THE REPUBLIC OF UGANDA

Sironko 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.

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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 outputs 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 etc. 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 Bukhulo, Sironko Budadiri and Zesui Sub-counties. Each Parish of the selected Sub-counties were 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 workshopin 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 Sironko 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 and invasive species.
- Human induced or Technological hazards including; bush fires, road accidents and land conflicts.

General findings from the participatory assessment indicated that Sironko 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. Soil erosion, land conflicts and environmental degradation were identified as most of the serious problems in Sironko district with almost all sub-counties being vulnerable to the hazards. This is because the area is generally hilly with steep slopes, valleys, radial drainage with Sipi being the main river and a number of other rivers and stream flowing Northwards from Mt. Elgon.

The limited adaptive capacity (and or/resilience) and high sensitivity of households and communities in the district increases their vulnerability to hazard exposure necessitating urgent external support. To reduce vulnerability at Community, Local Government and National Levels, there 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 toward 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 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 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 and development and 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 past year's Uganda has experienced frequent disasters that range from drought, floods, landslides, human and animal diseases, pests, animal attacks, earthquakes, fires, conflicts and other hazards which in many instances result 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, are becoming critical.

The Government of Uganda is shifting the disaster management paradigm from the traditional emergency response focus toward 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 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, UNDP has been supporting the Office of the Prime Minister to develop 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 participated in data collection and analysis. The data collected was used to generate hazard risk and vulnerability maps and profiles. Validation workshops were held in close collaboration with 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 visited of Rwenzori and Teso was improved in subsequent sub-regions.

This final draft report details methodological approach for HRV profiling and mapping for Sironko district.

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 Sironko 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 following:

i. Collection of field data using GIS in close collaboration and coordination with OPM in Sironko 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) mandates 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 “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 five Chapters: Chapter 1 provides Introduction on the assignment. Chapter 2 elaborates on the overview of Sironko district, Chapter 3 focuses on the methodology employed, Chapter 4 elaborates the Multi-hazard, Risks and Vulnerability profile and Coping strategies for Sironko District, Chapter 5 describes Conclusions and policy related recommendations.

OVERVIEW OF SIRONKO DISTRICT

2.1 Location

Sironko District was carved out of Mbale District in the year 2000. The District lies between longitudes 1^0 14 '0"N and latitudes 34^0 15' 0"E. It is bordered by Bulambuli to the North, Kween District to the East, Bududa District to the southeast, Mbale District to the southwest and Bukedea District to the west. The district has 19 sub-counties and 2 Town councils namely; Bugitimwa, Buhugu, Bukhulo, Bukiise, Bukiyi, Bukyabo, Bukyambi, Bumalimba, Bumasifwa, Bunyafa, Busulani, Butandiga, Buteza, Buwalasi, Buwasa, Buyobo, Masaba, Nalusala and Zesui sub-counties as well as Budadiri and Sironko town councils.

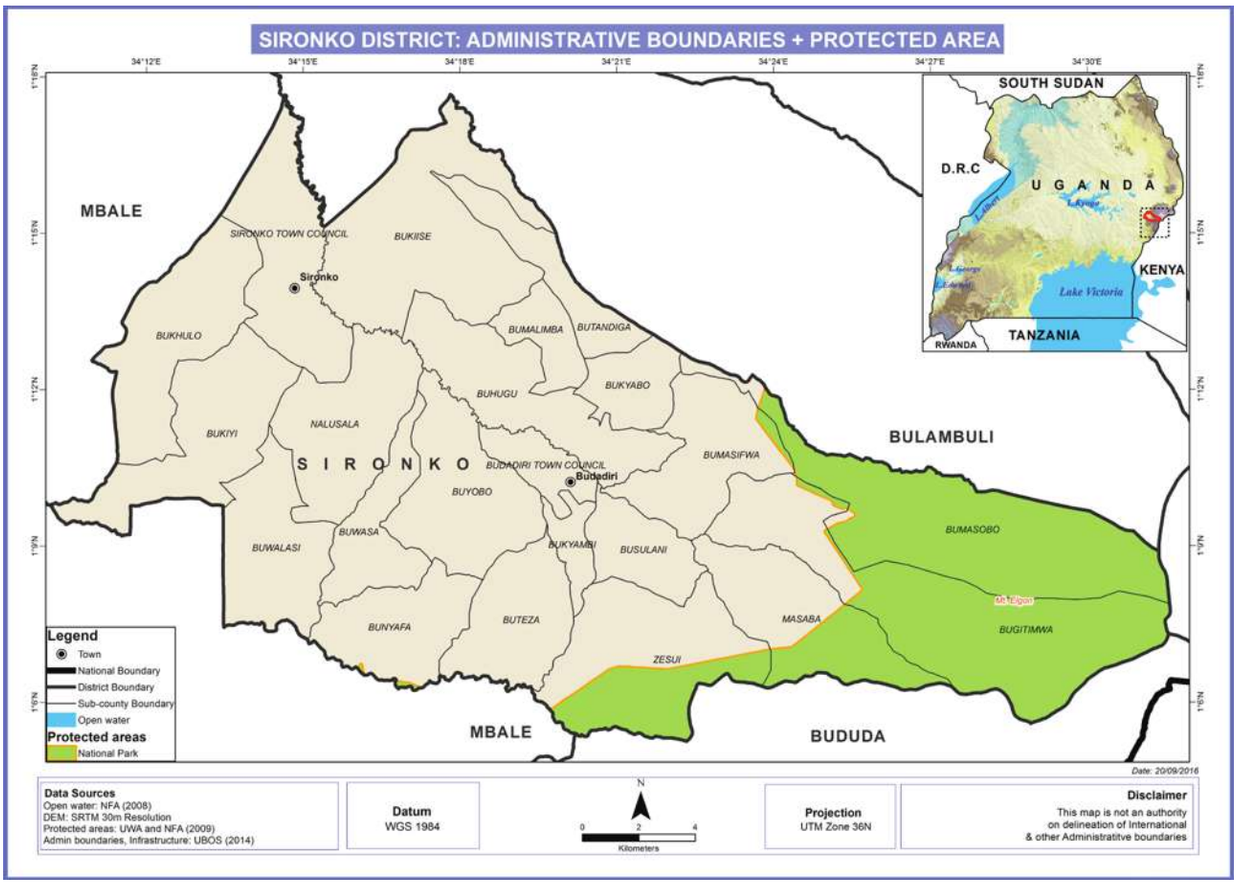


Figure 1: Administrative Boundaries and Gazetted areas, in Sironko District

2.1.1 Geomorphology

The topography of Sironko District can be conveniently divided into three different types namely the lowland (Plain), the Highland and the mountain landscapes.

Lowland (Plain)

The lowland topography stands at an altitudinal range of 1100-1350m with 1320-1340m being the most common level and it lies in North and North-West covering the sub-counties of Bukiise, Sironko Town Council, Bukhulo, lower Bukiyi & Nalusala.

Midland

From the upper level of the lowland, land rises significantly to form a hill and valley topography. The dominant altitude of this landscape is slightly over 1800m, but with many features lower and

higher than this. Most of the sub-counties fall under this region. These include; Bumalimba, Budadiri TC, Bukyambi, Buwasa, Buteza, Busulani, Buwalasi, Buyobo, Bunyafwa, part of Bukyabo part of Nalusala and Bukiiyi

Highland (Mountainous) landscape

The most striking topographic feature in Sironko District and indeed in the whole of Eastern Uganda is Mt. Elgon with its magnificent crater, deep and narrow valleys and ridges. Sitting astride Uganda – Kenya border in a North – East to South – West direction with a large portion in Uganda. Zesui, Masaba, Bugitimwa, Bumasifwa, Butandiga and upper Bukyabo are the sub counties found here.

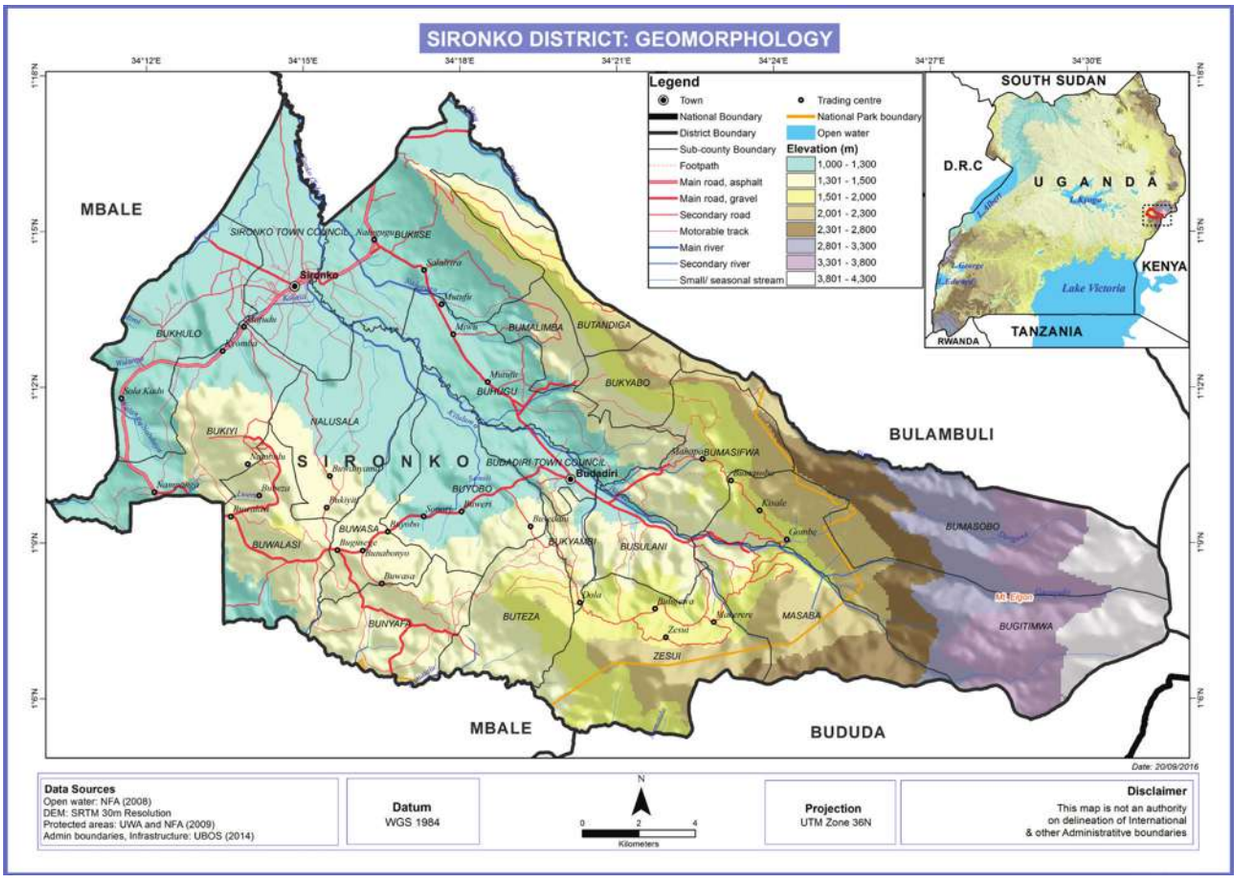


Figure 2: Geormophology, Sironko District

2.1.2 Geology and soils

Precambrian Basement in Sironko District is the Tertiary (Lower Miocene) extrusive volcanic strata resultant upon the eruption and creation of the Mt. Elgon volcanic massif. These volcanic strata consist of soda-rich agglomerates, tuffs and lavas in a spatial and temporal discontinuous sequence. Associated with these volcanic strata are the Tertiary and Quaternary erosion sediments that comprise conglomerates, sandstones, mudflows, and intra-erosional calcareous deposits that are widespread around the foothills of the Mt. Elgon massif. Overlying many of these sediments and occupying much of the Western and Northern portion of the District are a considerable thickness of Pleistocene to recent alluvium, black soils and river deposits with swamp alluvium in the valley bottoms and in the Lake Bisina swamp system to the North.

