



THE REPUBLIC OF UGANDA

Tororo District

Hazard, Risk and Vulnerability Profile



2016

Acknowledgment

On behalf of Office of the Prime Minister, I wish to express my sincere appreciation to all of the key stakeholders who provided their valuable inputs and support to this Multi-Hazard, Risk and Vulnerability mapping exercise that led to the production of a comprehensive district Hazard, Risk and Vulnerability (HRV) profiles.

I extend my sincere thanks to the Department of Relief, Disaster Preparedness and Management, under the leadership of the Commissioner, Mr. Martin Owor, for the oversight and management of the entire exercise.

The HRV assessment team was led by Ms. Ahimbisibwe Catherine, Senior Disaster Preparedness Officer supported by Odong Martin, Disaster Management Officer and the team of consultants (GIS/DRR specialists); Dr. Bernard Barasa, and Mr. Nsiimire Peter, who provided technical support.

Our gratitude goes to UNDP for providing funds to support the Hazard, Risk and Vulnerability Mapping. The team comprised of Mr. Steven Goldfinch – Disaster Risk Management Advisor, Mr. Gilbert Anguyo - Disaster Risk Reduction Analyst, and Mr. Ongom Alfred-Early Warning system Programmer.

My appreciation also goes to the Tororo District team.

The entire body of stakeholders who in one way or another yielded valuable ideas and time to support the completion of this exercise.

Hon. Hilary O. Onek

Minister for Relief, Disaster Preparedness and Refugees

EXECUTIVE SUMMARY

The multi-hazard vulnerability profile output from this assessment was a combination of spatial modeling using socio-ecological spatial layers (i.e. DEM, Slope, Aspect, Flow Accumulation, Land use, vegetation cover, hydrology, soil types and soil moisture content, population, socio-economic, health facilities, accessibility, and meteorological data) and information captured from District Key Informant interviews and sub-county FGDs using a participatory approach. The level of vulnerability was assessed at sub-county participatory engagements and integrated with the spatial modeling in the GIS environment. The methodology included five main procedures i.e.

Preliminary spatial analysis

Hazard prone areas base maps were generated using Spatial Multi-Criteria Analysis (SMCA) was done in a GIS environment (ArcGIS 10.1).

Stakeholder engagements

Stakeholder engagements were carried out in close collaboration with OPM's DRM team and the District Disaster Management focal persons with the aim of identifying the various hazards ranging from drought, to floods, landslides, human and animal disease, pests, animal attacks, earthquakes, fires, conflicts. Stakeholder engagements were done through Focus Group Discussions (FGDs) and key informant interviews guided by checklist tools (Appendix I). At district level Key Informants included: District Agricultural Officer, District Natural Resources Officer, District Health Inspector and District Planner while at sub-county level Key informants included: Sub-county and parish chiefs, community Development mobilisers and health workers.

FGDs were carried out in five purposively selected sub-counties that were ranked with highest vulnerability. FGDs comprising of an average of 12 respondents (crop farmers, local leaders, nursing officers, police officers and cattle keepers) were conducted at Paya, Osukuru, Nagongera Town Council and Malaba Town Council. Sub-counties. Each Parish of the selected Sub-counties was represented by at least one participant and the selection of participants was engendered. FGDs were conducted with utmost consideration to the various gender categories (women, men) with respect to age groups since hazards affect both men and women though in different perspectives irrespective of age.

Participatory GIS

Using Participatory GIS (PGIS), local communities were involved in identifying specific hazard prone areas on the Hazard base maps. This was done during the FGDs and participants were requested through a participatory process to develop a community hazard profile map.

Geo-referencing and ground-truthing

The identified hazard hotspots in the community profile maps were ground-truthed and geo-referenced using a handheld Spectra precision Global Positioning System (GPS) unit, model: Mobile Mapper 20 set in WGS 1984 Datum. The entities captured included: hazard location, (Sub-county and parish), extent of the hazard, height above sea level, slope position, topography, neighboring land use among others. Hazard hot spots, potential and susceptible areas will be classified using a participatory approach on a scale of "not reported/ not prone", "low", "medium" and "high".

Data analysis and integration

Data analysis and spatial modeling was done by integrating spatial layers and non-spatial attribute captured from FGDs and KIIs to generate final HRV maps at Sub-county level.

Data verification and validation

OPM organised a five days regional data verification and validation workshop in collaboration with UNDP in Mbale Municipality as a central place within the region. This involved key district DDMC focal persons for the purpose of creating local/district ownership of the profiles.

Multi-hazards experienced in Tororo district were classified as:

- Geomorphological or Geological hazards including; landslides, rock falls, soil erosion and earth quakes.
- Climatological or Meteorological hazards including; floods, drought, hailstorms, strong winds and Lightning
- Ecological or Biological hazards including crop pests and diseases, livestock pests and diseases, human disease outbreaks, vermin and wildlife animal attacks as well as invasive species.
- Human induced or Technological hazards including; bush fires, road accidents land conflicts.

General findings from the participatory assessment indicated that Tororo district has over the past two decades increasingly experienced hazards including; rock falls, soil erosion, floods, drought, hailstorms, strong winds, Lightning, crop pests and diseases, livestock pests and diseases, human disease outbreaks, vermin, wildlife animal attacks, invasive species, bush fires, road accidents and land conflicts putting livelihoods at increased risk. Drought and floods were identified as most serious problems in Tororo district with almost all sub-counties being vulnerable to the hazards. This is because the area is generally flat hence very prone to flooding in case of heavy rains.

The limited adaptive capacity (and or/resilience) and high sensitivity of households and communities in the district increase their vulnerability to hazard exposure necessitating urgent external support. To reduce vulnerability at Community, Local Government and National levels should be a threefold effort hinged on:

- Reducing the impact of the hazard where possible through mitigation, prediction, early warning and preparedness;
- Building capacities to withstand and cope with the hazards and risks;
- Tackling the root causes of the vulnerability such as; poverty, poor governance, discrimination, inequality, inadequate access to resources and livelihood opportunities.

The following were recommended policy actions targeting vulnerability reduction:

- The government should improve enforcement of policies aimed at enhancing sustainable environmental health.
- The government through MAAIF should review the animal diseases control act because of low penalties given to defaulters.
- The government should establish systems to motivate support of political leaders towards government initiatives and programmes aimed at Disaster Risk Reduction.
- The government should increase awareness campaigns aimed at sensitizing farmers/communities on Disaster Risk Reduction initiatives and practices.
- The government should revive disaster committees at district level and ensure funding of disaster and environmental related activities.
- The government through UNRA and the District authority should fund periodic maintenance of feeder roads to reduce on traffic accidents.

- The government through MAAIF and the District Production Office should promote use of drought and disease resistant crop seeds.
- The government through OPM and Meteorology Authority should increase importation of Lightning conductors and also reduce taxes on their importation.
- The government through OPM and Meteorology Authority should support and ensure establishment of disaster early warning systems.
- The government through MWE should increase funding and staff to monitor wetland degradation and non-genuine agro-inputs.
- The government through OPM should improve communication between the disaster department and local communities.
- The government through MWE should promote Tree planting along road reserves.
- The government through MAAIF should fund and recruit extension workers at sub-county level and also facilitate them.



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LIST OF ACRONYMS

BBW	Banana Bacterial Wilt
DDMC	District Disaster Management Committee
DEM	Digital Elevation Model
DLG	District Local Government
DRM	Disaster Risk Management
DWD	Directorate of Water Development
DWRM	Directorate of Water Resources Management
ENSO	El Niño Southern Oscillation
FGD	Focus Group Discussion
GIS	Geographical Information Systems
HRV	Hazard Risk Vulnerability
KII	Key Interview Informant
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MWE	Ministry of Water and Environment
NCCP	National Climate Change Policy
OPM	Office of the Prime Minister
PGIS	Participatory GIS
SMCA	Spatial Multi-criteria Analysis
STRM	Shuttle Radar Topography Mission
UBOS	Uganda Bureau of Statistics
UNDP	United Nations Development Program
UNRA	Uganda National Roads Authority
UTM	Universal Transverse Mercator
WGS	World Geodetic System

DEFINITION OF KEY TERMS

Climate change: Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer).

Drought: The phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems.

El Niño: El Niño, in its original sense, is warm water current that periodically flows along the coast of Ecuador and Peru, disrupting the local fishery. This oceanic event is associated with a fluctuation of the inter tropical surface pressure pattern and circulation in the Indian and Pacific Oceans, called the Southern Oscillation. This coupled atmosphere-ocean phenomenon is collectively known as El Niño Southern Oscillation, or ENSO. During an El Niño event, the prevailing trade winds weaken and the equatorial countercurrent strengthens, causing warm surface waters in the Indonesian area to flow eastward to overlie the cold waters of the Peru Current. This event has great impact on the wind, sea surface temperature, and precipitation patterns in the tropical Pacific. It has climatic effects throughout the Pacific region and in many other parts of the world. The opposite of an El Niño event is called La Niña.

Flood: An overflowing of a large amount of water beyond its normal confines.

Food insecurity: A situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth, development as well as an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate use of food at the household level. Food insecurity may be chronic, seasonal or transitory.

Impact: Consequences of climate change on natural and human systems.

Risk: The result of the interaction of physically defined hazards with the properties of the exposed systems i.e., their sensitivity or vulnerability.

Susceptibility: The degree to which a system is vulnerable to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.

Semi-arid: Ecosystems that have more than 250 mm precipitation per year but are not highly productive; usually classified as rangelands.

Vulnerability: The degree of loss to a given element at risk or set of elements at risk resulting from the occurrence of a natural phenomenon of a given magnitude and expressed on a scale from 0 (no damage) to 1 (total damage)" (UNDRO, 1991) or it can be understood as the conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of community to the impact of hazards "(UN-ISDR 2009.)

Also Vulnerability can be referred to as the potential to suffer harm or loss, related to the capacity to anticipate a hazard, cope with it, resist it and recover from its impact. Both vulnerability and its antithesis, resilience, are determined by physical, environmental, social, economic, political, cultural and institutional factors" (J.Birkmann, 2006)

Hazard: A physically defined source of potential harm, or a situation with a potential for causing harm, in terms of human injury; damage to health, property, the environment, and other things of value; or some combination of these (UNISDR, 2009).

INTRODUCTION

1.1 Background

Over the years Uganda has experienced frequent disasters that range from drought, to floods, landslides, human and animal diseases, pests, animal attacks, earthquakes, fires, conflicts and other hazards which in many instances resulted in deaths, property damage and losses of livelihood. With the increasing negative effects of hazards that accompany population growth, development and climate change, public awareness and pro-active engagement of the whole spectrum of stakeholders in Disaster Risk Reduction, is becoming critical.

The Government of Uganda is shifting the Disaster Risk Management paradigm from the traditional emergency response focus, towards one of prevention and preparedness. Contributing to the evidence base for Disaster and Climate Risk Reduction action, the Government of Uganda is compiling a National Risk Atlas of hazard, risk and vulnerability conditions in the Country to encourage mainstreaming of Disaster and Climate Risk Management in development planning and contingency planning at National and Local levels.

Since 2013 Office of the Prime Minister with support from UNDP has been developing District Hazard Risk and Vulnerability profiles in the sub-regions of Rwenzori, Karamoja, Teso, Lango, Acholi and West Nile covering 42 districts. During the above exercise, Local Government officials and community members have actively contributed in data collection and analysis. The data collected was used to generate Hazard Risk and Vulnerability maps as well as profiles. Validation workshops were held in close collaboration with key Ministries, District Local Government (DLG), Development Partners, Agencies and academic/research institutions. The developed maps show the geographical distribution of hazards and vulnerabilities up to sub-county level of each district. The analytical approach to identify risk and vulnerability to hazards in the pilot sub-regions of Rwenzori and Teso was improved in subsequent sub-regions.

This final draft report details methodological approach for HRV profiling and mapping for Tororo district in Eastern Uganda.

1.2 Objectives

The following main and specific objectives of the study were indicated:

1.2.1 Main objective

The main objective of the study was to develop Multi-hazard, Risk and Vulnerability Profile for Tororo District.

1.2.3 Specific Objectives

In fulfilling the above mentioned main objective the following are specific objectives as expected:

- i. Collect and analyze field data generated using GIS in close collaboration and coordination with OPM.
- ii. Develop District specific multi-hazard risk and Vulnerability profile using a standard methodology.
- iii. Preserve the spatial data to enable use of the maps for future information.
- iv. Produce age and sex disaggregated data in the HRV maps.

1.3 Scope of Work

Through UNDP's Project: "Strengthening Capacities for Disaster Risk Management and Resilience

Building” the scope of work entailed the following:

- i. Collection of field data using GIS in close collaboration and coordination with OPM in Tororo District and quantify them through a participatory approach on a scale of “not reported/ not prone”, “low”, “medium” and “high”.
- ii. Analysis of field data and review the quality of each hazard map which should be accompanied by a narrative that lists relevant events of their occurrence. Implications of hazards in terms of their effects on stakeholders with the vulnerability analysis summarizing the distribution of hazards in the district and exposure to multi-hazards in sub-counties.
- iii. Compilation of the entire district multi-hazard, risk and vulnerability HRV Profiles in the time frame provided.
- iv. Generating complete HRV profiles, maps and developing a database for all the GIS data showing disaggregated hazard risk and vulnerability profiles to OPM and UNDP.

1.4 Justification

The government recognizes climate change as a big problem in Uganda. The draft National Climate Change Policy (NCCP) notes that the average temperature in semi-arid climates is rising and that there has been an average temperature increase of 0.28°C per decade in the Country between 1960 and 2010. It also notes that rainfall patterns are changing with floods and landslides on the rise and are increasing in intensity, while droughts are increasing, and now significantly affect water resources, and agriculture (MWE, 2012). The National Policy for Disaster Preparedness and Management (Section 4.1.1) requires the Office of the Prime Minister to “Carry out vulnerability assessment, hazard and risk mapping of the whole Country and update the data annually”. UNDP’s DRM project 2015 Annual Work Plan; Activity 4.1 is to “Conduct national hazard, risk and vulnerability (HRV) assessment including sex and age disaggregated data and preparation of district profiles.”

1.5 Structure of the Report

This Report is organized into four sections: Section 1 provides an Introduction on the assignment, Section 2 elaborates on the overview of Tororo District, Section 3 focuses on the methodology employed, Section 4 elaborates the Multi-hazard, Risks and Vulnerability profile and Coping strategies for Tororo District, Section 5 describes Conclusions and policy related recommendations.



OVERVIEW OF TORORO DISTRICT

2.1 Location

Tororo District is located in Eastern Uganda at latitude of 00°1'N and longitude of 33°34'E. It is 1,194 Km² in total area consisting of 0.056 Km² of forest reserves. It borders with the Republic of Kenya to the East, Bugiri District to the West, Butaleja to the North and Busia to the South and Manafwa and Mbale to the North East. The District has two counties, one Municipality with two divisions, seventeen (17) rural sub-counties, two Town councils, two town boards, eighty eight (88) parishes and eight hundred and seventy five (875) villages. The District Headquarters is located in Tororo Municipality, which is at an altitude of 1,459.5 metres above sea level and 214km from Kampala City.

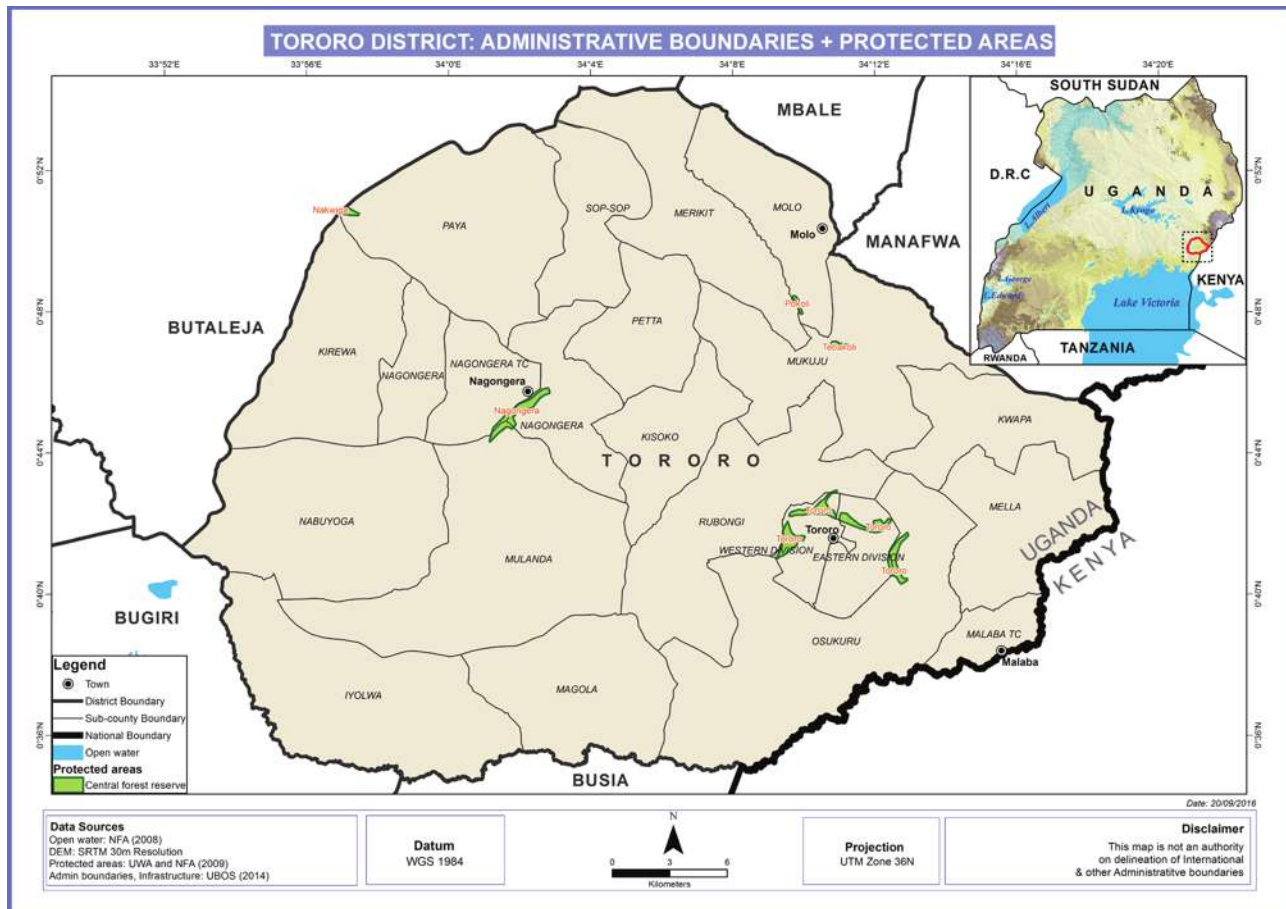


Figure 1: Administrative Boundaries and Gazetted areas of Tororo District

2.1.1 Topography

The topography of Tororo is not so much prone to soil erosion. Most of the land therefore is gentle and suitable for agriculture without risking severe run off of the top soils. This further makes Tororo soils good and appropriate for mechanized farming.

