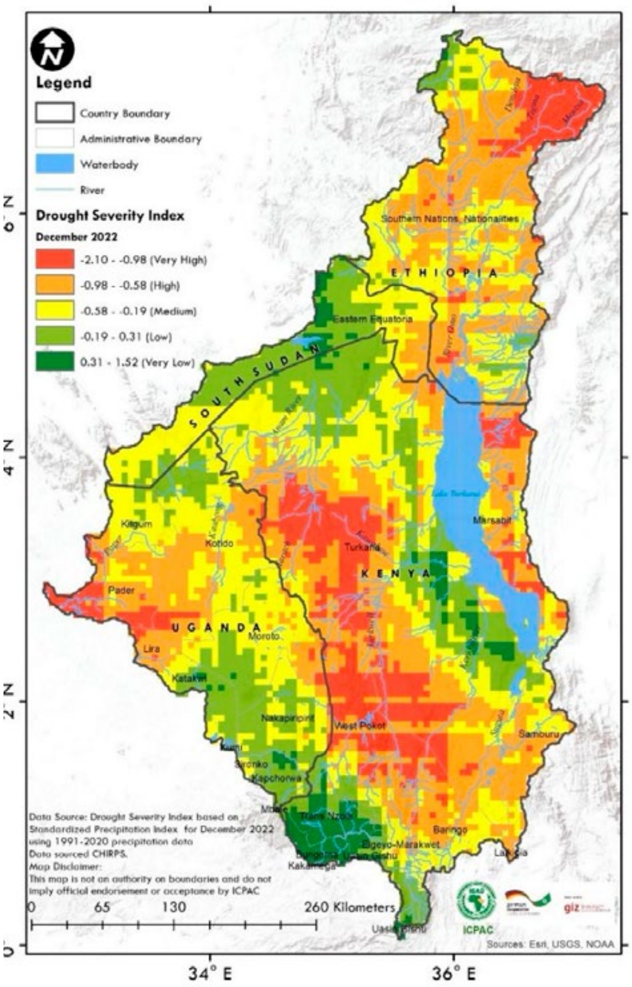


Figure 13: Drought Severity Index during December 2022

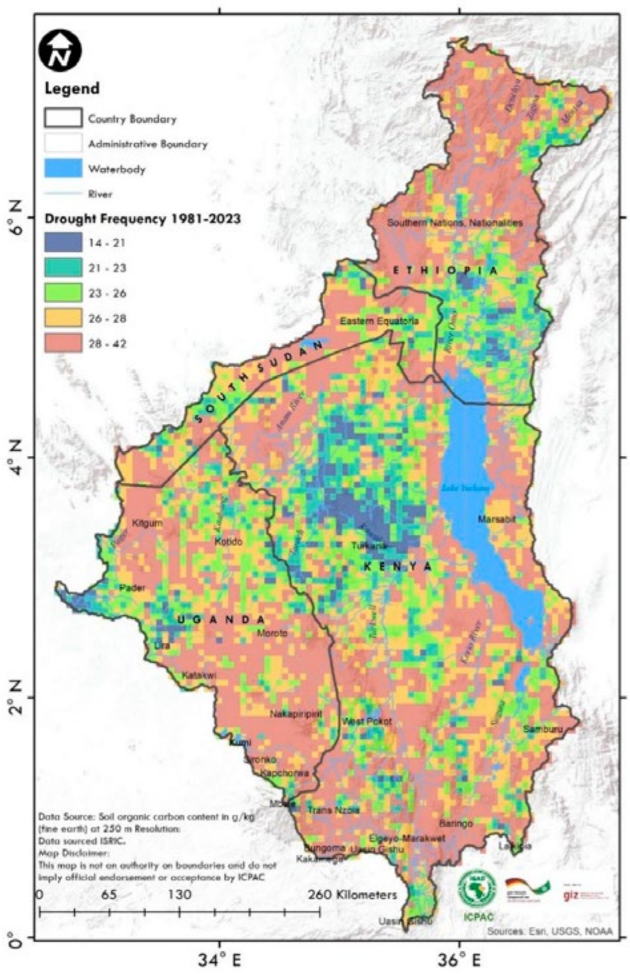


Figure 14: Long-term Drought Frequency Index (1981-2023)

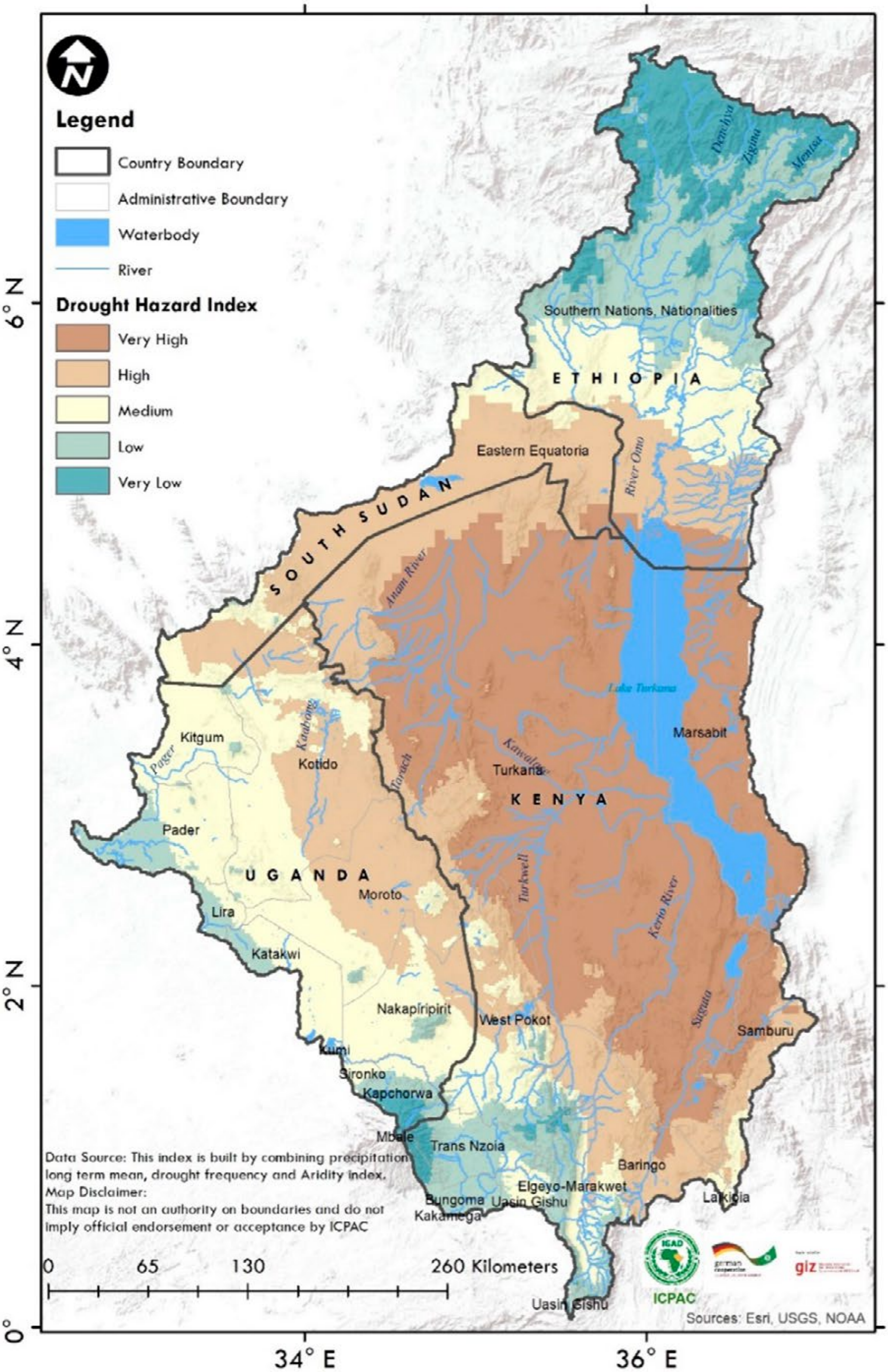


Figure 15: Drought Hazard Indicator across the Karamoja Cross-border Area.

4 RESULTS ON EXPOSURE COMPONENT OF DROUGHT DISASTER RISK

Source: Shutterstock

Under this section, a number of exposure layers were developed to provide the sensitivity of the cross-border area to drought conditions. The exposure layers include; land-use / land-cover changes, degradation, and livelihood characteristics.

4.1 Impact of Drought in Karamoja Cross-border Area

Drought has profound effects on the livelihoods of people in the Karamoja Cross-border Area. Drought in the Karamoja Cross-border Area severely disrupts the socio-economic dynamics of the region. Pastoralism, the primary economic activity, relies heavily on water and pasture availability. Prolonged droughts lead to loss of livestock, with mortality rates surging during drought periods (Ouma et al., 2022).

When there is reduced rainfall and erratic, crops fail, resulting in food shortages and loss of income for farmers. Pastoral communities also suffer, as water and forage resources become scarce, forcing them to migrate in search of suitable grazing lands for their livestock. For instance, during the 2010-2011 drought, livestock mortality in some areas of Karamoja was as high as 20%.

The loss of livestock translates into significant economic loss, as livestock are the main source of income (FAO, 2016). Unfortunately, this movement often leads to conflicts over limited resources, further worsening an already fragile socio-economic situation.

Drought-induced food insecurity is a recurring challenge in the region. Insufficient rainfall leads to decreased agricultural productivity, disrupting food production cycles and exacerbating existing food shortages. Limited access to food worsens malnutrition rates, especially among vulnerable groups such as children and the elderly.

Therefore, addressing the root causes of food insecurity, including building drought resilience, promoting sustainable rangeland management and agricultural practices, is crucial for ensuring the well-being of the population (Aklilu, Y., Okori, E. and Arasio, R. L. 2021).

Access to clean and reliable water sources is already limited. Reduced rainfall diminishes surface water availability, making it difficult for communities to meet their drinking, sanitation, and hygiene needs. Water scarcity increases the risk of waterborne diseases and sanitation-related illnesses, further compromising public health outcomes.

Additionally, deforestation, mining, degradation of water catchment, land use land cover changes and over-grazing have exacerbated the likelihood of and impact from floods and droughts. These conditions contribute to water scarcity and pollution, which limit water for drinking, livestock, agriculture, and other uses.

Moreover, drought contributes to environmental degradation in the Cross-border Area, exacerbating soil erosion, desertification, and loss of biodiversity. Reduced vegetation cover and land degradation diminish ecosystem services, including soil fertility and water retention capacity.

Furthermore, drought-induced resource scarcity often escalates inter-communal conflicts and triggers forced migration in the Karamoja Cross-border Area. Competition over dwindling water and pasture resources can increase tensions between pastoral communities, leading to conflicts over grazing lands and water points. Additionally, prolonged droughts force people to migrate in search of alternative livelihood opportunities, putting pressure on host communities and straining existing social networks.

Another Report by FEWS Net indicates that droughts directly impact food security and nutrition in the Karamoja Cross-border Area. Recurrent droughts lead to crop failure, reducing the availability of food. The 2017 drought saw a 70% reduction in maize and sorghum production in the region (FEWS Net, 2017; Nakalembe, 2018). Food scarcity and lack of dietary diversity led to malnutrition. According to UNICEF, in 2020, nearly 30% of children under five in Karamoja were acutely malnourished during a severe drought period (UNICEF, 2020).

Drought exacerbates environmental degradation, impacting the region's resilience to future climate events. Prolonged droughts depleted water sources such as wells and underground aquifers, leading to water scarcity (Ouma et al., 2022). Overgrazing and lack of vegetation cover during droughts lead to soil erosion and land degradation, reducing the land's productivity and increasing desertification risks. Health outcomes are significantly affected by drought conditions. Reduced water availability forces communities to use contaminated water sources, increasing the incidence of water-borne diseases such as cholera and diarrhea (WHO, 2021).

The stress and uncertainty caused by prolonged droughts contribute to mental health issues, including anxiety and depression, among the affected populations. Various strategies have been employed to mitigate the impact of drought in the Karamoja Cross-border Area.

Programs encouraging the diversification of income sources, such as crop farming, agro-pastoralism, and small-scale trade, help reduce reliance on pastoralism alone. Efforts to improve water harvesting, storage, and management are critical. For example, the construction of dams and water pans has been initiated to ensure water availability during dry periods (Gelsdorf et al., 2003).

Human-induced factors, such as poverty, limited infrastructure, and political instability, further compound the effects of drought by reducing community resilience and adaptive capacity.

Environmental degradation due to deforestation, overgrazing, and unsustainable land use has compromised the region's ability to retain water, worsening the impact of dry spells. The impact of these recurring droughts is profound and multidimensional, affecting water availability, food security, livestock productivity, and public health (USAID, 2018; 2017). Water scarcity not only disrupts daily life but also fuels migration and competition over dwindling resources, leading to inter-communal conflict.

Agricultural yields decline during drought, causing sharp rises in food insecurity and severely affecting income sources. Livestock losses during drought periods are substantial, undermining the primary livelihood for pastoralist communities and causing long-term economic strain.

The dynamics of the severe droughts in the region illustrate the harsh reality of climate stress in the Karamoja Cross-border Area. Each drought brought widespread disruption, from the severe food insecurity and displacement of 1984 to the livestock losses of 2000 and the prolonged dry spells and intense heat of 2022, a manifestation of accelerating climate change. These events have left lasting impacts on livelihoods, resilience, and adaptive capacity. This drought risk profile for the Karamoja Cross-border Area highlights to increase understanding of the various components of drought risk and provides policy recommendations for responding to the identified risks.

