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**Resilience Learning Activity**

# Climate Smart Research on Drought Response in Turkana County



## Acknowledgement

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## Abstract

Climate change has made marginalized areas more vulnerable to weather-related disasters such as floods and droughts, which have led to an increase in poverty and development challenges in places like Turkana County. To address these issues, it is important to improve disaster response and adapt to natural hazards. In the past five years, the Turkana County Government has worked with organizations like the National Disaster Management Authority, the national government, local communities, non-governmental organizations and private sector companies to implement measures and mechanisms that promote disaster resilience. These efforts have helped to save lives, protect infrastructure, livelihoods, social systems, and the environment. Building disaster resilience is a more sustainable and cost-effective approach than relying on disaster relief and development aid.

This research aims to study the trends and impacts of drought in Turkana County over the past three to five years, understand how drought affects the livelihoods of the Turkana people, document the adaptation and coping mechanisms to address the effects of drought, document the impact of drought on the peaceful coexistence of cross-border communities, highlight the policy and legislative frameworks that support the sustainability of pastoral livelihoods, and highlight integration of traditional and modern early warning systems.

Key findings from the study show that climate change has intensified drought in Turkana County over the past five years, leading to more frequent and severe drought events. Drought has also significantly impacted the economic and social livelihoods of communities in the county, including the livestock industry, access to water, agriculture, gender and women's issues, peaceful coexistence, education, and health. The efforts of the national and county government to adopt climate-centered policy and legislative frameworks have helped communities improve their ability to cope with drought. However, more programmatic efforts are still needed across the county to address ongoing challenges related to drought and other natural hazards.

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## Acronyms and Abbreviations:

|        |   |
|--------|---|
| ASAL   | Arid and Semi-arid land                             |
| CLTS   | Community Led Total Sanitation                      |
| CSO    | Civil Society Organizations                         |
| DANIDA | Danish International Development Agency             |
| DRR    | Disaster Risk Reduction                             |
| GIS    | Geographic Information Systems                      |
| ECDC   | Early Childhood Development Centers                 |
| EU     | European Union                                      |
| FGD    | Focus Group Discussions                             |
| IPCC   | Intergovernmental Panel on Climate Change           |
| KII    | Key Informant Interviews                            |
| KNBS   | Kenya National Bureau of Statistics                 |
| KPHC   | Kenya Population and Housing Census                 |
| LMA    | Livestock Marketing Associations                    |
| NDMA   | National Drought Management Authority               |
| PLWD   | Persons Living with Disability                      |
| PREG   | Partnership for Resilience and Economic Growth      |
| RLA    | Resilience Learning Activity                        |
| TWG    | Technical Working Group                             |
| UKAID  | United Kingdom Agency for International Development |
| USAID  | United States Agency for International Development  |
| UN     | United Nations                                      |
| VSLA   | Village Savings and Loan Association.               |

## Introduction

Turkana County is in northwest Kenya and borders Uganda, South Sudan, and Ethiopia. It is the largest of the 47 Kenyan counties, covering 68,233 square kilometers. The county is divided into seven sub-counties and has a population of 926,976, according to the 2019 Kenya Population and Housing Census. The population is primarily young, with 52% aged 15-64 and 42% aged 0-14. Only 3% of the population is over 65 years old. The population density is 14 persons per square kilometer

Table 1: Summary of Population distribution Per Sub-county

| Sub-county      | Population |         |         | Households | Land Area (Km <sup>2</sup> ) | Density (Persons/ Km <sup>2</sup> ) |
|-----------------|------------|---------|---------|------------|------------------------------|-------------------------------------|
|                 | Total      | Male    | Female  |            |                              |                                     |
| Turkana West    | 239,627    | 123,867 | 115,758 | 45,451     | 16,779                       | 14                                  |
| Turkana Central | 185,305    | 93,145  | 92,160  | 38,173     | 6,415                        | 29                                  |
| Turkana South   | 153,736    | 78,402  | 75,329  | 24,552     | 7,045                        | 22                                  |
| Turkana East    | 138,526    | 76,871  | 61,643  | 17,981     | 11,396                       | 12                                  |
| Turkana North   | 65,218     | 32,810  | 32,408  | 13,119     | 7,012                        | 9                                   |
| Loima           | 107,795    | 54,341  | 53,453  | 19,438     | 9,120                        | 12                                  |
| Kibish          | 36,769     | 18,651  | 18,117  | 5,805      | 10,466                       | 4                                   |

The county is predominantly arid or semi-arid, with 80% classified as such. The administrative division of the county into seven sub-counties allows for more effective governance and service delivery. The sub-counties are: Loima, Turkana Central, Turkana South, Turkana West, Turkana East, Turkana North, and Kibish Sub-County. Overall, Turkana County has a diverse and complex mix of physical, social, and economic characteristics that present both challenges and opportunities for development.

Livestock keeping is the main source of livelihood for communities in Turkana County, with approximately 54% of households depending on it as their primary source of income. The remaining population consists of 20% practicing agro-pastoralism, 12% relying on fishing, and 8% relying on casual labor. Turkana County is the poorest of Kenya's 47 counties, with 79.4% of the population living below the poverty line in 2016, compared to a national average of 31.6%.

The county has a hot, dry climate with temperatures ranging from 20°C to 41°C and an average annual rainfall of 200-250mm. Rainfall is unevenly distributed both spatially and temporally, with longer rain events occurring between March and July and shorter ones occurring between October and November. These rainfall events are often intense, leading to flash flooding due to the region's low vegetation cover. Turkana County has two permanent rivers, the Turkwel and the Kerio, which flow into Lake Turkana, the largest desert lake in the world and the most saline of the Rift Valley lakes. The lake is replenished by the Omo River, which originates in neighboring Ethiopia. Seasonal riverbeds are critical for pastoralists in the county, providing sources of wet season grazing and dry season pasture reserves. Turkana County has a history of experiencing cyclical droughts. Severe droughts occurred during

Table 2: Major Drought Events and associated Small Stock Mortalities Oba, G. (1997)

| Drought's local name(s) | Year | Mortality rate (%) |
|-------------------------|------|--------------------|
| Lotiira                 | 1952 | 61                 |
| Namotor                 | 1960 | 55                 |
| Kimududu/kibekbek       | 1970 | 54                 |
| Kiyoto atang'aa/Lopiar  | 1980 | 65                 |
| Lokwakoyo/Akalkal       | 1990 | 53                 |
| Logara/epompo           | 2000 | 64                 |



The county has experienced a rise in drought frequency in recent years, with droughts happening every 1-3 years. The 2011 drought, the worst in the Horn of Africa in 60 years, caused an estimated 50-70% loss of livestock for Turkana households. Between 1963 and 2019, Turkana County experienced 30 severe droughts, with occurrences becoming more frequent in the late 1970s. The county is vulnerable to the impacts of climate change, with minimum and maximum air temperatures increasing by 2-3°C between 1967 and 2012. These shifts in precipitation patterns and rising temperatures have had severe consequences for the environment and communities, leading to increased vulnerabilities. The 2015/2016 Kenya Integrated Household Budget Survey found that 27.3% of Turkana households reported being negatively affected by droughts and floods in the previous five years. These droughts and floods affected households through income losses (42.9%), asset losses (13.0%), and both income and asset losses (38.8%).