The roads can be easily constructed because of the bandy surfaces that are common in the District which provides opportunities for high grade feeder road surfacing. (Figure2).

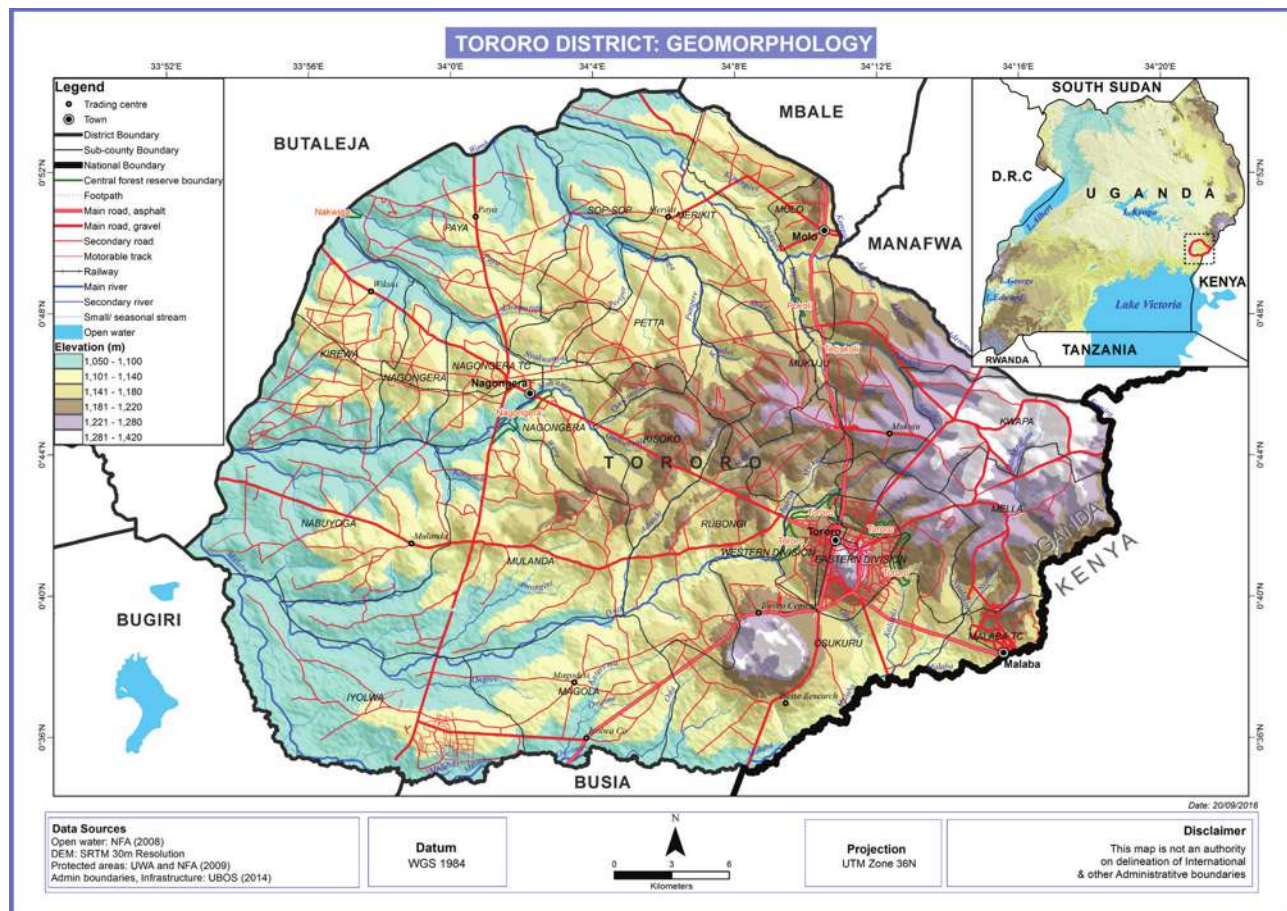


Figure 2: Geomorphology of Tororo District



2.1.2 Geology and soils

The district has Tertiary Pre-Elgon volcanic rocks of Tororo rocks and Osukuru hills with laterised clay, loam and sand soils. These soils are very rich in minerals, which are a potential for the growth of industries for cement, fertilizers and fungicides.

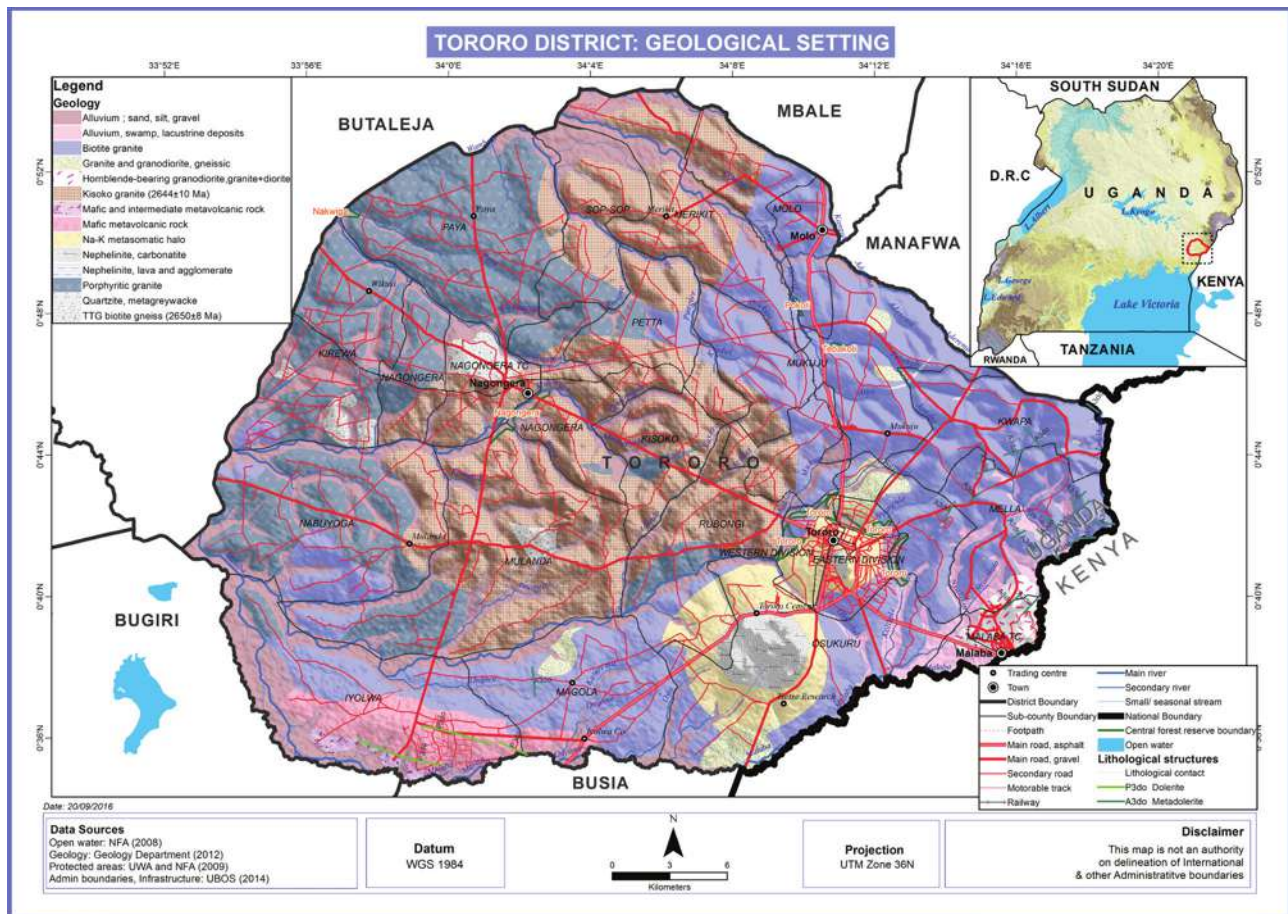


Figure 3: Geology and Lithological Structures of Tororo District

2.1.3 Vegetation and Land use Stratification

Tororo district has different ecosystem types such as medium altitude forests, savannah mosaic, swamp, wooded savannah and grass savannah. About 40% of this ecosystem types were destroyed for charcoal, grazing and agriculture.

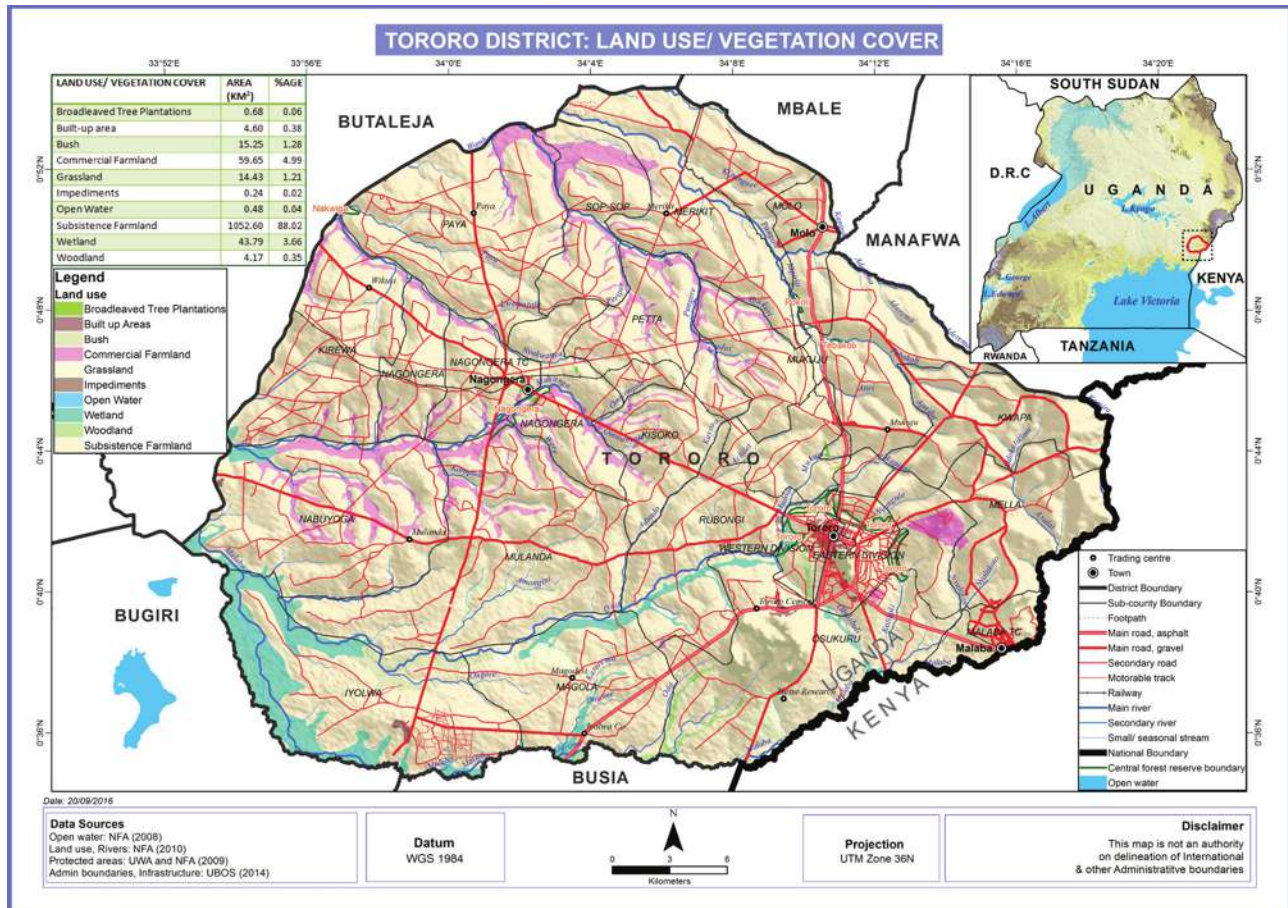


Figure 4: Land use stratification of Tororo District

2.1.4 Temperature and Humidity

Tororo District has a sub-humid climate with orographic and bi-modal rainfall with peaks during the months of May and October. The total rainfall lies between 1,130mm and 1,720mm a year with a temperature ranging from 16.2°C to 28.7°C. The relative humidity also ranges from 52% to 89%.

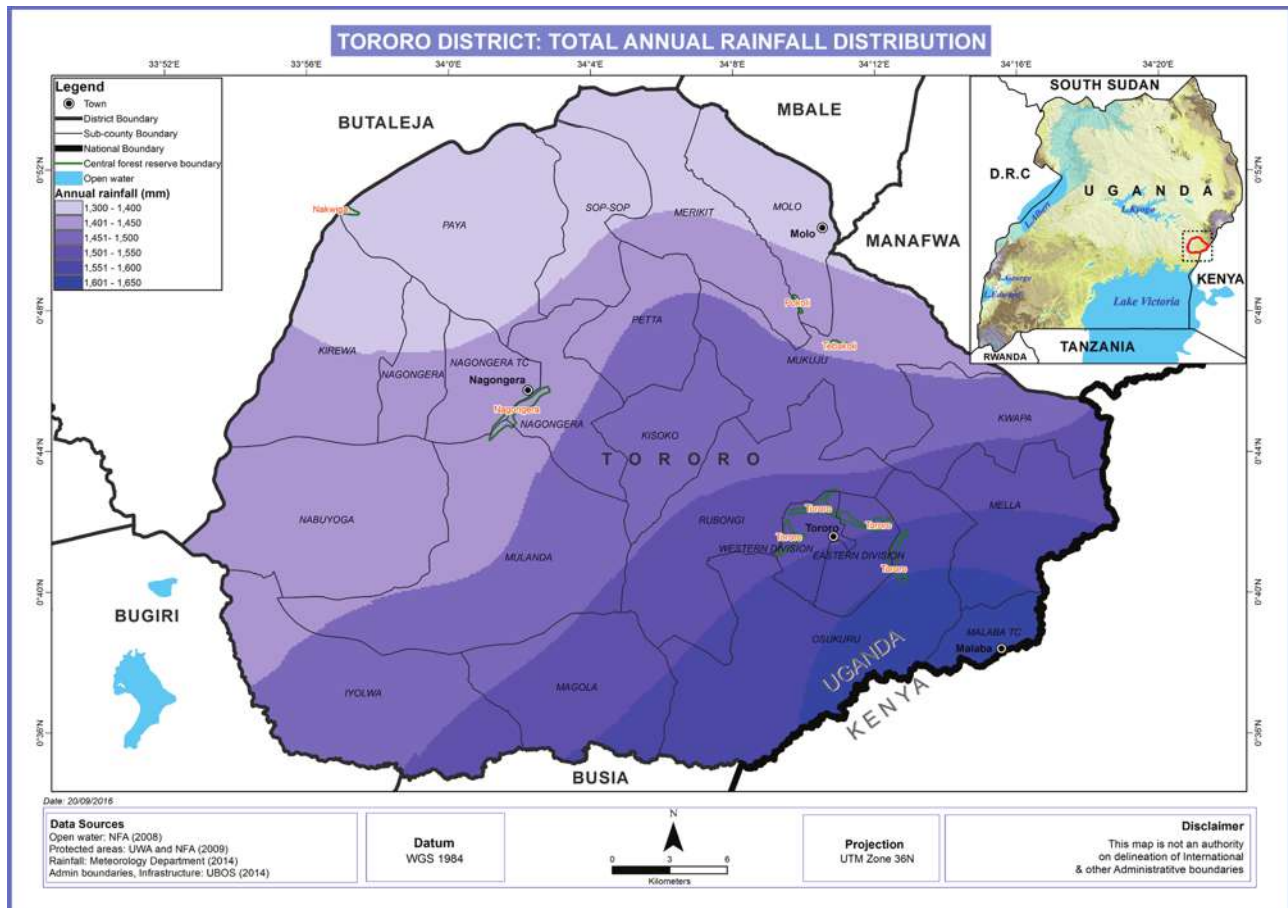


Figure 5: Total Annual Rainfall Distribution of Tororo District

2.1.8 Population

Tororo district has a total population of 540,430 (National Housing and Population Census, 2014). There are 280,329 females and 260,101 males with a sex ratio of 93%, which means for every 100 females there are 93 males. Close to 84% of the population lives in the rural areas and others (16%) reside at the urban areas. Figure 6 shows the population of Tororo district.