The Emergency Events Database and United Nations DesInvetar database (EM-DAT) contains data for different disasters including meteorological disasters like drought and floods. EM-DAT contains data from 1900 to the current year (2022).

During the time of access, there were 10 entries for drought in Uganda in the database. All 10 records were for droughts in Karamoja region. Table 3 shows the drought years in Karamoja and respective impacts as recorded in the EM-DAT database.

Table 4: Historical and current drought conditions events and associated effects and losses [Source: Drought disaster impact data from EM-DAT a global disaster database]

Year	Total Deaths of People	Total No of People Affected	Start Month (Duration)	End Month
1967		25,000	1	
1979		500,000		
1987		600,000	12	
1998		126,000	1	
1999	115	700,000	8	
2002	79	655,000	6	
2005		600,000	3	3
2008		1,100,000	7	10
2010		669,000	3	
2022	2,465	518,000	7	7

Figure 16 shows 2021 land use and land cover across the Karamoja cross-border area. Land use and land cover is heavily influenced by its pastoralist culture, semi-arid climate, and environmental constraints. A significant portion of Karamoja is characterized by rangelands and grasslands. The vegetation is predominantly savanna grassland with scattered trees and shrubs, adapted to the semi-arid climate. These areas are essential for pastoralism, which is the primary livelihood in the region. The nomadic and semi-nomadic pastoralists make them rely on these lands for grazing livestock such as cattle, goats, camel and sheep. The Karamoja Cross-border Area features scattered woodlands, especially in areas less utilized for agriculture or grazing. Acacia trees are common in these areas. These woodlands are used for firewood collection, charcoal production, and construction materials. Bushlands, consisting of dense shrubs and small trees, often occur in areas where there is limited human activity.

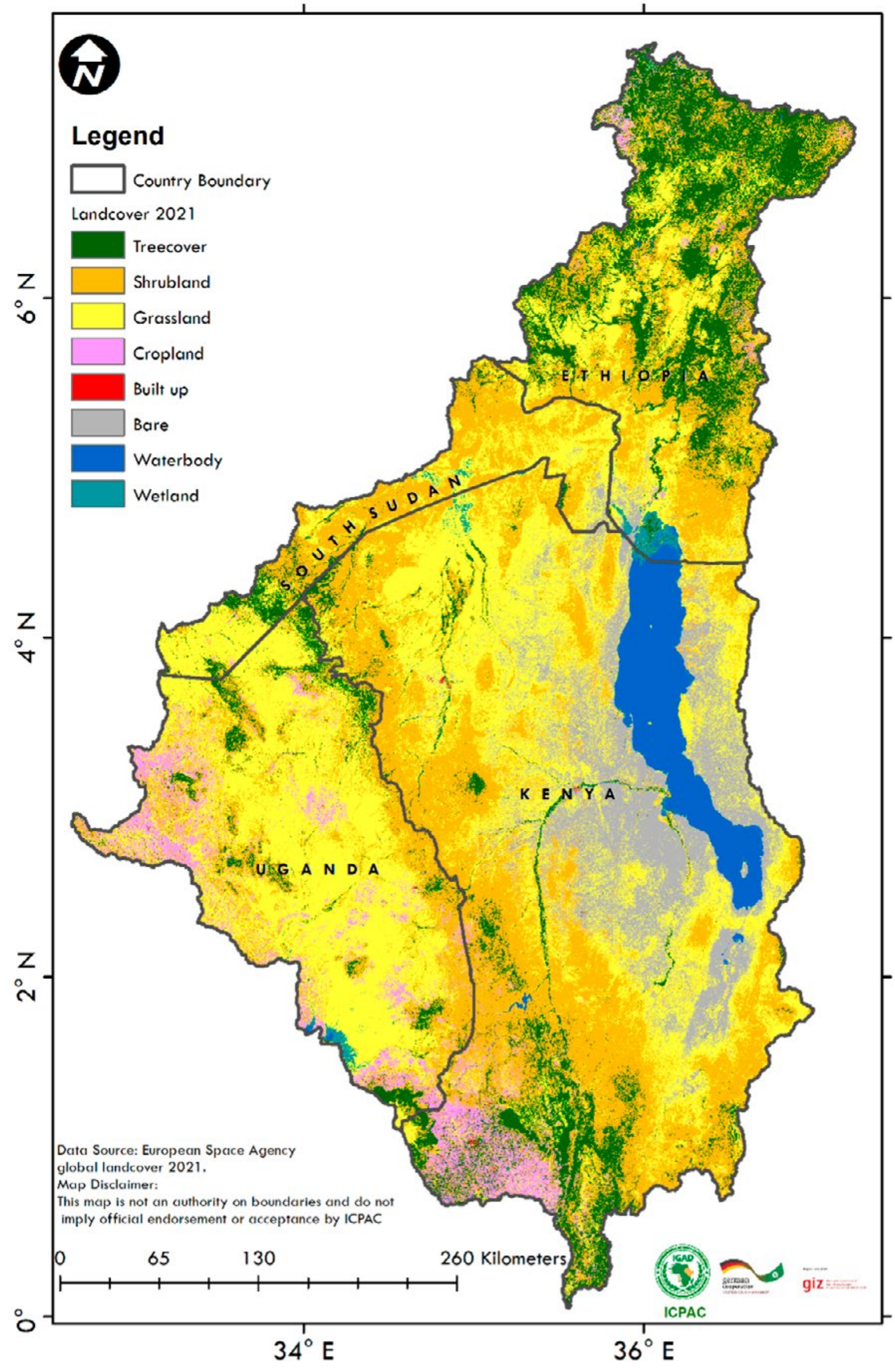


Figure 16: Land use land cover across the Karamoja Cross-border Area

Due to erratic rainfall, agriculture is limited to areas with sufficient rainfall. Small-scale subsistence agriculture is practiced, although limited by the arid conditions. Crops such as sorghum, millet, maize, and beans are grown, often in a shifting cultivation system. Agriculture is rain-fed, with the intensity of cultivation dependent on seasonal rainfall. In Turkana and West Pokot irrigation farming is ideal despite limited water for irrigation.

Urbanization is minimal, with the largest towns like Moroto and Kotido, Lodwar, Kapenguria acting as centers for trade and administrative functions. In recent years, there has been some expansion of settlements and trading centers as more people transition from a purely nomadic lifestyle to semi-settled living, driven by external interventions and development programs.

Certain areas in the Cross-border Area have experienced land degradation due to overgrazing, cutting of trees, leading to gullies, bare, eroded land (Figure 17). These areas are particularly vulnerable during the dry season when vegetation cover is sparse.

Soil erosion is exacerbated by seasonal flash floods during the rainy season, further degrading the land. Field validation photos for environmental degradation in West Pokot are shown in Figures 18 (Mtembur in West Pokot) – Figure 19 (taken at Cheposebei area). These are driven by over-grazing, cutting of trees and extreme rainfall and runoff that carry the top soils and many time leaving gullies and open soil.

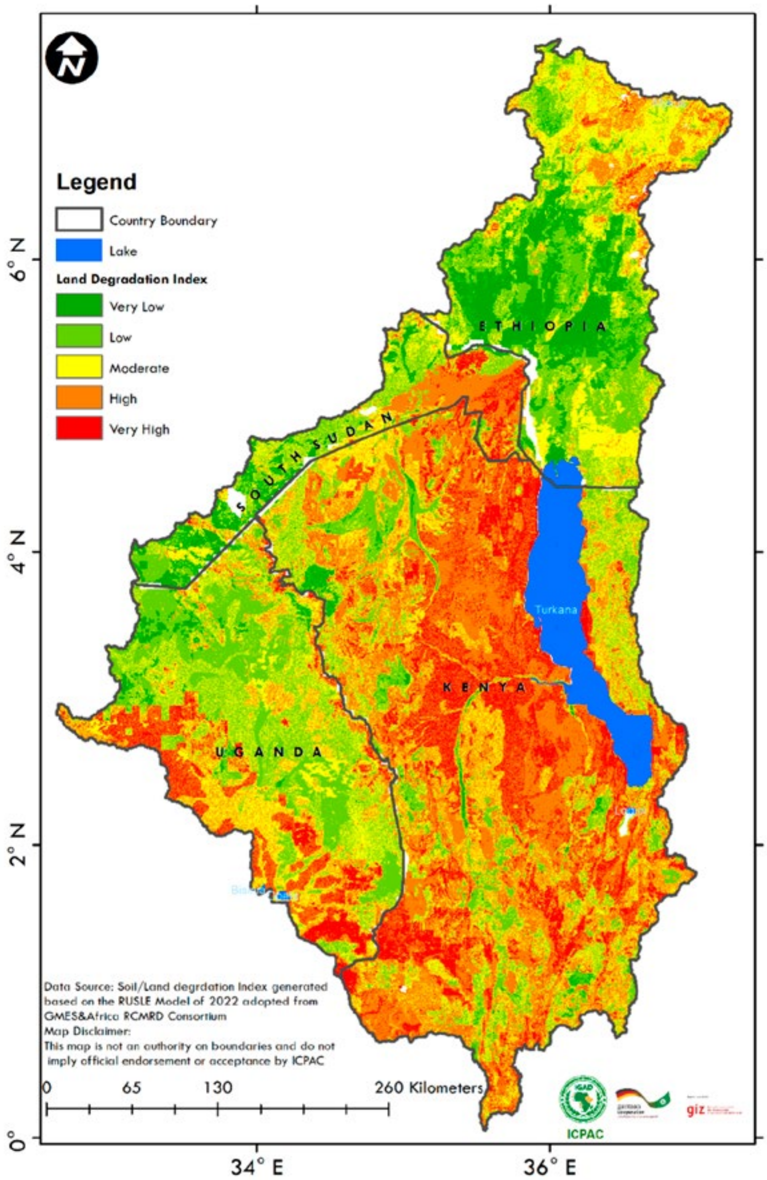


Figure 17: Land degradation map showing different levels of soil erosion severity

Figure 18: Very high degradation levels at Mtembur in West Pokot.

Figure 19: High degradation in Cheposebei close to the community borehole in West Pokot

Although Karamoja is largely arid, seasonal wetlands and riverine areas exist along the region's rivers and streams. These areas support a mix of vegetation, including grasses, reeds, and other water-tolerant plants. They are critical for livestock watering during the dry season. Figure 20 shows Soil Organic Carbon overlayed with the drainage / river systems and other water bodies.

On the other hand, Aridity Crop mask across the Karamoja Cross-border Area - regions where crop farming is heavily relied upon (Figure 21). Crop farming is intense in the humid and dry sub humid regions, there is minimal crop farming in the semi-arid areas while Arid areas have negligible crop (Figure 21).

The population density is shown in Figure 22 with areas around trading centres and high rainfall showing higher concentration of the population. These are also areas of higher drought risk exposure. Figure 23 shows a drought exposure layer based on a number of indicators including population density (Figure 22) and soil organic carbon (Figure 20). Results show very low exposure in the central and easter parts of the cross-border areas while very high to high exposure index is depicted in the north, western and Southern parts of the cross-border area (Figure 23).