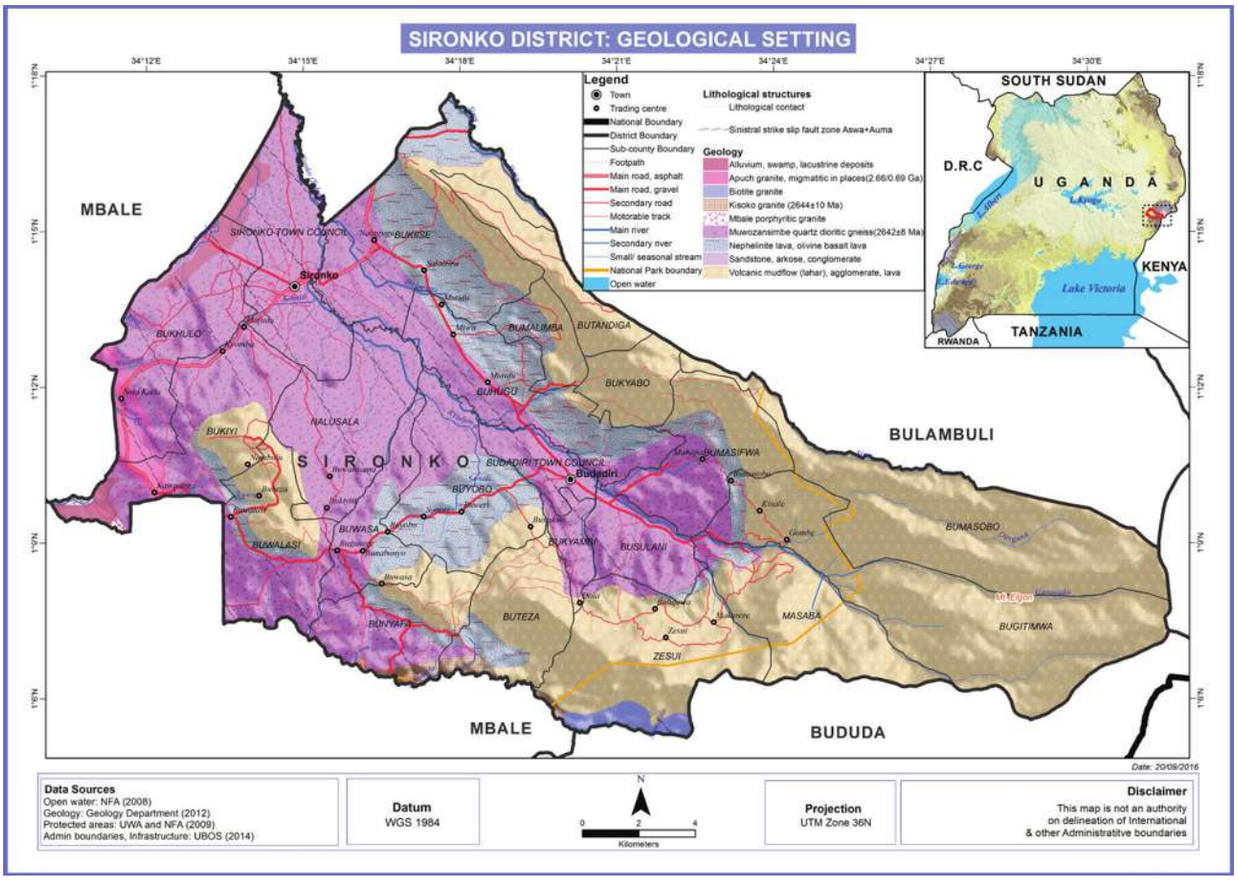


Figure 3: Geology and Lithological Structures, in Sironko District

2.1.3 Vegetation and Land use Stratification

Sironko District has a wide variety of vegetation types, their existence and distribution is influenced by climate, settlement, topography and generally human activity. At certain altitudes unique vegetation zones cut across sections of the district, these included grasses and woodlots in the low lying sub counties, along river banks, forest and swamp vegetation. Natural vegetation is mainly restricted in protected areas found in the East and South-East parts of the District i.e Mt. Elgon N.P. and Namatale C.F.R. Scattered Indigenous tree species such as Cordia, Albizia, Markhamia, and Ficus are common in the midland and highland sub counties mainly conserved agroforestry (intercropped with coffee). Woodlots are found mainly in valleys in Sironko and steep slopes. These are predominantly Eucalyptus grown fuelwood, poles and timber. The dominant vegetation cover in the District is coffee-banana farming system with scattered trees and pockets of grasslands in the lowlands.

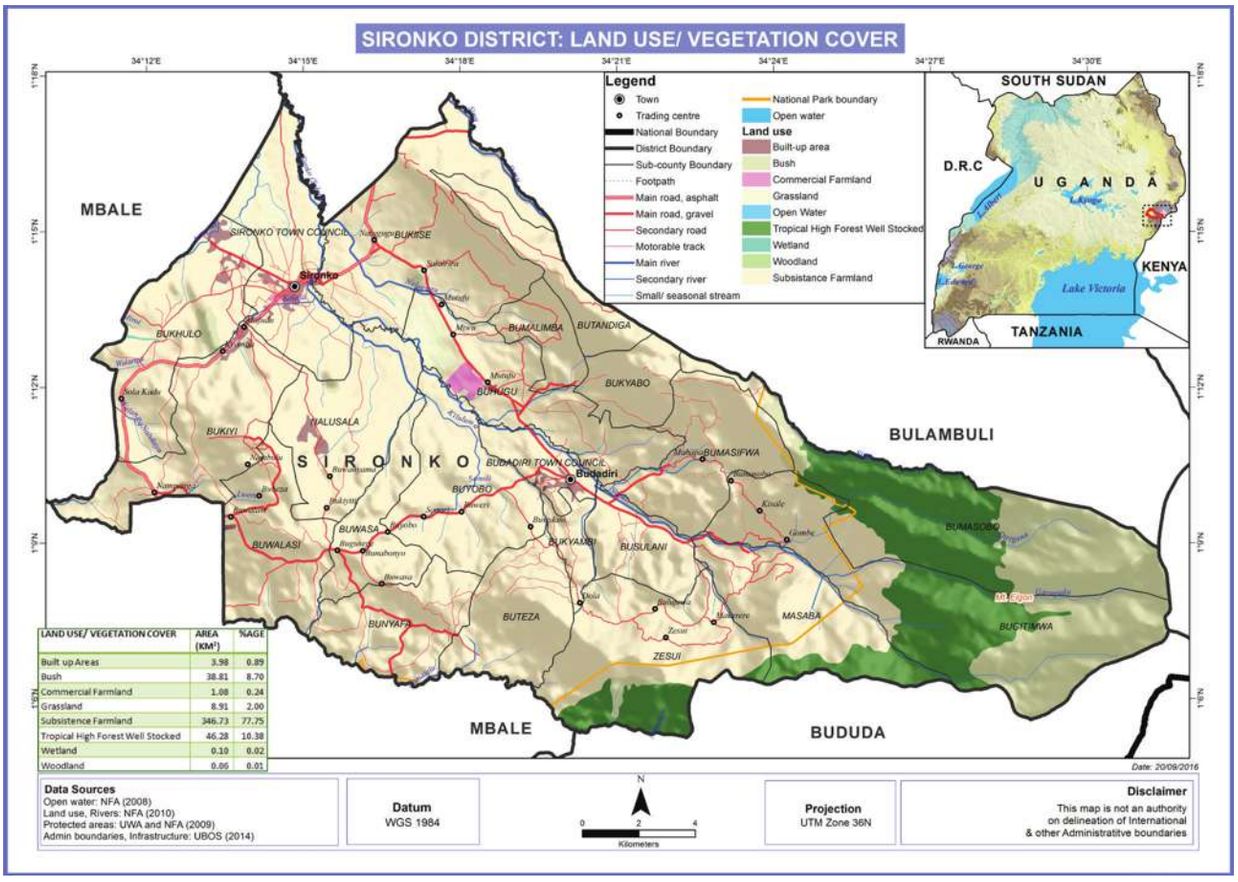


Figure 4: Landuse stratification, in Sironko District

2.1.4 Temperature and Humidity

Due to altitudinal differences a range of temperature conditions are experienced in Sironko District. Temperatures in lowland areas are warmer than high elevation areas. These range from 27°C to 32°C mean maximum temperatures and from 15°C - 17°C mean minimum temperatures in the lowlands. In highland areas mean maximum temperatures range from 25°C - 28°C and mean minimum temperatures 15 ° - 16 °C.

In general, temperatures in Sironko district are on average 28^0C but become lower as one goes up the highland areas.

2.1.5 Wind

2.1.6 Rainfall

The district experiences a bimodal type of rainfall with the heaviest in the first season of March-June while there is low rainfall in the second season between the months of August–November. The average rainfall is 1550 mm per year. This heavy rainfall supports the agriculture sector, which is the base of the district livelihood. There is a short dry period mid-June to July and a long dry period between the months of December-March.

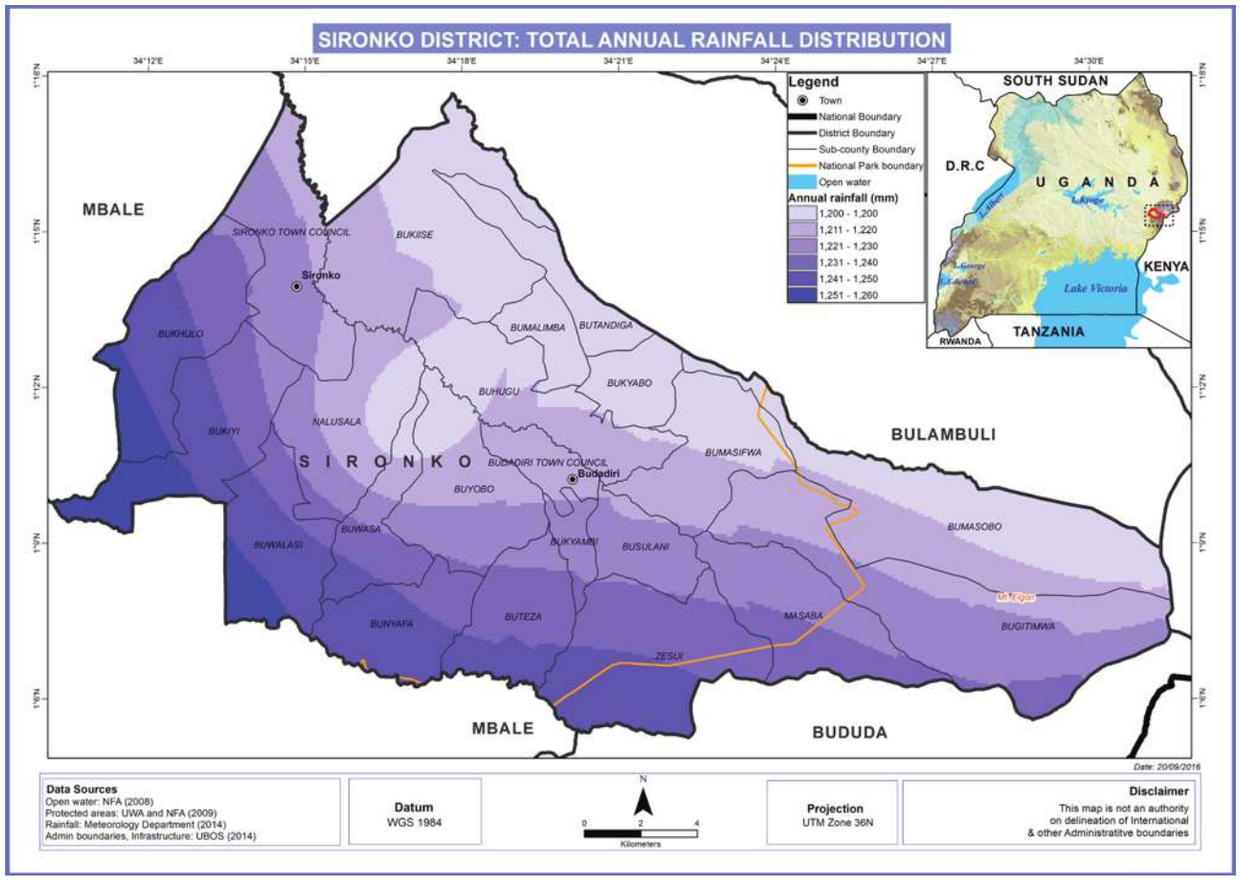


Figure 5: Total Annual Rainfall Distribution, in Sironko District

2.1.7 Hydrology

Mt. Elgon provides the single most important drainage system in Sironko District and the rest of Eastern Uganda. The drainage patterns of the mountain is radial with several rivers and numerous streams and brooks descending along the mountain in all directions through narrow valleys with a series of rapids and waterfalls. Mt. Elgon forms an important hydrological system to the Kyoga basin and therefore, the Nile Basin. The Mt. Elgon provides permanent rivers to Lake Kyoga basin via Sironko river system and Namatale River system. The Sironko river system drains in lake Bisina and Namatale river pours in the Mpologoma which are part of the Kyoga basin.

2.1.8 Population

According to the National Population and Housing Census (2014) results, Sironko District had a total population of 246,636 people. Results also showed that most of the people in Sironko District reside in rural areas (209,025 (84.7%) compared to (37,611 (15.3%) who reside in urban centers. The gender distribution was reported to be males: 121,989 (49.5%) and females: 124,647 (50.5%). About 99.6% (245,670) of the population form the household population and only 0.4% (966) is Non-household. Bukiise sub-county had the highest population of 20,283 people while Bukyambi sub-county had the least population of 3,485 people (Figure 6). Table 1 shows the population distribution per sub-county for the different gender.