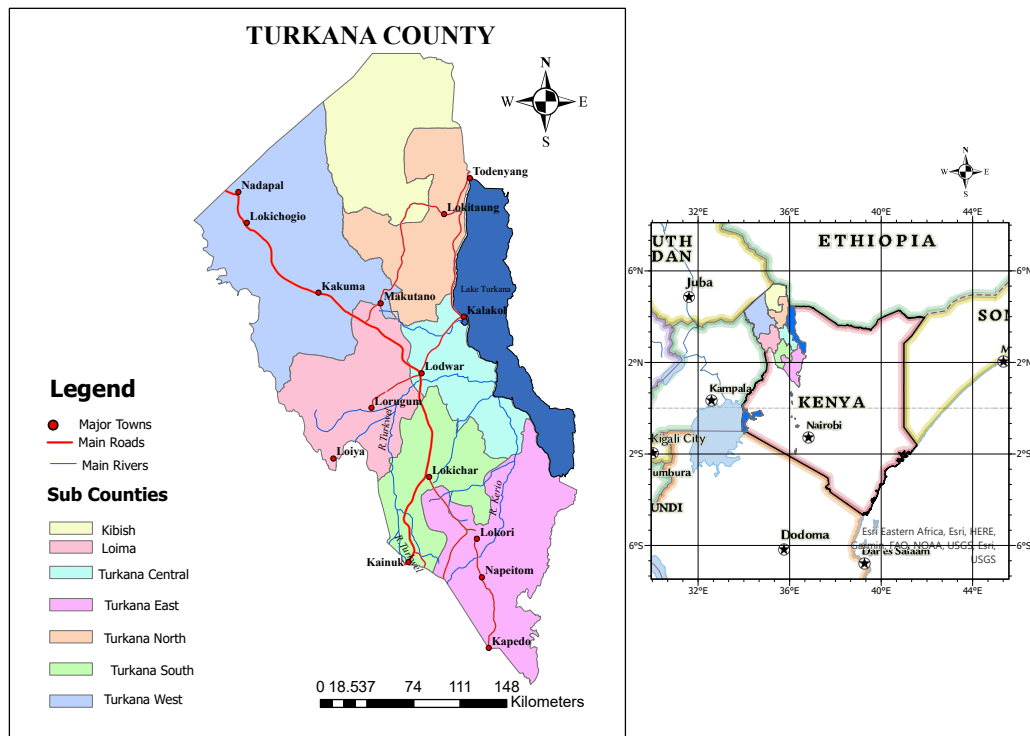


Figure 1: Map of Turkana County

Over the past five years, the County Government of Turkana, in partnership with the National Government, development partners, local communities, and the private sector, has implemented measures and mechanisms to promote disaster resilience. These efforts have saved lives, protected infrastructure, and livelihoods, and preserved social systems and the environment. This report presents the findings of a comprehensive study on the measures implemented in Turkana County to adapt to climate change. Specific objectives of the study are as below:

1. Study the analytics and trends and determine the occurrence of drought for the past 3-5 years using change detection criteria.
2. Understand the effects of drought on the livelihoods of the Turkana people using a mixed method approach i.e., qual and quant analysis.
3. Understand and document the adaptation and coping mechanisms put in place by the County Government against drought effects.
4. Document the impacts of drought on peaceful coexistence of cross border communities.
5. Highlight the policy and legislative frameworks to sustain pastoral livelihoods.
6. Highlight the importance of integrations of traditional and modern early warning systems.

## Methodology

This study used a mixed methods approach to collect and analyze both qualitative and quantitative data across all seven sub-counties in Turkana County: Turkana West, Turkana Central, Turkana South, Turkana East, Turkana North, Loima, and Kibish. This included conducting a change detection to evaluate and analyze the impacts of drought and related interventions. A desktop and literature review of existing data and documentation from the NDMA, County Government, KNBS, PREG partners, and other development agencies was conducted to understand the county context of drought response.

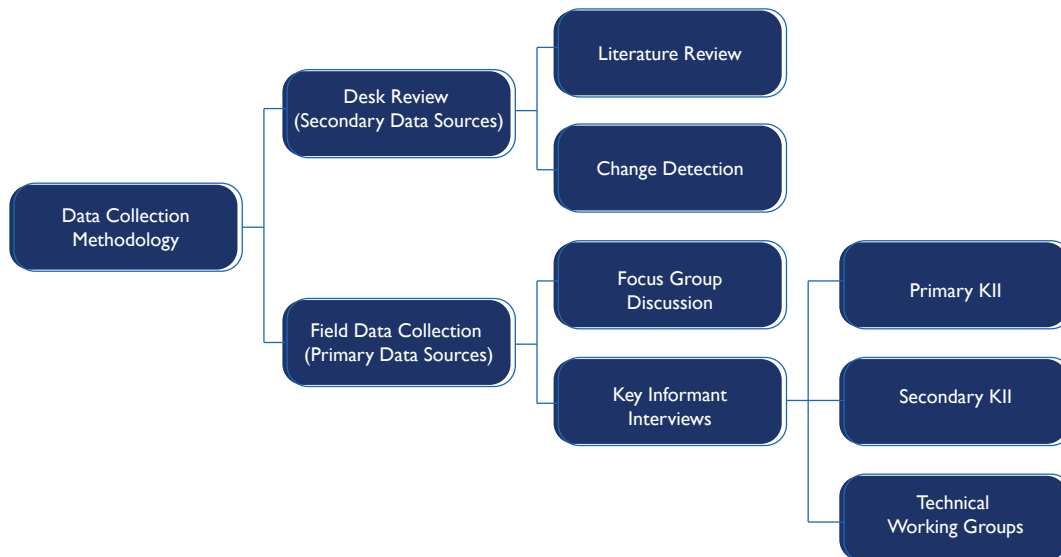


Figure 2: Study design flowchart

Primary data was collected from partner and community sources using focus group discussions (FGDs) and key informant interviews (KIIs) at selected ward level in each of the seven sub-counties. FGDs targeted various groups within the community including chiefs, village administrators, ward administrators, opinion leaders, kraal leaders, women reps, youth reps, religious reps, PLWDs, DRR, and peace committees across the seven sub-counties. Partner-level key informant interviews were also conducted with technical experts and climate-related technical working groups in the county including County Government departments, key National Government officials, NDMA, media, PREG partners, KNBS, civil society organizations (CSOs), private sector, and donors (USAID). The different approaches applied to respond to the different assessment questions are explained in the next sub-sections.

### Focus Group Discussions

In total, 22 focus group discussions (FGDs) were conducted in the seven sub-counties. Each FGD targeted 15 participants, and data was collected through surveys with both closed-ended and open-ended questions. The FGDs targeted various groups within the community, including Chiefs, Village administrators, Ward Administrators, Opinion leaders, Kraal leaders, Women reps, Youth reps, religious reps, people with disabilities, disaster risk reduction, and Peace committees. Key descriptors for the FGDs included the gender distribution of participants, the legal status of the group, the type of group, and the key areas of focus for the group.

Across all the 22 FGD's, a total of 281 participants were reached as summarized in the figure above. Out of the 281 participants, 39% were female and 69% were male. Based on the data collected, 47% of the groups under the FGD are formal, while 36% of the groups are not formalized. About 16% of the group sessions included a mix of both formalized and informal groups. A key observation from the data shows that most of the groups are community-based organizations, with representation also including local business groups, self-help groups, church-based groups, and government related groups.

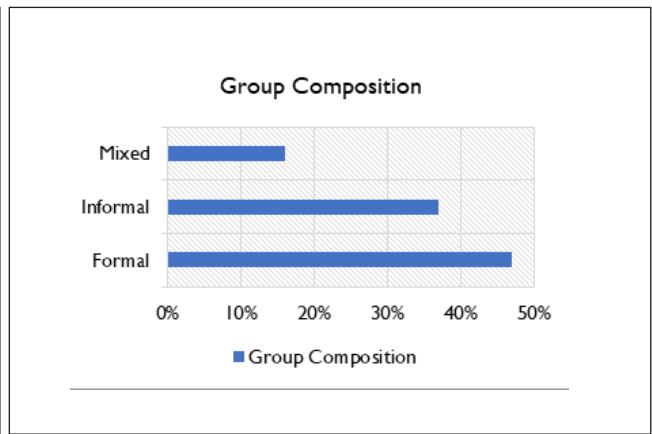
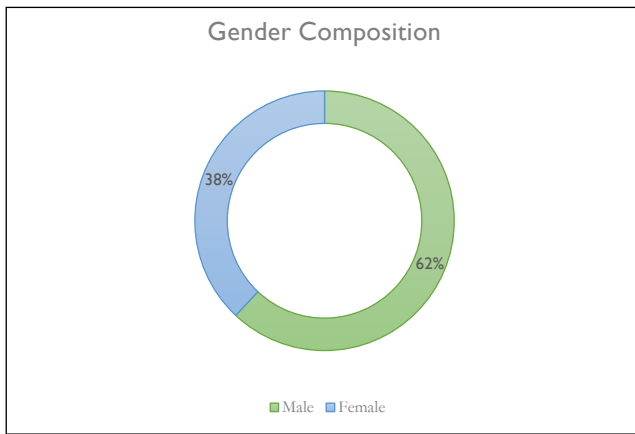