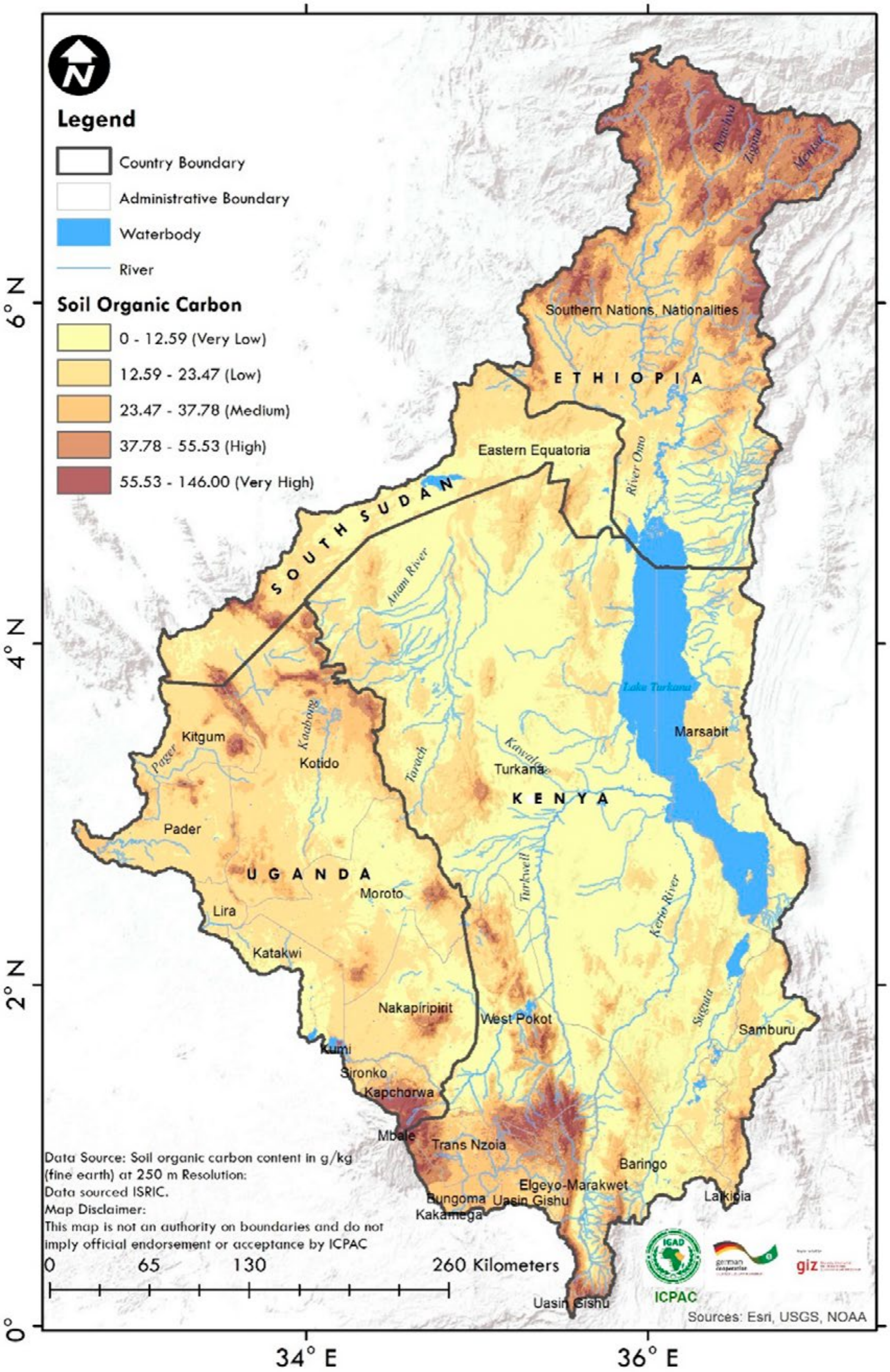


Figure 20: Soil organic carbon across the Karamoja cross-border area

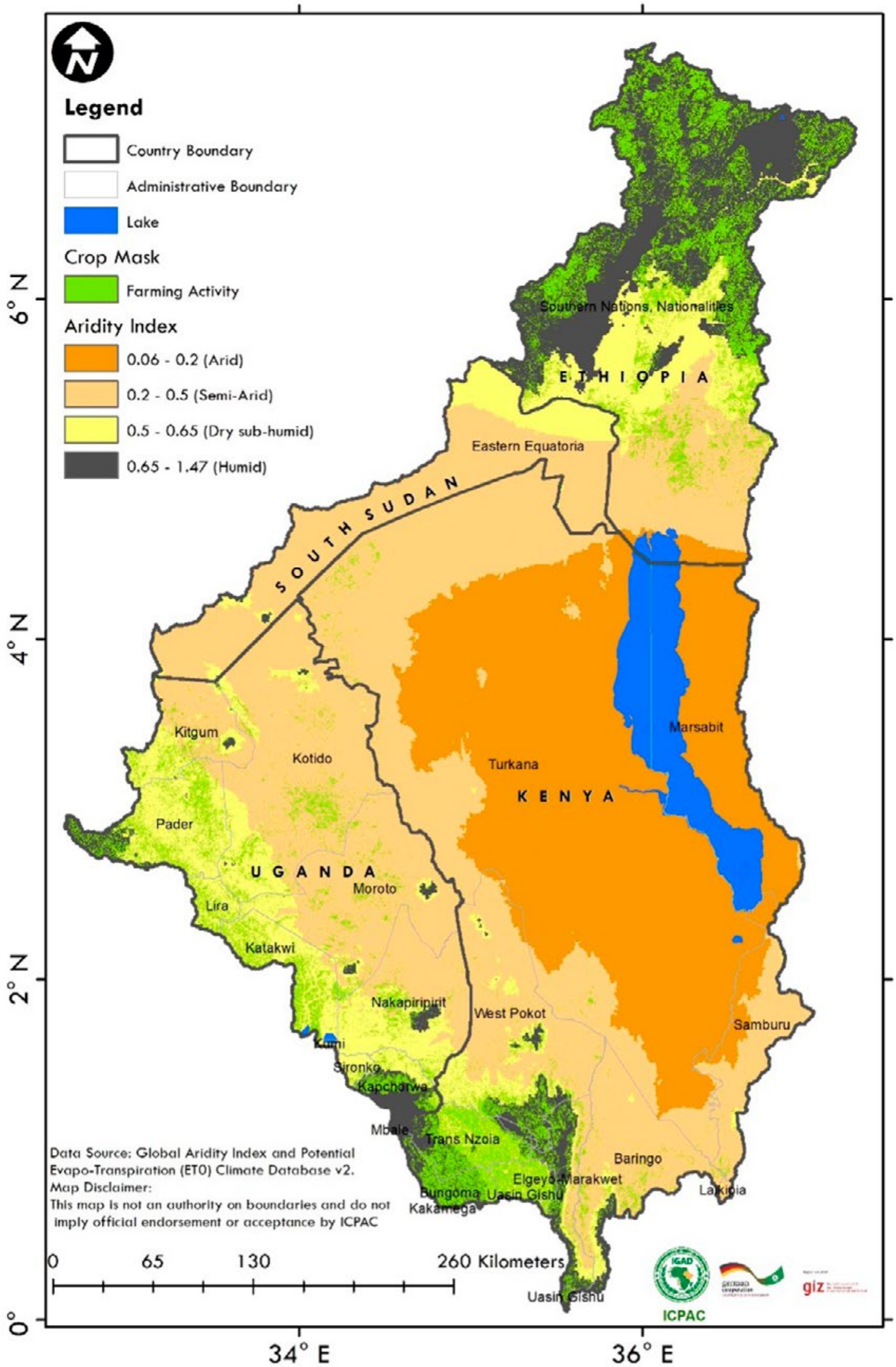


Figure 21: Aridity crop mask across the Karamoja cross-border Area - regions where crop farming is heavily relied upon. Crop farming is intense in the humid and dry sub humid regions, there is minimal crop farming in the semi-arid areas while Arid areas have negligible crop

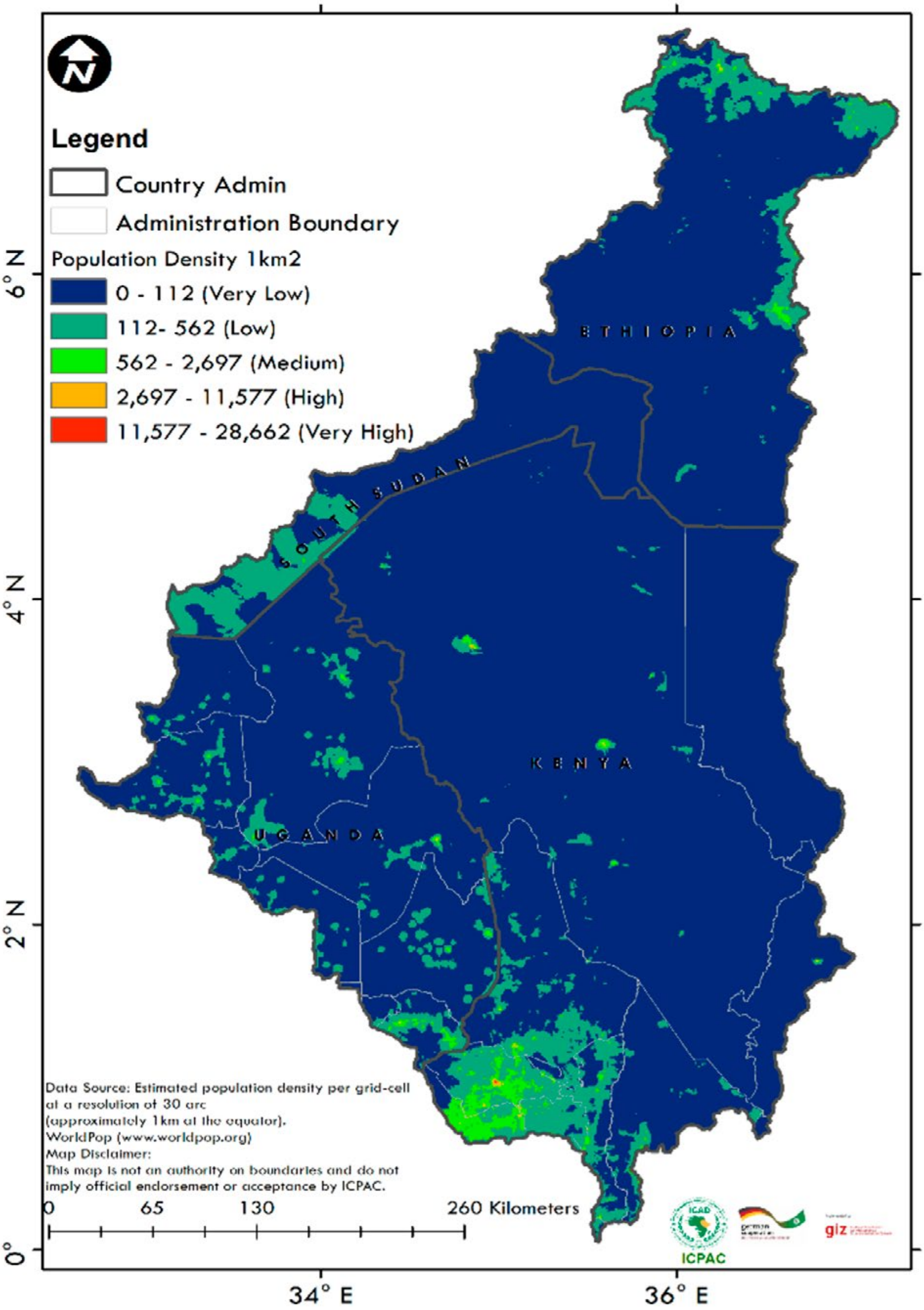


Figure 22: Estimated population density at one square kilometer

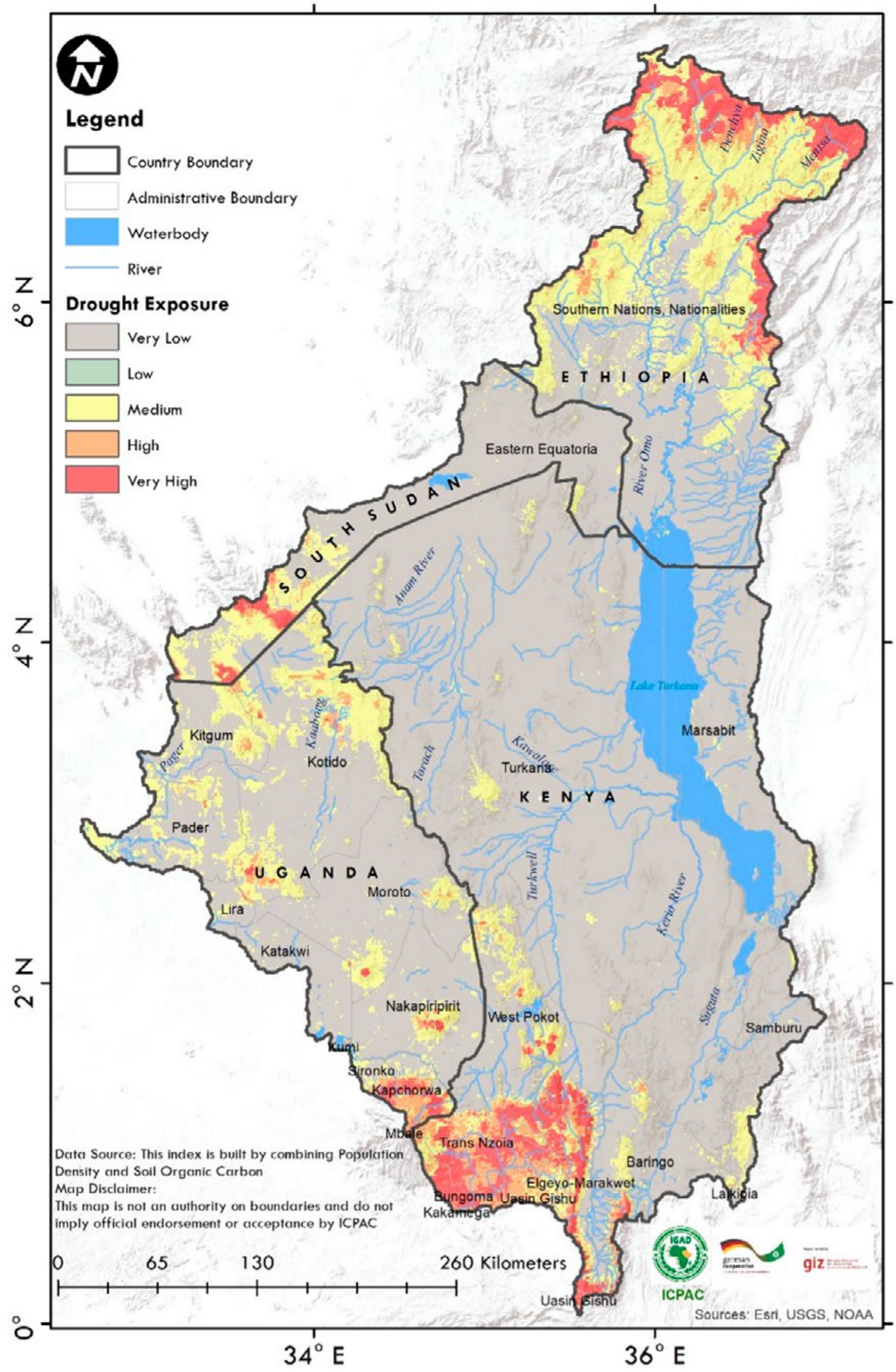
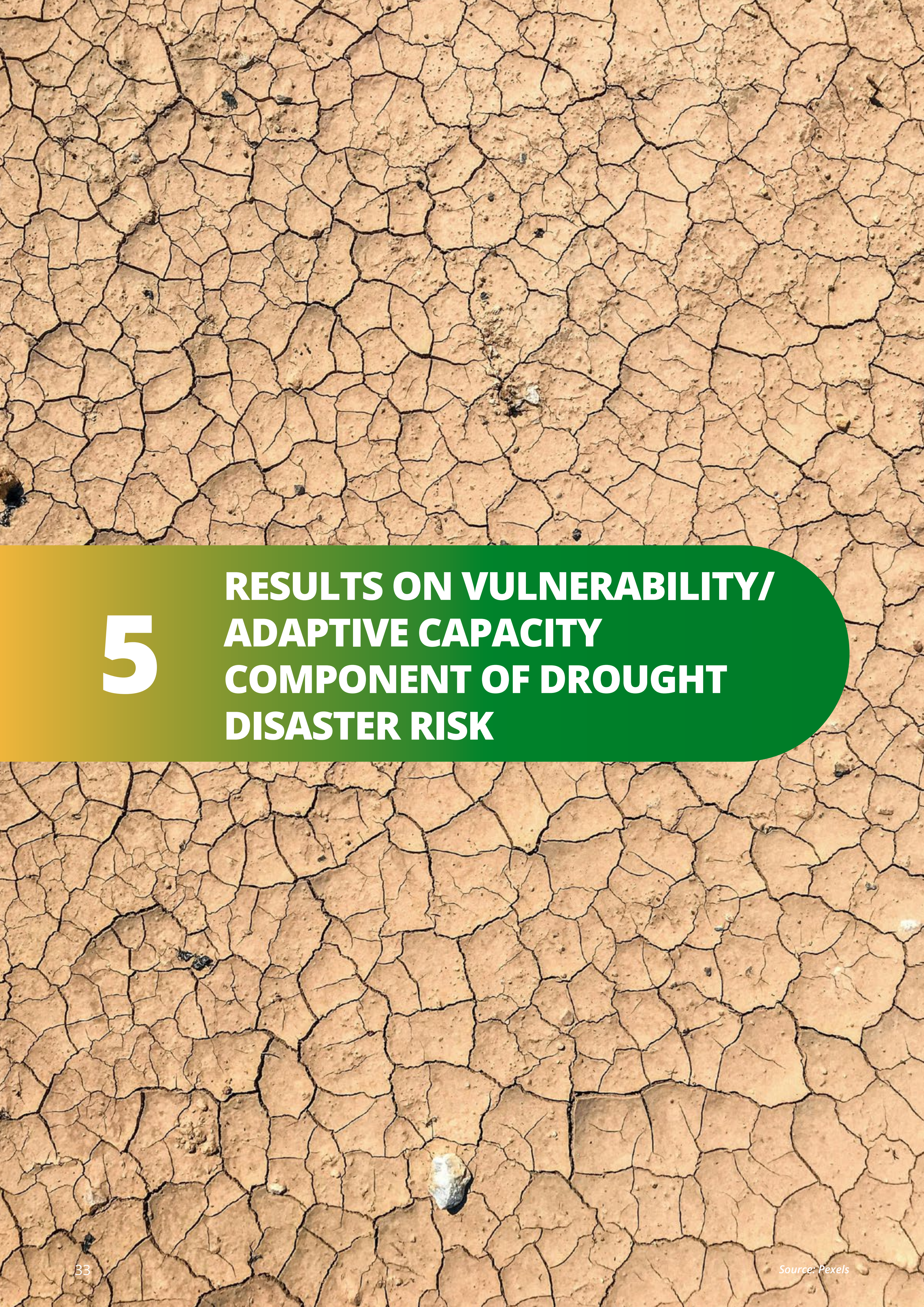