Table 1: Population Distribution in Tororo District

SUBCOUNTY	HOUSEHOLD		POPULATION				
	<i>Number</i>	<i>Average</i>	<i>Males</i>	<i>Females</i>	<i>Total</i>	<i>Area (km²)</i>	<i>Population Density</i>
Kwapa	3802	5.3	9664	10331	19995	42.6	469.2
Malaba Town Council	4431	3.9	8658	9566	18224	14.8	1231.4
Mella	3439	5.5	9054	9841	18895	50.0	378.1
Merikit	5097	5.1	12352	13533	25885	55.2	469.0
Molo	3670	5.1	8984	9850	18834	41.2	457.4
Mukuju	7568	5.1	18658	20061	38719	78.4	494.1
Osukuru	9154	5.0	23013	23599	46612	114.8	406.2
Eastern Division	8175	4.0	15389	17610	32999	17.7	1866.5
Western Division	5508	4.1	10752	12207	22959	13.5	1696.9
Iyolwa	3849	5.3	9855	10716	20571	89.6	229.7
Kirewa	5619	5.2	14122	15216	29338	64.0	458.6
Kisoko	3854	5.2	9656	10368	20024	36.6	546.8
Magola	3353	5.3	8559	9276	17835	60.7	293.8
Mulanda	8087	4.9	19256	20837	40093	110.5	362.7
Nagongera	4981	5.3	12756	13704	26460	55.6	476.1
Nagongera Town Council	2330	5.2	5998	6409	12407	24.9	498.5
Paya	6061	5.1	15100	15868	30968	80.2	386.3
Rubongi	7245	5.2	18545	19625	38170	80.3	475.5
Sop-Sop	2906	4.9	6872	7408	14280	37.3	382.9
Nabuyoga	5698	5.4	15112	15895	31007	90.8	341.7
Petta	3217	5.0	7746	8409	16155	35.3	457.7

Source: UBOS Census 2014

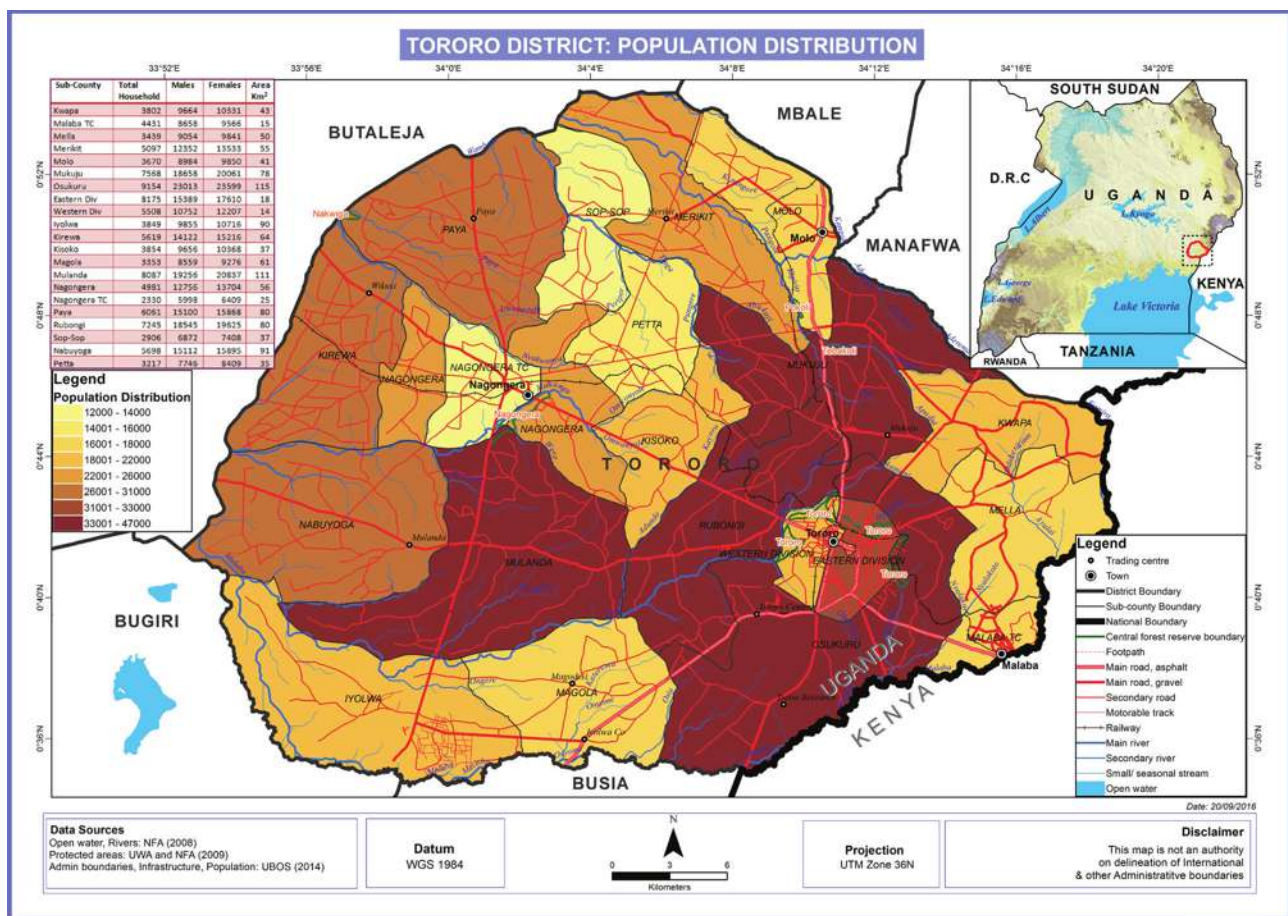


Figure 6: Population Distribution of Tororo District

2.1.9 Economic activities

The economy of Tororo District is mainly dependent on agriculture, which employs over 70% of the total population where family members constitute the single most important source of labour. Fertile soils and suitable climate support the cultivation of a number of crops in most parts of the district. Agriculture mainly (75%) takes place on smallholdings of approximately two acres where simple farming tools such as; hoes, pangas, etc are used. Only 0.35% of the population is engaged in commercial agriculture.

The main source of income is crop farming followed by livestock and fish farming; and other sources of income are derived from non-farming activities such as employment in the civil service, off-farm business and other services. There is an increasing trend towards non-farming activities due to uncertainty and seasonality of agricultural produce/income and also increase in new demands for households e.g. paying for tertiary education and health services. Below is a table showing the source of livelihood in the District (Table 2).

Table 2: Source of Livelihood

Livelihood	Rural	Urban	%age of total population
Subsistence farming	81.8	14.7	75.08
Employment income	8.3	44.3	11.92
Business enterprise	3.8	19.3	5.33
Cottage industry	0.2	0.2	0.25
Property income	0.5	1.5	0.56
Family support	4.4	16.0	5.57
Organizational support	0.1	0.1	0.07
Others	0.9	3.8	1.23

Source: Tororo District Planning Unit

METHODOLOGY

3.1 Collection and analysis of field data using GIS

3.1.1 Preliminary spatial analysis

Hazard prone areas base maps were generated using Spatial Multi-Criteria Analysis (SMCA) basing on numerical models and guidelines using existing environmental and socio-ecological spatial layers (i.e. DEM, Slope, Aspect, Flow Accumulation, Land use, vegetation cover, hydrology, soil types and soil moisture content, population, socio-economic, health facilities, accessibility, and meteorological data) in a GIS environment (ArcGIS 10.1).

3.1.2 Stakeholder engagements

Stakeholder engagements were carried out in close collaboration with OPM's DRM team and the District Disaster Management focal persons with the aim of identifying the various hazards ranging from; drought to floods, landslides, human and animal disease, pests, animal attacks, earthquakes, fires, conflicts, etc. Stakeholder engagements were done through Focus Group Discussions (FGDs) and key informant interviews guided by checklist tools (Appendix I). At district level, one key informant interview comprising of six categories of respondents (District Agricultural Officer, District Environment Officer, District Natural Resources Officer, District Production Officer, District Health Officer and 3 Sub-county Extension Officers) was held at Tororo District Headquarters (632260E; -76083N). At sub-county level, key informants included: Sub-county chiefs, Parish chiefs, Community Development mobilizers and Health workers.

Focus Group Discussions (FGDs) were carried out in four purposively selected sub-counties that were ranked with highest vulnerability. FGDs comprising of an average of 12 respondents (crop farmers, local leaders, nursing officers, police officers and cattle keepers) were conducted at Paya Sub-county, Osukuru Sub-county, Nagongera Town Council and Malaba Town Council. Each Parish or Ward of the selected Sub-counties or Town Councils was represented by at least one participant whose selection was engendered. FGDs were conducted with utmost consideration to the various gender categories (women and men) with respect to age groups since hazards affect both men and women though in different perspectives irrespective of age. This allowed for comprehensive representation as well as provision of detailed and verifiable information.

Focus Group Discussions and Key Informant Interviews were transcribed in the field for purposes of inputting into the NVIVO software for qualitative data analysis. Case stories and photographs were documented and captured, respectively. In order to produce age and sex disaggregated data, results from FGDs and KIIs were integrated with the district population census data. This was also input in the multi-hazard, risk and vulnerability profile maps.

3.1.3 Participatory GIS

Using Participatory GIS (PGIS), local communities were involved in identifying specific hazards prone areas on the Hazard base maps. This was done during the FGDs where participants were requested through a participatory process to develop a community hazard profile map.

3.1.4 Geo-referencing and ground-truthing

The identified hazard hotspots in the community profile maps were ground-truthed and geo-referenced using a handheld Spectra Precision Global Positioning System (GPS) unit (Model Mobile Mapper 20 set in WGS 1984 Datum). The entities captured included: hazard location (Sub-county/Town Council and Parish/Ward), extent of the hazard, height above sea level, slope position, topography

and neighboring land use, among others (Appendix I). Hazard hot spots, potential and susceptible areas were classified using a participatory approach on a scale of “not reported/ not prone”, “low”, “medium” and “high”, respectively. This information was generated through a participatory and a transect approach to validate modeled hazard, risk and vulnerability status of the district. The spatial extent of a hazard event was established through modeling and a participatory validation undertaken.

3.2 Develop District Specific Multi-hazard Risk and Vulnerability Profiles

3.2.1 Data analysis and integration

Data analysis and spatial modeling was done by integrating spatial layers and non-spatial attribute captured from FGDs and KIIs to generate final HRV maps at Sub-county level. Spatial analysis was done using ArcGIS 10.1 to generate specific hazard, risk and vulnerability profile for the district.

3.2.2 Data verification and validation

OPM in collaboration with UNDP organised a five days regional data verification and validation workshop was organized by UNDP in Mbale Municipality as a central location within the region. This involved key district DDMC focal persons for the purpose of creating local/district ownership of the profiles.

3.3 Preserve the Spatial data to enable future use of the maps

Hazard, Risk and Vulnerability (HRV) profile reports and maps were verified and validated and final HRV profiles inventory and geo-database containing all GIS data in various file formats to enable future use of the maps was prepared.



KEY FINDINGS OF MULTI-HAZARD, RISK AND VULNERABILITY MAPPING

4. Multi-hazards

A hazard and the resultant disaster can have different origins: natural (geological, hydro-meteorological and biological) or induced by human activities (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterized by its; location, intensity, frequency, probability, duration, area of extent, speed of onset, spatial dispersion and temporal spacing (Cees, 2009).

In the case of Tororo district, hazards were classified following main controlling factors:

- i. Geomorphological or Geological hazards such as natural soil erosion;
- ii. Climatological or Meteorological hazards such as; floods, drought/dry spells, hailstorms, strong winds and Lightning;
- iii. Ecological or Biological hazards such as; crop pests and diseases, livestock parasites/ vectors and diseases, human epidemic diseases, vermin and wildlife animal attacks; and
- iv. Human induced or Technological hazards such as; bush fires, road accidents, land conflicts, rock falls and accelerated soil erosion arising from poor soil and water conservation management practices.

4.1 Geomorphological and Geological Hazards

4.1.1 Landslides, rock falls and soil erosion

Results from the participatory assessments indicated that soil erosion is the most common occurrence in Tororo district mainly during the rainy season. The assessments also indicated that soil erosion is common along river banks which are poorly managed and wetland areas which have been converted into rice growing lands. Participants reported that crops such; as beans, maize, sweet potatoes and millet are majorly affected by erosion. Water quality deterioration and siltation was also reported due to soil erosion. The soil erosion impacts were mainly observed in Paya Sub-county and Malaba Town Council along River Malaba. This information was also integrated with the spatial modeling using socio-ecological spatial data, i.e., Soil texture (data from National Agricultural Research Laboratories (NARL)–Kawanda, 2014; Rainfall (Meteorology Department, 2014); Digital Elevation Model (DEM); SLOPE; ASPECT (30m resolution data from SRTM Shuttle Radar Topography Mission (SRTM) to generate land slide, rock falls and soil erosion vulnerability map (Figure 7).



Plate 1: Soil erosion hot spot in P’Okongo bridge along Tororo-Nagongera-Busolwe road.

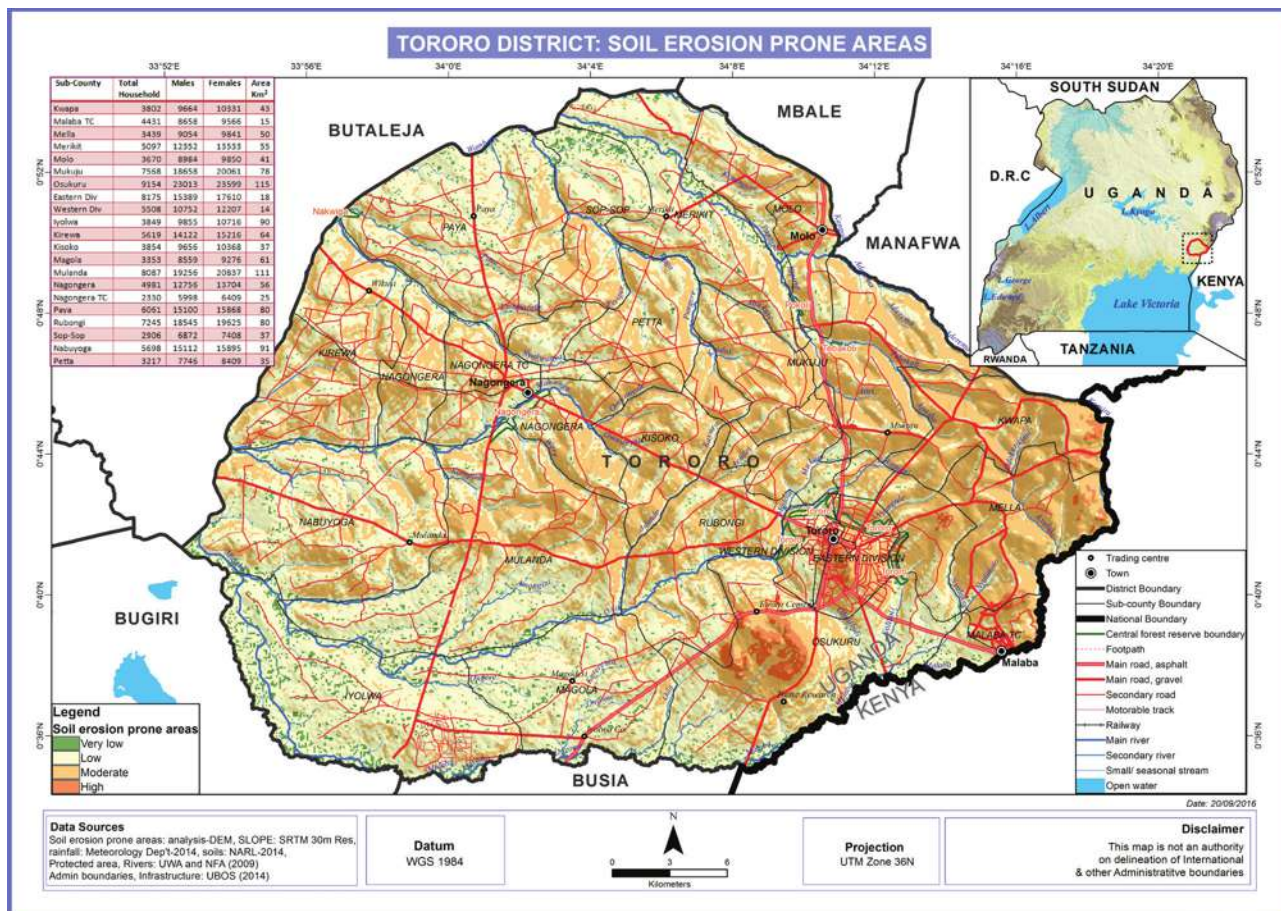


Figure 7: Soil erosion in Tororo District

4.1.2 Earthquakes and faults

Participants in the FGDs indicated that Tororo district experiences minor earth tremors once a year. It was observed that these earth tremors are not serious and thus do not cause any major damage (Figure 8).