Table 1: Population Distribution in Sironko District

	HOUSEHOLDS		POPULATION		
Sub-County	***Number***	***Average Size***	***Males***	***Females***	***Total***
Budadiri Town Council	3408	5.5	9261	9466	18727
Bugitimwa	2091	4	4236	4225	8461
Buhugu	1797	4.2	3663	3826	7489
Bukhulo	3693	4.9	8660	9459	18119
Bukiise	4639	4.4	9976	10307	20283
Bukiyi	3051	4.4	6713	6822	13535
Bukyabo	1416	5	3620	3454	7074
Bukyambi	826	4.2	1740	1745	3485
Bumalimba	3853	4.3	8251	8637	16888
Bumasifwa	2645	3.9	5155	5129	10284
Bunyafa	2417	4.6	5456	5695	11151
Busulani	1497	5	3779	3704	7483
Butandiga	1374	4.3	2952	2955	5907
Buteza	2755	4.3	5849	5949	11798
Buwalasi	3237	4.3	6802	6953	13755
Buwasa	2017	4.3	4381	4283	8664
Buyobo	3197	4.2	6723	6817	13540
Masaba	2318	4.4	5230	4898	10128
Nalusala	2251	4.2	4770	4789	9559
Sironko Town Council	4164	4.5	9127	9757	18884
Zesui	2744	4.2	5645	5777	11422

Source: UBOS Census 2014

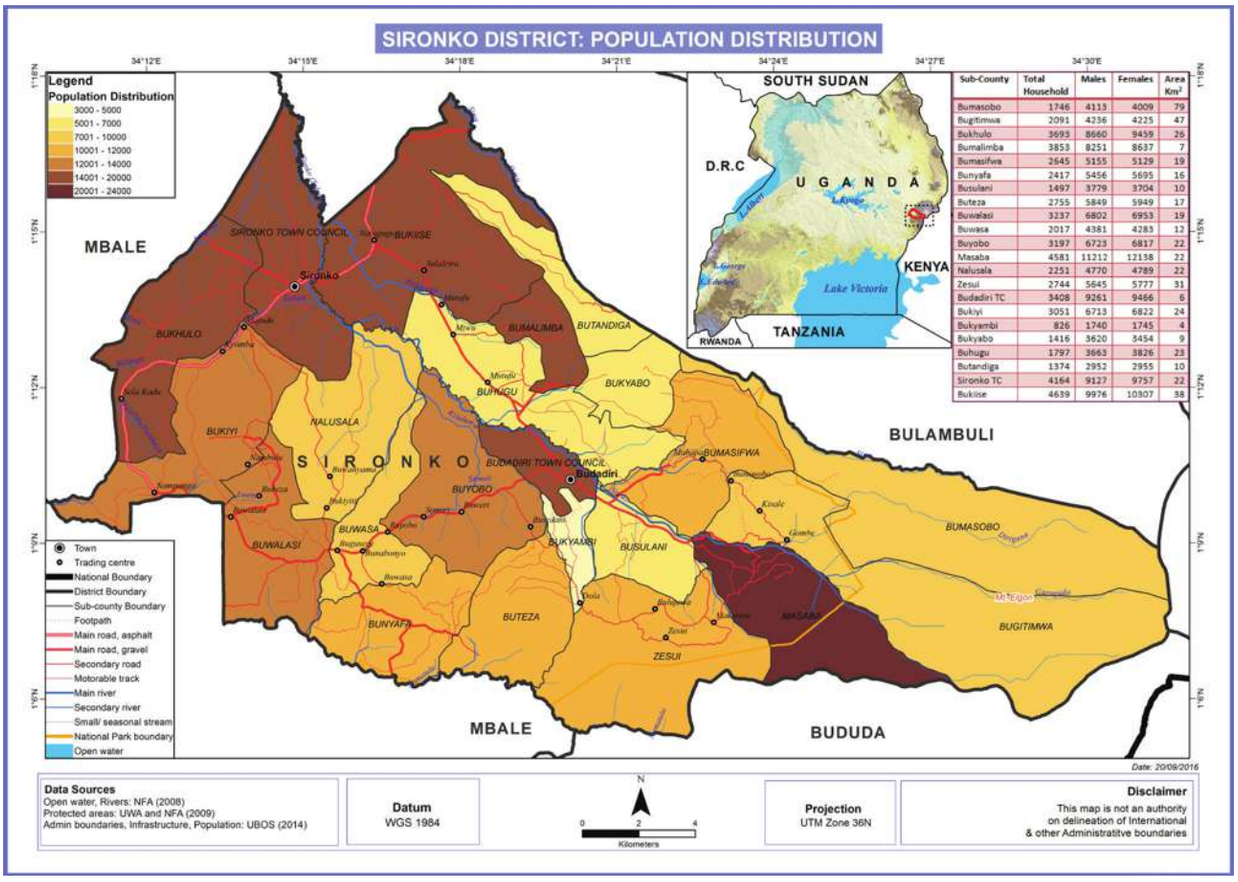


Figure 6: Population Distribution, in Sironko District

2.1.9 Economic activities

Most households in Sironko District engage in subsistence agriculture where cultivation of both cash and food crops such as; coffee, bananas, beans, maize and ground nuts in addition to raring of livestock. Other economic activities include; trading, forestry, industry, tourism, metal works and fabrication, transportation, agro-processing industry, mining (mainly in Bukhulo, Buwalasi, Bukyambi and along river Sironko and its tributaries) and stone quarrying mostly in Buwalasi and Bukhulo.

METHODOLOGY

3.1 Collection and analysis of field data using GIS

3.1.1 Preliminary spatial analysis

Hazard prone area 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, 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 five respondents (District Agricultural Officer, District Fisheries Officer and 3 Sub-county Extension Officers) was held at Sironko District Headquarters. At sub-county level Key informants included: Sub-county and Parish chiefs, Community Development mobilizers and Health workers.

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 Bukhulo Sub-county, Sironko Town council, Budadiri Town council and Zesui Sub-county. 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. 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 input into the NVIVO software for qualitative data analysis. Case studies and photographs were documented and captured respectfully. 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 and 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 and parish), extent of the hazard, height above sea level, slope position, topography, neighboring land use among others (Appendix I). 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". This information generated through a participatory and transect approach was used to validate modelled hazard, risk and vulnerability status of the district. The spatial extent of a hazard event was established through modelling 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 collabration with UNDP organised, a five days regional data verification and validation workshop 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.

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

HRV profiles report and maps have been verified and validated, final HRV profiles inventory and geo-database have been prepared containing all GIS data in various file formats to enable future use of the maps.

KEY FINDINGS FROM MULTI-HAZARD RISK, 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 processes (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 Sironko district, hazards were classified following main controlling factors:

i. Geomorphological or Geological hazards including landslides, rock falls and soil erosion

ii. Climatological or Meteorological hazards including floods, drought, hailstorms, strong winds and Lightning

iii. Ecological or Biological hazards including crop pests and diseases, livestock pests and diseases, human epidemic diseases, vermin attacks and wildlife animal attacks,

iv. Human induced or Technological hazards including bush fires, road accidents land conflicts.

4.1 Geomorphological and Geological Hazards

4.1.1 Landslides, rock falls and soil erosion

Results from the participatory assessments indicated that landslides, mudslides, rock falls and soil erosion are a common occurrence in Sironko district during the rainy season as very steep hill sides have been cultivated. Participants reported that the sub-counties of Bumasifwa, Zesui, Butandiga, Bukyabo, Masaba, Buteza and Bugitimwa were at high risk. It reported that in 2014, multiple landslides devastated five villages of Buwoluba, Busikyalo, Kyebuganga, Nabidoko, Bunamehe and Namayiga in the two parishes of Buwoluba and Bulujewa in Zesui sub - county. They destroyed coffee, cassava, banana, beans, onions, maize and cabbage plantations among others. This information was integrated with the spatial modelling using socio-ecological spatial data i.e. Soil texture (data for National Agricultural Research Laboratories – Kawanda (NARL) 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.

Plate 1: Landslide spot in Zesui sub-county

Source: Photo by Philip Massa (May 2016)


Plate 2: Earth crack spot in Zesui sub-county
Source: Photo by Philip Massa (May 2016)


Plate 3: Rocks exposed due to landslide seen from a distance in Masaba sub-county
Source: Photo by Peter Nsiimire (May 2016)


Plate 4: Community access route washed by landslide in Zesui sub-county
Source: Photo by Peter Nsiimire (May 2016)

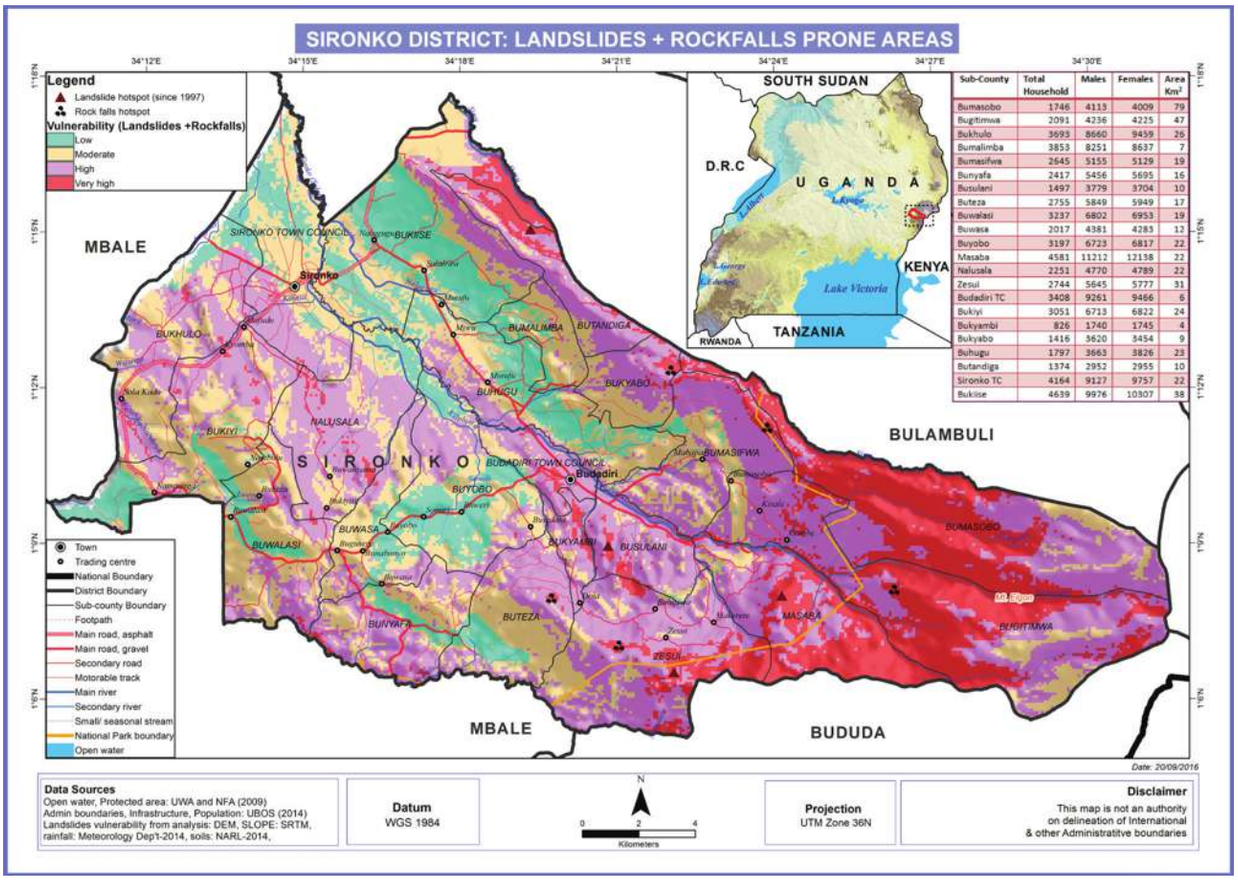


Figure 7: Landslides, rock falls and soil erosion, Sironko District

4.1.2 Earthquakes and faults

Participants in the focus group discussions indicated that Sironko district occasionally experiences minor earth tremors. However, participants reported that cracks which are life threatening developed in the sub-counties of Masaba, Zesui, Bumasifwa, Buteza, Bukyabo and Butandiga.

Plate 5: Earth crack spots in Zesui sub-county
Source: Photo by Philip Massa (May 2016)