Figure 3: Formal vs. informal groups

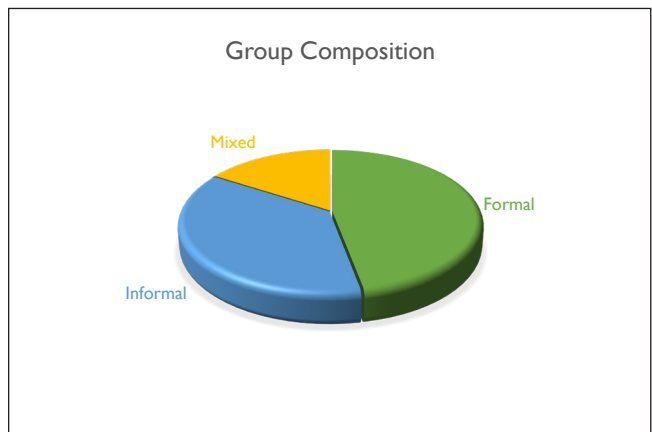
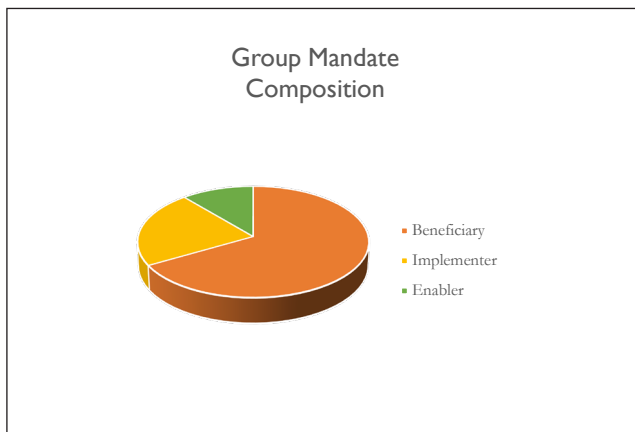


Figure 4: Gender mix of respondents per sub-county

Figure 5: Group type and composition

Most groups engage in crop farming, community mobilization and livestock rearing, only 3% represented groups working in water and sanitation as shown in the table below.

Table 3: Livelihood activities of FGD participants

| Main Activities of FGD groups | Responses |
|-------------------------------|-----------|
| Livestock Rearing             | 11        |
| Community Mobilization        | 12        |
| Climate Change Advisory       | 10        |
| Crop Farming                  | 14        |
| Land Protection and Rights    | 8         |
| Water and Sanitation          | 2         |
| Public Administration         | 7         |
| Other                         | 1         |

## Key Informant Interviews

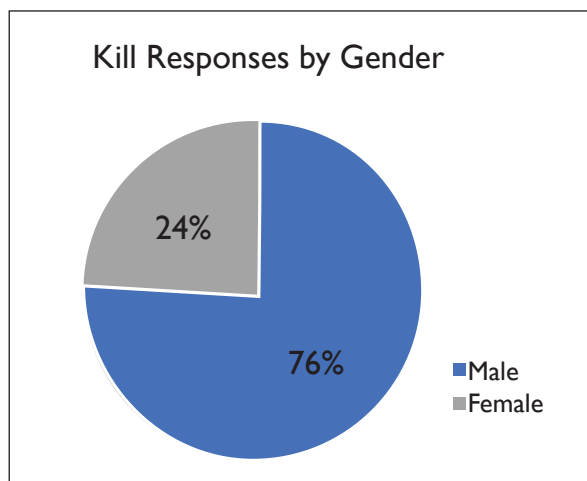


Figure 6: Gender representation of the key informants

The aim of the key informant interviews (KIIs) in this study was to collect primary data from key stakeholders involved in climate change and drought coping initiatives in Turkana County. A total of 70 KIIs were conducted across all seven sub-counties, with a target of 10 KIIs per sub-county. The primary KIIs were defined as interviews with community leaders in the locale of the target focus groups and were conducted as a follow-up to the focus group discussions to validate or authenticate the information collected. A total of 38 key informants across the seven sub-counties in the 22 sampled sites were interviewed. The age distribution of the respondents was 15.8% above 50 years, 53% between 35 and 50 years, 29% between 25 and 35 years, and 2% between 18 and 25 years. Approximately 82% of the KII respondents were youth between 25 and 35 years, bringing the total youth representation to approximately 32%. The gender distribution of the respondents was 24% female and 76% male.

Table 4: Designations of the primary KII's

| What is the designation of the Key Informant in the community? | No. of Informants |
|--|-------------------|
| Area/Assistant Chief   | 7                 |
| Community Representative                                       | 5                 |
| Official Climate Committee                                     | 1                 |
| Village/Ward Administrator/Elder/Representative                | 24                |
| Youth Representative   | 2                 |

## Data Analysis

The study employed a variety of statistical methods, including counts, percentages, means, medians, modes, proportions, standard deviations, variances, frequencies, and histograms, to analyze data obtained from focus group discussions and key informant interviews. Inter-comparisons between sub-counties were made using categorical, interval, and ordinal variables. Remote sensing data was utilized to detect changes in land use and land cover, utilizing the 10-day eMODIS dataset with a temporal resolution of 10 days and a spatial resolution of 250m, supplemented by the high-resolution Sentinel 2 dataset which offers a temporal resolution of 10 days and a spatial resolution of 10m. Image pre-processing was conducted using open-source GIS software (QGIS, Python). A trend analysis was developed to identify weather and climate patterns and changes, and maps and graphs were generated for visualization. The study also referenced literature on drought occurrence and correlated this with responses from focus group discussions and key informant interviews, as well as drought recall, change detection, and time series analysis of CHIRPS and e-MODIS rainfall and NDVI data to examine drought occurrences in the county over the past decade.

# Drought Mapping

To identify and evaluate the effectiveness of interventions for addressing drought events in Turkana County, policy makers and development partners require verifiable data and information. To gather this data, we employ three methods: recall exercises based on focus group discussions and key informant interviews, remote sensing data analysis utilizing change and anomaly detection techniques applied to both normalized difference vegetation index and rainfall data, and correlation of the resulting datasets to create a validated dataset for decision-making purposes. Our aim is to use these methods to map drought events across the county and inform more effective interventions.

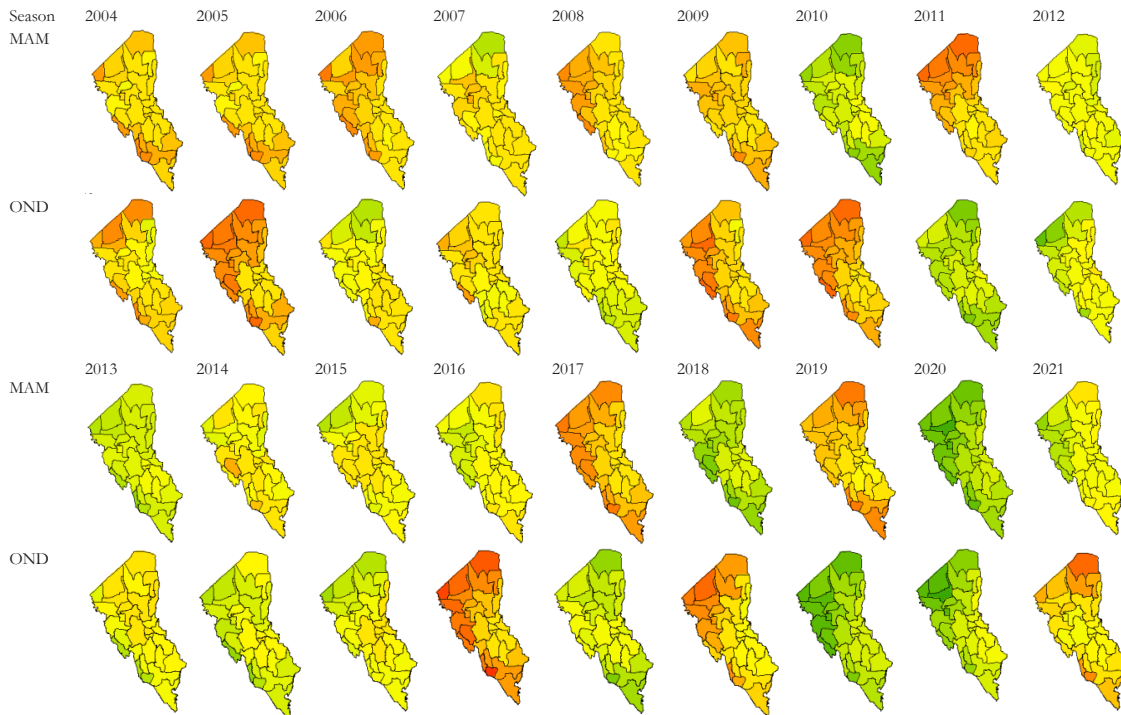


Figure 7: Spatiotemporal analysis of Seasonal NDVI trends

The data indicates a strong positive correlation between the responses from focus group discussions and key informant interviews regarding drought years. The trend from past to present is somewhat skewed due to the subjectivity of recall exercises and the potential for time-based recollection bias. Most of the key participants in the study identified the current year (2022) as being severely affected by drought, with the years 2021, 2020, 2019, 2018, and 2017 also experiencing significant drought conditions. The data suggests that drought has been prevalent and worsening in recent