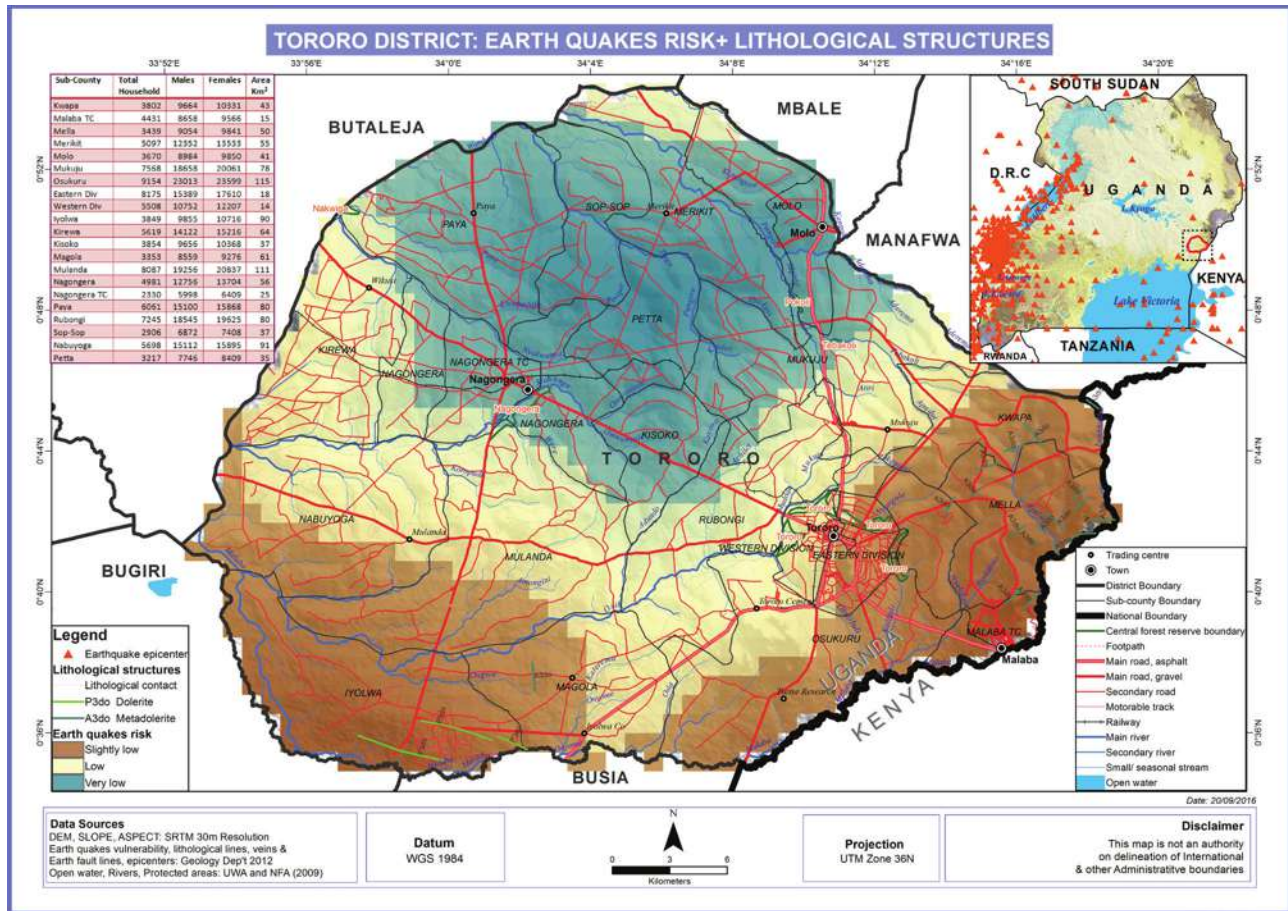


Figure 8: Earthquakes Vulnerability and Fault lines, in Tororo District

4.2 Climatological and Meteorological Hazards

4.2.1 Floods

Participants in the FGDs indicated that flooding in Tororo district mainly occurs in the lower parts of the district during rainy seasons and the most affected sub-counties were Paya, Iyolwa, Magola, Nagongera and Osukuru; and Malaba Town Council. Floods were reportedly increasing due to wetland degradation. In March 2016, property and crops were reportedly submerged in the low land sub-county of Nagongera, among others. This information was integrated with the spatial modeling using socio-ecological spatial data i.e. Soil texture (data from National Agricultural Research Laboratories (NARL)–Kawanda, 2014; Rainfall (Meteorology Department, 2014); Digital Elevation Model (DEM); SLOPE; ASPECT (30m resolution data from SRTM Shuttle Radar Topography Mission (SRTM) to generate flood susceptibility map (Figure 9).



Plate 2: Flooding hot spot at P'Okongo bridge along Tororo-Nagongera-Busolwe road.

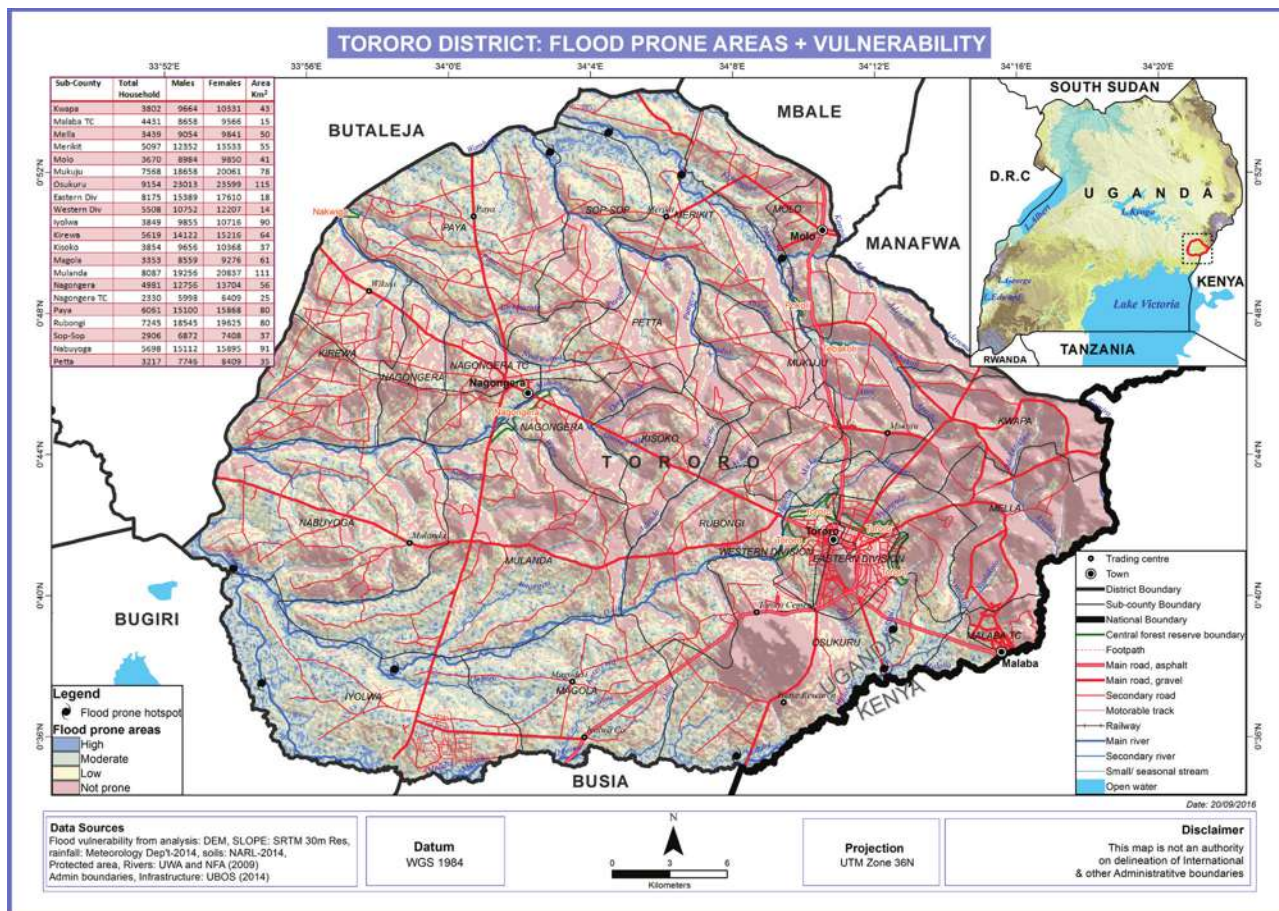


Figure 9: Flood Prone Areas and Vulnerability Ranking, in Tororo District

4.2.2 Prolonged Dry Spells

Results from participatory assessments indicated that droughts in form of dry spells are a serious problem in the entire district especially in the Months of December, January, February and March. Of recent, there have been changes in weather patterns in the district due to human activities like deforestation and conversion of wetlands into agricultural land. Crops such as; beans, cabbages and maize are mainly affected by these dry spells. This information was integrated with spatial modeling using socio-ecological spatial data i.e. Rainfall and Temperature (Uganda National Meteorological Authority, 2014) using the Standardized Precipitation Index (SPI) to generate drought vulnerability map (Figure 10).

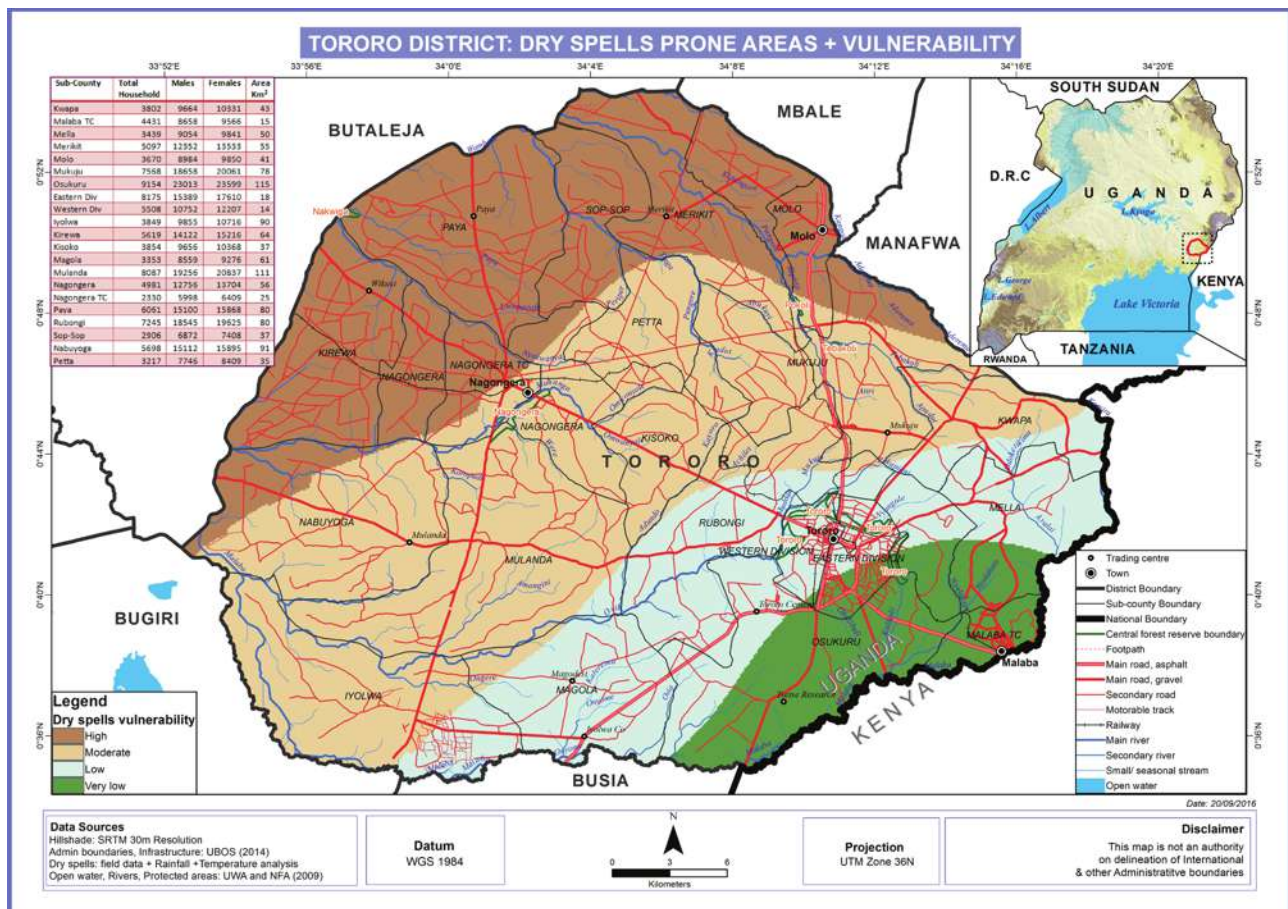


Figure 10: Drought Vulnerability Ranking, in Tororo District

4.2.3 Hailstorms

Participatory assessments through the FGDs indicated that hailstorms are experienced during heavy rains. It was reported that hailstorms are a common occurrence in the sub-counties of Kisoko, Petta and Magola. Participants observed that hailstorms destroy crops including; bananas, beans, sweet potatoes, cassava and maize, among others.

4.2.4 Strong winds

Results from participatory assessments showed that strong winds occur in the rainy seasons. Participants reported that strong winds blow off roof tops of houses, schools and cause banana plantations and tree falls. The most affected sub-counties were Kirewa, Nabuyoga, Magola and Rubongi .

4.2.5 Lightning

Lightning is a sudden high-voltage discharge of electricity that occurs within a cloud, between clouds, or between a cloud and the ground. The distribution of Lightning on Earth is far from uniform. The ideal conditions for producing Lightning and associated thunderstorms occur where warm-moist air rises and mixes with cold air above. Participants indicated that Lightning was a common occurrence in Tororo district. For instance, in 2006, it struck Akworot primary school in Mukuju Sub County and Rock view primary school in Tororo Municipality. However, no deaths were registered.

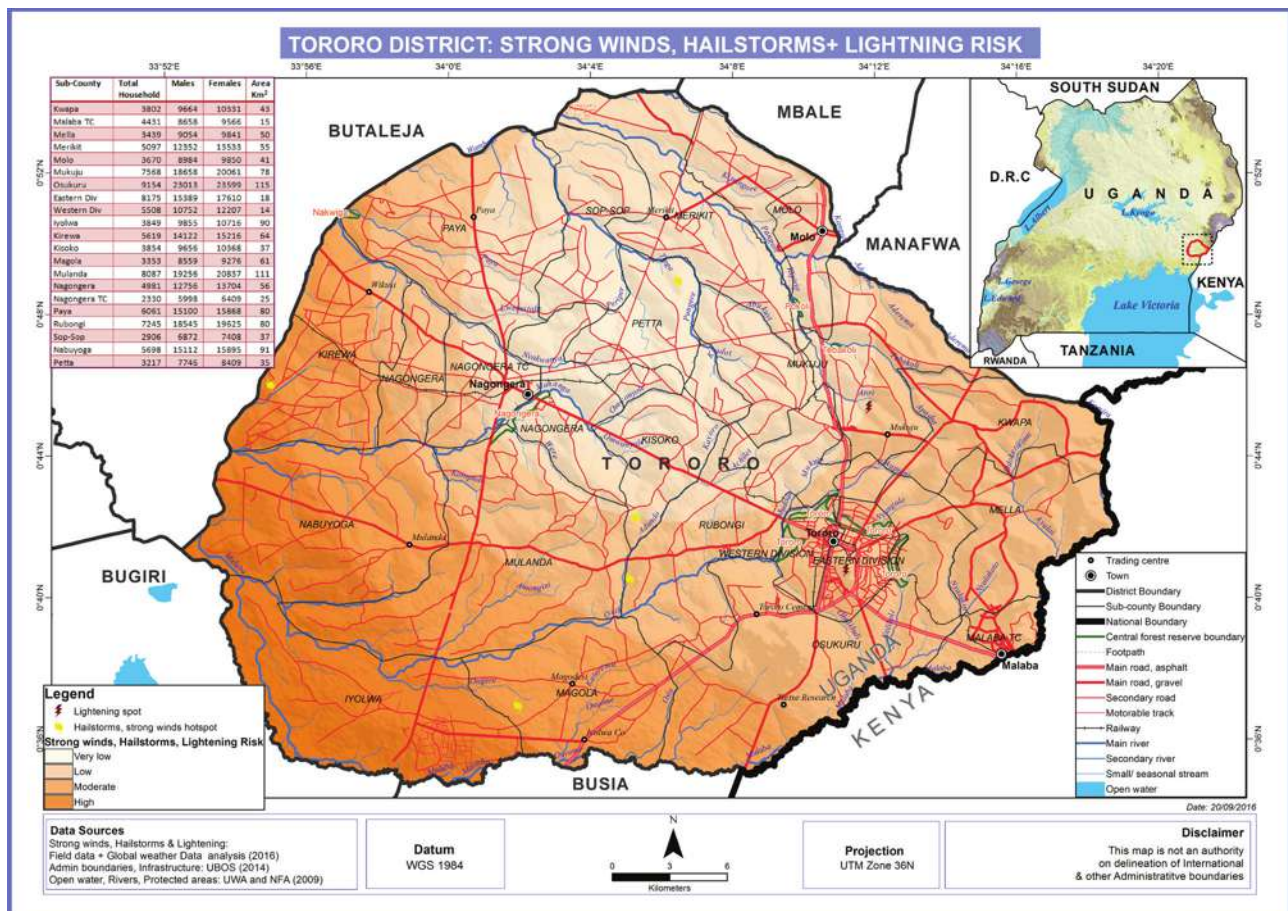


Figure 11: Strong winds, Hailstorms and Lightning Hotspots and Vulnerability, in Tororo District

4.3 Ecological and Biological Hazards

4.3.1 Crop pests and Diseases

Results from participatory assessments indicated that Tororo district is vulnerable to crop pests and diseases. The most reported crop pests and diseases include; late blight, early blight, maize stalk borer, smuts in sorghum, root rot, leaf rust and anthracnose in beans, banana bacterial wilt in bananas, cassava mosaic and mango fruit fly where over 1000 mango trees were affected in the entire district. Maize lethal necrosis was also reported and it mainly affected sub counties neighboring Kenya such as Malaba Town Council, Mella, Osukuru and Kwapa. Figure 12 shows crop pests and diseases vulnerability in Tororo district.