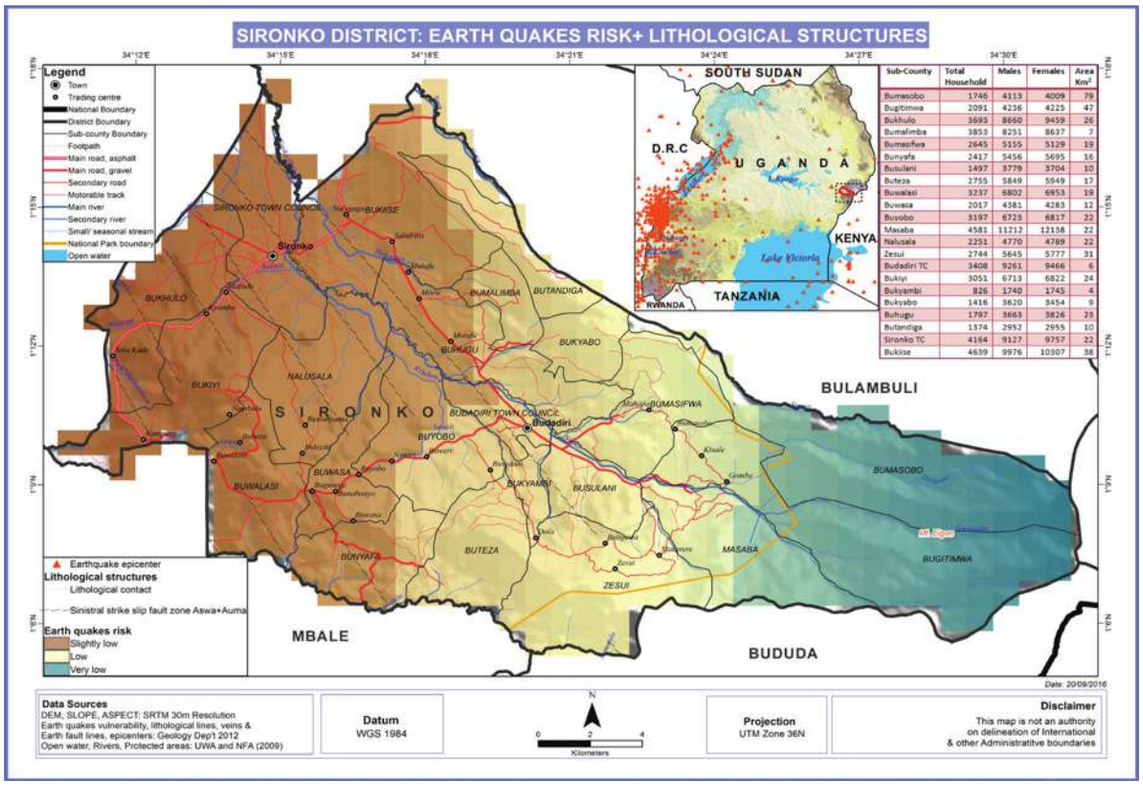


Figure 8: Earthquakes Vulnerability and Fault lines, Sironko District

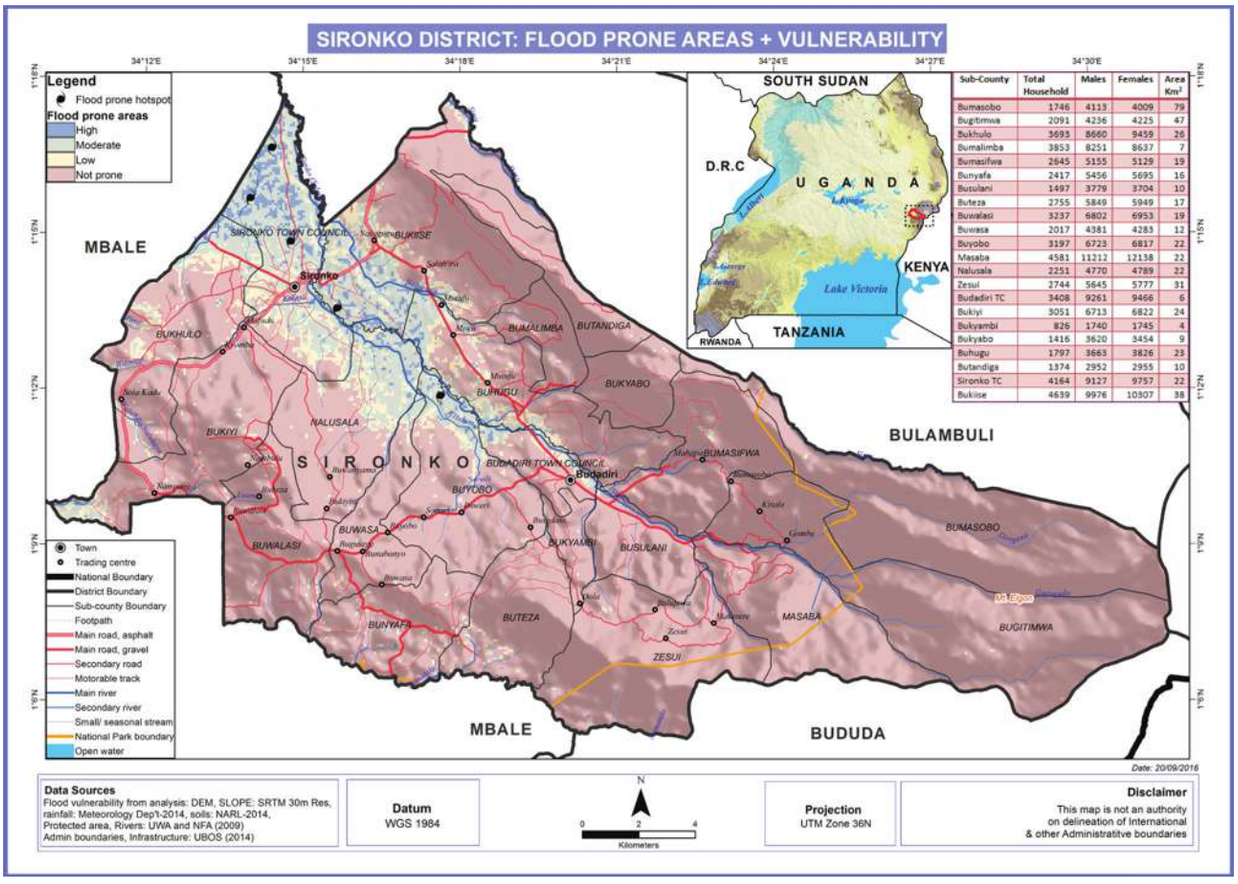
4.2 Climatological and Meteorological Hazards

4.2.1 Floods

Participants in the focus group discussions indicated that flooding in Sironko district mainly occurs in low lying areas and valleys in the rainy season. It was reported that Sironko Town council and Bukiise sub-county were the most prone to flooding. Participants further reported that floods submerge and wash away crops such as maize, rice, beans, cassava, millet, ground nuts and soya beans among others thus causing food insecurity and considerable economic losses. This information was integrated with the spatial modelling using socio-ecological spatial data i.e. Soil texture (data for National Agricultural Research Laboratories – Kawanda (NARL) 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 6: Flood hotspot along R. Sironko in Sironko Town council

Source: Photo by Philip Massa (May 2016)



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Buhugu	1797	3663	3826	23
Butandiga	1374	2952	2955	10
Sironko TC	4164	9127	9757	22
Bukiise	4639	9976	10307	38

Figure 9: Flood Prone Areas and Vulnerability Ranking, Sironko District

4.2.2 Drought

Drought is a period of below-average precipitation in a given region, resulting in prolonged shortages in its water supply, whether atmospheric, surface water or ground water. A drought can last for months or years, or may be declared after as few as 15 days. It can have a substantial impact on the ecosystem and agriculture of the affected region and harm to the local economy. Annual dry seasons in the tropics significantly increase the chances of a drought developing and subsequent bush fires. Periods of heat can significantly worsen drought conditions by hastening evaporation of water vapour.

Many plant species, such as those in the family Cactaceae (or cacti), have drought tolerance adaptations like reduced leaf area and waxy cuticles to enhance their ability to tolerate drought. Some others survive dry periods as buried seeds. Semi-permanent drought produces arid biomes such as deserts and grasslands. Prolonged droughts have caused mass migrations and humanitarian crises. Most arid ecosystems have inherently low productivity. The most prolonged drought ever in the world in recorded history occurred in the Atacama Desert in Chile (400 Years)[1].

Causes of drought

Precipitation deficiency: Mechanisms of producing precipitation include convective, stratiform, and orographic rainfall. Convective processes involve strong vertical motions that can cause the overturning of the atmosphere in that location within an hour and cause heavy precipitation, while stratiform processes involve weaker upward motions and less intense precipitation over a longer duration. Precipitation can be divided into three categories, based on whether it falls as liquid water, liquid water that freezes on contact with the surface, or ice. Droughts are mainly course by in low rain areas. If these factors do not support precipitation volumes sufficient to reach the surface over a sufficient time, the result is a drought. Drought can be triggered by a high level of reflected sunlight and above average prevalence of high pressure systems, winds carrying continental, rather than oceanic air masses, and ridges of high pressure areas aloft can prevent or restrict the developing of thunderstorm activity or rainfall over one certain region. Once a region is within drought, feedback mechanisms such as local arid air, hot conditions which can promote warm core ridging, and minimal evapotranspiration can worsen drought conditions.

Dry season: Within the tropics, distinct, wet and dry seasons emerge due to the movement of the Intertropical Convergence Zone or Monsoon trough. The dry season greatly increases drought occurrence and is characterized by its low humidity, with watering holes and rivers drying up. Because of the lack of these watering holes, many grazing animals are forced to migrate due to the lack of water and feed to more fertile spots. Because of the lack of water in the plants, bushfires are common. Since water vapor becomes more energetic with increasing temperature, more water vapor is required to increase relative humidity values to 100% at higher temperatures (or to get the temperature to fall to the dew point). Periods of warmth quicken the pace of fruit and vegetable production, increase evaporation and transpiration from plants, and worsen drought conditions.

Climate change: Activities resulting in global climate change are expected to trigger droughts with a substantial impact on agriculture throughout the world, and especially in developing nations. Overall, global warming will result in increased world rainfall. Along with drought in some areas, flooding and erosion will increase in others. Paradoxically, some proposed solutions to global warming that focus on more active techniques, solar radiation management through the use of a space sunshade for one, may also carry with them increased chances of drought.

1 *https://en.wikipedia.org/wiki/Drought*

Types

As a drought persists, the conditions surrounding it gradually worsen and its impact on the local population gradually increases. People tend to define droughts in three main ways:

Meteorological dry spells are brought about when there is a prolonged time with less than average precipitation. Meteorological dry spells usually precede the other kinds of droughts.

Agricultural dry spells are dry spells that affect crop production or the ecology of the range. This condition can also arise independently from any change in precipitation levels when soil conditions and erosion triggered by poorly planned agricultural endeavors cause a shortfall in water available to the crops. However, in a traditional dry spell, it is caused by an extended period of below average precipitation.

Hydrological dry spell is brought about when the water reserves available in sources such as aquifers, lakes and reservoirs fall below the statistical average. Hydrological dry spell tends to show up more slowly because it involves stored water that is used but not replenished. Like an agricultural dry spell, this can be triggered by more than just a loss of rainfall.

Key findings of this study indicated that Sironko district experiences droughts in form of dry spells without rain. Participants reported that these dry spells are responsible for the increased drying up of water sources such as boreholes, wetlands, wells and streams in the district.

- Diminished crop growth or yield productions and carrying capacity for livestock
- Dust bowls, themselves a sign of erosion, which further erode the landscape
- Dust storms, when drought hits an area suffering from desertification and erosion
- Famine due to lack of water for irrigation
- Habitat damage, affecting both terrestrial and aquatic wildlife
- Hunger, drought provides too little water to support food crops.
- Malnutrition, dehydration and related diseases
- Mass migration, resulting in internal displacement and international refugees
- Reduced electricity production due to reduced water flow through hydroelectric dams[
- Shortages of water for industrial users
- Snake migration, which results in snakebites
- Social unrest
- War over natural resources, including water and food
- Wildfires, such as Australian bushfires, are more common during times of drought and even death of people.
- Exposure and oxidation of acid sulfate soils due to falling surface and groundwater levels.
- Cyanotoxin accumulation within food chains and water supply, some of which are among the most potent toxins known to science, can cause cancer with low exposure over long term. High levels of microcystin has been found in San Francisco Bay Area salt water shellfish and fresh water supplies throughout the state of California in 2016.

Such water sources that have dried up include Nalugaya wetland near the district headquarter, Lwere River and wells in Bukhulo and Mpogo. The dry spells were also reported to cause crop failures. This information was integrated with spatial modelling 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).

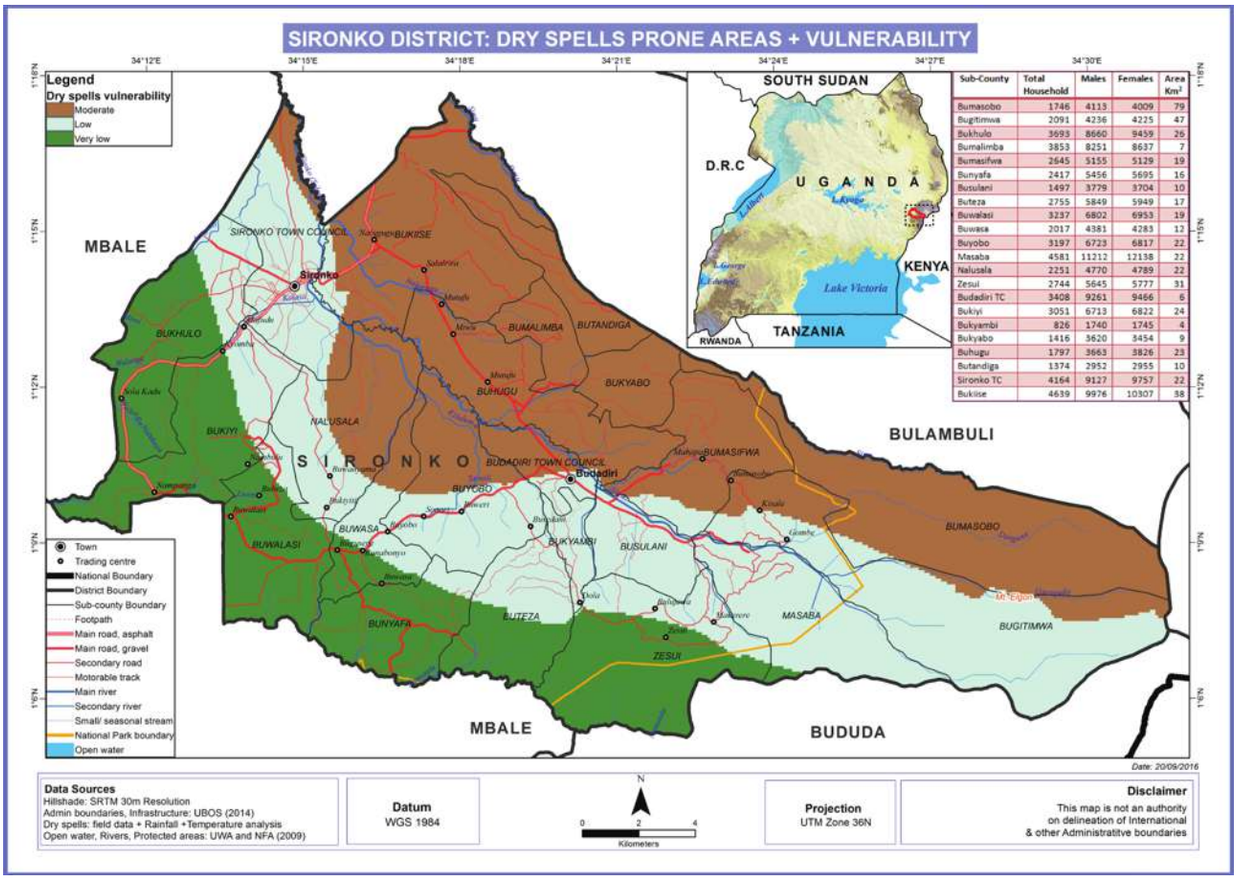


Figure 10: Drought Vulnerability Ranking, Sironko District

4.2.3 Hailstorms

Participatory assessments through the focus group discussions indicated that hailstorms are usually experienced at the onset of heavy rains. i.e. August to September and March to April. It was reported that hailstorms are a common occurrence in the sub-counties of Bumalimba, and Buteza. Participants observed that hailstorms destroy crops including bananas, beans, cassava and maize (Figure 11).