Table 5: Drought occurrence correlation between FGD and KII responses

| Historical Years     | Respondent Types | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|----------------------|------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Kibish               | FGD              |      |      |      |      |      | ●    | ●    |      | ●    | ●    | ●    |      |      | ●    | ●    |
|                      | KII              |      | ●    |      |      |      |      |      | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    |
| Loima                | FGD              | ●    | ●    |      |      | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    |
|                      | KII              | ●    |      | ●    |      | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    |
| Turkana Central      | FGD              |      |      |      | ●    |      |      |      | ●    |      | ●    |      |      |      | ●    | ●    |
|                      | KII              |      |      |      |      | ●    | ●    |      |      |      | ●    |      |      | ●    | ●    | ●    |
| Turkana East         | FGD              |      | ●    |      |      |      | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    |
|                      | KII              |      | ●    | ●    | ●    |      |      | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    |
| Turkana North        | FGD              | ●    |      |      |      |      | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    |
|                      | KII              | ●    | ●    |      |      |      | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    |
| Turkana South        | FGD              |      | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    |
|                      | KII              | ●    | ●    | ●    |      |      | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    |
| Turkana West         | FGD              | ●    | ●    |      |      |      | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    |
|                      | KII              |      | ●    |      | ●    |      | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    | ●    |
| Summary of FGD       |                  | ● 3  | ● 6  | ● 2  | ● 2  | ● 1  | ● 4  | ● 6  | ● 4  | ▲ 10 | ▲ 13 | ▲ 13 | ▲ 10 | ▲ 11 | ▲ 13 | ▲ 16 |
| Summary of KII       |                  | ● 7  | ● 5  | ● 4  | ● 3  | ● 2  | ● 6  | ● 8  | ● 7  | ● 9  | ▲ 11 | ▲ 13 | ▲ 17 | ▲ 14 | ▲ 19 | ◆ 28 |
| Summary of responses |                  | 10   | 11   | 6    | 5    | 3    | 10   | 14   | 11   | 19   | 24   | 26   | 27   | 25   | 32   | 44   |

Correlation (KII/FGD) 88%

To validate the accuracy of the data collected through recall exercises, this study also employed remote sensing and GIS techniques using available satellite datasets. Specifically, the study analyzed drought in different sub-counties of Turkana County using eMODIS Normalized Difference Vegetation Index (NDVI) data and Climate Hazards Group Infrared Precipitation with Station data (CHIRPS). The analysis revealed drought occurrences in 2005, 2006, 2007, 2009, 2011, 2016, 2017, and 2021, with the sub-counties of Kibish, Turkana North, Turkana West, and Turkana South being the most affected.

To identify drought events, the study used a time series of eMODIS vegetation and CHIRPS rainfall data from 2003 to 2022 and employed statistical analysis to generate thresholds based on the mean value. Droughts were then identified and categorized based on frequency and severity, using the MAM and OND rainfall seasons of the year (totaling six months). Results from the analysis of CHIRPS rainfall data indicated that the years 2004, 2005, 2007, 2008, 2009, 2014, 2016, 2017, and 2021 were particularly affected by drought, based on the frequency and severity of drought events across the MAM and OND months. In contrast, analysis of eMODIS vegetation data identified 2003, 2004, 2005, 2007, 2009, and 2016 as the years most affected by drought, based on the frequency and severity of vegetation reductions.

## Early Warning Systems and Sources of Drought Information

Early Warning Systems (EWS) have been identified as a critical element since it provides for early action that can be very crucial in the prevention of losses, be it life or economic. Indigenous knowledge is still intact amongst the Turkana Community with the community's vast body of knowledge on early warning indicators and preparedness mechanisms being part of a well-structured, time-proven social system inclined towards reconciliation, maintenance, and improvement of socioeconomic relationships. The methods, processes and regulations are deeply rooted in the customs and beliefs of the people. However, the Indigenous knowledge and skills are not applied to mitigate prevailing risks. As a coping mechanism, the Turkana communities devised ways and means of determining upcoming droughts to continue sustaining their livelihoods, and most recently there has been incorporation of modern early warning systems which the communities have also adopted. The diverse sources of drought information and their ability to reach respondents on time plays a leading role in ensuring that responsive decision making is done. Through this research that involved FGD and KII, we determine traditional drought early warning detection methods, the current/modern early warning drought detection methods, and sources of drought information in Turkana County.

## Traditional Early Warning Drought Detection Methods

Table 6: Traditional early warning drought detection methods

| Traditional drought detection methods           | Kibish |     | Loima |     | Turkana Central |     | Turkana East |     | Turkana North |     | Turkana South |     | Turkana West |     | Total FGD | Total KII | Percentage |    |
|---|--------|-----|-------|-----|-----------------|-----|--------------|-----|---------------|-----|---------------|-----|--------------|-----|-----------|-----------|------------|----|
|   | FGD    | KII | FGD   | KII | FGD             | KII | FGD          | KII | FGD           | KII | FGD           | KII | FGD          | KII |           |           |            |    |
| Migration of birds & wild animals               |        | 1   | 1     | 1   |                 |     | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 5         | 6         | 9%         |    |
| Wind direction                                  | 1      | 1   | 1     | 1   |                 |     | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 4         | 7         | 9%         |    |
| Study of animal meat & intestines               | 1      | 1   | 1     | 1   |                 |     | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 7         | 3         | 9%         |    |
| Shedding of leaves from trees                   |        | 1   | 1     | 1   | 1               | 1   | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 4         | 6         | 9%         |    |
| Drying of permanent rivers & water sources      |        | 1   |       | 1   | 1               | 1   | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 3         | 7         | 9%         |    |
| Observation of stars & moon                     | 1      | 1   | 1     | 1   | 1               | 1   | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 5         | 5         | 9%         |    |
| Traditional seers                               | 1      | 1   | 1     | 1   | 1               | 1   | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 4         | 5         | 8%         |    |
| Migration of human in search of water & pasture |        | 1   | 1     | 1   | 1               | 1   | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 2         | 6         | 7%         |    |
| Increased temperatures                          |        | 1   |       | 1   | 1               | 1   | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 2         | 6         | 7%         |    |
| Drying of pasture                               |        | 1   | 1     | 1   | 1               | 1   | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 3         | 3         | 5%         |    |
| Animal diseases & deteriorated health           |        | 1   | 1     | 1   | 1               | 1   | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 1         | 4         | 4          | 4% |
| Death of livestock                              |        |     | 1     | 1   | 1               | 1   | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 3         | 0         | 3%         |    |
| Yearly & seasonal calendar review               |        |     |       |     |                 |     | 1            | 1   |               |     |               |     | 1            | 1   | 2         | 0         | 2%         |    |
| Increased insecurities                          |        |     |       |     |                 |     | 1            | 1   |               |     |               | 1   | 1            | 1   | 2         | 0         | 2%         |    |
| Lack of rain/ excess rains                      |        |     |       | 1   |                 |     |              |     |               |     |               | 1   | 1            | 1   | 1         | 1         | 2%         |    |
| Wild Fruits Disappearance                       |        | 1   |       |     |                 |     |              |     |               |     |               |     |              |     | 0         | 1         | 1%         |    |
| Shortage of food                                |        |     |       |     | 1               | 1   | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 1         | 0         | 1          | 1% |
| Diseases & malnutrition in communities          |        |     |       |     | 1               | 1   | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 1         | 0         | 1          | 1% |
| Destabilized livestock markets                  |        |     |       |     | 1               | 1   | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 1         | 0         | 1          | 1% |
| Lack of adequate fish                           |        |     |       |     | 1               | 1   | 1            | 1   | 1             | 1   | 1             | 1   | 1            | 1   | 1         | 0         | 1          | 1% |
| Death Of Wild Animals                           |        |     |       |     |                 |     |              |     |               |     |               | 1   | 1            | 1   | 0         | 1         | 1%         |    |
| Low Livestock Yield                             |        |     |       |     |                 |     |              |     |               |     |               | 1   | 1            | 1   | 0         | 1         | 1%         |    |
| Locust Infestation                              |        |     |       |     |                 |     | 1            | 1   |               |     |               | 1   | 1            | 1   | 0         | 1         | 1%         |    |
| Through Dreams                                  |        |     |       | 1   |                 |     |              |     |               |     |               |     |              |     | 0         | 1         | 1%         |    |

As summarized in the table above, the communities have quite strong traditional drought detection mechanisms which have been passed down from one generation to another. Some of the notable methods common within most of the sub-counties both from the KII and FGD data collected shows that migration of animals, wind direction, study of animal intestines and shedding of leaves are among the key techniques traditionally used to detect drought.