Figure 23: Drought Exposure Indicator built by population density and soil organic carbon across the Karamoja Cross-border Area.



5 RESULTS ON VULNERABILITY/ ADAPTIVE CAPACITY COMPONENT OF DROUGHT DISASTER RISK

Source: Pexels

5.1 Vulnerability Assessment

Vulnerability considers both socio-economic profile of the population and gender, ethnicity, and marginalized groups in the Karamoja Cross-border Area. Pastoralism is the dominant socio-economic activity and source of livelihood for most of the population.

The area is highly vulnerable to climatic variations such as drought that renders communities perennially food-insecure and limits their livelihood options (Chilambe et al., 2022). On the Ugandan side, these vulnerabilities were compounded, in part, by colonial land policies such as gazettement of fertile grazing land as wildlife conservation areas and forest reserves, accounting for 52.4% of the total land area. During the dry season, pastoralists are compelled to migrate to other areas to access pasture and water points, often crossing national and international boundaries (UNDP, 2019).

Field data collected and analyzed indicates that most of communities in Karamoja cross-border area depend on pastoralism as their number one livelihood activity and crop production is also their second livelihood option (Figure 23). Fishing also happens to be the least livelihood option among the communities (Figure 23)

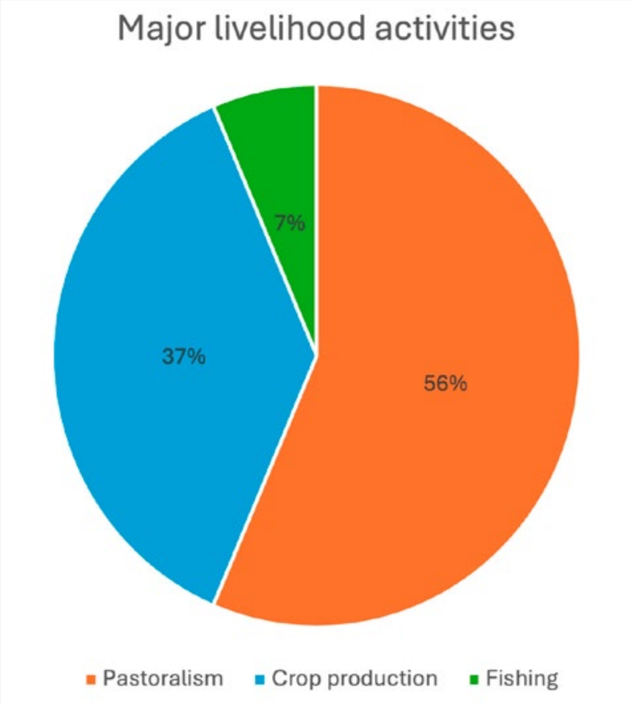


Figure 24: Major Livelihood options in Karamoja Cross-border Area

5.1.1 Mapping of Vulnerable Areas to Drought

Table 4 shows results that which came out from a field survey by ICPAC team, summarizes major drought prone areas in Karamoja Cross-border Area.

Table 5: Drought prone areas in Karamoja Cross-border Area

County/District	Sub-county	Ward
West Pokot County	Pokot North	Kiwawa, Kasei, Kapchok, Kodich, Suam, Alale
	Pokot Central	Masol, Weiwei, Lower Sekerr, Lomut
	West Pokot	Lower Kapenguria Ward-Riwo, Endough,
	Kipkomo	Lower Chepareria
	Shalpogh, Chepkopegh, Tukumwo	
Turkana County	Loima	Turkwel, Loima, Lomil
	Turkana west	Lokangae, Nasinyono, Lopiding
	Turkana South	Lokichar, Kalapata,
	Turkana Central	Kerio Delta, Central, Kalokol, Kangatotha, Kanamkemer, Lodwar township
	Turkana North	Lake zone, Lapur, Kaleng /Kaikor, Nakalale, Kaeris
	Kibish	Kibish

County/District	Sub-county	Ward
Karamoja	Moroto	Rupa, Lotisan, Nadunget, Loputuk, Tapac, Katikekile
	Nabilatuk	Lorengedwat, Kosike, Nabilatuk, Nabilatuk town council
	Karenga	Kawalakol, Kapedo Sub County, Sangar, Kapedo town council
	Kotido	Nakapelmoru, Rengen, Panyangara, North division, Maaru, Kotido, Loletio
	Abim	Alerek sub county, Alerek town council, Camkok, Opopongo, Nyakwae
	Napak	Lokopo, Lotome, Lopeei, Ngoleriet, Matany
	Nakapiripirit	Loregae, Loreng, Lemusui, Kakomongole
	Kaabong	Kalapata, Lotim
	Amudat	Kongorok, Amudat sub county, Katabok, Amudat town council, Abileyep

5.1.2 Capacity Analysis

Existing early warnings and institutional mechanisms in the cross-border area

As per the chart below from a field data collection of ICPAC team, there are different early warning systems in the Cross-border Area. The chart/graph indicated that the forecasting and warning institutional mechanisms, the respondents pointed out the national drought management agencies, followed by national/district meteorological services and others exist in the area

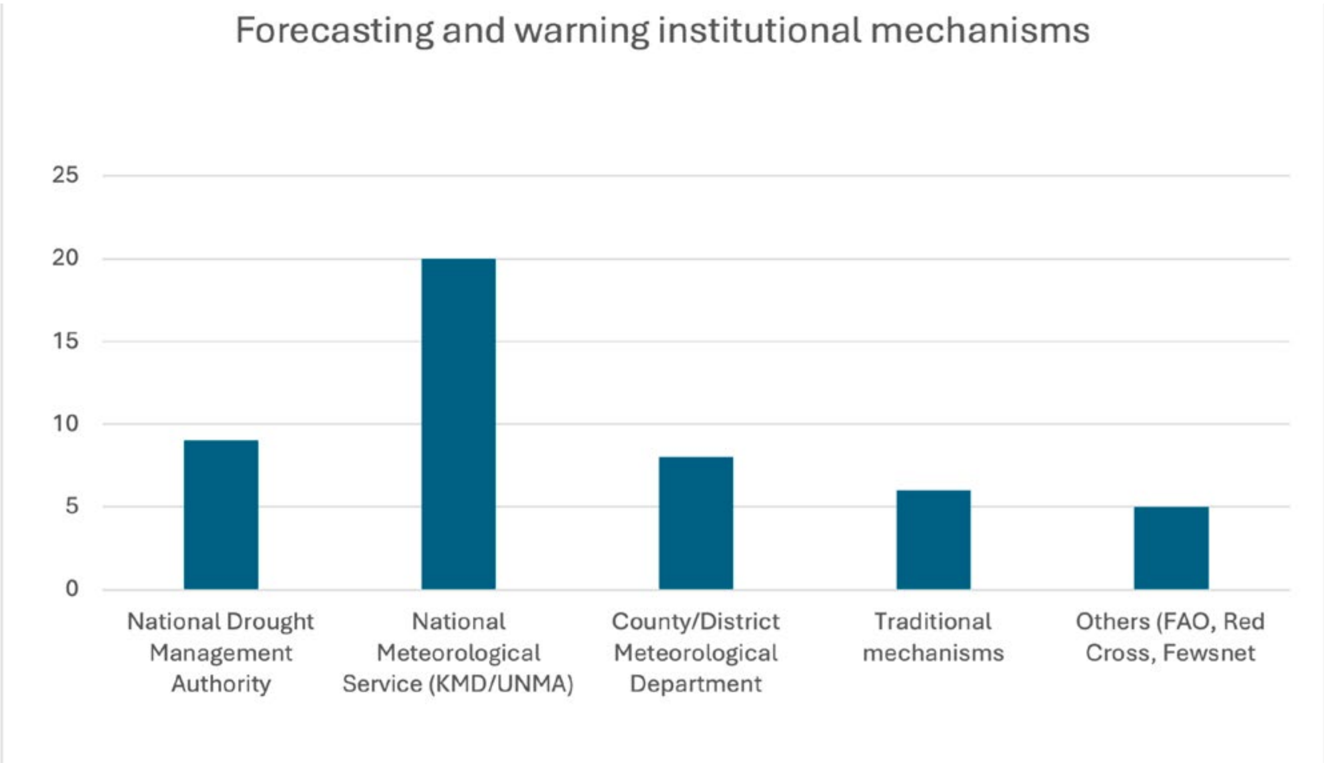


Figure 25: Forecasting and warning institutional mechanisms

As per the pie chart below from field data collected by ICPAC team, 51% of respondents confirmed presence of hazard monitoring systems while 49% indicated absence of monitoring systems for drought.