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 and schools and cause logging of banana plantations and tree falls. The most affected sub-counties include; Butandiga, Bukhulo Sironko TC, Buwalasi, Buteza, Bumalimba and Bukiyi (Figure 11).

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 Sironko district. It is reported that of recent in 2015, 1 people was killed by Lightning in Sola village, Bukiyi sub-county (Figure 11).

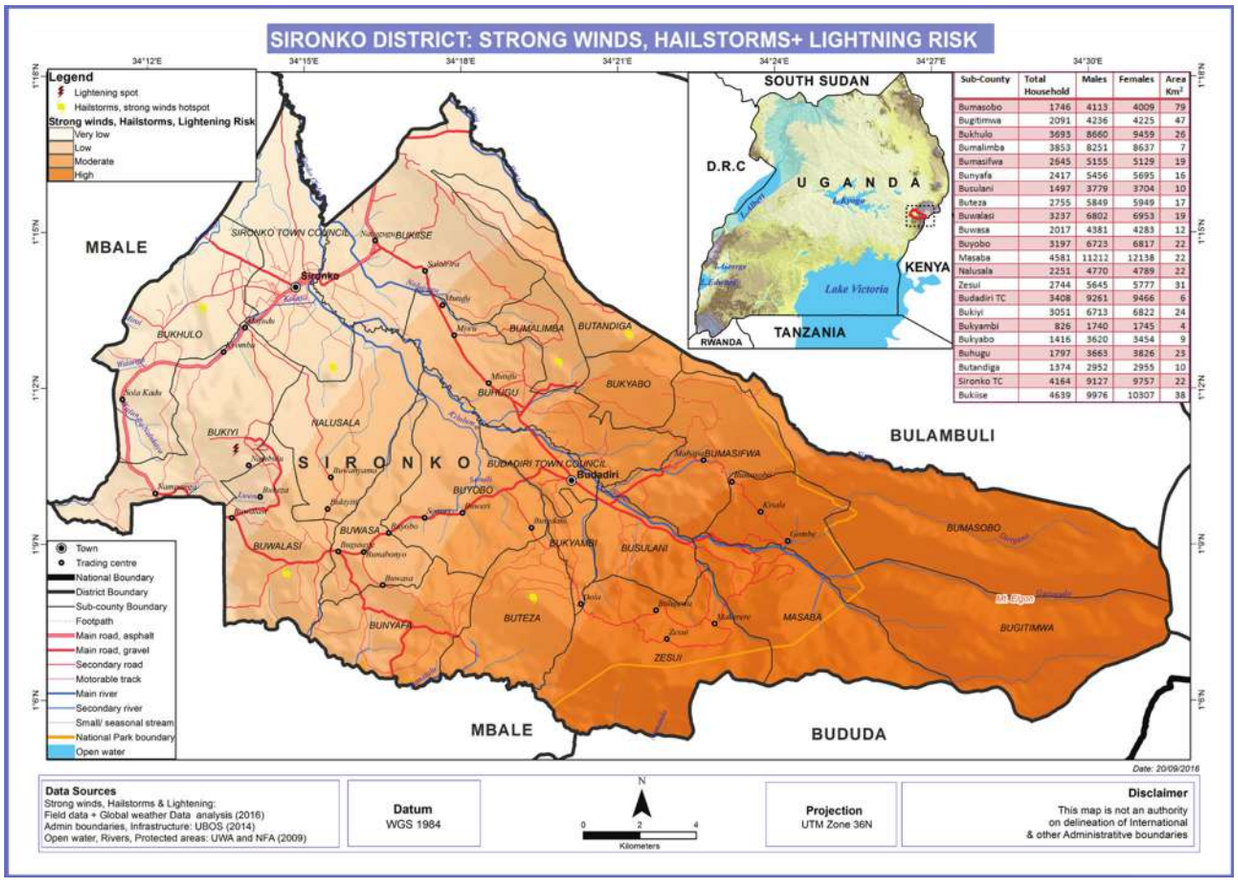


Figure 11: Strong winds, Hailstorms and Lightning Hotspots and Vulnerability, Sironko District

4.3 Ecological and Biological Hazards

4.3.1 Crop Pests and Diseases

Results from participatory assessments indicated that Sironko district was vulnerable to crop pests and diseases. The most reported crop diseases include; banana bacterial wilt, coffee leaf rust, coffee belly disease and sigatoka while the most common crop pests are army worms and giant caterpillars. It was observed that army worms are common at the onset of the rainy season. The entire district is affected by these crop pests and diseases. Figure 12 shows crop pests and diseases vulnerability in Sironko district.

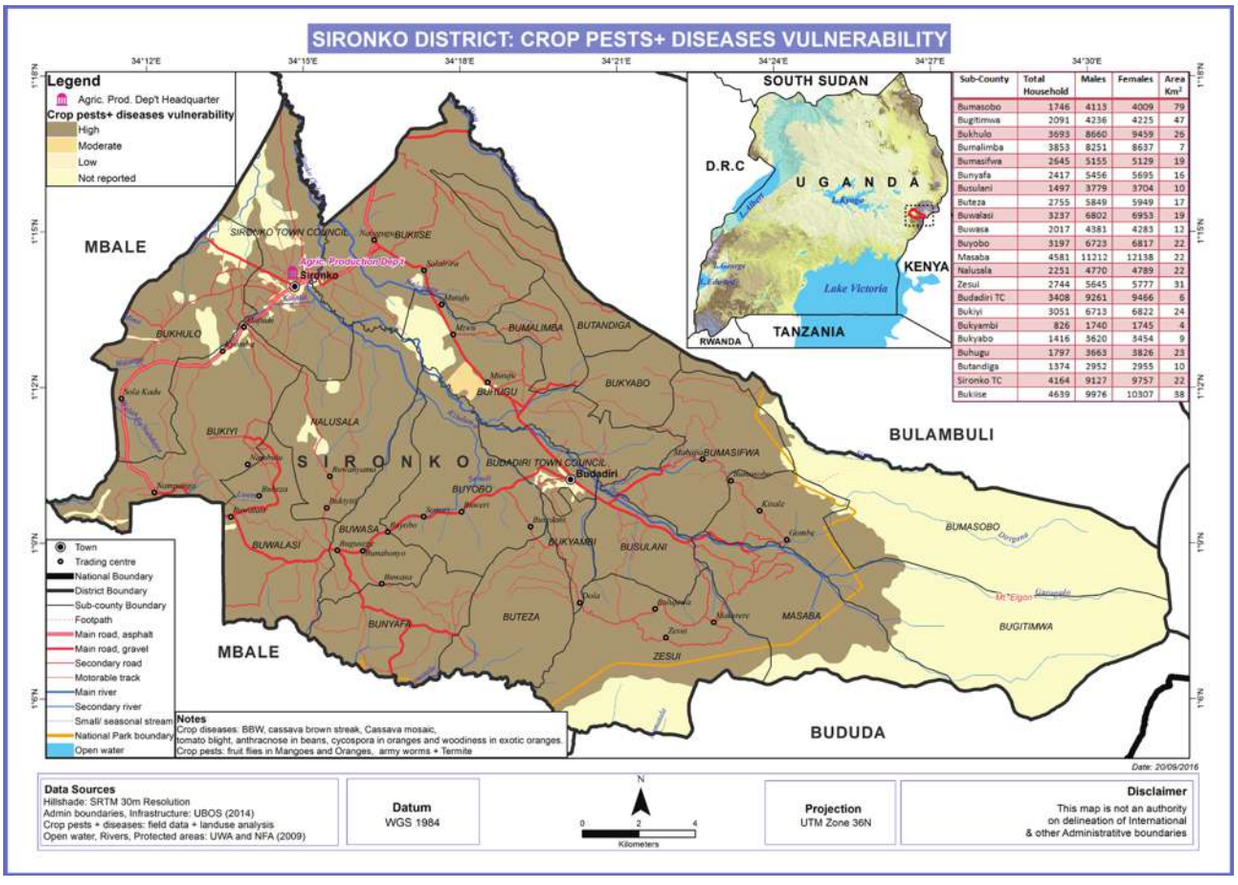


Figure 12: Crop Pests and Diseases Vulnerability, Sironko District

4.3.2 Livestock Pests and Diseases

Participants reported that the most common livestock diseases in Sironko district were East Coast Fever, foot and mouth disease, brucellosis, CBPP, Newcastle and rabies while the pests include; ticks, tsetse flies, worms, nuisance flies and houseflies. It was observed that tick borne diseases were a problem in the flood prone areas of Bukiise, Bukhulo, Nalusala, Buwalasi and Buyobo sub-counties. Figure 13 shows livestock pests and diseases vulnerability in Sironko district.

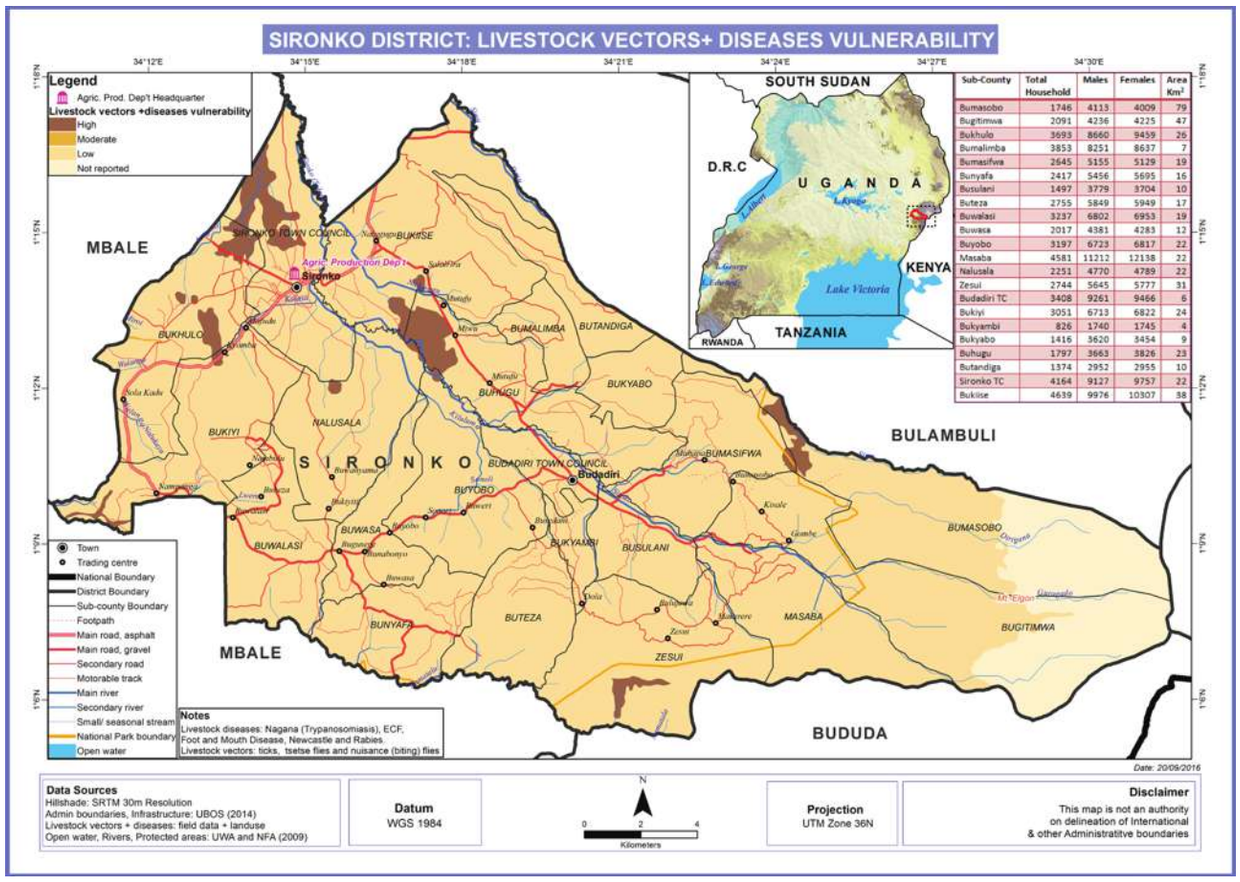
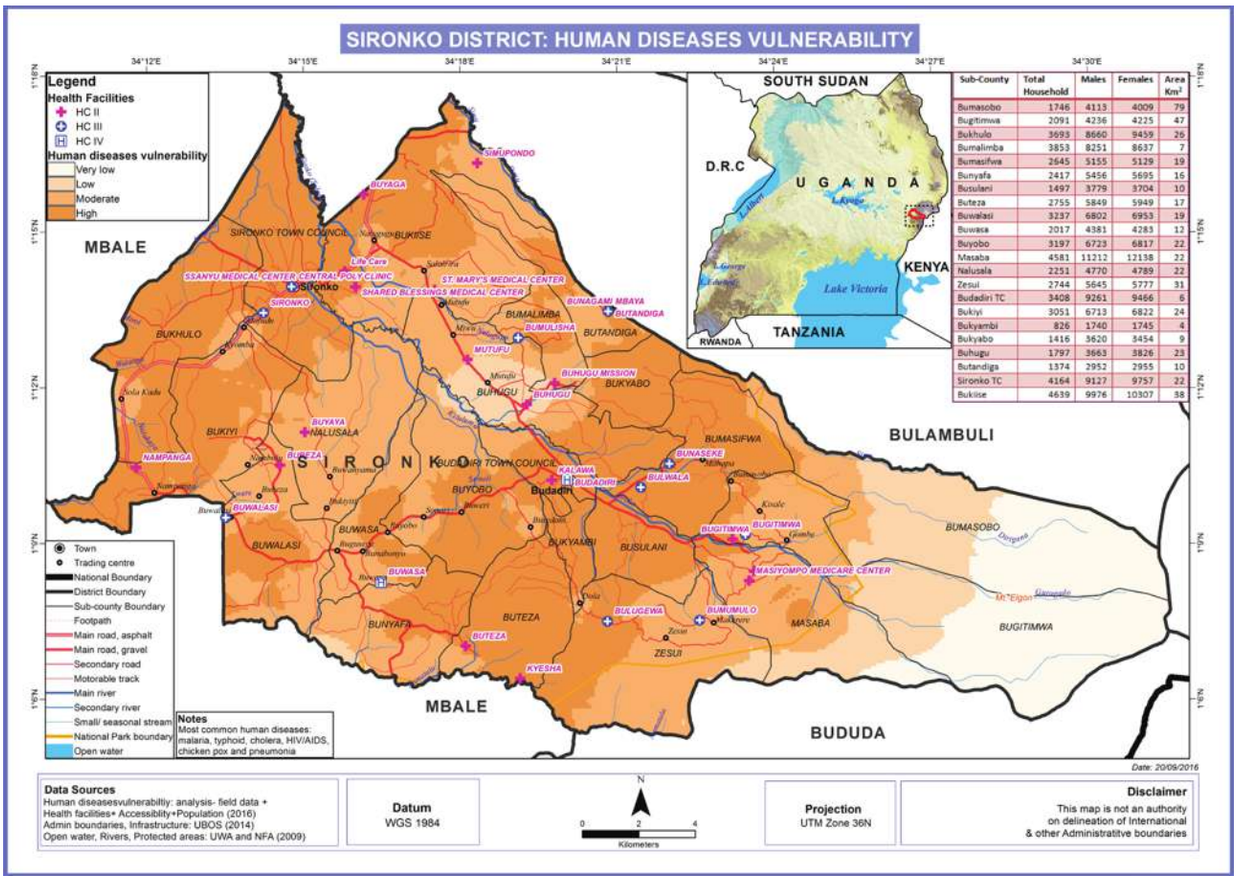