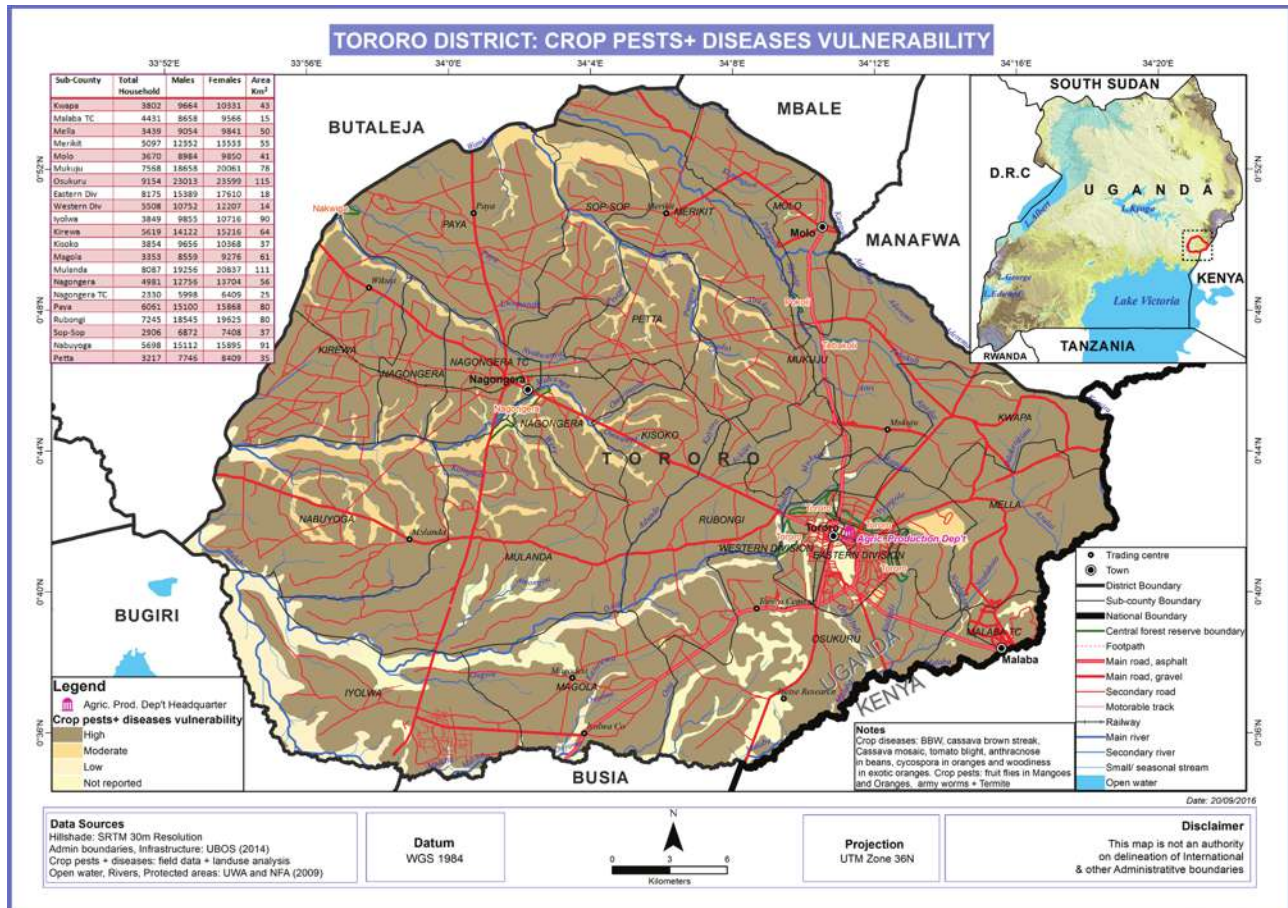


Figure 12: Crop Pests and Diseases Vulnerability, in Tororo District

4.3.2 Livestock parasites/vectors and diseases

The most common diseases that affect livestock in Tororo district include East coast fever, Heart water, Babesiosis, Pink eye, Anaplasmosis, Trypanosomiasis, Black quarter, Anthrax, Foot and mouth disease and Brucellosis in cattle; Newcastle disease, Coccidiosis, Fowl pox and Fowl typhoid in poultry and African swine fever in pigs. These animal diseases are common in the entire district due to a number of factors such as increasing population of infected vectors, poor hygiene and sanitation and inadequate regulation animal movements in and out of the district.

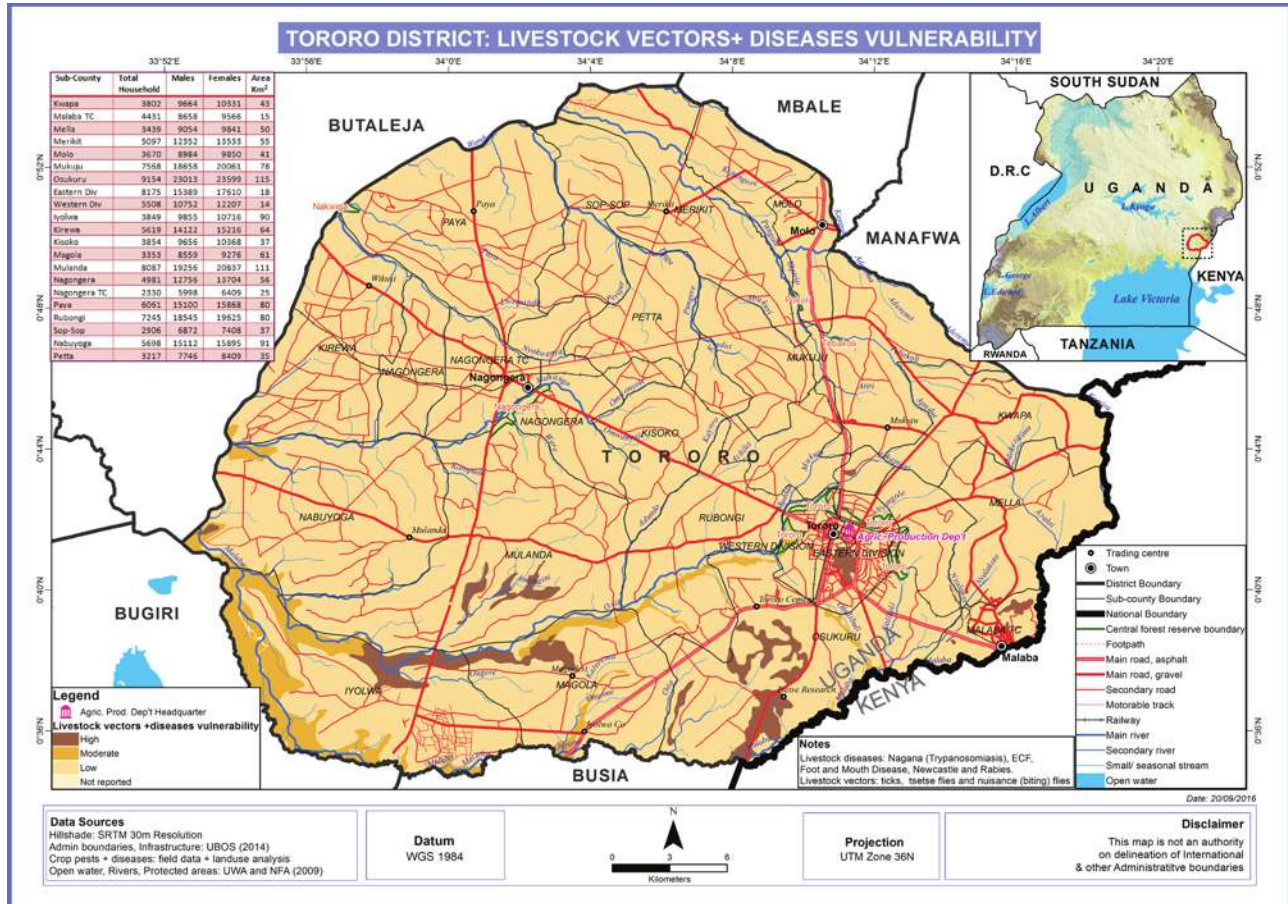


Figure 13: Livestock Pests and Diseases Vulnerability, in Tororo District

4.3.3 Human Diseases

Participatory assessments indicated that the most common disease epidemics experienced in Tororo district are; malaria 19%, cholera outbreak in 2009/10 in Kirewa, Paya and Mulanda sub counties, respiratory tract diseases and diarrhea 35% and skin diseases 3%, which account for 75% of morbidity and mortality. Others are; malnutrition, ear infections, maternal health related conditions and HIV/AIDS (Figure 14). The prevalence of HIV/AIDS was reported to be higher in Tororo Municipality, Malaba Town Council and Osukuru Sub County. This was reportedly due to the high influx of long distance truck drivers and immigrants.

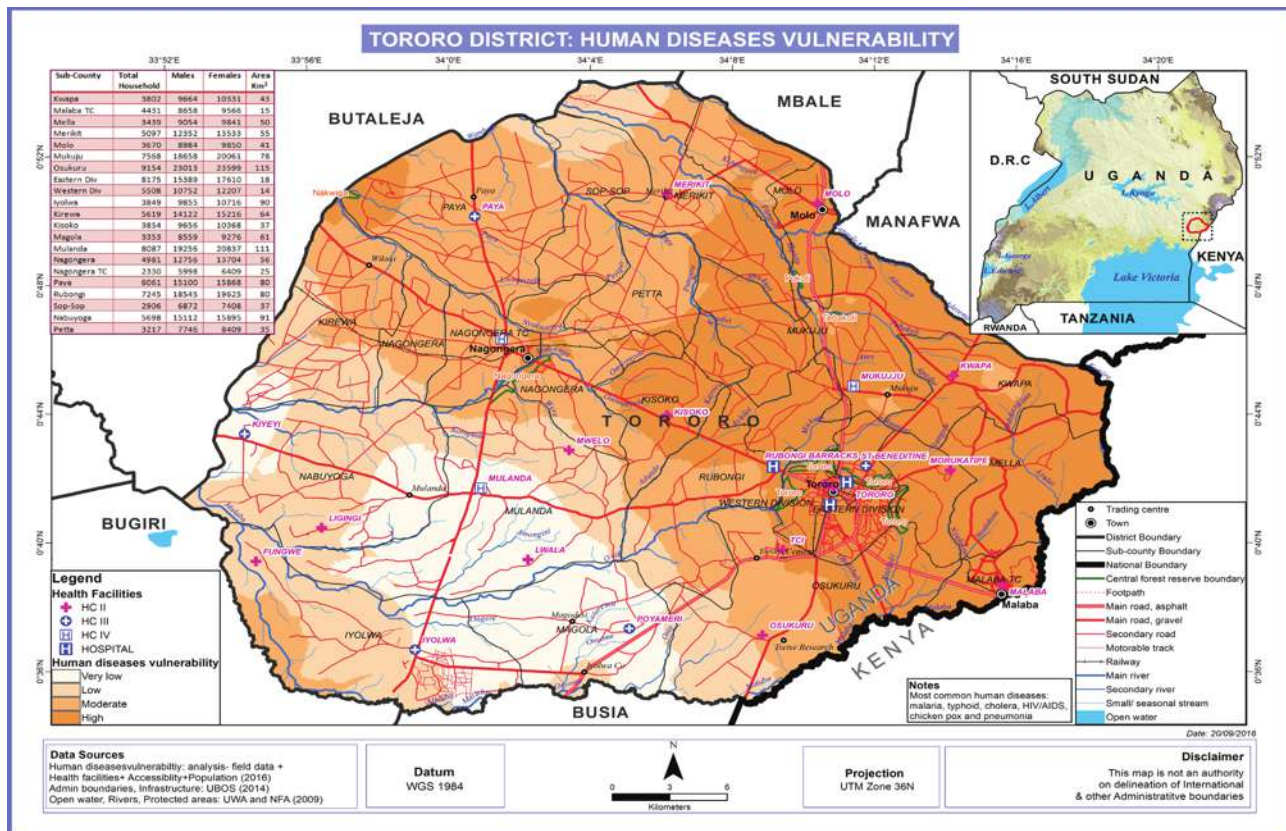


Figure 14: Human Diseases Prevalence and Health Facilities, in Tororo District

4.3.4 Vermin and Wild-life Animal Attacks

In Tororo district, human-wildlife conflicts are a serious issue in Iyolwa Sub County where Monkeys, Baboons, Crocodiles and Hippos damage/destroy crops and/or kill livestock of local communities. Snakes are also known to be common during dry seasons especially in the rice fields.



Plate 3: Primates observed along Busia-Tororo road in Busitema Forest reserve

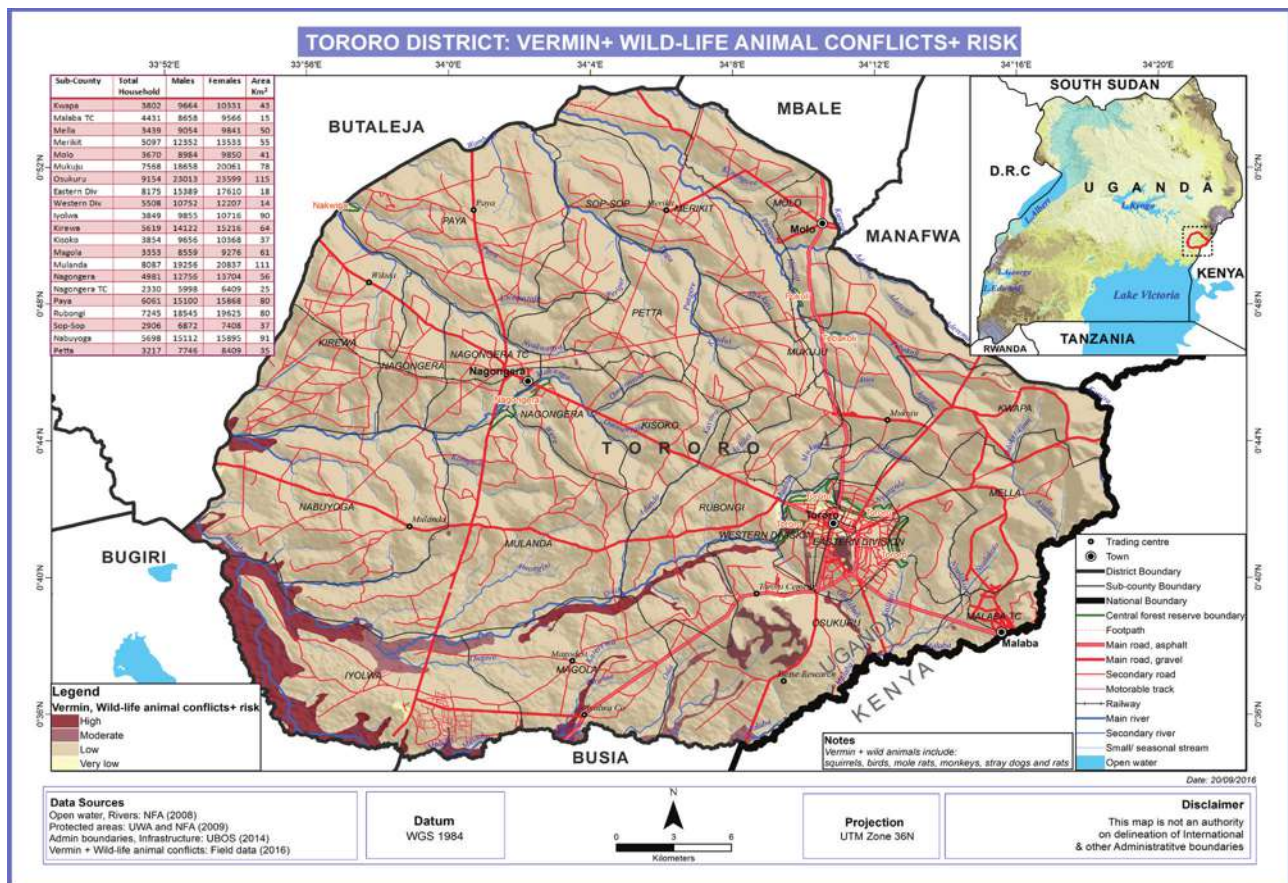


Figure 15: Vermin, Wildlife Animal Conflicts and Vulnerability, in Tororo District

4.3.5 Invasive species

The most common invasive species in Tororo district were *Lantana camara*, *Tithonia diversifolia*, *Striga weed (Striga hermontheca)*, water hyacinth (*Euchornia sp.*), *Azolla sp.*, *Cassia sp.*, *Acacia sp.* and *Mimosa sp.* These invasive species are in the entire district. They usually grow out of hand and colonize all land thus stop other plants from growing; and reduce crop production and prevent livestock from accessing grass.



Plate 4: Invasive species (*Lantana camara*) hot spot in Paya Sub-county



Plate 5: Invasive species (*Tithonia diversifolia*) hot spot in Malaba Town Council

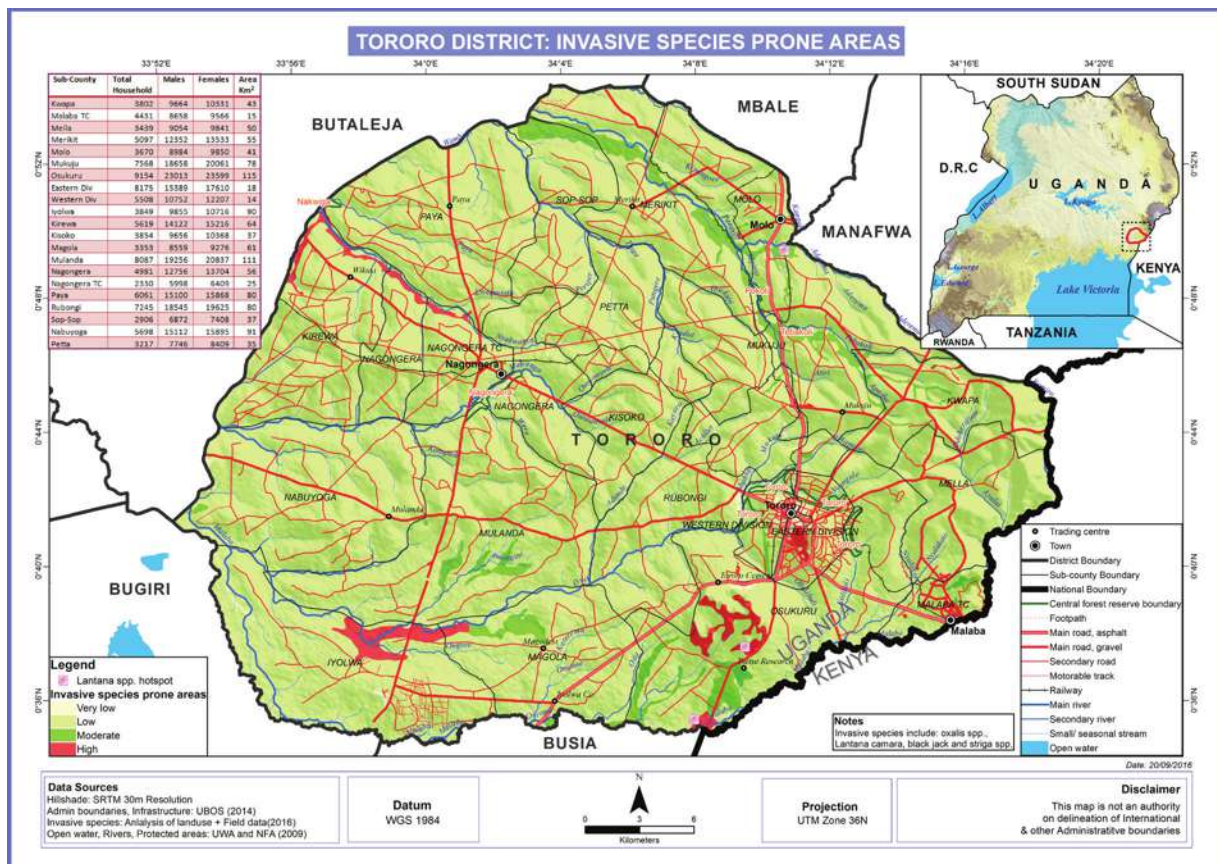


Figure 16: Invasive Species Vulnerability, in Tororo District

4.4 Human Induced and Technological Hazards

4.4.1 Fires outbreaks

Participants in the FGDs indicated that cases of bush and forest fires are common during the dry season in Tororo district. In 2011, Rubongi swamp reportedly got burnt and destroyed the entire eucalyptus tree plantations. A number of cases have been registered in Paya Sub County during every dry season. Figure 17 shows bush/forest fires hotspot areas in Tororo District.