## Modern and Current Early Warning Drought Detection Methods

Turkana county also significantly employs modern drought detection methods largely supported through use of technology and communication channels. KII and FGD interviews conducted provide data that shows that meteorological alerts and local radio stations are the key dissemination channels used to alert the communities for drought preparation. Other sources used to provide the communities with information related to drought forecasts include , county government information and NGO awareness programmes as summarized below.

Table 7: Modern and current early warning drought detection methods

| Modern/ Current Drought detection forms | Kibish |     | Loima |     | Turkana Central |     | Turkana East |     | Turkana North |     | Turkana South |     | Turkana West |     | Total FGD | Total KII | Percentage |
|---|--------|-----|-------|-----|-----------------|-----|--------------|-----|---------------|-----|---------------|-----|--------------|-----|-----------|-----------|------------|
|   | FGD    | KII | FGD   | KII | FGD             | KII | FGD          | KII | FGD           | KII | FGD           | KII | FGD          | KII |           |           |            |
| Meteorological alerts                   | ✓      | 1   | ✓     | 1   | ✓               | 1   | ✓            | 1   | ✓             | 1   | ✓             | 1   | ✓            | 1   | 6         | 7         | 14%        |
| Local radio stations                    | ✓      | 1   | ✓     | 1   | ✓               | 1   | ✓            | 1   | ✓             | 1   | ✓             | 1   | ✓            | 1   | 6         | 7         | 14%        |
| Refer to traditional                    |        | ✓   | 1     | ✓   | 1               | ✓   | 1            | ✓   | 1             | ✓   | 1             | ✓   | 1            | 4   | 5         | 10%       |            |
| County government information           | ✓      | 1   | ✓     | 1   | ✓               | 1   | ✓            | 1   | ✓             | 1   | ✓             | 1   | ✓            | 1   | 3         | 5         | 9%         |
| Television networks                     |        |     | ✓     | 1   | ✓               | 1   | ✓            | 1   | ✓             | 1   | ✓             | 1   | ✓            | 1   | 3         | 4         | 8%         |
| NGO awareness programmes                |        |     | ✓     | 1   | ✓               | 1   | ✓            | 1   | ✓             | 1   | ✓             | 1   | ✓            | 1   | 3         | 4         | 8%         |
| Increased price of food commodities     |        | ✓   | 1     | ✓   | 1               | ✓   | 1            | ✓   | 1             | ✓   | 1             | ✓   | 1            | 3   | 3         | 7%        |            |
| SMS alerts                              |        | ✓   | 1     | ✓   | 1               | ✓   | 1            | ✓   | 1             | ✓   | 1             | ✓   | 1            | 2   | 3         | 5%        |            |
| Newspapers                              |        |     | ✓     | 1   | ✓               | 1   | ✓            | 1   | ✓             | 1   | ✓             | 1   | ✓            | 1   | 3         | 1         | 4%         |
| NDMA : flag colour change               |        |     | ✓     | 1   | ✓               | 1   | ✓            | 1   | ✓             | 1   | ✓             | 1   | ✓            | 1   | 2         | 2         | 4%         |
| Internet*                               |        |     | ✓     | 1   | ✓               | 1   | ✓            | 1   | ✓             | 1   | ✓             | 1   | ✓            | 1   | 0         | 4         | 4%         |
| Malnutrition in the community           |        |     | ✓     | 1   | ✓               | 1   | ✓            | 1   | ✓             | 1   | ✓             | 1   | ✓            | 1   | 3         | 0         | 3%         |
| Theft & insecurities                    |        |     | ✓     | 1   | ✓               | 1   | ✓            | 1   | ✓             | 1   | ✓             | 1   | ✓            | 1   | 2         | 0         | 2%         |
| Scarcity of water                       |        |     | ✓     | 1   | ✓               | 1   | ✓            | 1   | ✓             | 1   | ✓             | 1   | ✓            | 1   | 2         | 0         | 2%         |
| Local weather equipments                |        |     | ✓     | 1   | ✓               | 1   | ✓            | 1   | ✓             | 1   | ✓             | 1   | ✓            | 1   | 0         | 2         | 2%         |
| Observation of weather patterns         |        | ✓   | 1     | ✓   | 1               | ✓   | 1            | ✓   | 1             | ✓   | 1             | ✓   | 1            | 0   | 2         | 2%        |            |
| Religious institutions                  |        |     | ✓     | 1   | ✓               | 1   | ✓            | 1   | ✓             | 1   | ✓             | 1   | ✓            | 1   | 0         | 1         | 1%         |

## Sources of Drought Information

Table 8: Sources of drought information

| Source of drought information | Kibish | Loima | Turkana Central | Turkana East | Turkana North | Turkana South | Turkana West |
|-------------------------------|--------|-------|-----------------|--------------|---------------|---------------|--------------|
| Local radio stations          | ✓      | ✓     | ✓               | ✓            | ✓             | ✓             | ✓            |
| County government information | ✓      | ✓     | ✓               | ✓            | ✓             | ✓             | ✓            |
| NGO awareness programmes      | ✓      | ✓     | ✓               | ✓            | ✓             | ✓             | ✓            |
| SMS alerts                    | ✓      | ✓     | ✓               | ✓            | ✓             | ✓             | ✓            |
| Internet                      | ✓      | ✓     | ✓               | ✓            | ✓             | ✓             | ✓            |
| Traditional seers             |        | ✓     | ✓               | ✓            | ✓             | ✓             | ✓            |
| Friend & neighbours           |        | ✓     | ✓               | ✓            | ✓             | ✓             | ✓            |
| NGO awareness programmes      |        |       | ✓               | ✓            | ✓             | ✓             | ✓            |
| Newspapers                    |        |       |                 |              |               |               | ✓            |

Drought information sources used to provide the communities with information related to drought forecasts include county government information and NGO awareness programmes.

## Impacts and Coping Mechanisms

### Impacts of Drought on Livelihoods

To effectively address drought and improve resilience, it is important to understand the economic activities that communities rely on for their livelihoods and to strengthen systems and value chains in these areas. In Turkana County, livestock rearing, and trading is the primary economic activity, but fishing, crop production, and small-scale agroforestry also play important roles in some areas. Other economic activities that contribute to community livelihoods include firewood collection, weaving, charcoal burning, and retail businesses. Drought impacts these economic activities in various ways, including livestock death, reduced crop production, drying of water sources, unaffordable commodity prices, increased animal diseases, poor animal health, low livestock prices, starvation and food insecurity, diseases, and

Over the past four decades, the ability of Turkana people to sustain their livelihoods through nomadic pastoralism has been increasingly challenged by population growth and drought events, which have contributed to environmental degradation. These factors have led to significant losses in livestock, which form the main source of livelihood for nearly 54% of the Turkana population. Some of the effects of drought on pastoral livelihoods identified by this study include conflicts and disputes over limited resources, often resulting from migration in search of pasture and water, drying of pasture, migration,. Other impacts include increased theft and crime, animal diseases and poor health, water scarcity, death of livestock, human diseases and malnutrition, low animal produce, increased pests and diseases, and reliance on aid for survival as summarized below.

Table 9: Impact of drought on pastureland

| Drought on access to pastureland       | Severity |
|--|----------|
| Conflicts & disputes                   | 21.95%   |
| Drying of pasture                      | 21.95%   |
| Migration in search of pasture & water | 14.63%   |
| Theft & crime                          | 9.76%    |
| Animal diseases & deteriorated health  | 7.32%    |
| Scarcity of water                      | 7.32%    |
| Death of livestock                     | 4.88%    |
| Human diseases & malnutrition          | 2.44%    |
| Low animal produce                     | 2.44%    |
| Pests & diseases                       | 2.44%    |
| Purchase of pasture                    | 2.44%    |
| Reliance on aid for survival           | 2.44%    |

### Agriculture and Irrigation

Over the past few decades, the increasing frequency and severity of droughts in Turkana has led state and non-state agencies to promote an agenda of incorporating irrigated agriculture and fishing as alternative livelihoods and settlement options that make it easier to provide access to services such as clean water, health care, and education. Drought has a significant impact on food access for Turkana communities, exacerbating hunger and starvation. The study found that the severity of drought's impact varies from one sub-county to another and has significant consequences, including increased food prices, rationing at the household level, and shortages at the community level. Drought also causes malnutrition, worsens deforestation, and affects all aspects of social, economic, and environmental areas.