Figure 13: Livestock Pests and Diseases Vulnerability, Sironko District

4.3.3 Human Diseases

Participatory assessments indicated that the most common disease epidemics experienced in Sironko district are; malaria, cholera, HIV/AIDS and respiratory tract diseases. It was reported that the HIV/AIDS prevalence rate was at 3.1% in Budadiri and Sironko Town councils. It was noted that malaria prevalence rates were very high and thus responsible for most deaths in the district. In early 2016, there was an outbreak of cholera in Budadiri and Sironko Town councils where 192 cases were registered and 4 people died.



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Sironko TC	4164	9127	9757	22
Bukiise	4639	9976	10307	58

Figure 14: Human Diseases Prevalence and Health Facilities, Sironko District

4.3.4 Vermin and Wild-life Animal Attacks

Participatory assessments through focus group discussions revealed that there are incidences of vermin and wildlife animal attacks in the areas adjacent to Mt. Elgon National Park. It was reported that there was an influx of Jackals and vermin such as mole rats and monkeys in the sub-counties of Butandiga, Bumasifwa and Bukyabo that are neighboring the national park. The mole rats and monkeys destroy maize and ground nuts gardens thereby causing economic losses and food insecurity. Figure 15 shows vermin and wildlife animal conflicts and vulnerability in Sironko district.

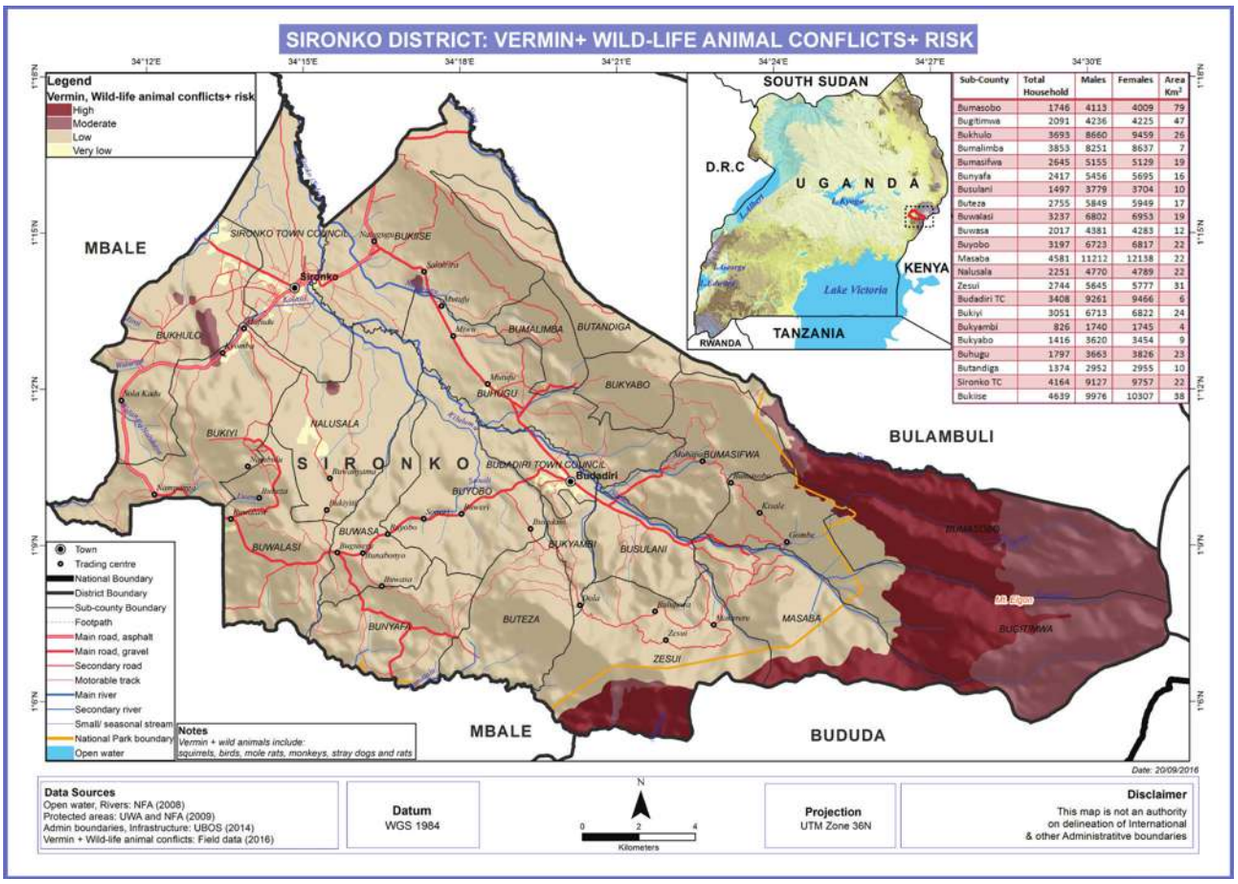

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Figure 15: Vermin and Wildlife Animal Conflicts and Vulnerability, Sironko District

4.3.5 Invasive species

The most common invasive species in Sironko district include Lantana camara, oxalis spp. and striga spp. Participants reported that striga spp. was responsible for the spread of maize lethal necrosis in Bukhulo sub-county and Sironko Town council. Figure 16 shows invasive species prone areas in Sironko district.

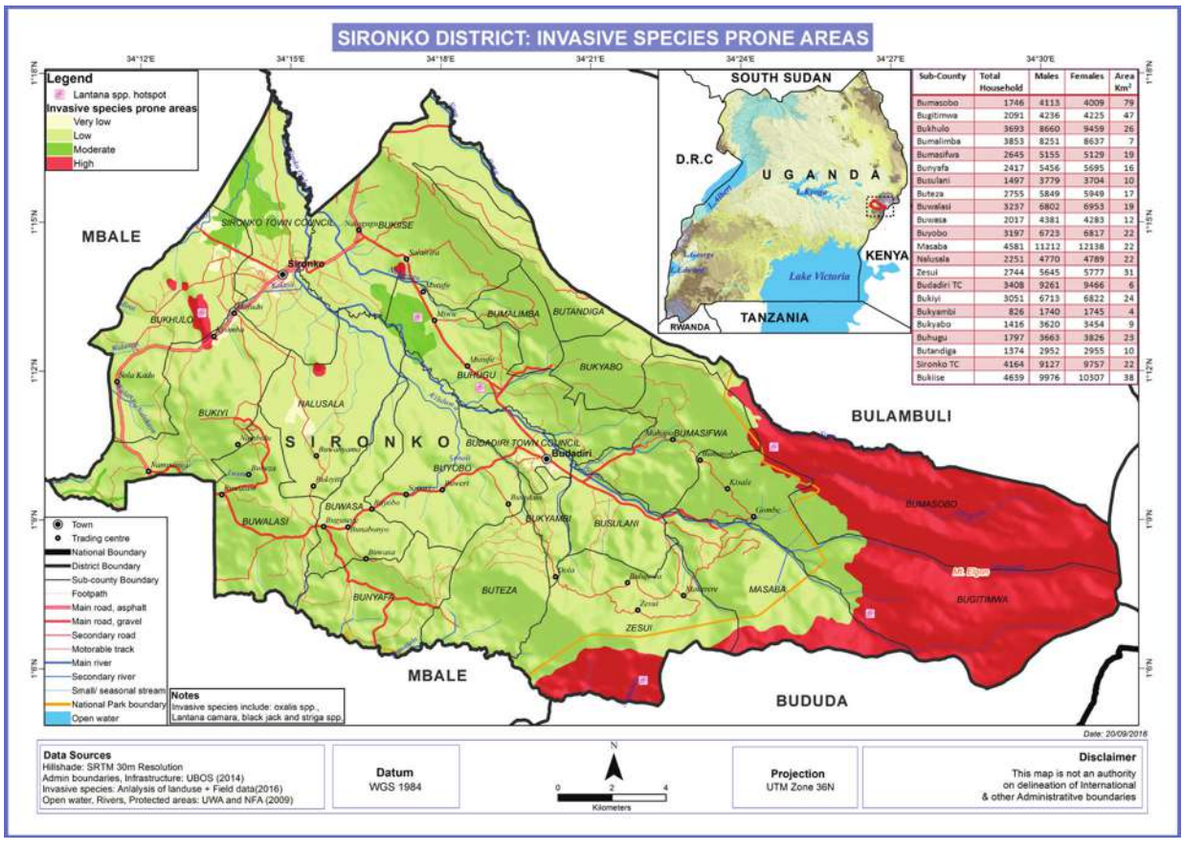

Figure 16: Invasive Species Vulnerability, Sironko District

4.4 Human Induced and Technological Hazards

4.4.1 Bush fires and Forest fires

Participants in the focus group discussions indicated that Sironko district experiences uncontrolled bush burning in the dry seasons. It was observed that the plains and hills are usually burnt in preparation of land for agriculture. Incidences of house and forest fires were reported in Sironko Town council. Figure 17 shows bush/forest fires hotspot areas in Sironko District.

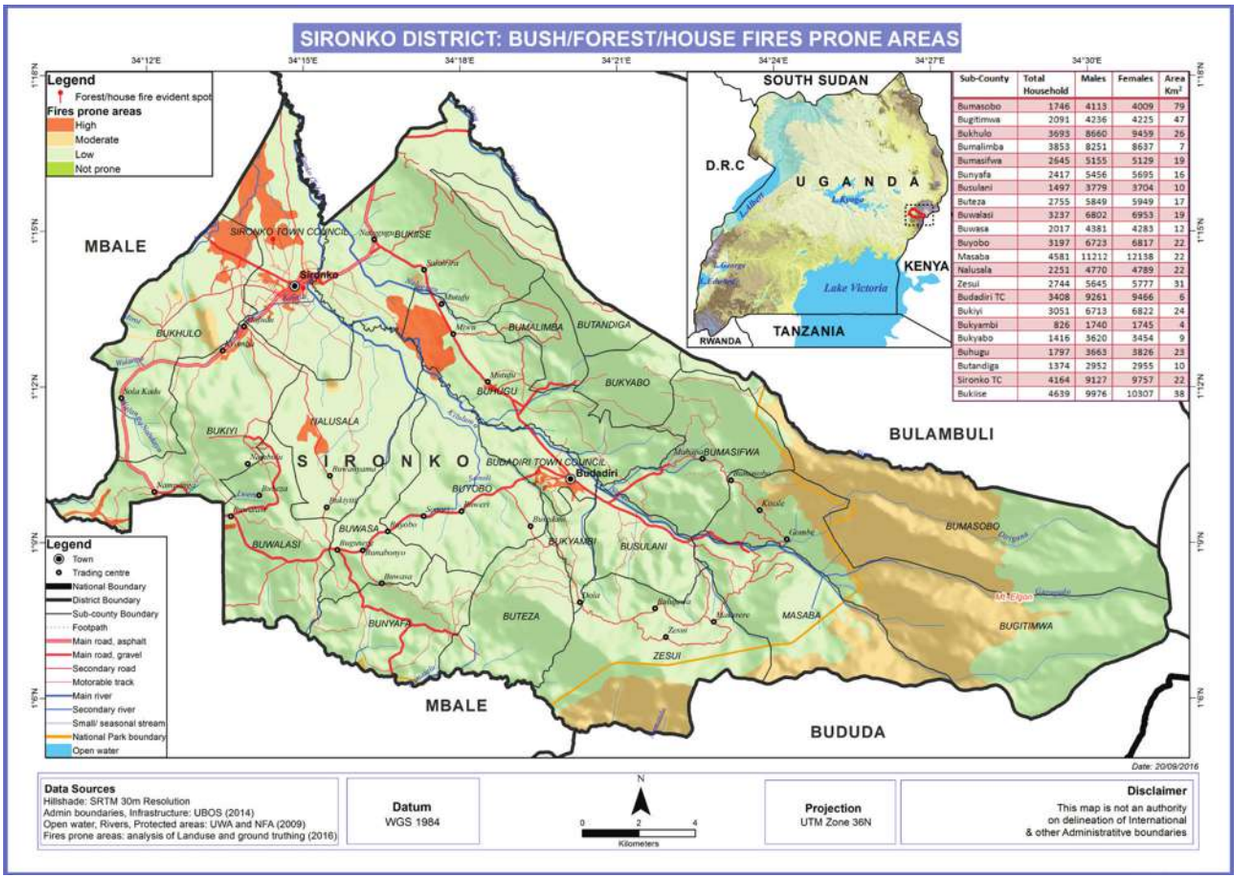

Figure 17: Bush/Forest fires Hotspot Areas and Vulnerability, Sironko District

4.4.2 Land conflicts

Results from the participatory assessments indicated that land conflicts were common in the entire district. Participants reported that there was a district boundary conflict between Mbale district and Sironko district at Bufumbo village. Other reported land disputes were between family members. Figure 18 shows land conflict prone areas in Sironko district.