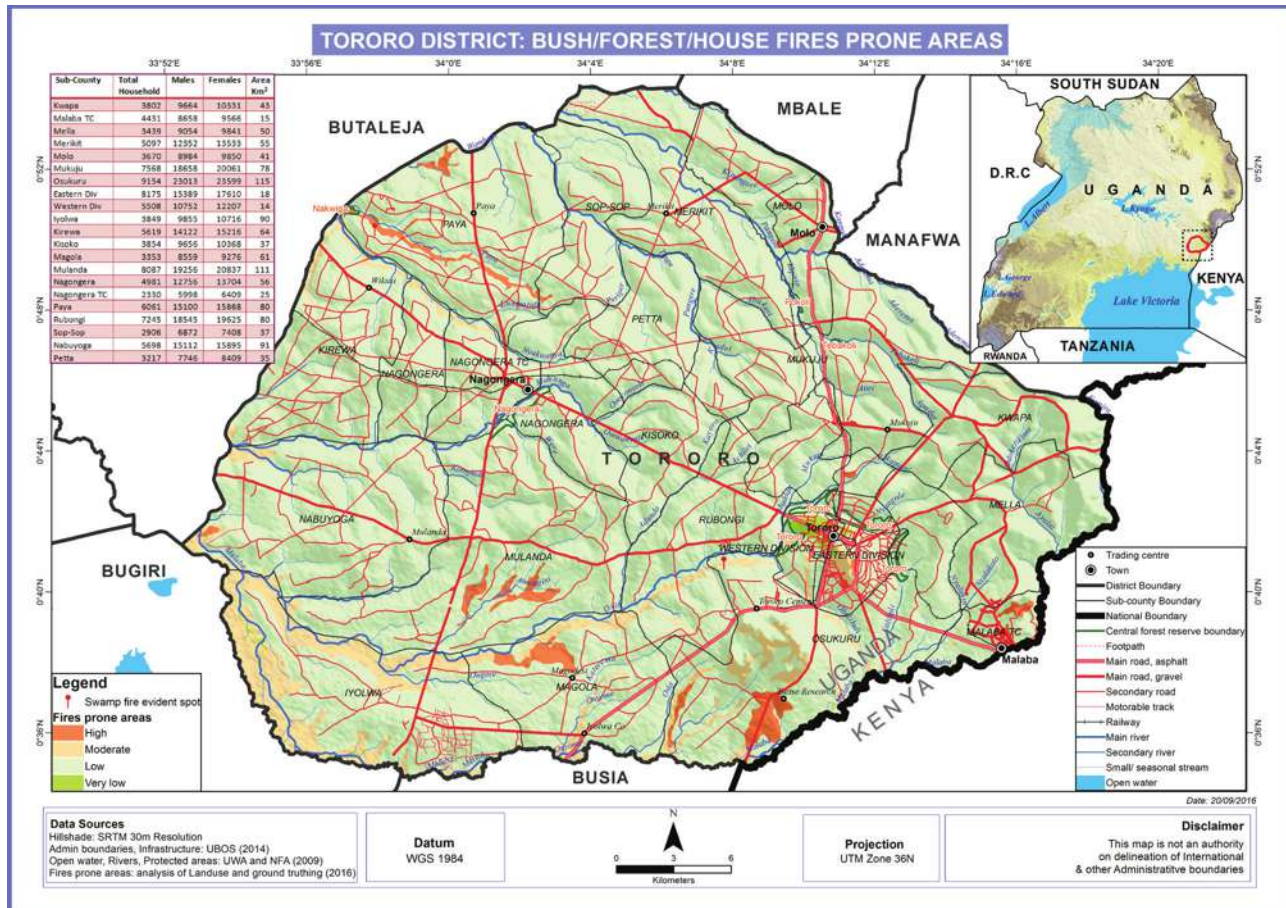


Figure 17: Bush/Forest fires Hotspot Areas and Vulnerability, in Tororo District

4.4.2 Land conflicts

Results from the participatory assessments indicated that land conflicts were common and these included inter-district boundary conflicts between Butaleja and Tororo (Paya/Merikit). A case of inter-sub county boundary conflicts were also reported in Mulanda and Magola over the Lwala wetland boundary. Participants reported that there are cases of land disputes between family members. Figure 18 shows land conflict prone areas in Tororo district.

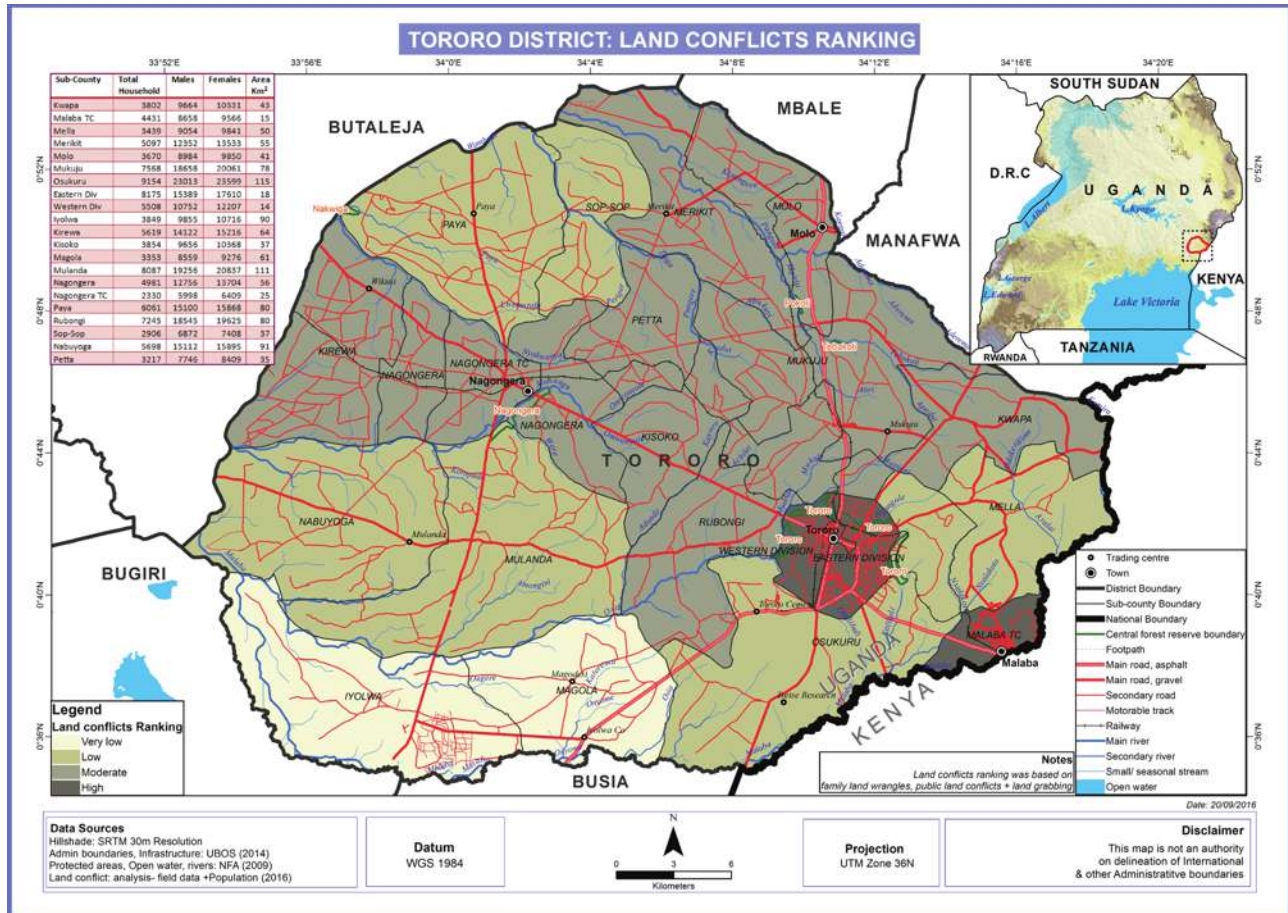


Figure 18: Land Conflicts Ranking, in Tororo District

4.4.3 Environmental Degradation

The most common forms of environmental degradation in Tororo district are; sand mining, conversion of wetlands into crop land, river bank encroachment along River Malaba, stone quarrying on Osukuru hill and deforestation where some tree species such as Mvule that were planted by Kakungulu have been depleted.



Plate 6: Wetland in Paya Sub County converted into a rice field



Plate 7: River bank encroachment along River Malaba in Malaba Town Council

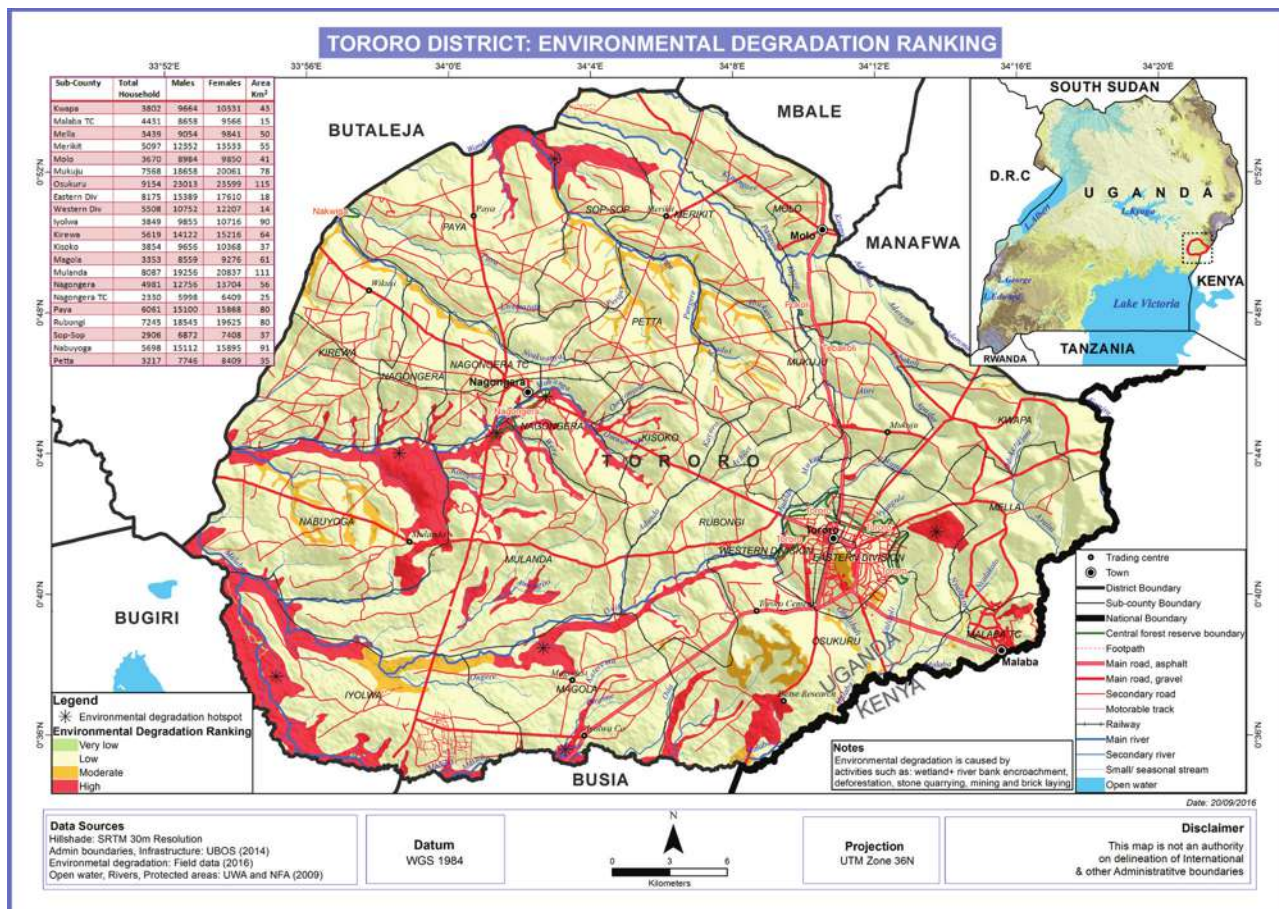


Figure 19: Environmental Degradation Ranking, in Tororo District

4.4.4 Road Accidents.

Participants in the FGDs reported that accidents mainly occur on Tororo-Malaba road, Tororo-Mbale highway and Tororo-Jinja high way. Some of these accidents are reportedly caused by over speeding and reckless driving/riding. From 2015 to date, two (2) people reportedly died at Osukuru corner/ junction along Tororo-Jinja highway arising out of a head-on collision between a taxi and a trailer.



Plate 8: Accident hot spot on Tororo–Jinja Highway near Corner, in Osukuru Sub-county

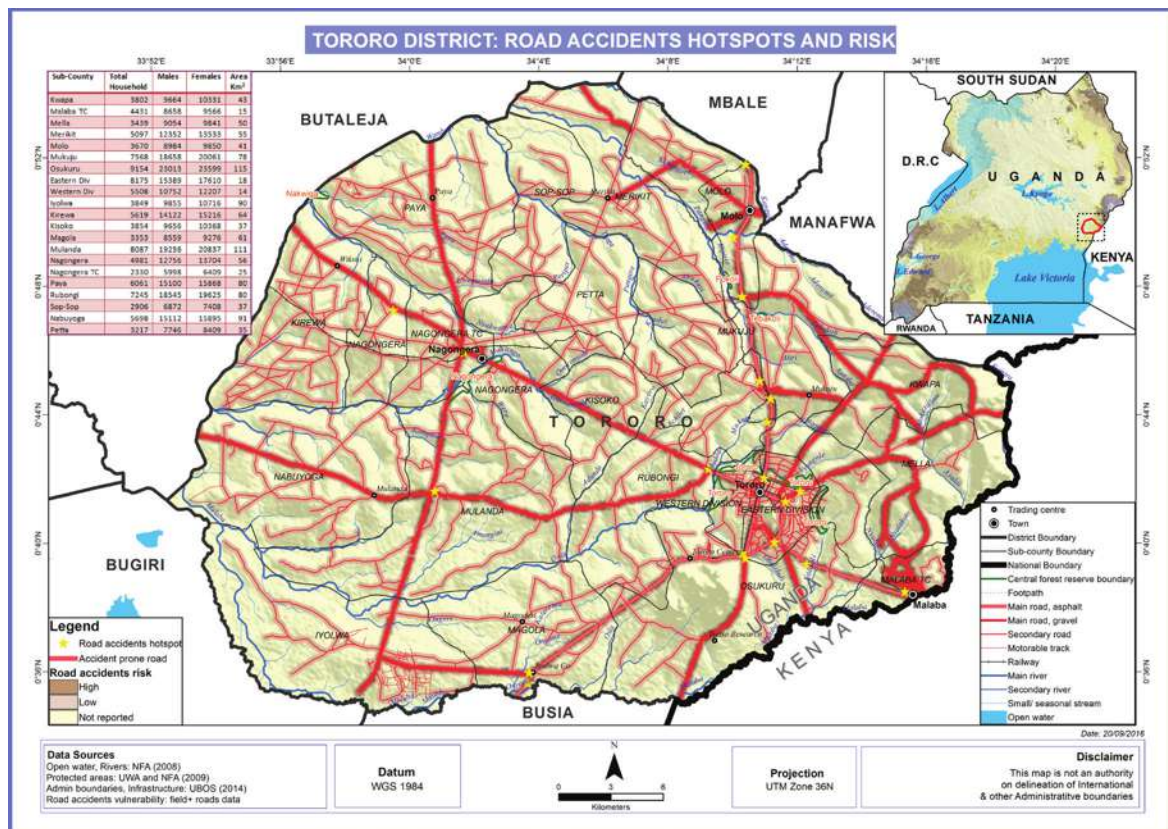


Figure 20: Road and Water Accidents Hotspots and Vulnerability, in Tororo District

4.5 VULNERABILITY PROFILE

Vulnerability depends on low capacity to anticipate, cope with and/or recover from a disaster and is unequally distributed in a society. The vulnerability profile of Tororo district was assessed based on; exposure, susceptibility and adaptive capacity at community (village, parish, sub-county and district levels) highlighting their sensitivity to a certain risk or phenomena. Indeed, vulnerability was divided into biophysical or natural (including environmental and physical components) and social (including social and economic components) vulnerability. Whereas the biophysical vulnerability is dependent upon the characteristics of the natural system itself, the socio-economic vulnerability is affected by economic resources, power dynamics, institutions or cultural aspects of a social system. Differences in socio-economic vulnerability can often be linked to differences in socio-economic status, where a low status generally means that you are more vulnerable.

Vulnerability was assessed basing on two broad criteria, i.e., socio-economic and environmental components of vulnerability. Participatory approach was employed to assess these vulnerability components by characterizing the exposure agents that include; hazards, elements at risk and their spatial dimension. Participants also characterized the susceptibility of the district including identification of the potential impacts, the spatial disposition and the coping mechanisms. Participants also identified the resilience dimension at different spatial scales (Table 2).

Table 3 (Vulnerability Profile) shows the relationship between hazard intensity (probability) and degree of damage (magnitude of impacts) depicted in the form of hazard intensity classes; and for each class, the corresponding degree of damage (severity of impact) is given. The hazard assessment revealed that climatological and meteorological hazards in form of drought and hailstorms predispose the community to high vulnerability state. The occurrence of pests and diseases, and Lightning, also create a moderate vulnerability profile in the community (Table 3). Table 4 shows Hazard assessment for Tororo District.

