THE REPUBLIC OF UGANDA

Pallisa District

Hazard, Risk and Vulnerability Profile

2016

ACKNOWLEDGEMENT

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 comprehensive district Hazard, Risk and Vulnerability (HRV) profiles.

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

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

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

My appreciation also goes to Pallisa District Team;

1. Mr. Mbooge Isa, Chief Administrative Officer
2. Mr. Galya Muhammad, Senior Environment Officer
3. Mr. Okiror Francis, Information Officer

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 Butebo, Gogonyo, Kamuge, Pallisa and Pallisa Town. Each Parish of the selected Sub-counties was represented by at least one participant and the selection of participants was engendered. FGDs were conducted with utmost consideration to the various gender categories (women, men) with respect to age groups since hazards affect both men and women though in different perspectives irrespective of age.

Participatory GIS

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

Geo-referencing and ground-truthing

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

Data analysis and integration

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

Data verification and validation

In collaboration with OPM, a five days regional data verification and validation workshop was organized by 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 Palisa 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 land conflicts.

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

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

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

DLG	:	District Local Government
DPP	:	District Development Plan
DWRM	:	District Water Resources Management
GIS	:	Geographical Information Systems
HRV	:	Multi hazard, Risk and Vulnerability
MWE	:	Ministry of Water and Environment
NARO	:	National Agricultural Research Organisation
NEMA	:	National Environmental Management Authority
NFA	:	National Forestry Authority
OPM	:	Office of the Prime Minister
SRTM	:	Shuttle Radar Topography Mission
ToR	:	Terms of Reference
UBOS	:	Uganda Bureau of Statistics
UNDP	:	United Nations Development Programme
UNRA	:	Uganda National Roads Authority

Definition of key terms

Hazard is a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation

Risk is a probability of a hazard occurring or threatening to occur

Vulnerability refers to the propensity of exposed elements such as human beings, their livelihoods, and assets to suffer adverse effects when impacted by hazard events

Climate variability refers to the climatic parameter of a region varying from its long-term mean. Every year in a specific time period, the climate of a location is different. Some years have below average rainfall, some have average or above average rainfall

Disaster is a progressive or sudden widespread or localized, natural or human caused occurrence which causes or threatens to cause death or injury, damage to property, infrastructure or environment, disruption of life of a community and its magnitude exceeds the ability of those affected to cope using only their own resources

Disaster management is a continuous and integrated multi-sectoral and multidisciplinary process of planning and implementation of measures aimed at disaster prevention, mitigation, preparedness, response, recovery and rehabilitation

Mitigation means structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards

Preparedness means activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations

Response means measures taken during or immediately after an incident or a disaster in order to bring relief to affected communities or individuals

Adaptation means the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities

CHAPTER ONE

1.1 Background

Uganda has over the past years experienced frequent disasters that range from drought, to floods, landslides, human and animal diseases, pests, animal attacks, earthquakes, fires, conflicts and other hazards which in many instances resulted in death, property damage and loss of livelihood. With the increasing negative effects of hazards that accompany population growth, development and climate change, public awareness and proactive 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 the Disaster and Climate risk Reduction action, the Government of Uganda is compiling a National Risk atlas of hazard, risk and vulnerability conditions in the Country to engage mainstreaming of disaster and 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 sub-regions of Rwenzori, Karamoja, Teso, Lango, Acholi, West Nile, Central and South western sub regions. During the exercise, local government officials and community members actively participated in the data collection and analysis through focus groups discussions and the key informant interviews. The data collected was used to generate hazard, risk and vulnerability maps and profiles for each district. Validation workshops were held in close collaboration with the district local government (DLG) technocrats, development partners, agencies and academic/research institutions. The developed maps show the local geographical distribution of hazards and vulnerabilities up to sub county level of the district.

1.2 Justification

The National Policy for Disaster Preparedness and Management (Section 4.1.1) requires the Office of the Prime Minister to “Carry out vulnerability assessment, hazard and risk mapping of the whole country and update the data annually”. UNDP’s DRM project 2016 Annual Work Plan; Activity 4.1 is “conduct national hazard, risk and vulnerability (HRV) assessment including sex and age disaggregated data preparation of district profiles.”