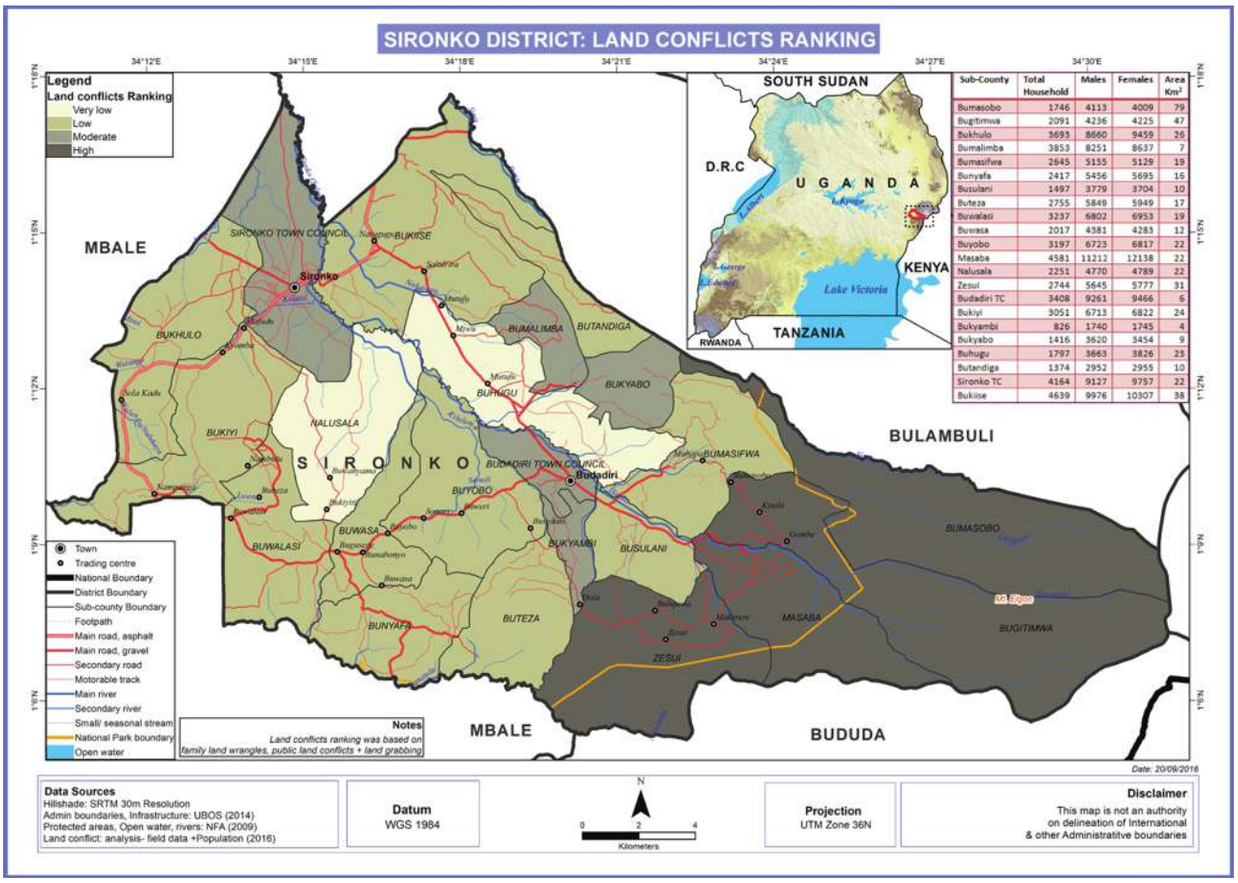

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Figure 18: Land Conflicts Ranking, Sironko District

4.4.3 Environmental Degradation

The most common forms of environmental degradation in Sironko district are; swamp reclamation at Nalugugu wetland, deforestation at Mutufu and Nakiwonde forest, sand mining on river banks and encroachment on Mt. Elgon national park The most affected sub-counties are; Butandiga, Bukiise, Zesui Bukyambi,Busulani and Sironko Town council (Figure 19).

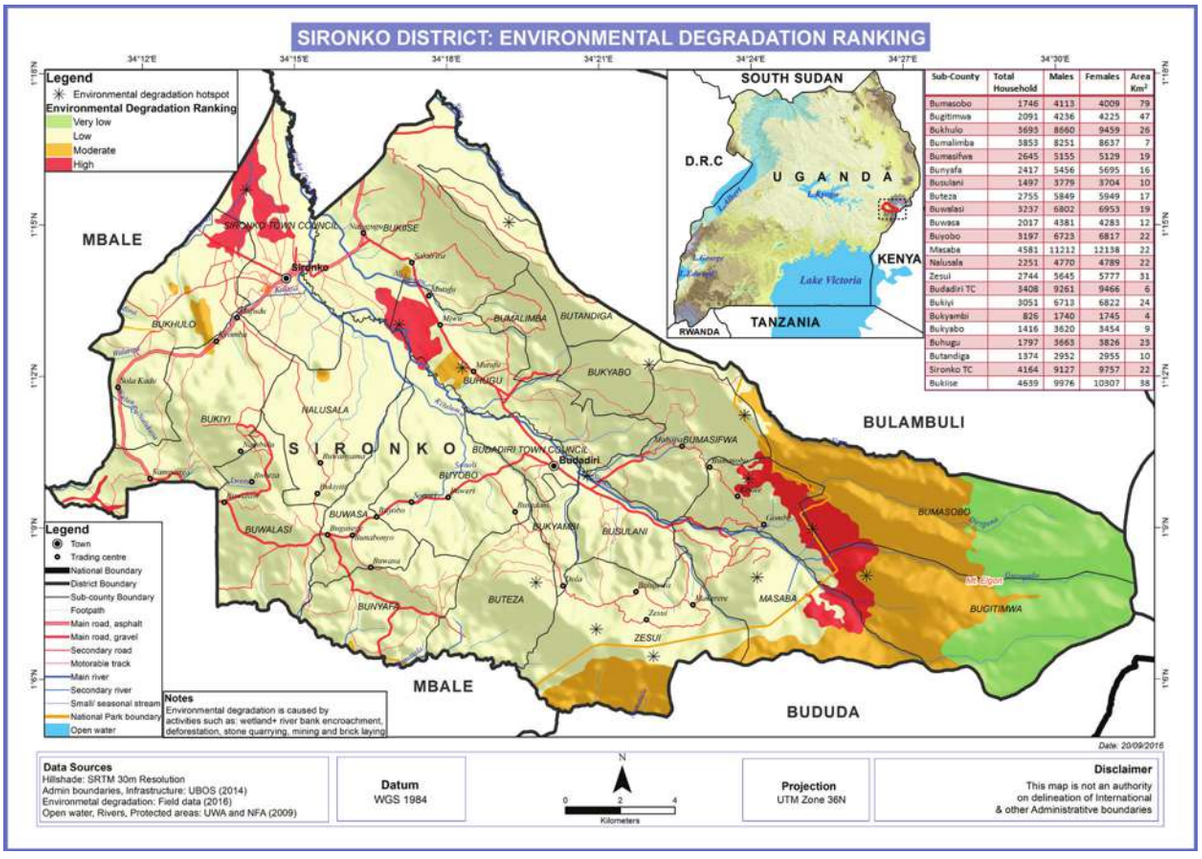

Figure 19: Environmental Degradation Ranking, Sironko District

4.4.4 Road Accidents

Participants in the focus group discussions reported that accidents mainly occur on the Mbale – Sironko Muyembe – Kapchorwa roads. It was observed that boda-boda accidents were common especially during the rainy season along these roads. It was reported that these roads are so slippery and sometimes impassable during the rainy season. Figure 20 shows road accident hotspots in Sironko district.

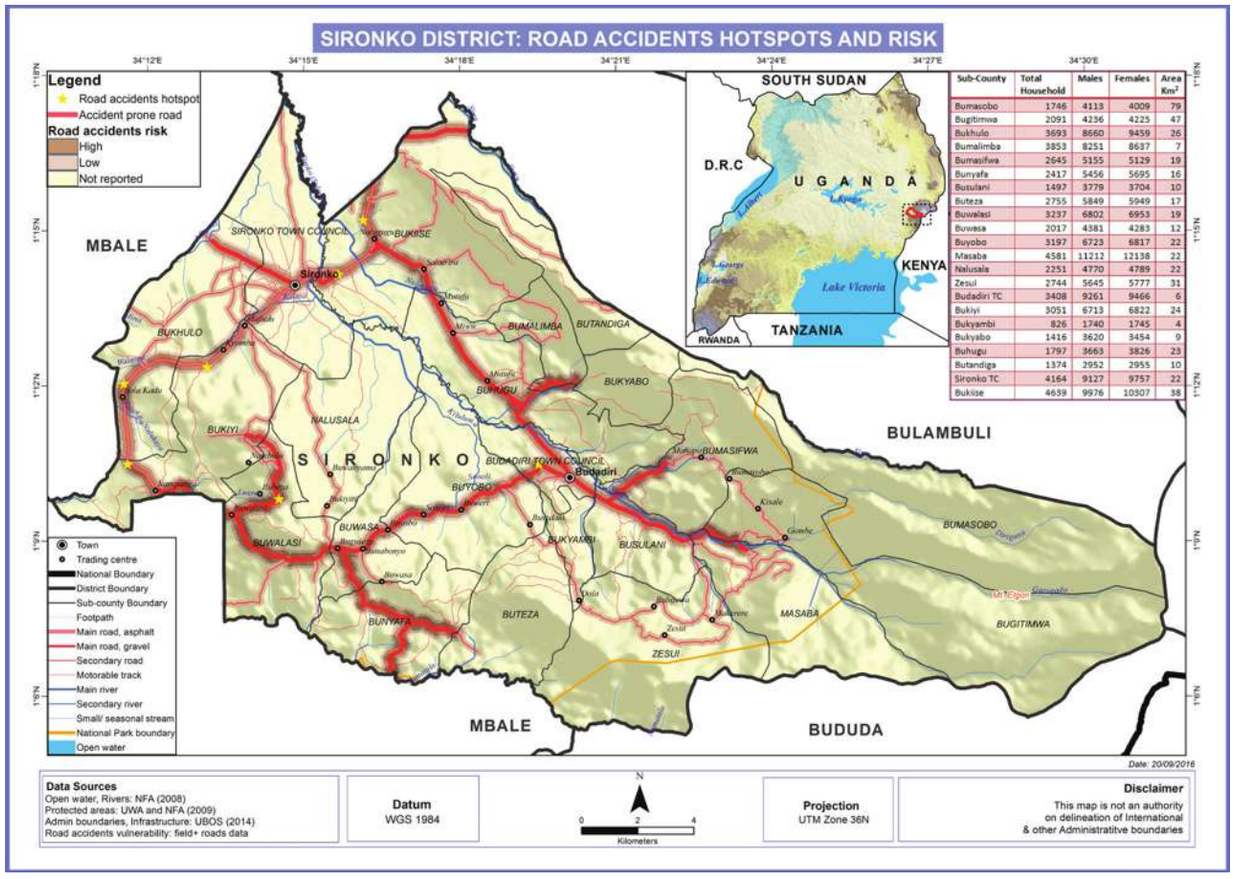

Figure 20: Road Accidents Hotspots and Vulnerability, Sironko District

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 Sironko district were 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 relationships, 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, including 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 relation 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. It reveals 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 Sironko District.