Table 3: Components of Vulnerability in Tororo District

Vulnerability	Exposure			Susceptibility			Resilience		
	Hazards	Elements at Risk	Geographical Scale	Susceptibility	Geographical Scale	Coping strategies	Geographical Scale		
Socio-economic component	Hazards	Human and Exposure livestock adjacent to hill slopes - Crops on hill slopes - Infrastructure e.g. houses, schools, health facilities	Parish	- Complete crop failure - Destruction of infrastructure e.g. homes, and schools	Parish	-Migration -Sensitization by both governmental and non-governmental agencies	Parish		
	Rock falls and Soil erosion								
	Earth quakes	- Infrastructure e.g. houses, schools	District	- Loss of lives - Destruction of Infrastructure e.g. houses, schools	District	-No much measure so far	District		
	Floods	- Livestock adjacent to flood plains - Crops on flood plains - Infrastructure e.g. houses, schools, roads adjacent to flood plains	Parish	- Livestock loss - Destruction of crops - Destruction of infrastructure e.g. houses, schools, roads adjacent to flood plain	Parish	-Migration -Sensitization on wetland conservation -Dig trenches -Flood resilient construction designs	Parish		
	Drought/ Prolonged dry spells	- Livestock - Crops - Human population	Village	- Hunger & poverty - Livestock loss - Crop failure - Shortage of pasture - Shortage of water	Village	-Plant drought tolerant crops -Sensitization on tree planting -Buy food from elsewhere -Practice water conservation practices	Village		
	Hailstorms, strong winds and Lightning	- Human and livestock populations - Crops - Infrastructure e.g. houses, schools, health facilities	Parish	- Loss of lives - Destruction of crops - Destruction of infrastructure e.g. houses, schools, roads adjacent to flood plains	Parish	-Plant trees as wind breaks -Install Lightning arrestors on schools and other installations	Parish		
	Crop Pests and Diseases	-Crops -Tree crops	District	- Complete crop Failure -Poor crop health -Reduced crop productivity	District	- Plant pests and disease tolerant crops and trees Spraying -Cut and bury affected crops -Sensitization on crop disease management	District		
	Livestock Pests and Diseases	-Livestock (cattle, goats, poultry, pigs, etc.)	District	- Loss of livestock - Reduced livestock productivity	District	- Vaccination and treatment - Bury and burn animals that have died from infection - Good nutrition - Good hygiene and sanitation -Quarantine	District		

Human Disease outbreaks	- Human Population	District	- Loss of lives -Morbidity -Low labor productivity	District	- Mass immunization - Use of mosquito nets and indoor residual spray -Use of personal protective equipment (PPE's)	District
Invasive species	-Indigenous species -Animals -Crops and pasture	District	- Outcompete the indigenous spp, suppress growth of indigenous spp - Loss of indigenous spp. - Complete crop Failure - Suppress growth of pasture	District	- Cut and burn -Sensitization on Invasive species management	District
Bush fires	- Livestock - Crops - Infrastructure e.g. houses, schools	Sub-county	- Loss of livestock - Shortage of pasture - Destruction of crops - Destruction of infrastructure e.g. houses, schools	Sub-county	-Sensitization -Keep under growth short -Fire break lines -Plant fire tolerant species	Sub-county
Road accidents	- Human population - Infrastructure adjacent to accident black spots e.g. houses, schools, etc.	Sub-county	- Loss of lives - Destruction of vehicles - Destruction of Infrastructure adjacent to accident black spots e.g. houses, schools, etc.	Sub-county	-Humps on roads -Signage on speed limits -Sensitization on traffic rules -Institute express penalties	Sub-county
Land conflicts	- Human population	Village	-Loss of lives -Family violence and break outs	Village	- Community dialogue - District court in charge of land issues	Village
Vermin and Wildlife animal attacks	- Human population - Livestock - Crops	Parish	-Loss of lives -Livestock loss -Crop destruction	Parish	- Report to UWA - Guard gardens -Poison -Hunt and kill -Fence water collection points with Wildlife animals	Village
Environmental degradation	- Human and livestock populations - Crops - Natural vegetation	Sub-county	-Crop failure -Shortage of pasture -Shortage of water -Decline of water quality	Sub-county	-Sensitization on wetland conservation -Sensitization on tree planting -Setting bye-laws	Sub-county
Landslides, Rock falls and Soil erosion	- Human and livestock adjacent to hill slopes - Crops on hill slopes - Infrastructure e.g. houses, schools, roads adjacent to hill, slopes	Parish	- Loss of lives - Complete crop failure - Destruction of infrastructure e.g. homes, and schools	Parish	-Migration -Sensitization by both government and non-governmental agencies	



Earth quakes	- Infrastructure e.g. houses, schools	District	- Loss of lives - Destruction of Infrastructure e.g. houses, schools	District	-No much measure so far	
Floods	- Livestock adjacent to flood plain - Crops on flood plain - Infrastructure e.g. houses, schools, roads adjacent to flood plain	Parish	- Livestock loss - Destruction of crops - Destruction of infrastructure e.g. houses, schools, roads adjacent to flood plain	Parish	-Migration -Sensitization on wetland conservation -Dig trenches	
Drought/ Prolonged dry spells	- Livestock - Crops - Human population	Village	- Hunger & poverty - Livestock loss - Crop failure - Shortage of pasture - Shortage of water	Village	-Migration -Sensitization on tree planting -Buy food from elsewhere	
Hailstorms, strong winds and Lightning	- Human and livestock populations - Crops - Infrastructure e.g. houses, schools, health centers	Parish	- Loss of lives - Destruction of crops - Destruction of infrastructure e.g. houses, schools, roads adjacent to flood plains	Parish	- Planting Trees	
Crop Pests and Diseases	-Crops -Tree crops	District	- Complete crop failure	District	- Spraying - Cut and bury affected crops -Sensitization on crop disease management	
Livestock Pests and Diseases	-Livestock (cattle, goats, etc.)	District	- Loss of livestock - Reduced livestock productivity	District	- Vaccination - Bury and burn animals that have died from infection -Quarantine	
Human Disease outbreaks	- Human Population	District	- Loss of lives	District	- Mass Immunization - Use of mosquito nets	
Invasive species	-Indigenous species -Animals	District	- Outcompete the indigenous species, suppress growth of indigenous spp - Loss of indigenous spp. - Complete crop Failure - Suppress growth of pasture	District	- Cut and burn -Sensitization on Invasive species management	
Bush fires	- Livestock - Crops - Infrastructure e.g. houses, schools	Sub-county	- Loss of livestock - Shortage of pasture - Destruction of crops - Destruction of infrastructure e.g. houses, schools	Sub-county	-Sensitization	

Environmental component



Road accidents	- Human population - Infrastructure adjacent to accident black spots e.g. houses, schools, etc.	Sub-county	- Loss of lives - Destruction of vehicles - Destruction of Infrastructure adjacent to accident black spots e.g. houses, schools etc.	Sub-county	- Humps on roads - Signage on speed limits - Sensitization on traffic rules	Sub-county			
Land conflicts	- Human population	Village	-Loss of lives -Family violence and break outs	Village	- Community dialogue - District court in charge of land issues	Village			
Vermin and Wildlife animal attacks	- Human population - Livestock - Crops	Parish	-Loss of lives -Livestock loss -Crop destruction	Parish	- Report to UWA - Guard gardens -Poison -Hunt and kill -Fence water collection points with Wildlife animals	Parish			
Environmental degradation	- Human and livestock populations - Crops - Natural vegetation	Sub-county	-Crop failure -Shortage of pasture -Shortage of water -Decline of water quality	Sub-county	-Sensitization on wetland conservation -Sensitization on tree planting -Setting bye-laws	Sub-county			



Table 4: Vulnerability Profile for Tororo District

	PROBABILITY	SEVERITY OF IMPACTS	RELATIVE RISK	VULNERABLE SUB COUNTIES
	<i>Relative likelihood this will occur</i>	<i>Overall Impact (Average)</i>	<i>Probability x Impact Severity</i>	
Hazards	1 = Not occur 2 = Doubtful 3 = Possible 4 = Probable 5 = Inevitable	1 = No impact 2 = Low 3 = medium 4 = High	0-1 = Not Occur 2-10 = Low 11-15 = Medium 16-20 = High	
Floods	5	4	20	The most affected sub-counties: Paya, Iyolwa, Magola, Nagongera, Osukuru, and Malaba Town Council.
Droughts/ Prolonged dry spells	3	2	6	All sub-counties.
Soil erosion, rock falls and landslides	5	4	20	Tororo Municipality, Malaba Town Councils, Paya, Petta, Kwapa, Mella, Osukuru, Nabuyoga, Nagongera, Sopsop.
Hail storms, Lightning and strong winds	4	4	16	The most affected sub-counties: Petta, Kisoko, Magola, Nabuyoga, Mella, Rubongi, Kirewa, Kwapa, Mukuju, Tororo Municipality.
Bush fires and Forest fires	4	3	12	The most affected sub-counties: Rubongi, Paya, Magola, Tororo Municipality, Iyolwa, Nabuyoga, Kirewa.
Crop pests and diseases	4	3	12	All sub-counties
Livestock parasites/ and diseases	4	3	12	All sub-counties
Human Diseases outbreaks	5	3	15	The most affected areas: Kirewa, Paya, Mulanda, Osukuru, Malaba Town Council, Tororo Municipality.
Land conflicts	4	3	12	All sub-counties
Vermin and Wild-life animal attacks	5	4	20	The most affected areas: Iyolwa, Magola, Nabuyoga, Osukuru, Malaba Town Council, Tororo Municipality.
Earthquakes and faults	3	1	3	All sub-counties
Accidents (Road and Water)	4	2	8	The most affected areas: Osukuru, Magola, Malaba Town Council, Tororo Municipality, Molo, Nagongera.
Environmental degradation	4	4	16	All sub-counties.
Invasive species	4	2	8	All sub-counties.

Note: This table presents relative risk for hazards to which the community was able to attach probability and severity scores.

Key for Relative Risk

	High
	Medium
	Low
	Not reported/ Not prone

Table 5: Hazard Risk Assessment

Hazard	Eastern Division	Western Division	Kwapa	Malaba TC	Mella	Merikit	Molo	Mukuju	Osukuru	Iyolwa	Magola	Mulanda	Nabuyoga	Rubongi	Kirewa	Kisoko	Nagongera SC	Nagongera TC	Paya	Petta	Sopsop
Floods	L	L	L	H	M	L	L	L	H	H	H	L	L	L	L	L	H	H	VH	L	M
Drought/ Prolonged dry spells	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Landslides, Rock falls and Soil erosion	M	M	M	M	M	L	L	M	M	L	L	L	L	L	M	M	M	M	M	M	M
Strong winds, Hailstorms and Lightning	H	H	H	M	M	M	M	H	M	M	H	M	M	M	M	H	M	M	M	H	M
Crop pests and Diseases	M	M	H	H	H	M	M	M	H	M	M	M	M	M	M	M	M	M	M	M	M
Livestock pests and Diseases	L	L	M	H	H	M	M	M	H	H	H	M	H	M	H	M	M	M	H	M	M
Human disease outbreaks	M	M	L	M	L	L	L	L	M	L	L	M	L	L	M	L	L	L	M	L	L
Vermin and Wildlife animal attacks	M	M	L	M	L	L	L	L	M	VH	M	M	M	L	M	L	M	M	L	L	M
Land conflicts	M	M	M	M	M	M	M	M	M	H	H	M	M	M	M	M	M	M	H	M	M
Bush fires and Forest fires	M	M	L	M	L	M	L	L	M	M	M	M	M	M	M	L	L	M	M	M	M
Environmental degradation	M	M	H	H	H	H	H	H	H	M	M	M	M	M	M	H	M	M	M	H	M
Earthquakes and faults	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Road accidents	H	H	L	VH	L	L	M	L	VH	M	H	L	L	M	M	M	M	M	L	L	L
Invasive species	L	L	L	M	L	L	L	L	M	H	H	H	H	M	H	L	M	M	M	L	M

Key

VH	Very high
H	High
M	Medium
L	Low
	Not reported/ Not prone



4.5.1 Gender and Age groups mostly affected by Hazards

Table 6: Gender and age groups mostly affected by hazards

Hazard	Gender and Age mostly affected
Drought	Affects mostly women and children since most water wells dry up increasing distance for fetching water
Erosion	All age groups and gender are affected
Hailstorms and Strong winds Lightning	All gender and age groups children in schools are mostly affected
Crop pests and Diseases	All gender and age groups
Livestock pests and Diseases	All gender and age groups are affected. However, children and women are most affected.
Human disease outbreaks	Malaria mostly in women and children; HIV especially prominent in sexually active groups; Diarrhea and pneumonia in children
Vermin and Wildlife animal attacks	All gender and age groups
Land conflicts	All gender and age groups
Bush fires	All gender and age groups
Environmental degradation	All gender and age groups
Road accidents	All gender and age groups

4.5.2 Coping Strategies

In response to the various hazards, participants identified a range of coping strategies that the community employs to adjust to and build resilience towards the challenges. The range of coping strategies used by communities are broad and interactive often tackling more than one hazard at a time; and focus was towards adaptation actions and processes including social and economic frameworks within which livelihood and mitigation strategies take place. This ensures that there are buffers, irrespective of the direction of climate change, to face adverse impacts and associated effects of climate induced and technological hazards (Table 5).

Table 7: Coping strategies to the Multi-hazards in Tororo District

No	Multi-Hazards		Coping strategies
1	Geomorphological or Geological	Erosion	<ul style="list-style-type: none"> • Contour farming • Plant trees to control water movement on steep slopes • Mulching • Plant grass boundaries on hill slopes
2		Earthquakes and faults	<ul style="list-style-type: none"> • Designs of houses (pillars) • Early warning system • Vigilance • Sensitization • Emergency response mechanisms
3	Climatological or Meteorological	Floods	<ul style="list-style-type: none"> • Digging up of trenches in the flood plains • Planting trees to control water movement to flood plains • Migration to other areas • Seek for government food aid
4		Dry spells	<ul style="list-style-type: none"> • Leave wetlands as water catchments • Plant trees as climate modifiers • Buy food elsewhere in case of shortage • Pay for cost of water distribution • Food storage especially dry grains • Plant drought resistant crops • Water harvesting
5		Strong winds, Hailstorms and Lightning	<ul style="list-style-type: none"> • Plant trees as wind breakers • Use of forked poles against wind in banana plantations • Use of ropes to tie banana against wind • Stay indoors during rains • Changing building designs and roof types • Removal of destroyed crops • Request for aid from the Office of the Prime Minister • Installation of Lightning conductors on newly constructed schools

6	Ecological or Biological	Crop pests and Diseases	<ul style="list-style-type: none"> • Spraying pests • Cutting and burying BBW affected crops • Burning of affected crops • Vigilance • Clean plant materials • Plant disease and pest resistant varieties
7		Livestock Parasites and Diseases	<ul style="list-style-type: none"> • Spraying against parasites/vectors • Vaccinations • Burying animals that have died from infection • Quarantine
8		Human epidemic Diseases	<ul style="list-style-type: none"> • Mass immunisation • Visiting health centres • Use of mosquito nets
9		Vermin and Wild-life animal attacks	<ul style="list-style-type: none"> • Guarding the gardens • Poisoning • Hunt and kill • Report to UWA • Recommend vermin guards
10		Invasive species	<ul style="list-style-type: none"> • Uproot • Spray with herbicides (e.g 2-4-D for broad-leaved plants) • Cut and burn • Sensitization on Invasive species management
11	Human induced or technological	Land conflicts	<ul style="list-style-type: none"> • Community dialogues • Report to court • Migration • Resettlement • Surveying and titling • Strengthen Land management structures • Sensitization on land ownership • Proper land demarcation (live fencing)
12		Fires	<ul style="list-style-type: none"> • Stop the fires in case of fire outbreaks • Fire lines (may be constructed, cleared grass) • Fire breaks planted along gardens e.g. Euphorbia spp. • Vigilance especially in dry seasons where most burning is done • Formulation, enforcement of bye-laws and ordinances • Sensitization on dangers of fires • Recommend controlled burning
13		Accidents (Road, Water)	<ul style="list-style-type: none"> • Construction of humps • Road signage including speed limits • Separate lanes on sharp corners • Sensitisation • Widen narrow roads • Plant trees on road and railway reserves as road and railway guards • Deployment of traffic officers • Sensitization on illegal electricity connections • Reduce on electricity tariffs to be affordable • Encourage alternative sources of energy
14		Environmental degradation	<ul style="list-style-type: none"> • Leave wetlands as water catchments • Plant appropriate tree species as climate modifiers • Get approval of the physical planning committee before construction • Sensitization • Bye-laws and ordinances • Enforcement • Gazette and demarcate wetlands • Restore wetlands and other fragile ecosystems • EIA for new developments • No land titles for wetland areas • Cancellation of existing wetland land titles • Developing land use plans and enforce them
		Rock falls	<ul style="list-style-type: none"> • Regulate stone quarrying • Plant trees on steep slopes to stop rock falls • Vigilance • Sensitization

GENERAL CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The multi-hazard vulnerability profile output from this assessment was a combination of spatial modeling using socio-ecological spatial layers (i.e. DEM, Slope, Aspect, Flow Accumulation, Land use, vegetation cover, hydrology, soil types and soil moisture content, population, socio-economic, health facilities, accessibility, and meteorological data) and information captured from district Key Informant interviews and sub-county FGDs using a participatory approach. The level of vulnerability was assessed at sub-county participatory engagements and integrated with the spatial modeling in the GIS environment.

Results from the participatory assessment indicated that Tororo district has over the past two decades increasingly experienced hazards including; stone falls, soil erosion, floods, drought, hailstorms, strong winds, Lightning, crop pests and diseases, livestock pests and diseases, human disease outbreaks, vermin/wildlife animal attacks, invasive species, bush fires and land conflicts putting livelihoods at increased risk. Generally, flooding was identified as the most serious problem in Tororo district with almost all low lying sub-counties/town councils being vulnerable to the hazard. The limited adaptive capacity and/or resilience and high sensitivity of households and communities in Tororo district increase their vulnerability to hazard exposure necessitating urgent external support.