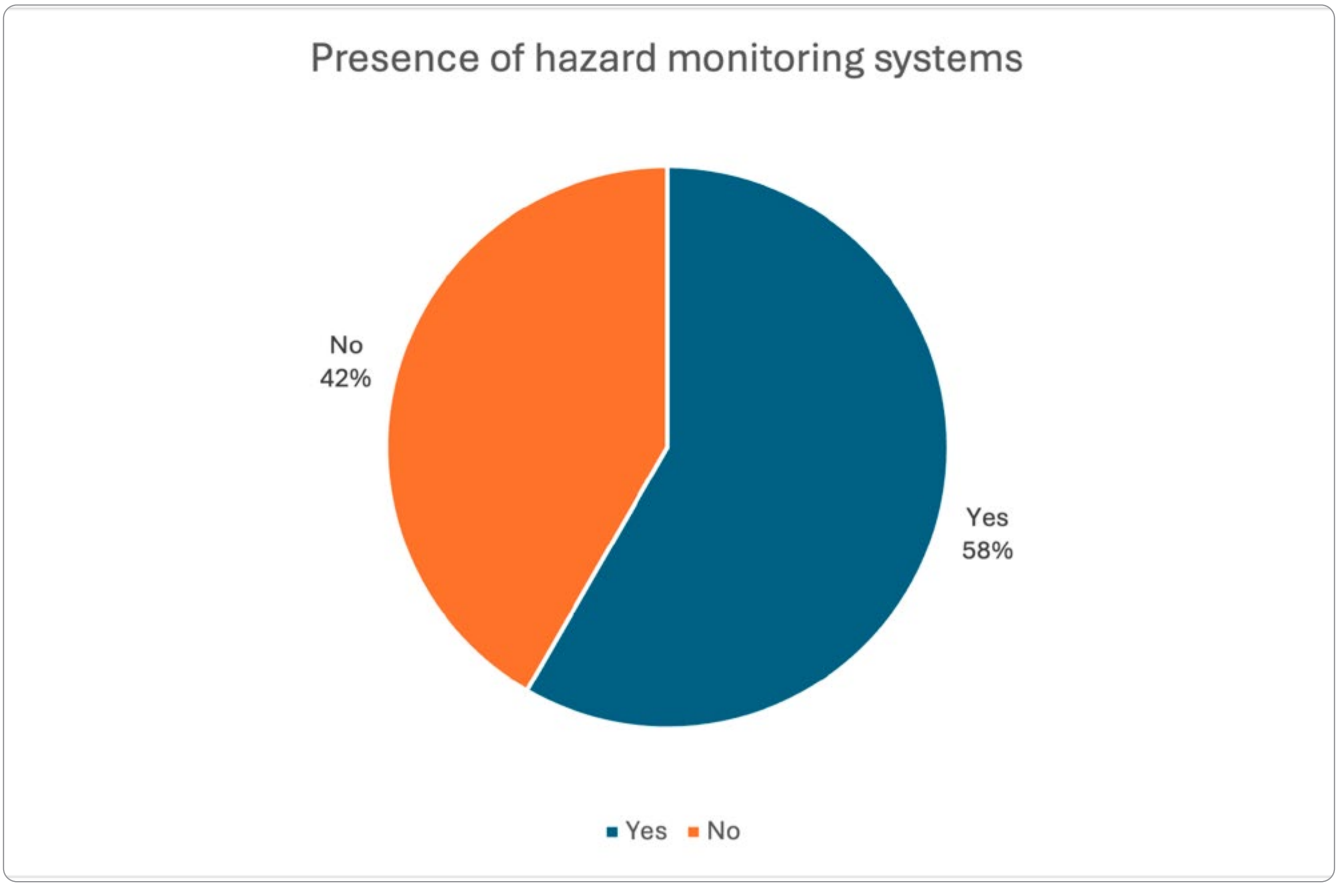


Figure 26: Presence of Hazard Monitoring System

5.1.3 Risk Analysis

Identification of disaster risk based on hazard, vulnerability, and exposure assessments.

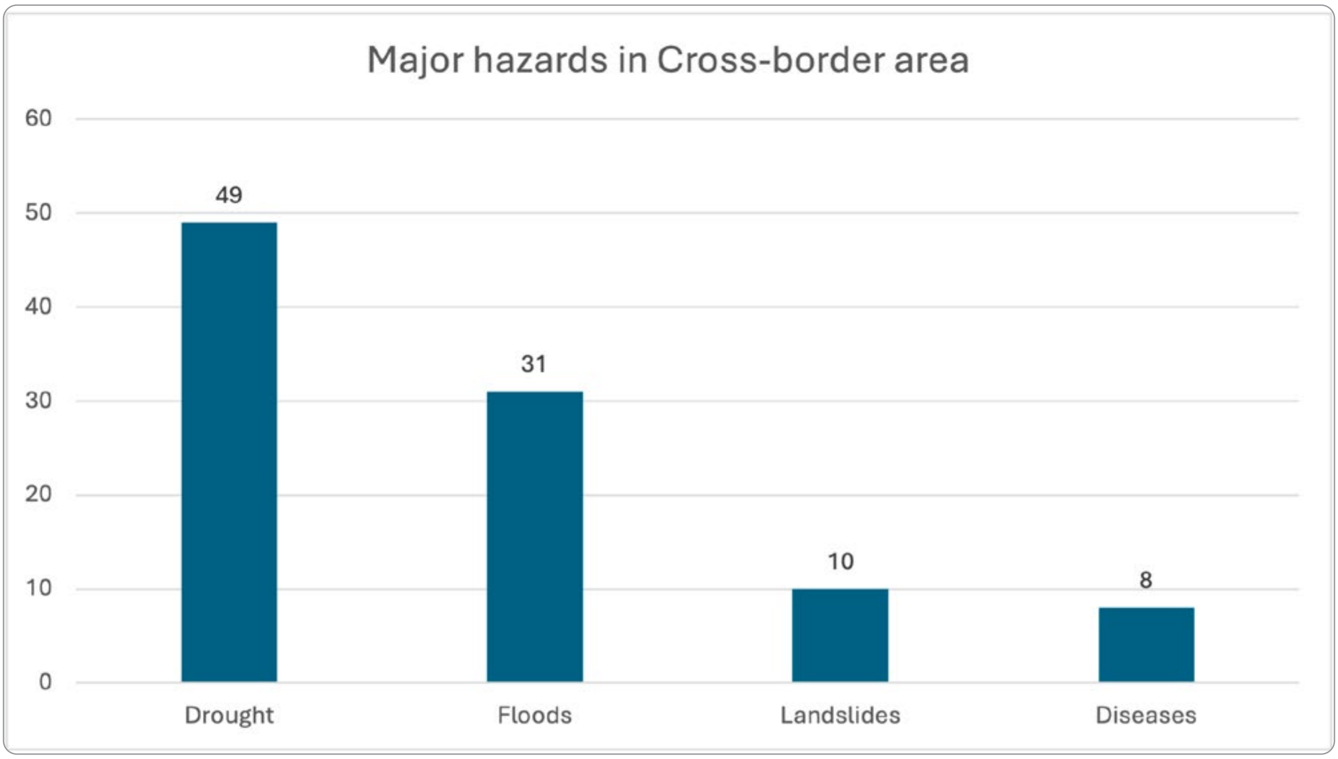


Figure 27: Major hazards in Karamoja Cross-border Area

Field level data collected by ICPAC team displays the major hazards in the cross-border area identifying drought is rated as the number one hazard in the cross-border area, while floods are ranked as the second major hazard in the area. Landslides and diseases are ranked as number three and four respectively.

5.2 Drought Vulnerability Index Analysis

To understand the indicators of vulnerability associated with drought in the cross-border area, a number of indicators have been analyzed. These include Relative Wealth Index (Figure 28), market Access (Aklilu et al., 2013) through Accessibility to nearest cities and towns (Figure 29), and Livelihood Zones (Figure 30). Figure 31 shows results from the combined vulnerability indicator based on Relative Wealth Index, Accessibility to market and trading centers and Anthropogenic biomes.

The results on drought vulnerability index show that very low to low drought vulnerability is concentrated in the western and Southern together with the northeastern parts of the cross-border areas (Figure 31). On the other hand, high to very high vulnerability index is concentrated in the areas of central to eastern part of the cross-border area (Figure 31).

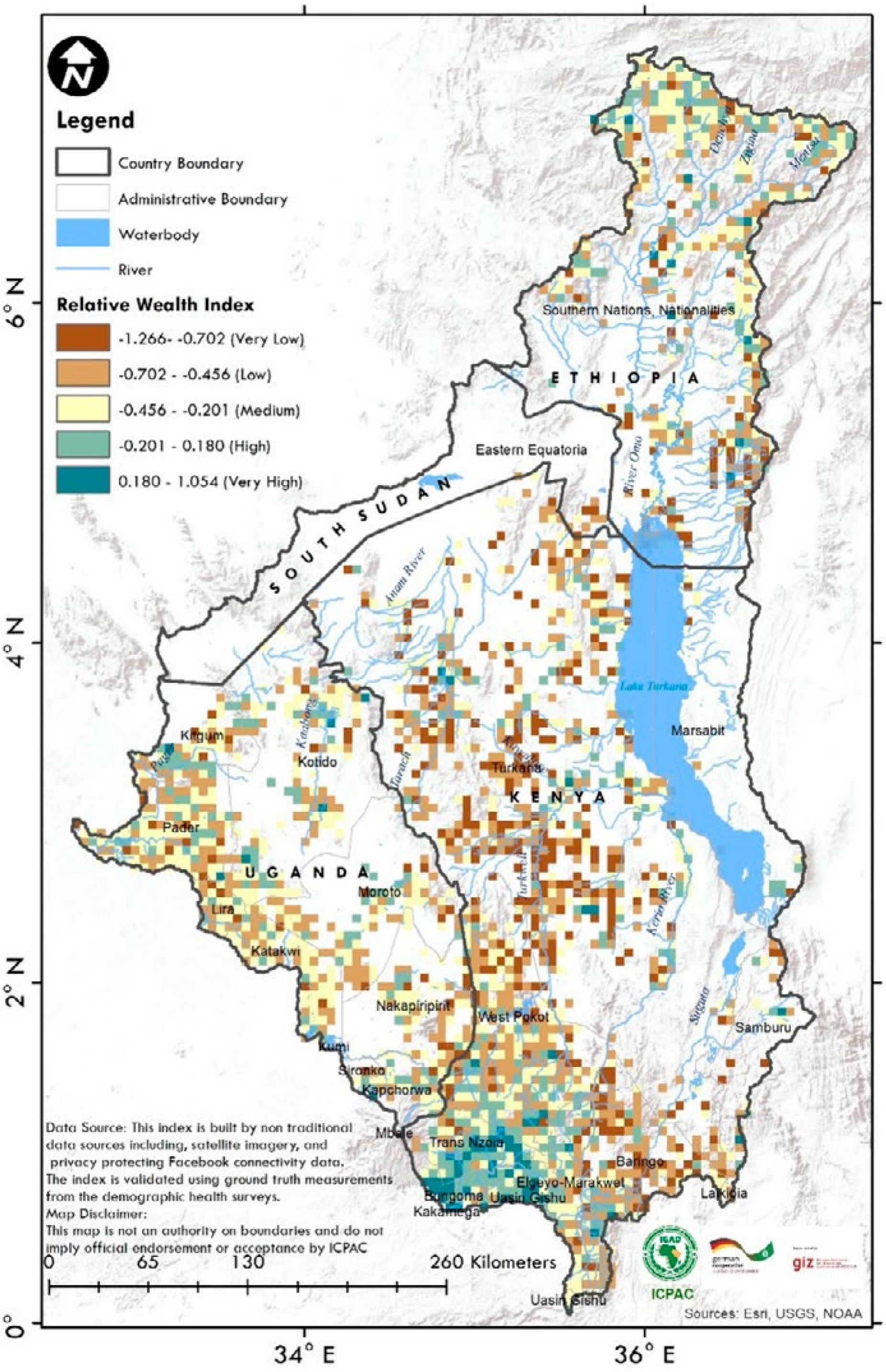


Figure 28: Relative wealth index across the Karamoja Cross-border Area

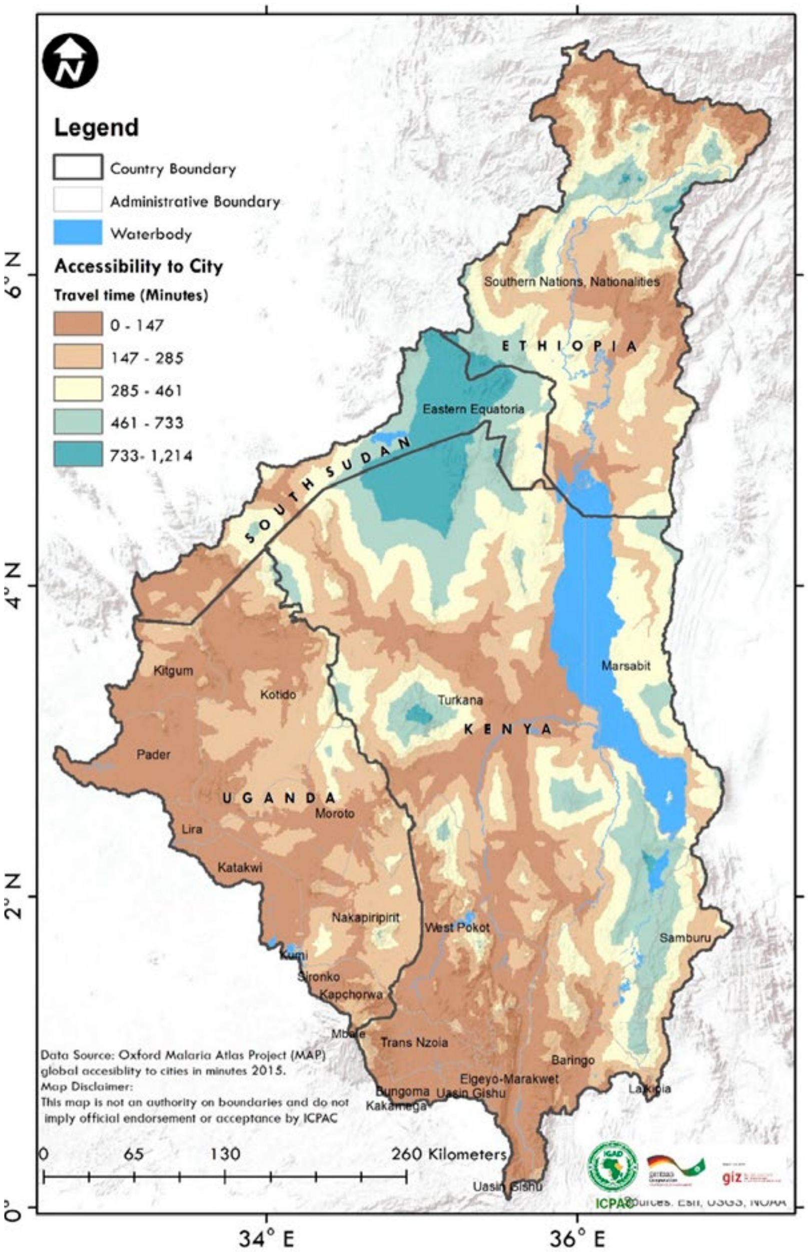


Figure 29a: Accessibility to the nearest cities and major towns

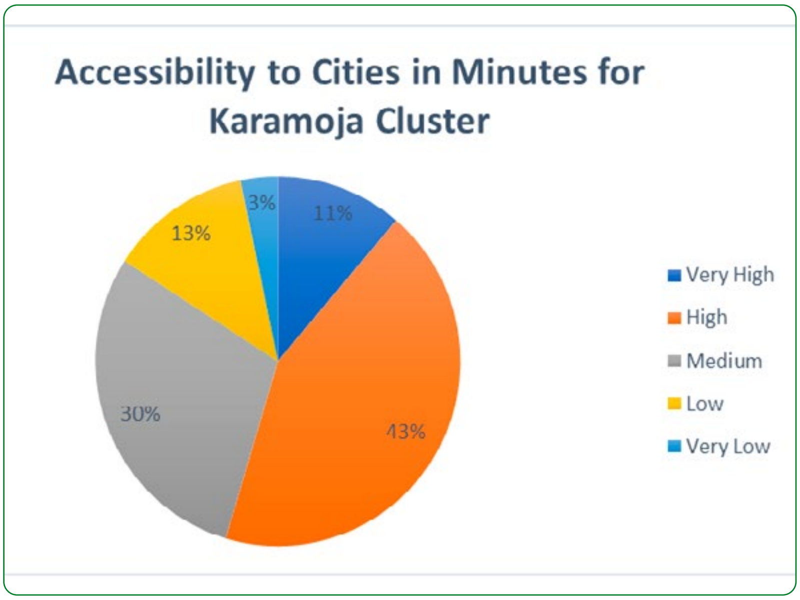


Figure 29b: Accessibility to the nearest cities and major towns

Approximately 46 percent comprising of medium, low and very low classes is categorized as remote, due to inaccessibility.