### Education, Skills, Literacy, and Infrastructure

Turkana County has a low adult literacy rate of 20%, compared to the national average of 92%. Only half of school-age children in Turkana are enrolled in primary school. The number of primary schools in the county increased from 315 in 2013 to 389 in 2017, and the number of secondary schools increased from 2013 to 56 in 2017. Turkana University College, a constituent college of Masinde Muliro University of Science and Technology, is the only university in the county. The Kenya Medical Training College is also located in Lodwar. Drought significantly impacts access to education in



Turkana, leading to high rates of school dropouts due to lack of access to food and tuition fees. Many of these dropouts engage in early marriages as a means of escaping poverty.

## Women Youth and Gender

Currently, women make up approximately 50% of the population of Turkana County. While the Turkana society is largely patriarchal, changing drought conditions have led to transformations in the sociocultural and socioeconomic organization, with women playing an increasingly active role in helping families cope with these changes. Despite this increased involvement, women in Turkana are still more vulnerable to food insecurity and poverty, as they have low levels of participation in leadership, management, and decision-making positions. When it comes to asset ownership, women and youth are disadvantaged, as girls do not gain ownership of land, livestock, farms, or fishing nets, and the income from these assets belongs to men. Only 0.05% of elected members in Turkana County are female.

## Water and Sanitation

According to the United Nations, approximately 80% of people living in Turkana do not have access to the 50 liters of water per day that is required to meet most basic water needs. Poor sanitation in Turkana County costs 1.1 billion KES per year, and the rate of open defecation is 86.1%. In response, the county has implemented the Community Led Total Sanitation (CLTS) strategy, which focuses on behavior change rather than provision of hardware and seeks to create villages free of open defecation. Water is essential for the livelihoods of Turkana communities, as it is needed for household use, livestock survival, and crop production. The key effects of drought on access to water include drying up of sources of water such as dams, rivers, wells, and boreholes, migration, and long travels in search of water that can lead to conflicts and disputes at water points, and water-borne diseases within communities.

## Peaceful Coexistence

Drought has significant implications for conflict and peaceful coexistence. Turkana County has successfully reduced conflict along its international borders with Uganda, Ethiopia, and South Sudan through the implementation of national and county government-supported treaties. Inter-County border conflicts however still remain rampant. 51.43% of respondents noted that drought-induced migration in search of pasture and water resulted in increased conflict with neighboring communities. Additionally, droughts are associated with increased theft and crime, intermarriages for the purpose of promoting peace, loss of human lives, and hoarding of limited resources as summarized in the figure below. The Turkana County government faces challenges in managing conflicts along its internal borders with Baringo, West Pokot, Marsabit, and Samburu Counties, with the Baringo and West Pokot borders experiencing the most frequent conflicts. Political goodwill among local politicians is also seen as a key factor in finding effective solutions to these

Table 10: Drought impact on peaceful co-existence

| Drought impact on peaceful co-existence | Severity |
|---|----------|
| Conflict & insecurities                 | 51.43%   |
| Migration in search of pasture & water  | 17.14%   |
| Theft & crime                           | 17.14%   |
| Intermarriages to promote peace         | 5.71%    |
| Loss of human lives                     | 5.71%    |
| Hoarding of limited resources           | 2.86%    |

## Community Adaptation and Coping Mechanisms

In relation to the impact on the community's livelihood, there are several coping mechanisms that the communities employ to overcome drought impacts. Based on the location and other characteristics of the community, different communities reported diverse coping mechanisms that they employ to cope with droughts, amongst them, sale of livestock, migration in search of water and pasture, food preservation, food rationing, eating wild fruits, seeking help from government & donor agencies, venturing into other businesses, small scale trading, migrating to urban areas in search for employment, charcoal burning, firewood collection and weaving.

# Drought Response and Interventions

## Policy and Interventions.

Before devolution, the National Government, aided by donor support, implemented short-term, project-based interventions in response to increasingly frequent and intense drought periods that threatened household food security and livelihoods. Humanitarian interventions, largely conducted by the Kenyan government in collaboration with organizations such as Oxfam, increased in scale beginning in 1963, with the first large-scale distribution of food relief occurring in response to the 1960-1961 drought. Due to recurrent severe droughts and minimal state investment in development and public services, Turkana became a primary recipient of relief assistance, with Christian missions and international aid organizations playing a significant role in providing social services to the predominantly rural Turkana population, intermittently throughout the 1960s, 1980s, and 1990s. According to Akall (2021), there have been at least four major relief operations supported by international organizations in Turkana since 1991. While reactive drought response efforts have reduced human mortality rates, they have generally failed to enhance the adaptation and coping strategies of pastoralists to reduce their vulnerability to drought and prepare for future extreme climate events.

In recognition of the need to improve the sustainability and quality of drought management in the country, the National Drought Management Authority (NDMA) was established in 2011, with the mandate of coordinating drought risk management and ending drought emergencies. NDMA is the national agency responsible for incorporating risk reduction and climate adaptation into planning, as well as implementing social protection programs in food-insecure populations and implementing strategic projects that improve drought preparedness in the country. The NDMA also prepares, consolidates, and disseminates drought early warning information through the management of the early warning system, participation in national and county food security measures, communication of the current drought status, and mapping of vulnerable zones (NDMA, 2017). The NDMA has several drought mitigations approaches, including the use of global standard indicators for providing early warning

## Policy Adoption by County Government

The national government is also responsible for developing national policies, which county governments are expected to streamline into county-level policies for devolved functions. In this regard, the Ministry of Devolution and ASALs has a mandate to develop policies on ASALs, including those related to socio-economic development, special programs, and food relief management.

The County government of Turkana has implemented several key policies and initiatives to improve drought response and increase drought resilience in the last 10 years. These include the establishment of a County Disaster Management Unit (CDMU) and a County Risk Reduction Fund (2010); the adoption of a County Disaster Risk Reduction and Management Strategy (2011); the introduction of the Turkana Disaster Risk Reduction and Resilience Framework (2013); and the establishment of the Turkana County Climate Change Adaptation and Mitigation Programme (2014). Other initiatives include the development of the Turkana County Drought Early Warning System (2015), the Turkana County Drought Management Plan (2016), the Turkana Drought Risk Reduction Fund (2017), the Turkana County Climate Change Information Portal (2018), and the Turkana County Climate Change Adaptation and Mitigation Fund (2019). The impact of these policies and initiatives has been significant in improving the county's drought response and resilience. For example, the County Disaster Management Unit has been instrumental in developing and implementing a comprehensive drought risk reduction and management strategy, while the Turkana County Climate Change Information Portal has provided access to useful information and data on climate change and drought. The Turkana County Climate Change Adaptation and Mitigation Programme has also provided a platform for communities to adapt and mitigate the effects of climate change. Through these interventions, the county government has enabled interventions targeting broadly the following areas.

1. **Turkana County Integrated Drought Management Plan:** This plan outlines a range of strategies for reducing the impacts of drought on the local population, including water conservation, irrigation, and improved natural resource management.
2. **Water resource management:** The county government has implemented several initiatives to improve the management of water resources, including the construction of new water reservoirs and the rehabilitation of existing ones, as well as the expansion of irrigation schemes.

3. **Natural resource management:**The county government is working with local and international organizations to improve the management of natural resources, including through the establishment of protected areas and the promotion of sustainable land use practices.
4. **Drought-resistant crops and irrigation systems:**The county government is promoting the use of drought-resistant crops and other adaptation strategies, such as the construction of water harvesting systems and the establishment of early warning systems for drought.
5. **Training and capacity building:**The county government is providing training and capacity building support to local communities, including in sustainable farming practices and financial management, to help them better cope with drought and build more resilient livelihoods.
6. **Disaster risk reduction:**The county government is working to improve the county’s disaster risk reduction and emergency response capabilities, including through the establishment of early warning systems and the development of contingency plans for drought and other disasters.