Hazards experienced in Tororo district can be classified as:

- i. Geomorphological or Geological hazards including; stone falls, soil erosion and earth quakes (minor cases)
- ii. Climatological or Meteorological hazards including; floods, drought, hailstorms, strong winds and Lightning.
- iii. Ecological or Biological hazards including; crop pests and diseases, livestock parasites/vectors and diseases, human disease outbreaks, vermin and wildlife animal attacks and invasive species.
- iv. Human induced or Technological hazards including; bush fires, road accidents and land conflicts.

However, reducing vulnerability at community, Local Government and National Levels should be a threefold effort hinged on:

- i. Reducing the impact of the hazard where possible through prevention, mitigation, prediction, early warning and preparedness.
- ii. Building capacities to withstand and cope with the hazards and risks.
- iii. Tackling the root causes of vulnerability such as poverty, poor governance, discrimination, inequality and inadequate access to resources and livelihood opportunities.

5.2 Policy-related Recommendations

The recommended policy actions targeting vulnerability reduction include but are not limited to:

- i. The government should improve enforcement of policies aimed at enhancing sustainable environmental health.
- ii. The government through MAAIF should review the animal diseases control act because of low penalties given to defaulters.
- iii. The government should establish systems to motivate support of political leaders toward

government initiatives and programs aimed at Disaster Risk Reduction.

- iv. The government should increase awareness campaigns aimed at sensitizing farmers/communities on Disaster Risk Reduction initiatives and practices.
- v. The government should provide adequate support to existing disaster committees and revive them where they do not exist at all levels and ensure funding of disaster and environmental related activities.
- vi. The government through UNRA and the District Authority should fund periodic maintenance of trunk roads and feeder roads to reduce on traffic accidents.
- vii. The government through OPM and Meteorology Authority should encourage increased importation of Lightning conductors and also reduce taxes on their importation.
- viii. The government through OPM and Meteorology Authority should enhance support in the establishment of disaster early warning systems.
- ix. The government through MWE and MAAIF should increase funding and support staff to monitor wetland degradation and non-genuine agro-inputs.
- x. The government through OPM should improve communication between the disaster department and local communities.
- xi. The government through MWE should promote tree planting along road and/or railway reserves.
- xii. The government through MAAIF should fund and enhance recruitment of agricultural extension workers at sub-county level/town council and also facilitate them.
- xiii. The government through MAAIF and MWE should support districts to construct flood control structures in all flood prone areas.

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APPENDIX I: LIST OF CONTRIBUTORS FROM DISTRICT DISASTER MANAGEMENT COMMITTEE

S/n	Name of Participant	Designation
1	Epodoi Pauline	D/CAO
2	Owino Felix	Senior Planner
3	Anguti Silas	Ag DNRO
4	Omitta Patrict Owino	ADHO
5	Alloo Eunice	Senior Agriculture Officer

**APPENDIX I: DATA COLLECTION TOOLS
FOCUS GROUP DISCUSSION GUIDE FOR DISTRICT DISASTER RISK MANAGEMENT FOCAL PERSONS**

Interviewer Team Name(s)	District:	GPS Coordinates	
	Sub- county:	X:	
	Parish:	Y:	
	Village:	Altitude	

No.	Name of Participants	Designation	Contact	Signature

Introduction

- i. You have all been requested to this session because we are interested in learning from you. We appreciate your rich experiences and hope to use them to strengthen service delivery across the district and the country as whole in a bid to improve access to information on Hazards and early warning.
- ii. There is no “right” or “wrong” answers to any of the questions. As a Focus Group Discussion leader, I will try to ask all people here today to take turns speaking. If you have already spoken several times, I may call upon someone who has not said as much. I will also ask people to share their remarks with the group and not just with the person beside them, as we are anxious to hear what you have to say.
- iii. This session will be tape recorded so we can keep track of what is said, write it up later for our report. We are not attaching names to what you have said, so whatever you say here will be anonymous and we will not quote you by name.
- iv. I would not like to keep you here long; at most we should be here for 30 minutes to 1 hour.

Section A: Geomorphological or Geological Hazards (Landslides, rock falls, soil erosion and earth quakes)

1. Which crops are majorly grown in your area of jurisdiction?
2. Which domestic animals are dominant in your area of jurisdiction?
3. What challenges are faced by farmers in your area of jurisdiction?
4. Have you experienced landslides and rock falls in the past 10 years in your area of jurisdiction?
5. Which villages, parishes or sub-counties have been most affected by landslide and rock falls?
6. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-counties that have been most affected?
7. Which crops are majorly affected by landslides and rock falls in your area of jurisdiction?
8. In which way are the crops affected by landslides and rock falls?
9. Which domestic animals are majorly affected by landslides and rock falls in your area of jurisdiction?
10. In which way are the domestic animals affected by landslides and rock falls?
11. Which agricultural practices are being adopted by farmers in a bid to mitigate the above challenges?
12. What are the relevant government's interventions focusing at helping farmers mitigate the challenges mentioned?
13. Do you have any earth faults or earth cracks as lines of weakness in your area of jurisdiction?
14. Have you experienced any earth quakes in the past 10 years in your area of jurisdiction?
15. Which particular villages, parishes or sub-counties have been majorly affected by earth quakes in your area of jurisdiction?
16. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-counties that have been most affected?
17. What impacts have been caused by earth quakes?
18. To what extent have the earth quakes affected livelihoods of the local communities in your area of jurisdiction?
19. Which mitigation measures have been adopted local communities in a bid to mitigate the above challenges?
20. What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?

Section B: Meteorological or climatological hazards (Floods, Droughts, Lightning, strong winds, hailstorms)

21. Have you experienced floods in the past 10 years in your area of jurisdiction?
22. Which villages, parishes or sub-counties have been most affected by floods?
23. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-counties that have been most affected?
24. Which crops are majorly affected by floods in your area of jurisdiction?
25. In which way are the crops affected by floods?
26. Which domestic animals are majorly affected by floods in your area of jurisdiction?
27. In which way are the domestic animals affected by floods?
28. Which agricultural practices are being adopted by farmers in a bid to mitigate the above challenges?
29. What are the relevant government's interventions focusing at helping farmers mitigate the challenges mentioned?
30. Have you experienced drought in the past 10 years in your area of jurisdiction?
31. Which villages, parishes or sub-counties have been most affected by drought?
32. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-counties that have been most affected?
33. Which crops are majorly affected by drought in your area of jurisdiction?
34. In which way are crops affected by drought?
35. Which domestic animals are majorly affected by drought in your area of jurisdiction?
36. In which way are the domestic animals affected by drought?
37. Which agricultural practices are being adopted by farmers in a bid to mitigate the above challenges?
38. What are the relevant government's interventions focusing at helping farmers mitigate the challenges mentioned?
39. Have you experienced hailstorms or Lightning in the past 10 years in your area of jurisdiction?
40. Which villages, parishes or sub-counties have been most affected by hailstorms or Lightning?
41. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-counties that have been most affected?
42. What impacts have been caused by hailstorms or Lightning?

43. To what extent have the hailstorms or Lightning affected livelihoods of the local communities in your area of jurisdiction?
44. Which mitigation measures have been adopted local communities in a bid to mitigate the above challenges?
45. What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?

Section C: Biological hazards (Crop pests and diseases, Livestock pests and Diseases, Invasive species, vermin and wild-life animal attacks)

46. Have you experienced any epidemic animal disease outbreaks in the past 10 years in your area of jurisdiction?
47. Which villages, parishes or sub-counties have been most affected by epidemic animal disease outbreaks?
48. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-counties that have been most affected?
49. Specify the epidemic animal disease outbreaks that have majorly affected animals in your area of jurisdiction?
50. Which domestic animals are majorly affected by epidemic animal disease outbreaks in your area of jurisdiction?
51. In which way are the domestic animals affected by epidemic animal disease outbreaks?
52. Which mitigation practices are being adopted by farmers in a bid to mitigate the above epidemic animal disease outbreaks?
53. What are the relevant government's interventions focusing at helping farmers mitigate the epidemic animal disease outbreaks mentioned?
54. Have you experienced any crop pests and disease outbreaks in the past 10 years in your area of jurisdiction?
55. Which villages, parishes or sub-counties have been most affected by epidemic animal disease outbreaks?
56. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-counties that have been most affected?
57. Specify the crop pests and disease outbreaks that have majorly affected animals in your area of jurisdiction?
58. Which crops are majorly affected by crop pests and disease outbreaks in your area of jurisdiction?
59. In which way are the crops affected by crop pests and disease outbreaks?
60. Which mitigation practices are being adopted by farmers in a bid to mitigate the above crop pests and disease outbreaks?

61. What are the relevant government's interventions focusing at helping farmers mitigate the crop pests and disease outbreaks mentioned?
62. Have you experienced any epidemic human disease outbreaks in the past 10 years in your area of jurisdiction?
63. Specify the epidemic human disease outbreaks that have majorly affected animals in your area of jurisdiction?
64. In which way are the humans affected by epidemic human disease outbreaks?
65. Which mitigation measures have been adopted by local communities in a bid to mitigate the above epidemic human disease outbreaks?
66. What are the relevant government's interventions focusing at helping local communities mitigate the epidemic human disease outbreaks mentioned?
67. Do you have any national park or wildlife reserve in your area of jurisdiction?
68. Have you experienced wildlife attacks in the past 10 years in your area of jurisdiction?
69. Which particular villages, parishes or sub-counties have been majorly affected by wildlife attacks in your area of jurisdiction?
70. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-counties that have been most affected?
71. What impacts have been caused by wildlife attacks?
72. To what extent have the wildlife attacks affected livelihoods of the local communities in your area of jurisdiction?
73. Which mitigation measures have been adopted local communities in a bid to mitigate the above challenges?
74. What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?
75. Are there invasive species in your area of jurisdiction?
76. Specify the invasive species in your area of jurisdiction?
77. Which villages, parishes or sub-counties have been most affected by invasive species in your area of jurisdiction?
78. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-counties that have been most affected?
79. Which crops or animals are majorly affected by invasive species in your area of jurisdiction?
80. In which way are the crops or animals affected by invasive species?

81. Which mitigation practices are being adopted by farmers in a bid to mitigate the above invasive species?

82. What are the relevant government's interventions focusing at helping farmers mitigate the invasive species mentioned?

Section D: Human induced or Technological hazards (Land conflicts, bush and forest fires, road accidents, water accidents and environmental degradation)

83. Have you experienced environmental degradation in your area of jurisdiction?

84. What forms of environmental degradation have been experienced in your area of jurisdiction?

85. Which villages, parishes or sub-counties have been most affected by environmental degradation?

86. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-counties that have been most affected?

87. What impacts have been caused by environmental degradation?

88. Which measures have been adopted by local communities in a bid to mitigate the above challenges?

89. What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?

90. Have you experienced land conflicts in the past 10 years in your area of jurisdiction?

91. Which particular villages, parishes or sub-counties have been majorly affected by land conflicts in your area of jurisdiction?

92. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-counties that have been most affected?

93. What impacts have been caused by land conflicts?

94. To what extent have the land conflicts affected livelihoods of the local communities in your area of jurisdiction?

95. Which conflict resolution measures have been adopted local communities in a bid to mitigate the above challenges?

96. What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?

97. Have you experienced Road accidents in the past 20 years in your area of jurisdiction?

98. Which roads have experienced Road accidents?

99. What impacts have been caused by Road accidents?

100. To what extent have the Road accidents affected livelihoods of the local communities in your



area of jurisdiction?

101. Which conflict resolution measures have been adopted local communities in a bid to mitigate the above challenges?
102. What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?
103. Have you experienced any serious bush and or forest fires in the past 10 years in your area of jurisdiction?
104. Which particular villages, parishes or sub-counties have been majorly affected by bush and or forest fires in your area of jurisdiction?
105. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-counties that have been most affected?
106. What impacts have been caused by serious bush and or forest fires?
107. To what extent have the serious bush and or forest fires affected livelihoods of the local communities in your area of jurisdiction?
108. Which mitigation measures have been adopted local communities in a bid to mitigate the above challenges?
109. What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?

FOCUS GROUP DISCUSSION GUIDE FOR LOCAL COMMUNITIES

Interviewer Team Name(s)	District:	GPS Coordinates	
	Sub- county:	X:	
	Parish:	Y:	
	Village:	Altitude	

No.	Name of Participants	Village/ Parish	Contact	Signature

Introduction

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12. What are the relevant government's interventions focusing at helping farmers mitigate the challenges mentioned?
13. Do you have any earth faults or earth cracks as lines of weakness in your community?
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Section B: Meteorological or climatological hazards (Floods, Droughts, Lightning, strong winds, hailstorms)

21. Have you experienced floods in the past 10 years in your community?
22. Which villages and parishes have been most affected by floods?
23. As a way of ranking from Low, Medium, High and Very high, rank the villages and parishes that have been most affected?
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41. As a way of ranking from Low, Medium, High and Very high, rank the villages and parishes that have been most affected?
42. What impacts have been caused by hailstorms or Lightning?
43. To what extent have the hailstorms or Lightning affected livelihoods of the local communities in your community?
44. Which mitigation measures have been adopted local communities in a bid to mitigate the above challenges?
45. What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?

Section C: Biological hazards (Crop pests and diseases, Livestock pests and Diseases, Invasive species, vermin and wild-life animal attacks)

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47. Which villages and parishes have been most affected by epidemic animal disease outbreaks?
48. As a way of ranking from Low, Medium, High and Very high, rank the villages and parishes that have been most affected?

49. Specify the epidemic animal disease outbreaks that have majorly affected animals in your community?
50. Which domestic animals are majorly affected by epidemic animal disease outbreaks in your community?
51. In which way are the domestic animals affected by epidemic animal disease outbreaks?
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62. Have you experienced any epidemic human disease outbreaks in the past 10 years in your community?
63. Specify the epidemic human disease outbreaks that have majorly affected animals in your community?
64. In which way are the humans affected by epidemic human disease outbreaks?
65. Which mitigation measures have been adopted by local communities in a bid to mitigate the above epidemic human disease outbreaks?
66. What are the relevant government's interventions focusing at helping local communities mitigate the epidemic human disease outbreaks mentioned?
67. Do you have any national park or wildlife reserve in your area of jurisdiction?
68. Have you experienced wildlife attacks in the past 10 years in your community?

69. Which particular villages and parishes have been majorly affected by wildlife attacks in your community?
70. As a way of ranking from Low, Medium, High and Very high, rank the villages and parishes that have been most affected?
71. What impacts have been caused by wildlife attacks?
72. To what extent have the wildlife attacks affected livelihoods of the local communities in your community?
73. Which mitigation measures have been adopted local communities in a bid to mitigate the above challenges?
74. What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?
75. Are there invasive species in your community?
76. Specify the invasive species in your community?
77. Which villages and parishes have been most affected by invasive species in your community?
78. As a way of ranking from Low, Medium, High and Very high, rank the villages and parishes that have been most affected?
79. Which crops or animals are majorly affected by invasive species in your community?
80. In which way are the crops or animals affected by invasive species?
81. Which mitigation practices are being adopted by farmers in a bid to mitigate the above invasive species?
82. What are the relevant government's interventions focusing at helping farmers mitigate the invasive species mentioned?

Section D: Human induced or Technological hazards (Land conflicts, bush and forest fires, road accidents, water accidents and environmental degradation)

83. Have you experienced environmental degradation in your community?
84. What forms of environmental degradation have been experienced in your community?
85. Which villages and parishes have been most affected by environmental degradation?
86. As a way of ranking from Low, Medium, High and Very high, rank the villages and parishes that have been most affected?
87. What impacts have been caused by environmental degradation?
88. Which measures have been adopted by local communities in a bid to mitigate the above challenges?

89. What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?
90. Have you experienced land conflicts in the past 10 years in your community?
91. Which particular villages and parishes have been majorly affected by land conflicts in your community?
92. As a way of ranking from Low, Medium, High and Very high, rank the villages and parishes that have been most affected?
93. What impacts have been caused by land conflicts?
94. To what extent have the land conflicts affected livelihoods of the local communities in your community?
95. Which conflict resolution measures have been adopted local communities in a bid to mitigate the above challenges?
96. What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?
97. Have you experienced Road accidents in the past 20 years in your community?
98. Which roads have experienced Road accidents?
99. What impacts have been caused by Road accidents?
100. To what extent have the Road accidents affected livelihoods of the local communities in your community?
101. Which conflict resolution measures have been adopted local communities in a bid to mitigate the above challenges?
102. What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?
103. Have you experienced any serious bush and or forest fires in the past 10 years in your community?
104. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-counties that have been most affected?
105. What impacts have been caused by serious bush and or forest fires?
106. To what extent have the serious bush and or forest fires affected livelihoods of the local communities in your community?
107. Which mitigation measures have been adopted local communities in a bid to mitigate the above challenges?
108. What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?

SPATIAL DATA COLLECTION SHEET FOR HAZARD VULNERABILITY AND RISK MAPPING

Observer Name: Date:	District:	Coordinates		
	Sub- county:	X:		
	Parish:	Y:		
	Village:	Altitude		
Slope characterization	Bio-physical characterization	Vegetation characterization		Land use type (tick) Bush Grassland Wetland Tree plantation Natural forest Cropland Built-up area Grazing land Others
Slope degree (e.g 10, 20, ...)	Soil Texture	Veg. cover (%)		
Slope length (m) (e.g 5, 10, ...)	Soil Moisture	Tree cover (%)		
Aspect (e.g N, NE...)	Rainfall	Shrubs cover (%)		
Elevation (e.g high, low...)	Drainage	Grass / Herbs cover (%)		
Slope curvature (e.g concave, convex...)	Temperature	Bare land cover		
Area Description (Susceptibility ranking: landslide, mudslide, erosion, flooding, drought, hailstorms, Lightning, cattle disease outbreaks, human disease outbreaks, land conflicts, wildlife conflicts, bush fires, earthquakes, faults/ cracks, pictures, any other sensitive features)				



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Department of Relief, Disaster
Preparedness and Management
Office of the Prime Minister
P.O.Box 371, Kampala, Uganda

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Plot 11 Yusuf Lule, Road, Nakasero
P. O. Box 7184, Kampala, Uganda
Tel: (+256) 417 112 100
Fax: (+256) 414 344 801
www.undp.org