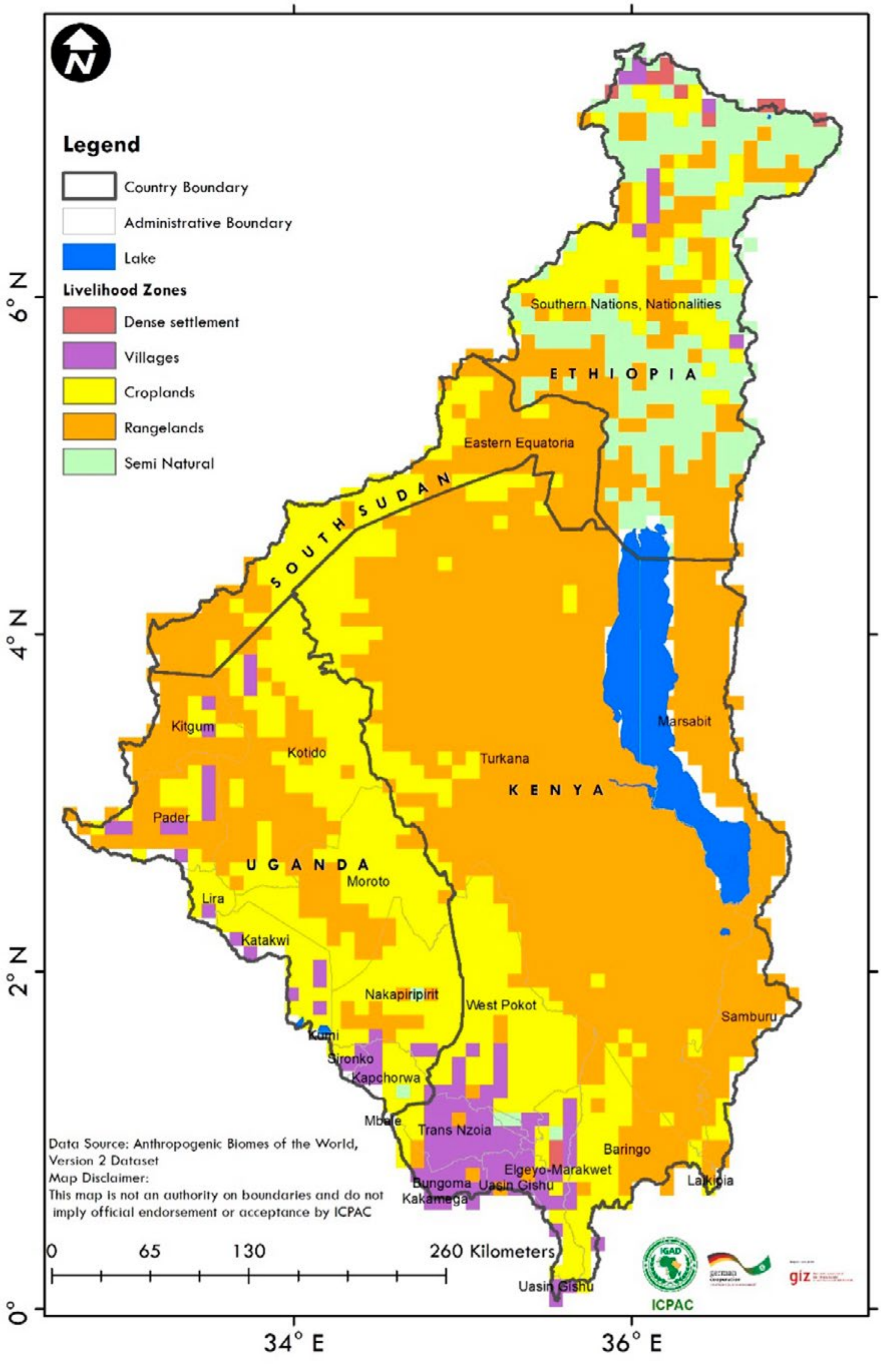


Figure 30: Livelihood zones across the Karamoja Cross-border Area

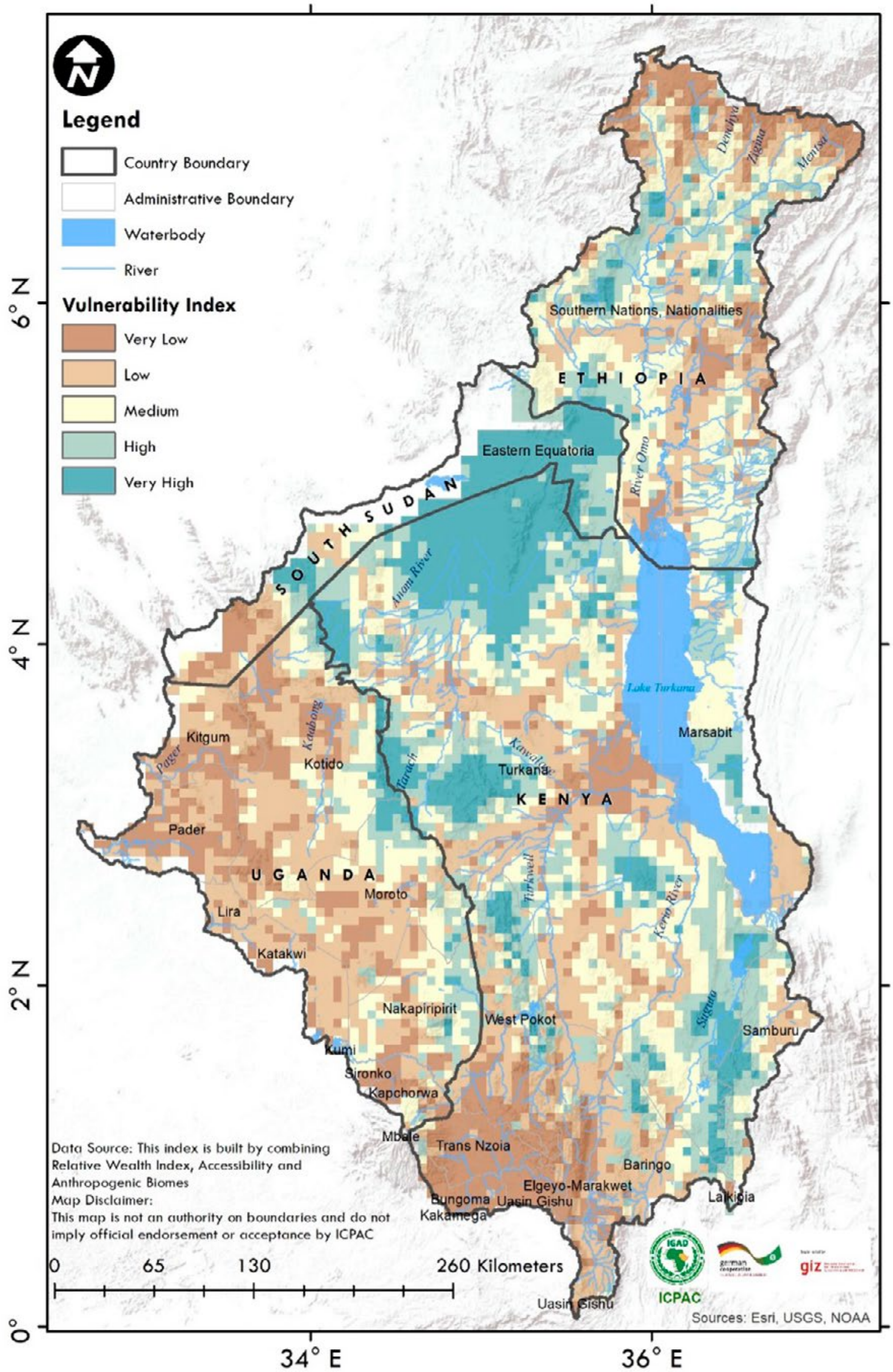


Figure 31: Vulnerability / adaptive capacity index patterns across the Karamoja cross-border area

6 RESULTS ON COMBINED HAZARD, EXPOSURE AND VULNERABILITY COMPONENTS OF DROUGHT DISASTER RISK

Figure 32 shows the drought risk index across the Karamoja cross-border areas. The drought risk is a combination of drought hazard (Figure 15), drought exposure (Figure 23) and drought vulnerability (Figure 31) indicators. Results show that the central and eastern parts of the Karamoja cross-border area experience high to very high drought risk while the western parts for the cross-border area experience low, medium and high drought risk. Very low to low drought risk is experienced over Southern and northeastern parts of the cross-border area (Figure 32).

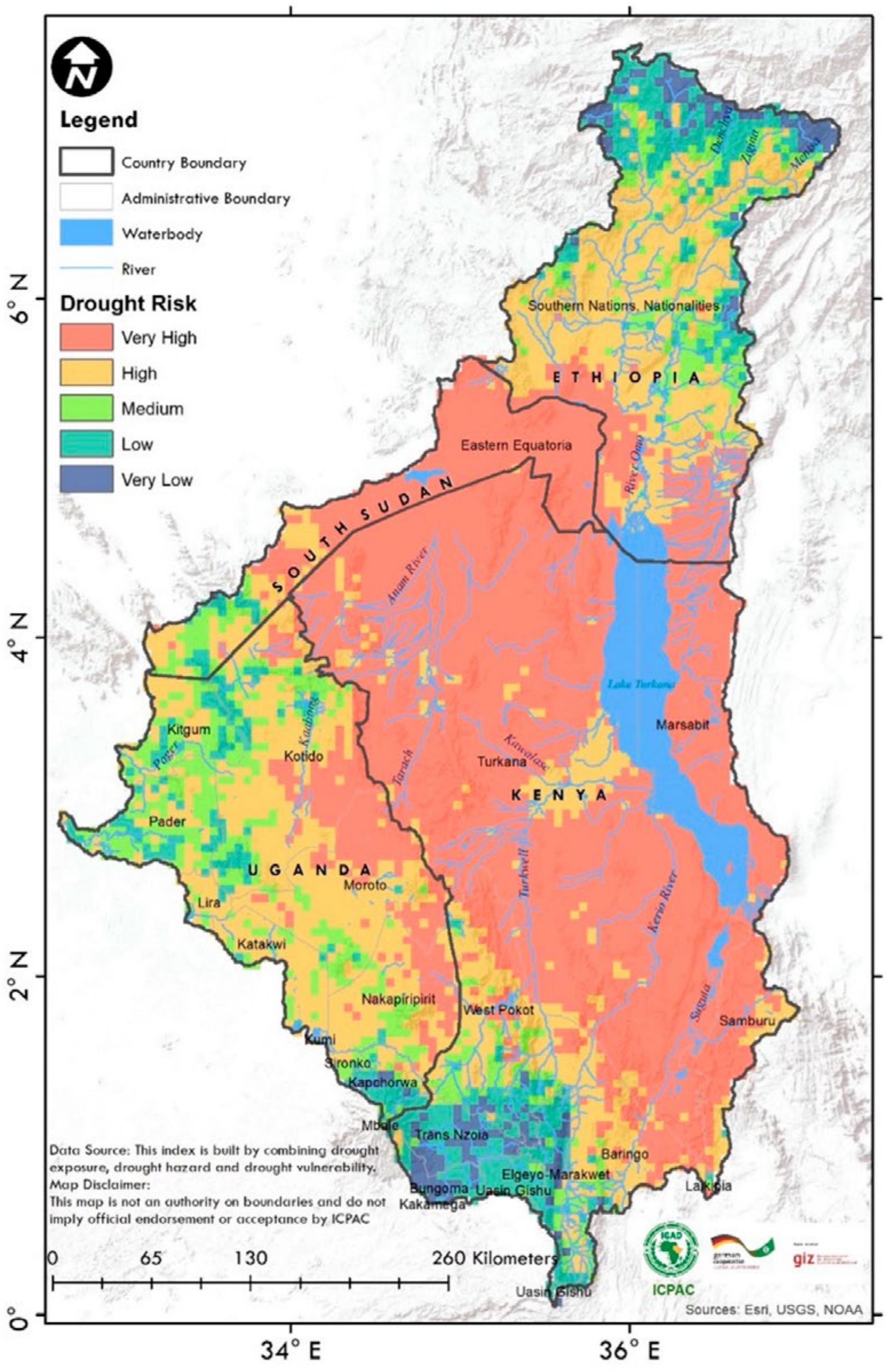


Figure 32: Drought Risk over Karamoja Cross-border area

7 PREPAREDNESS AND RESPONSE INTERVENTIONS

To address current and future drought risk, a number of interventions for preparedness and response have been provided to cushion communities and safeguard their livelihoods across the crop sector, livestock and rangeland sector, water resources sector, health and nutrition sector, and social protection sector.