### Role of Developmental Partners and Key Interventions

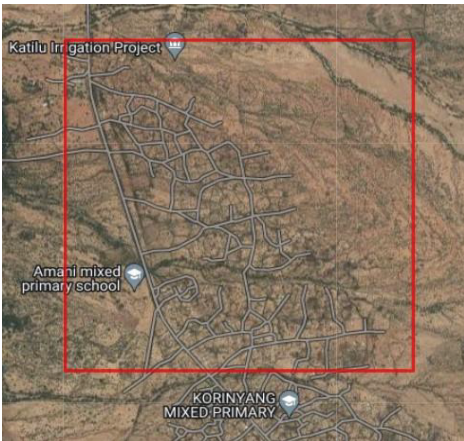
The goal of developmental actors in response to drought has mainly been to secure livelihoods and increase income for the pastoralists of Turkana County, to increase the communities’ capacity to withstand future droughts and livestock disease epidemics. Current interventions identified across all the 7 sub-counties include livestock related programmes, water and sanitation interventions, food security and environmental protections programmes. Livestock interventions involve livestock vaccination, livestock restocking, rangeland management, preservation of grassland and fodder production and purchase. Water and sanitation response includes emergency water trucking, protection of water sources & catchments and building of water security and infrastructure such as dams, water pans and boreholes. Programmes related to food security include direct food aid, irrigation schemes for crop production and introduction of climate smart agricultural practices, while environmental protection interventions flood control, re-afforestation, agro-forestry, introduction of clean cooking technologies programs. Infrastructural interventions not related to drought, but key in improving the community’s livelihood include construction of schools and improved road network. Post drought interventions usually rolled out to support recovery after drought events include cash transfers programs, kitchen gardening, and programs that target small enterprises through provision of loans and credit facilities. These are majorly implemented through government and donor aid. We outline some of the interventions by key partners in the table below.

Table 11: USAID PREG Partners Supported Projects

| USAID PREG Partners Supported Projects            |                         |   |  |
|---|-------------------------|---|--|
| Project   | Implementing Partners   | Location  | Impact   |
| Youth Empowerment and Livelihoods (2018-2023)     | ActionAid International | Lodwar, Kalokol, and Turkana Central sub-counties           | Improved economic opportunities for youth through vocational training and entrepreneurship support   |
| Wind Power Project (2017-2022)                    | KenGen                  | Turkana West sub-county                                     | Increased access to clean and reliable electricity in the region   |
| Water, Sanitation, and Hygiene (WASH)-(2019-2024) | WaterAid                | Turkana West, Turkana South, and Turkana North sub-counties | Improved access to safe and clean water, sanitation, and hygiene facilities for communities in the region  |
| Agriculture and Food Security (2017-2022)         | World Vision            | Turkana West, Turkana South, and Turkana North sub-counties | Improved food security and livelihoods for small-scale farmers through the promotion of sustainable agriculture practices and access to market opportunities |

|   |  |   |  |
|---|--|---|--|
| Health Systems Strengthening (2018-2023)            | John Snow, Inc.                          | Turkana West, Turkana South, and Turkana North sub-counties | Improved access to quality healthcare services through the strengthening of the health systems and capacity building of health workers                                 |
| Education and Skills Development (2019-2024)        | Save the Children                        | Turkana West, Turkana South, and Turkana North sub-counties | Improved access to education and skills development for children and youth in the region through the construction of schools and training programs                     |
| Renewable Energy and Energy Efficiency (2018-2023)  | Practical Action                         | Turkana West, Turkana South, and Turkana North sub-counties | Increased access to clean and reliable energy through the promotion of renewable energy technologies and energy efficiency measures                                    |
| Pastoralist Livelihoods and Resilience (2019-2024)  | Mercy Corps                              | Turkana West, Turkana South, and Turkana North sub-counties | Improved resilience and livelihoods for pastoralist communities through the promotion of sustainable livestock management practices and access to market opportunities |
| Emergency Drought Response (2018-2019)              | Save the Children                        | Turkana West, Turkana South, and Turkana North sub-counties | Improved access to food, water, and other emergency assistance for communities affected by drought   |
| Community-Based Disaster Risk Reduction (2017-2022) | International Organization for Migration | Turkana West, Turkana South, and Turkana North sub-counties | Improved preparedness and response to disasters through the establishment of community-based disaster risk reduction committees and training programs.                 |

## Case Study: Using Change Detection in Drought Response Interventions



Change detection can be employed to spatially track and analyze some of the Key irrigation interventions implemented in the county in the last 5 years. For this exercise, we sample Katilu Irrigation Scheme in Turkana South, one of the interventions by the national government and the county government that was identified during the FGD and KII exercise. Using change detection and the location of the scheme, we can calculate and quantify the change in the land cover based on NDVI.

Figure 8: Katilu irrigation scheme location

We calculate the NDVI of our area of interest for the period 2017 and our year of reference to establish the level of change in greenness

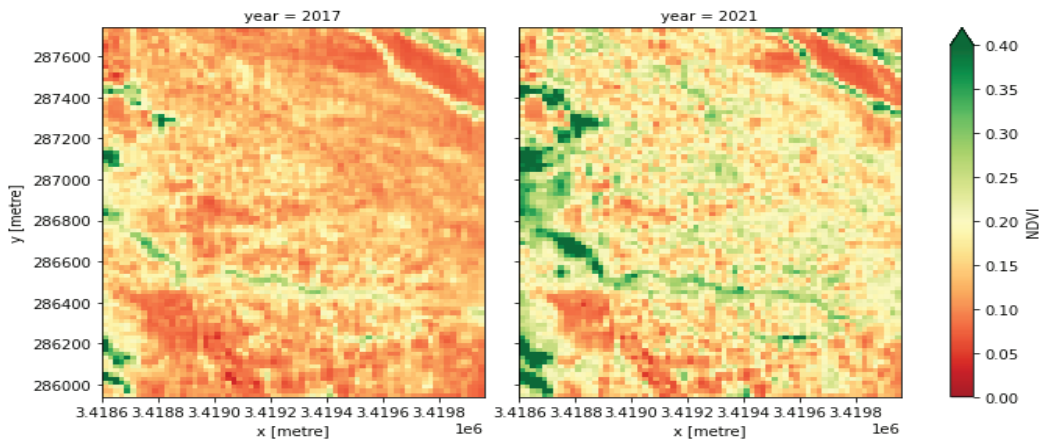


Figure 9: NDVI calculation of AOI in 2017 and 2021

We then calculate the difference between the two time periods to establish the changes that have occurred.

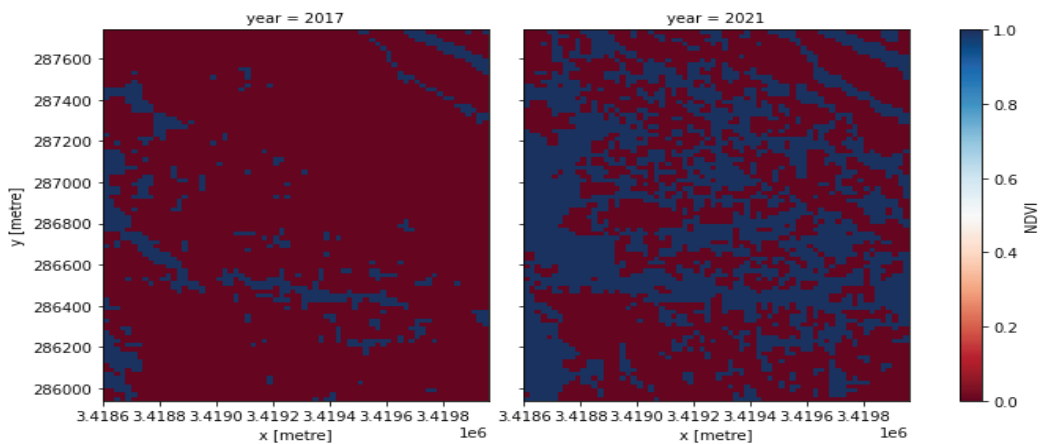
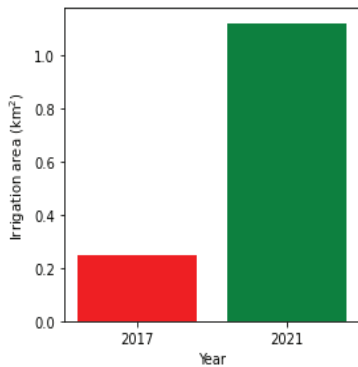


Figure 10: Visual inspection of change

From the above diagram we can visually inspect and identify the areas under irrigation in 2017 and the total area under irrigation as of 2021. To quantify this, we can plot the actual change and quantify this output in a graph.