Table 2: Components of Vulnerability in Sironko District

Vulnerability	Exposure			Susceptibility			Resilience
	Hazards	**Elements at Risk**	**Geographical Scale**	Susceptibility	**Geographical Scale**	**Coping strategies**	**Geographical Scale**
Socio-economic component	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 - bee- hives	Parish	- Loss of lives - Complete crop failure - Destruction of infrastructure e.g. homes, and schools destruction of bee colonies and honey	Parish	-Migration -Sensitization by both government and non-governmental agencies	Parish
	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 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	Parish
	Drought	- Livestock - Crops - Human population	Village	- Hunger & poverty - Livestock loss - Crop failure - Shortage of pasture - Shortage of water - shortage of nectar for bee	Village	-Migration -Sensitization on tree planting -Buy food from elsewhere	Village
	Hailstorms, strong winds and Lightening	- Human and livestock populations - Crops - Infrastructure e.g. houses, schools, health centres	Parish	- Loss of lives - Destruction of crops - Destruction of infrastructure e.g. houses, schools, roads adjacent to flood plain	Parish		Parish
	Crop Pests and Diseases	- Crops	District	- Complete crop failure	District	- Spraying - Cut and burry affected crops -Sensitization on crop disease management	District
	Livestock Parasites, vectors and Diseases	-Livestock (cattle, goats etc.)	District	- Loss of livestock - Reduced livestock productivity	District	- Vaccination - Burry and burn animals that have died from infection - Quarantine -Trapping tse tse flies and other nuisance biting flies	District
	Human Disease outbreaks	- Human Population	District	- Loss of lives	District	- Mass Immunization - Use of mosquito nets	District
	Invasive species	- indigenous species - Animals	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	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	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 plating -Setting bi-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	- 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 Lightening	- Human and livestock populations - Crops - Infrastructure e.g. houses, schools, health centres	Parish	- Loss of lives - Destruction of crops - Destruction of infrastructure e.g. houses, schools, roads adjacent to flood plain	Parish		

Environmental component	Crop Pests and Diseases	-Crops	District	- Complete crop failure	District	- Spraying - Cut and burry affected crops -Sensitization on crop disease management	
	Livestock Pests and Diseases	-Livestock (cattle, goats etc.)	District	- Loss of livestock - Reduced livestock productivity	District	- Vaccination - Burry 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	- Out compete 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	
	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	
	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	
	Land conflicts	- Human population	Village	-Loss of lives -Family violence and break outs	Village	- Community dialogue - District court in charge of land issues	
	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	
	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 plating -Setting bi-laws	

Table 3: Vulnerability Profile for Sironko District

	PROBABILITY	SEVERITY OF IMPACTS	RELATIVE RISK	VULNERABLE SUB COUNTIES
	Relative likelihood this will occur	*Overall Impact (Average)*	*Probability x Impact Severity*	
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	3		Bukiise, Sironko T.C., Bukhulo and Budadiri T.C.
Droughts	3	3		Bukhulo and Sironko T.C.
Soil erosion, rock falls and landslides	5	4		Zesui, Masaba, Bugitimwa, Bumasifwa Butandiga and upper Bukyabo
Hail storms, Lightning and strong winds	4	4		All the nineteen sub countie and the two Toun councils
Bush fires and Forest fires	3	2		Butandiga and Bukyabo
Crop pests and diseases	5	2		All the nineteen sub countie and the two Toun councils
Livestock pests and diseases	5	2		All the nineteen sub countie and the two Toun councils
Human Diseases outbreaks	5	2		All the nineteen sub countie and the two Toun councils
Land conflicts	5	3		All the nineteen sub countie and the two Toun councils
Vermin and Wild-life animal attacks	3	2		Butandiga, Bumasifwa, Masaba, Zesui, Bugitimwa, Buteza & Bunyafa.
Earthquakes and faults	3	2		Bukiise, Bukyabo, Masaba and Zesui.
Road accidents	5	3		Bukhulo, Sironko T C Bukiise, Buwalasi, Bukiyi and Bumaalimba.
Environmental degradation	5	4		All the nineteen sub countie and the two Toun councils
Invasive species	3	2		All the nineteen sub countie and the two Toun councils

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 4: Hazard Risk Assessment

Hazard	Butandiga	Bukiise	Bumalimba	Buhugu	Bukyabo	Bumasifwa	Bugitimwa	Masaba	Zesui	Buteza	Bunyafa	Buwasa	Buyobo	Buwalasi	Nalusala	Bukiyi	Sironko T.C.	Bukhulo	Busulani	Budadiri T.C.	Bukyambi
Floods		H	L			L									L		H	H		L	
Drought		M													M	M	H	H			
Landslides, Rock falls and Erosion	L				L	H	H	H	H	M	L								L		L
Strong winds, Hailstorms and Lightning	M	L	L	L	L	L	L	L	L	L	L	L	L	M	L	L	M	M	L	L	L
Crop pests and Diseases	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Livestock pests and Diseases	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Human disease outbreaks	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Vermin and Wildlife animal attacks	M					M	M	M	M	L	L										
Land conflicts	L	L	L	L	L	L	L	M	M	L	L	L	L	L	L	L	L	L	L	L	L
Bush fires and Forest fires	L				L																
Environmental degradation	M	M	M	M	M	H	H	H	H	M	M	M	M	M	M	M	M	M	M	M	M
Earthquakes and faults		L			L			M	M												
Road accidents		M	M											L		L	M	M			
Invasive species	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M	M	L	L	L

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 5: 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 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
Human disease outbreaks	All gender and age groups
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 are broad and interactive often tackling more than one hazard at a time and the focus of the communities leans towards adaptation actions and processes including social and economic frameworks within which livelihood and mitigation strategies take place; ensuring extremes are buffered irrespective of the direction of climate change and better positioning themselves to better face the adverse impacts and associated effects of climate induced and technological hazards (Table 5).

Table 6: Coping strategies to the Multi-hazards in Sironko District

No	Multi-Hazards		Coping strategies
1	Geomorphological or Geological	Landslides, Rock falls and Erosion	• Migration to safe areas • Terracing/ contour farming • Plant trees to control water movement on hill slopes • Mulching in banana plantations • Plant grass in banana plantations on hill slopes • Removal of stones from banana farmlands
2		Earthquakes and faults	• No action, communities think the tremors are minor • Designs of houses (pillars) • Early warning system • Vigilance • Sensitization • Emergency response mechanisms
3	Climatological or Meteorological	Floods	• 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		Drought	• Leave wetlands as water catchments • Plant trees as climate modifiers • Buy food elsewhere in case of shortage • Buy water from the nearby areas • Food Storage especially dry grains
5		Strong winds, Hailstorms and Lightning	• Plant trees as wind breakers • Use of stakes against wind in banana plantations • Use of ropes to tie banana against wind • Installation of Lightning conductors • 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 • To put on rubber shoes or sandals

6	Ecological or Biological	Crop pests and Diseases	• Spraying pests • Cutting and burying BBW affected crops • Burning of affected crops • Vigilance
7		Livestock pests and Diseases	• Spraying pests • Vaccinations • Burying animals that have died from infection • Quarantine • Trapping tse tse and other nuisance biting flies
8		Human epidemic Diseases	• Mass immunisation • Visiting health centres • Use of mosquito nets
9		Vermin and Wild-life animal attacks	• Guarding the gardens • Poisoning • Hunt and kill • Report to UWA • Hugo group • Mauritius thorns • Plant tea as buffer • Dig trenches • Chain link • Plant red pepper as buffer • Recommend vermin guards • Controlling dieses vectors
10		Invasive species	• Uproot • Spray with herbicides (e.g 2-4-D) • Cut and burn • Sensitization on Invasive species management • Blacklisting exotic species • Bye-laws regulating the movement of planting materials

11	Human induced or technological	Land conflicts	• Community dialogues • Report to court • Migration • Resettlement • Surveying and titling • Strengthen Land management structures • Sensitization on land ownership • Proper demarcation (live fencing)
12		Bush fires/ Forest fires	• Stop the fires in case of fire outbreak • 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 • Bye-laws • Sensitization on dangers of fires
13		Road accidents	• Construction of humps • Road Signage including speed limits • Separate lanes on sharp corners • Sensitisation • Widen narrow roads • Plant trees on road reserve, as road guards • Deployment of Traffic officers • Mantainace to avoid pothole
14		Environmental degradation	• Leave wetlands as water catchments • Plant appropriate tree species as climate modifiers • Sensitization • Bye-laws • Enforcement • Gazatte 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 • No approval of applications for developments in wetlands by Physical Planning Committees

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 Sironko 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 and land conflicts putting livelihoods at increased risk. Generally landslides and flooding were identified as most serious problem in Sironko district with almost all sub-counties being vulnerable to the hazards. The limited adaptive capacity (and or/resilience) and high sensitivity of households and communities in Sironko district increase their vulnerability to hazard exposure necessitating urgent external support.

Hazards experienced in Sironko district can be classified as:

i. Geomorphological or Geological hazards including landslides, rock falls, soil erosion and earth quakes.
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 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 mitigation, prediction, warning and preparedness.
ii. Building capacities to withstand and cope with the hazards and risks.
iii. Tackling the root causes of the vulnerability such as poverty, poor governance, discrimination, inequality and inadequate access to resources and livelihood opportunities.

5.2 Policy-related Recommendations

The following recommended policy actions targeting vulnerability reduction include:

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 programmes 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 revive disaster committees at district level and ensure funding of disaster and environmental related activities.

vi. The government through UNRA and the District Authority should fund periodic maintenance of feeder roads to reduce on traffic accidents.

vii. The government through OPM and Meteorology Authority should increase importation of Lightning conductors and also reduce taxes on their importation.

viii. The government through OPM and Meteorology Authority should support establishment of disaster early warning systems.

ix. The government through MWE increase funding and 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 reserves.

xii. The government through MAAIF should fund and recruit extension workers at sub-county level and also facilitate them.

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APPENDIX I: DATA COLLECTION TOOLS

LIST OF CONTRIBUTORS FROM DISTRICT DISASTER MANAGEMENT COMMITTEE

No.	Name of Participants	Designation	Contact
1	Lomongin Joseph	CAO	0782398708
2	Mafabi Rashid Nambale	DEN officer	0772435178
3	Dr Okori Patrick Charles	DPO	0772847439
4	Simiyu Christine	Ass DHO	0772945248
5	Wosi Fred	D- planner	0782892912
6	Ojiabo Joseph	DCDO	0772440726
7	Muduku Charles	DHS	0772875993

FOCUS GROUP DISCUSSION GUIDE FOR DDMC

Interviewer Team Name(s)	District:	GPS Coordinates	
	Sub- county:	X:	637754
	Parish:	Y:	135747
	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 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 to what is 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- 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

v. 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 information on Hazards and early warning.

vi. 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 anxious to hear what you have to say.

vii. 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 to what is said, so whatever you say here will be anonymous and we will not quote you by name.

viii. I would not like to keep you here long; at most we should be here for 30 minutes- 1 hour.

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

1. Which crops are majorly grown in your community?

2. Which domestic animals are dominant in your community?

3. What challenges are faced by farmers in your community?

4. Have you experienced landslides and rock falls in the past 10 years in your community?

5. Which villages and parishes 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 and parishes that have been most affected?

7. Which crops are majorly affected by landslides and rock falls in your community?

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 community?

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 community?

14. Have you experienced any earth quakes in the past 10 years in your community?

15. Which particular villages, parishes or sub-counties have been majorly affected by earth quakes in your community?

16. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes 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 community?

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 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?

24. Which crops are majorly affected by floods in your community?

25. In which way are the crops affected by floods?

26. Which domestic animals are majorly affected by floods in your community?

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 community?

31. Which villages and parishes have been most affected by drought?

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

33. Which crops are majorly affected by drought in your community?

34. In which way are crops affected by drought?

35. Which domestic animals are majorly affected by drought in your community?

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 community?

40. Which villages and parishes have been most affected by hailstorms or Lightning?

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)

46. Have you experienced any epidemic animal disease outbreaks in the past 10 years in your community?

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?

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 community?

55. Which villages and parishes 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 and parishes that have been most affected?

57. Specify the crop pests and disease outbreaks that have majorly affected animals in your community?

58. Which crops are majorly affected by crop pests and disease outbreaks in your community?

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 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?

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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?

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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?

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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

<table>
<tr><td colspan="2" rowspan="4">Observer Name:

Date:</td><td colspan="2" rowspan="4">District:

Sub- county:

Parish:

Village:</td><td colspan="2">Coordinates</td><td colspan="2" rowspan="4"></td></tr>
<tr><td>X:</td><td></td></tr>
<tr><td>Y:</td><td></td></tr>
<tr><td>Altitude</td><td></td></tr>
<tr><td colspan="2">Slope characterization</td><td colspan="2">Bio-physical characterization</td><td colspan="2">Vegetation characterization</td><td colspan="2" rowspan="7">Land use type (tick)
Bush
Grassland
Wetland
Tree plantation
Natural forest
Cropland
Built-up area
Grazing land
Others</td></tr>
<tr><td>Slope degree (e.g 10, 20, …)</td><td></td><td>Soil Texture</td><td></td><td>Veg. cover (%)</td><td></td></tr>
<tr><td>Slope length (m) (e.g 5, 10, …)</td><td></td><td>Soil Moisture</td><td></td><td>Tree cover (%)</td><td></td></tr>
<tr><td>Aspect (e.g N, NE…)</td><td></td><td>Rainfall</td><td></td><td>Shrubs cover (%)</td><td></td></tr>
<tr><td>Elevation (e.g high, low…)</td><td></td><td>Drainage</td><td></td><td>Grass / Herbs cover (%)</td><td></td></tr>
<tr><td>Slope curvature (e.g concave, covex…)</td><td></td><td>Temperature</td><td></td><td>Bare land cover</td><td></td></tr>
<tr><td colspan="8">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)</td></tr>
</table>

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