Crop sector

- Farmers are advised to adopt fast maturing, drought tolerant and nutritious content crops.
- Enhance post-harvest management measures in order to minimize crop loses for food security
- Promote value addition to increase value of produce e.g, milk, beef, hay, processing of crops
- Provision of relief food for the affected areas
- Farmers income is likely to increase if adequate preservation of food crops for the next season is adhered

Livestock and Rangeland sector

- Farmers are advised to regularly spray and treat their livestock against ticks and flies, as well as deworming.
- Farmers should vaccinate against Newcastle and rabies
- Farmers should be trained and adopt Apiculture, including climate-smart livestock farming management practices
- Farmers should carry out regular monitoring and timely reporting of any animal disease occurrence in the community.

Water Resources sector

- Water harvesting during seasons of heavy rainfall should be promoted including through nature-based approaches
- Community ownership of water sources is strongly encouraged. This will help in the maintenance of those water points
- By-laws should be put by local/community leaders to strongly protect water sources from being contaminated by animals
- Mobilize and secure resources for/and rehabilitation of boreholes and other water sources
- Capacity building on sustainable water management practices

Health and Nutrition

- Parents are advised to provide proper care for their children in terms of feeding and medical attention in order to improve on their nutrition status
- The security officials at the district need to send a strong warning to the community not to hide any cases of crime noted within the district so that culprits are prosecuted.

Social Protection

- Affected communities need to be supported by non-conditional financial support

8 POLICY RECOMMENDATIONS

Strengthening Cross-Border Early Warning Systems: Establish a robust cross-border early warning system that integrates meteorological data, traditional knowledge, and real-time information sharing between Kenya and Uganda. This system should include regular data exchange and joint monitoring to anticipate and mitigate drought impacts effectively. Promote the development of comprehensive risk assessment and management actions across the border areas.

Integrated Climate-Resilient Agricultural Policies

Both Kenya and Uganda should promote the adoption of drought-resistant crops and climate-smart agricultural practices in the Cross-border Area. This includes providing subsidies, research support, and extension services for farmers in the Karamoja Cross-border Area, to reduce vulnerability to drought.

Community-Based Natural Resource Management

Empower local communities in the Karamoja Cross-border Area to manage their natural resources through community-based organizations. Support should be provided for the creation and capacity building of local resource management committees that oversee grazing lands, water points, and forests.

Promote risk informed investment including nature based solutions and infrastructure development to improve access to markets and inter-connectivity.

Diversification of Livelihoods

Implement programs that encourage diversification of livelihoods in the Karamoja Cross-border Area which can be through a demonstration pilots. This includes promoting alternative income-generating activities such as beekeeping, poultry farming, bio nature entrepreneur (Aloe, Gum arabica) and small-scale trade, along with providing vocational training to enhance skills for non-agricultural employment

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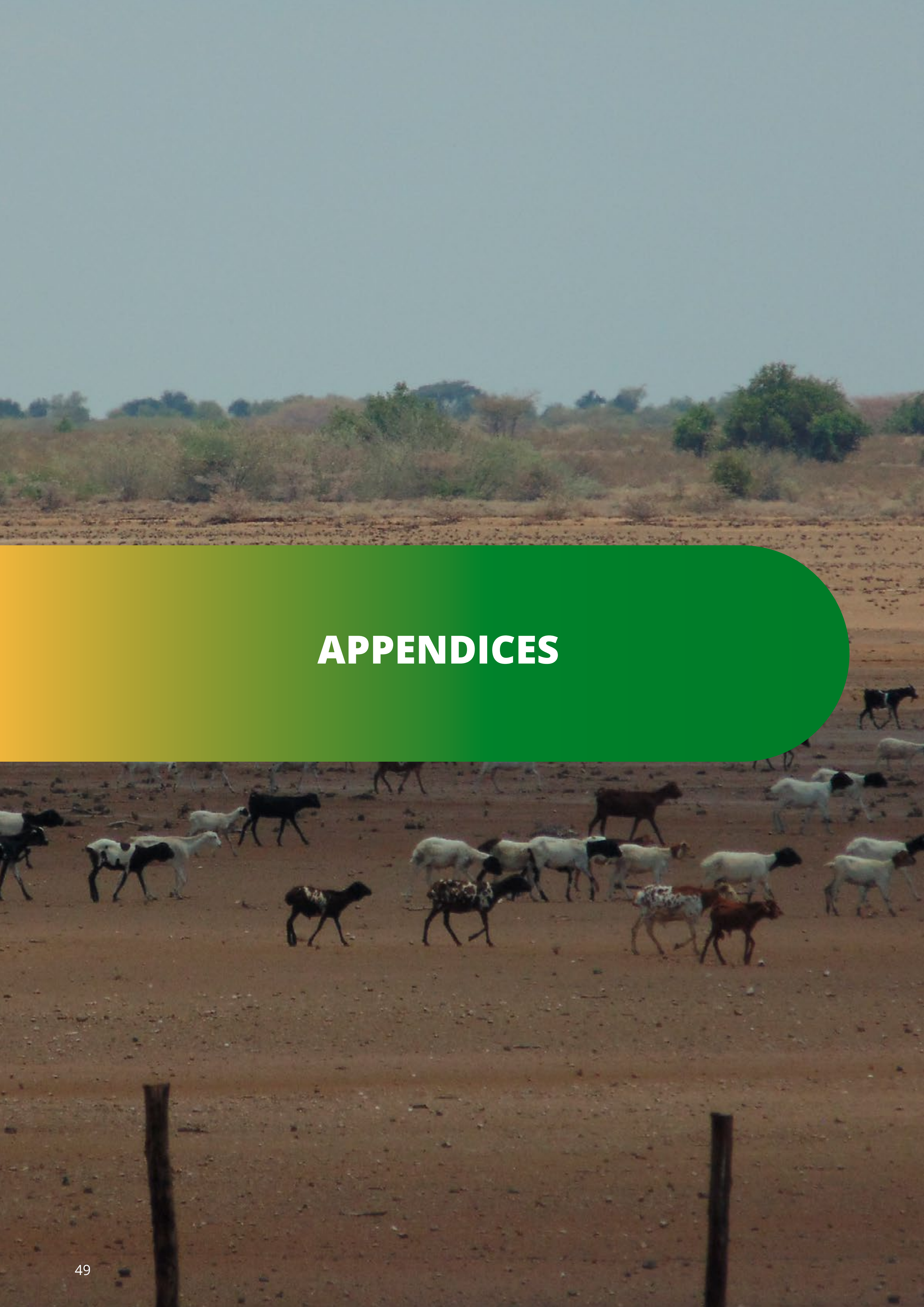


APPENDICES

Annex I: Climatology

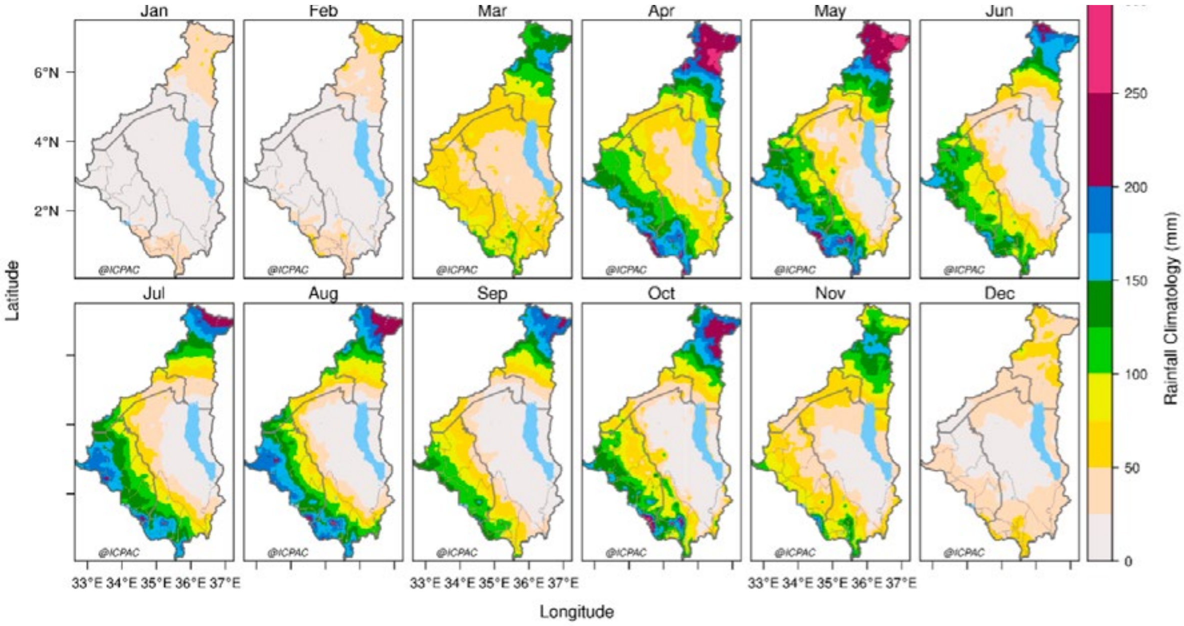


Figure 33A: Monthly long-term mean (1991 - 2020) rainfall distribution for the Karamoja Cross-border Area

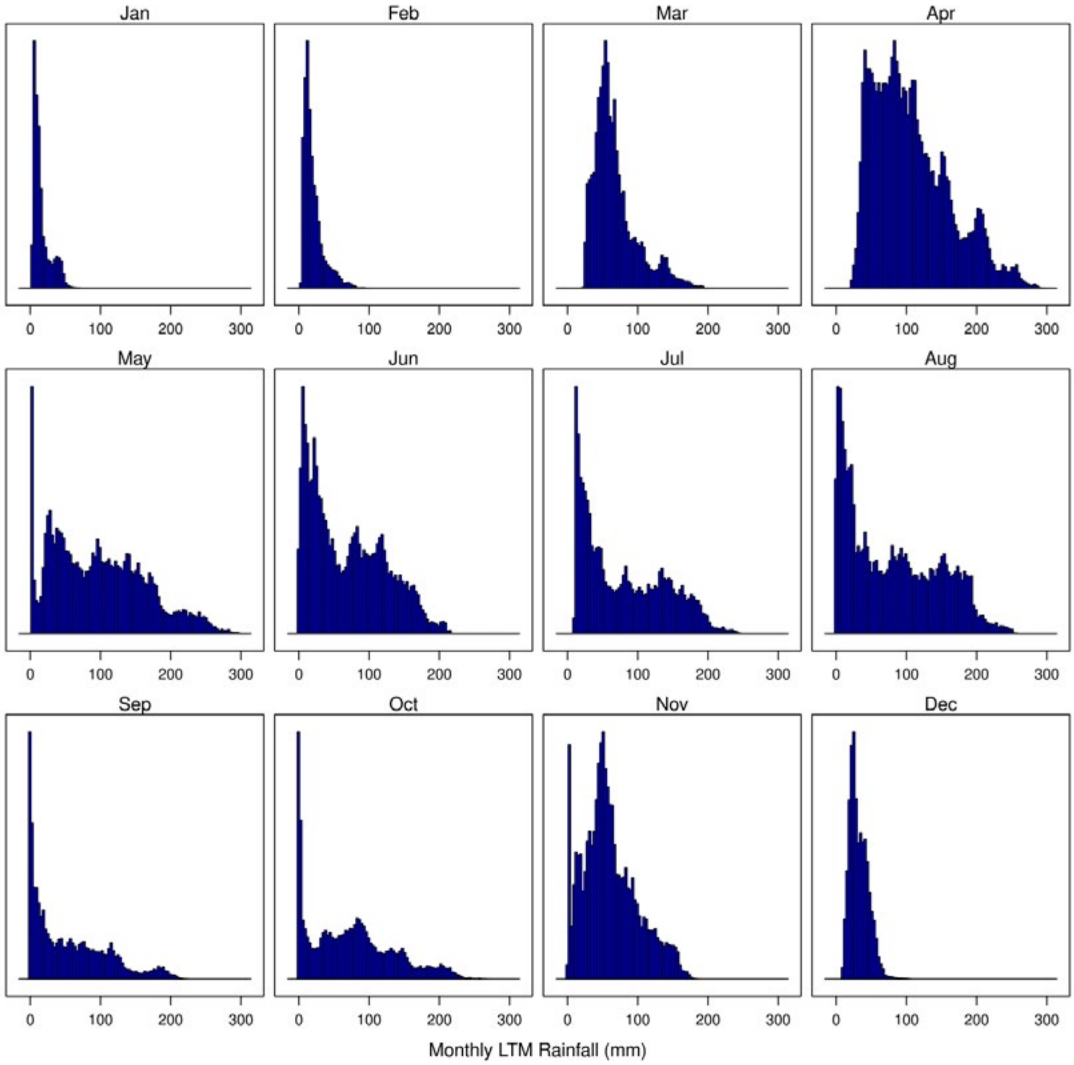


Figure 34A: The frequency distribution of monthly long-term mean (LTM) rainfall amounts for the period 1991 - 2020 over Karamoja Cross-border Area