From the above plot, the Irrigation extent in 2017 was 0.246 km<sup>2</sup> while in 2021 the irrigation extent is 1.124 km<sup>2</sup>. This represents an increase of land under irrigation by nearly 4 times or 400%. This is for our chosen sample area. To further identify and quantify the impact of some of the interventions at scale, we sample Lotubae Irrigation scheme, a larger scheme in Turkana East County. A true colour image of the scheme in 2017 and 2021 are plotted as below

Figure 11: Quantifying change using histogram analysis of NDVI

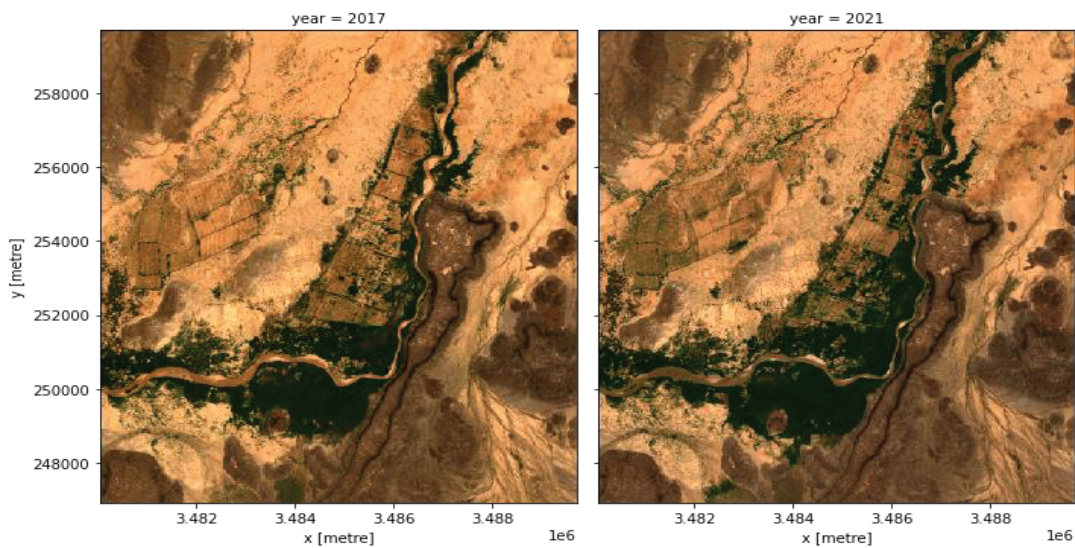


Figure 12: True colour image of Lotubae irrigation scheme

From the true color image, we can see changes but not very clearly and it is important to quantify these changes. We calculate and plot the NDVI images of the region as shown below

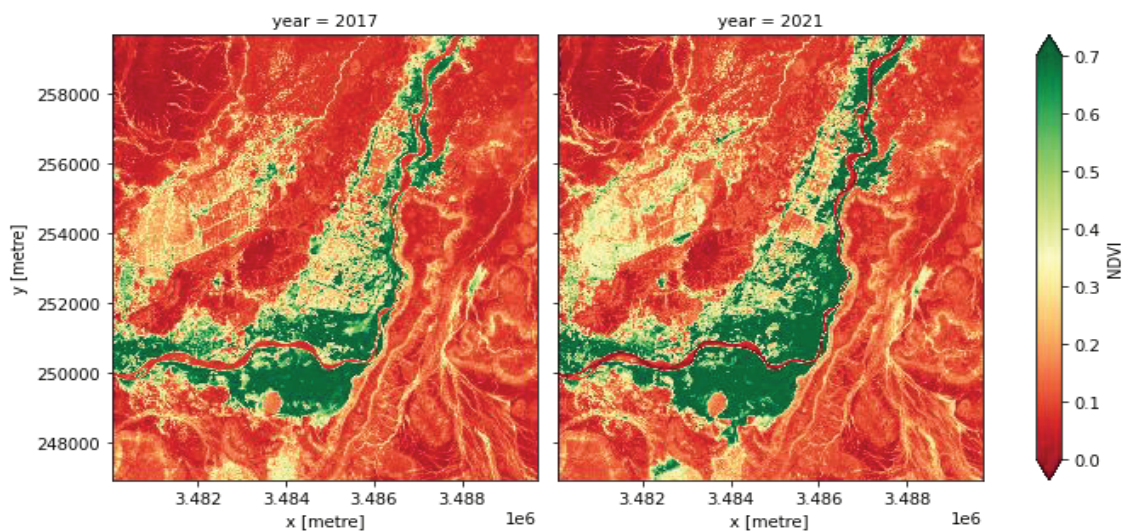


Figure 13: NDVI calculation of Lotubae, 2017 and 2021

This provides a much better visualization of the changes in the scheme between 2017 and 2021. However, because of the size of the scheme, we need to zoom in further visually, which leads to loss of information. We can overcome this by plotting the graph and calculating the actual extent of the land under irrigation.

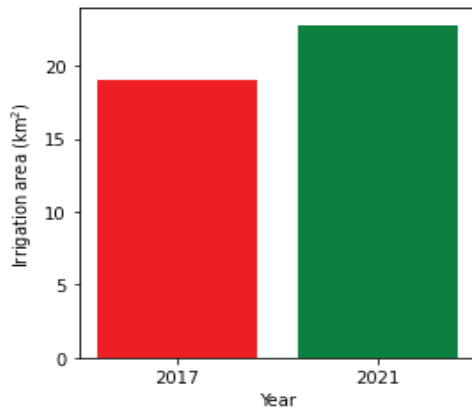


Figure 14: Quantified change of NDVI in Lotubae

From the above plot, the Irrigation extent in 2017 was 19.03 km<sup>2</sup> while in 2021 the irrigation extent has increased to 22.791 km<sup>2</sup>.

## Conclusion

In conclusion, this study has identified that the impact of drought on the communities in Turkana County has severe and far-reaching consequences that affect the Turkana people's livelihoods and economic activities significantly.

A combined method drought analysis employed in this study shows that there has been an increase in drought occurrence over the last 10 years in Turkana County, with drought occurring every 1-2 years between 2013 and 2022, a marked increase in frequency compared to 3-5 years frequency over the preceding decade, with Kibish, Turkana West, Turkana North, and Turkana South sub-counties experiencing higher severity. Currently (2022), Turkana County is being devastated by the worst drought in at least 70 years also affecting Ethiopia and Somalia, because of four back-to-back seasons of poor rainfall since late 2020. Previous droughts were the result of two or three consecutive failed rainy seasons. With an unprecedented fifth failed rainy season expected to take place in late 2022, humanitarian actors warn that things could get even worse in the coming months, with millions of people already in need of emergency food assistance.

Analysis of KII and FGDs responses shows that the main impacts of drought are increased conflicts & disputes, drying of pasture, migration in search of water and pastureland, increased theft and crime, animal diseases and deteriorated health, water scarcity, death of livestock. Other impacts include human diseases and malnutrition, low animal produce, pests and diseases and reliance on aid for survival. Interventions undertaken through the programs initiated by the County government of Turkana, USAID and other development partners have been observed to have increased over the years and could have led to improvement of beneficiary communities coping mechanisms. For example, only 4.88% of respondents interviewed identified death of livestock as an effect of drought compared to 21.95% who mentioned increased conflicts and disputes and drying of pasture. The main coping mechanisms applied by communities in Turkana County are the sale of livestock, venturing into other businesses, migration, purchase of pasture, charcoal burning and aid from donor agencies. Notable successes identified include early action and intervention by government departments and partners and coordinated response through forums such as PREG and County steering group (CSG).

The study shows that drought has an adverse effect on peaceful coexistence of cross border communities by increasing conflict and insecurities due to increased migration in search of pasture and water, as well as increased episodes of theft and crime. The biggest challenge remains its four internal borders with Baringo, West Pokot, Marsabit and Samburu Counties, with most conflicts being experienced between Baringo and West Pokot borders. Turkana County has made successful strides in mitigating conflict along its 3 international borders (Uganda, Ethiopia, and South Sudan) due to international treaties supported by the National government and partly by the Turkana County government including the historic signing of the Memorandum of Understanding signed by Kenya and Uganda for Cross border peace and development in the Turkana-Pokot-Karamoja region along the border of the two countries.

Key policies and legislative frameworks have been enacted both at national and at county government level to guide adaptation and mitigation against climate change impacts. Some of the recently enacted policies include Turkana County Disaster Risk Management Policy, 2019, Turkana County Peace Building and Conflict Management Bill, Turkana County Climate Change Bill, 2020 and the Turkana County Water Act, 2019. There is need for particular attention on operationalization of the legislative and institutional framework to improve drought response and mitigation and to build the local communities coping strategies and resilience.

Local communities report receiving modern drought early warning information through meteorological alerts, local radio stations, county government information and NGO awareness programmes. Indigenous knowledge is however still intact amongst the Turkana Community. Most of the respondents were aware of traditional drought early warning methods employed by the locals, with the most common ones being examining of intestines of by local experts known as "El Murons", migration of birds and wild animals, wind direction, observation of stars and moon. There is need for research to corroborate these methods and preserve the knowledge since most "El Murons" are elderly and the knowledge is not passed to younger generations.



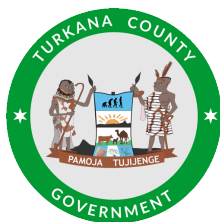
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