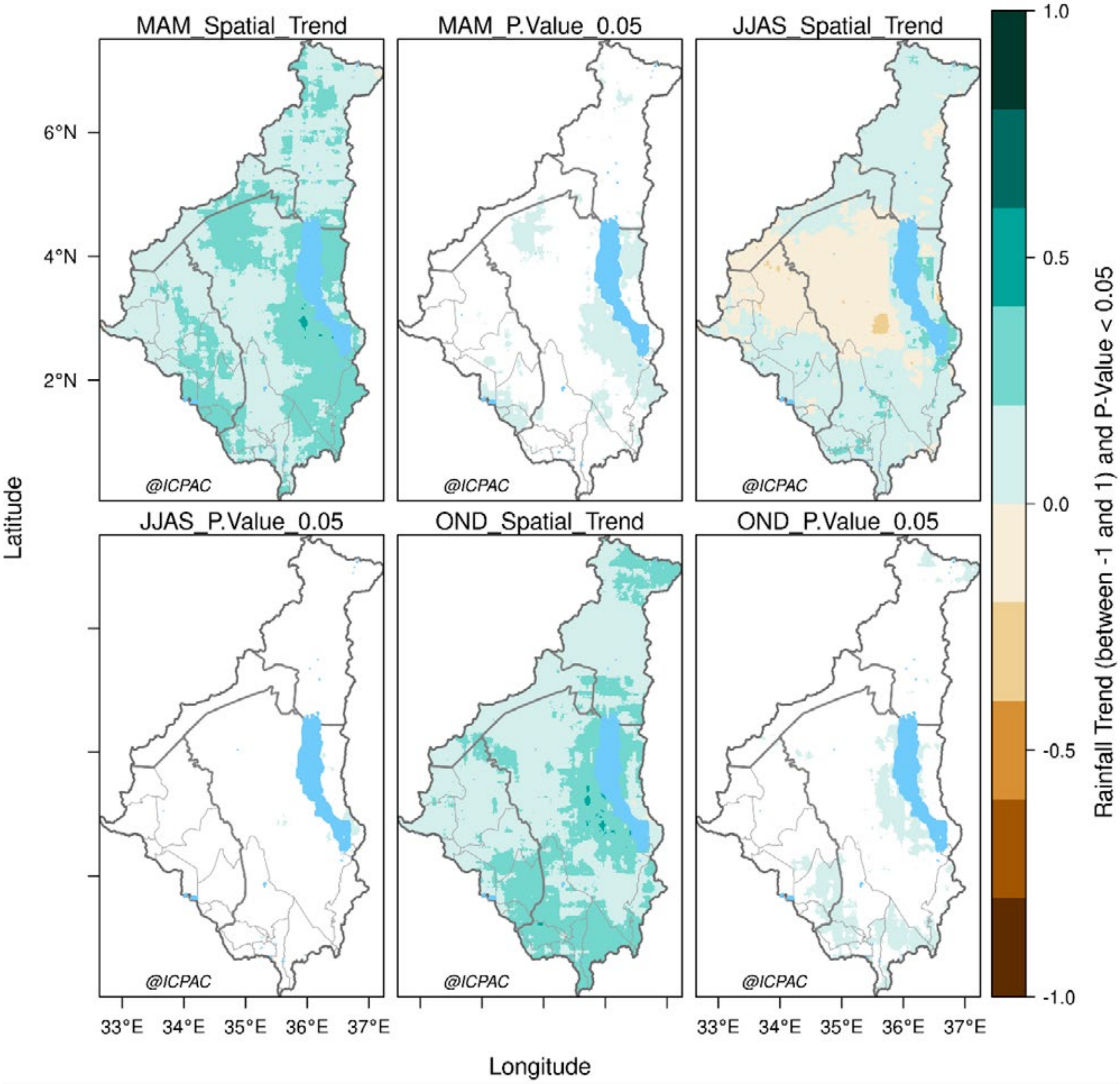


Figure 35A: The spatial trends and statistical significance of rainfall changes in the Karamoja Cross-border Area from 1991 to 2020, for March-May (MAM), June-September (JJAS), and October-December (OND)

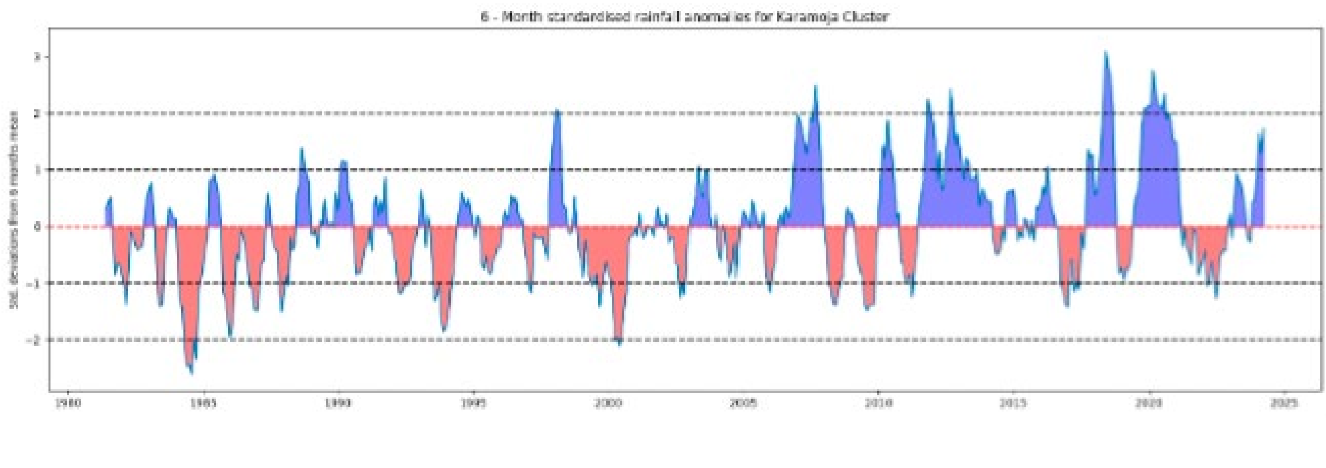


Figure 36A: Timeseries of 6 – Month Standardized Precipitation Index (SPI) in Karamoja Cross-border Area

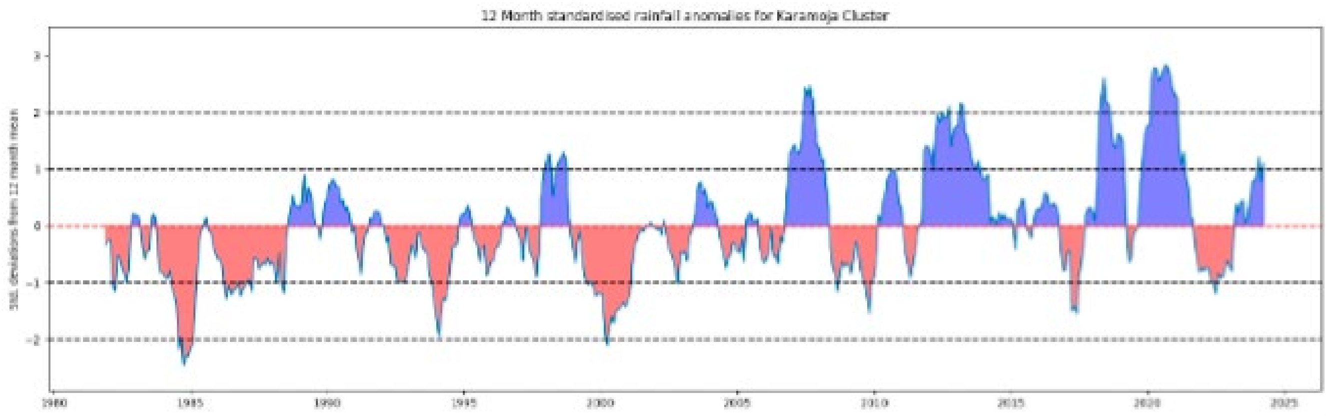


Figure 37A: Timeseries of 12 – Month Standardized Precipitation Index (SPI) in Karamoja Cross-border Area

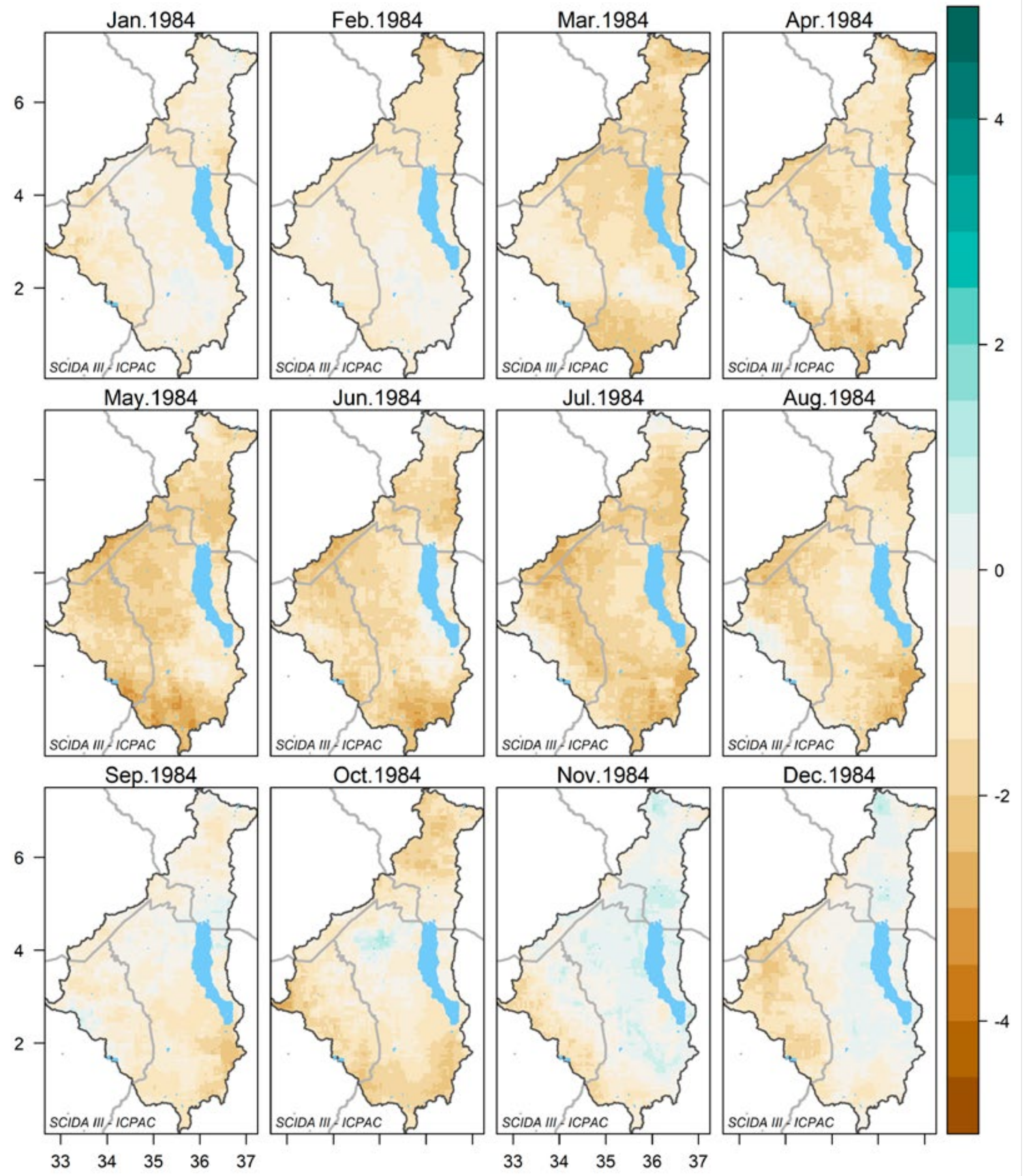
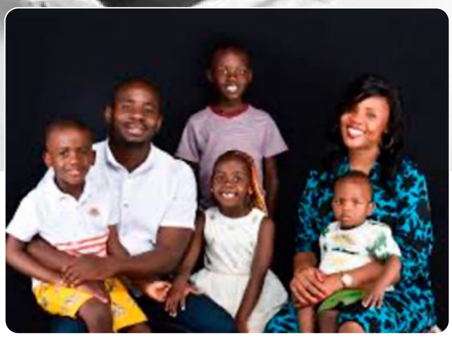


Figure 38A: The Standardized Precipitation Index (SPI) for the Karamoja Cross-border Area during the drought of 1984.



Dedication of this Drought Profile

This report is dedicated to late David Ongo and his Family.

David who passed away on February 9th, 2025 having contributed immensely from conceptualization and formulation to data collection and analysis of this report which could not have been achieved in its current form without his brilliance and team work. David was a valued member of the SCIDA III project team whose work was instrumental in advancing earth observation and environmental sustainability in cross-border area of Karamoja and beyond through his skills, research and engagements. He managed to identify highly degraded areas and interventions required to rehabilitate and restore those areas for higher productivity in Karamoja sub-region covering parts of Kenya, Uganda, Ethiopia and South Sudan.

He was passionate and instrumental in translating climate hazards information to actionable and community support programmes and initiatives including tree planting in Karamoja Cluster. Above all, he demonstrated a steadfast commitment to IGAD and its shared goals. Many at IGAD continue to remember him as witty, dedicated, optimistic, ingenious and each will attest to his unrelenting demeanor in their lives. We celebrate the phenomenal being he was and the lasting legacies he has created in our lives and the communities he impacted positively through his incredible support. His unfaltering energy will forever be embedded to us, as IGAD family. We will deeply miss David and we will forever cling on to his memories and the work he did.

Rest in perfect peace, David.

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