1.3 Objectives

The objectives of the assignment were to:

1) Collect and analyse the field data using GIS in close collaboration and coordination with OPM in Pallisa District
2) Develop district specific multi hazard risk and vulnerability profiles using a standard methodology.
3) Preserve the spatial data to enable use of the maps for future information.
4) Produce age and sex disaggregated data in HRV maps

1.4 Scope of the assignment

This assignment was carried out by a team of consultants under the overall technical supervision by the Office of the Prime Minister and UNDP, Uganda. The assignment was conducted in the month of May, 2016.

CHAPTER TWO

2.1 Overview of Pallisa District

2.1.1 Location

Pallisa District is located in Eastern Uganda, bordered by Kumi, Ngora, Serere and Bukedea Districts in the North, Kibuku and Budaka Districts in the South, Mbale District in the East, and Kaliro and Buyende Districts in the West (figure 1). Physically the district lies between: Latitudes 0˚ 45' N and 1˚ 05 'N and longitudes 33˚47'E and 34˚05'E. The district covers approximately a total area of 1095 Km^2 and is made up of four (4) counties, eighteen (18) sub-counties, one town council, 85 parishes and 587 villages. Of all these counties Pallisa is the largest with an area of 612.6Km^2 while Butebo is the smallest with a land area of 304sq.km. Out of the 1905 sq.kms, water bodies (open water and swamps) cover an area of 403 sq.km. This leaves 692 sq. km for human settlement and related activities.

The district lies at altitude between 910 and 1220 meters above sea level. There are two main categories of geological formations in Pallisa district (Atlas of Uganda 1962) these include: Basement complex (mainly undifferentiated acid gneiss), which covers much of the district, and Pleistocene to recent sediments in the northwest and southwest. Pallisa district has a variety of soils – clay soils along swamps and lakes, clay loams covering west and central, sandy loams covering mainly the south and south east and black loams to the north of the District. the district experiences the equatorial type of climate with bi-modal types of rainfall increasing southwards 82% of the year is bi-modal but the climate is increasingly changing in the district with fluctuating climatic seasons. The average yearly rainfall is 900-1500 mm, increasing southwards to 1250-1400mm; the rainfall is bi-modal with peaks in March-June and with a main dry season from December-February. Day and night temperatures reach their highest and lowest respectively in the dry season. The mean annual maximum temperature is about 32.5˚Cand the mean annual temperature is about 15^oC.

The vegetation of the District is mainly savanna species. There are some forests and riparian vegetation. The savanna group includes mainly Combretum associated with Hyperrennia in the South and Southwest, Butyrospermun associated with Hyperrennia spp. in the centre and northeast and mixed savanna in the northwest. The district total population capacity as by 2012 census was 367,169 persons of whom 176,246 were male and 190,923 female. The projected population by 2015 is 396,900 persons out of whom 192,000 are male and 204,900 females. The district has a population density of 375.7persons/sq.km. About 90% of the households are engaged in subsistence agriculture, fishing, livestock rearing, formal employment, small scale business, sand mining among others. The farmers depend on rain-fed agriculture which has apparently resulted into low crop harvests due to changes in weather patterns.

Figure 1: Pallisa District map

CHAPTER THREE

3.1 Materials and methods

3.1.1 Multi-hazard, risk and vulnerability profile assessment

3.1.1.1 Approach

A multidisciplinary approach was adopted for the assessment of multi-hazard, risk and vulnerability profiles production. The approach included; the investigation of socio-economic parameters, biophysical characteristics and spatial analysis of hazards in the district.

3.1.1.2 Data collection

3.1.1.2.1 Socio economic investigation

The socio economic assessment of multi-hazards, risks and vulnerability was threefold: the consultations, key informant interviews and Focus Group Discussion. The consultations were conducted at the district level and this included government officials who were selected on the advice of the Chief Administrative Officer and assessment team. The issues and concerns discussed were the causes, effects, adaptive responses, risks and vulnerability of multi-hazards experienced in the district. The question and answer session was selected purely because the officials were knowledgeable and had vast experience in the occurrence, severity and frequency of hazards in the district.

In addition to consultations, the key informant interviews were also carried out on the sub county officials for evidence based discovery. A total of two focus group discussions were also conducted in the sub counties: Gogonyo and Butebo. The groups on average comprised 10-15 members who were randomly selected by the sub county focal persons from the different parishes. The risk and vulnerability factors were determined through ranking and weighting procedures. The discussions helped to identify the most prone areas that were later visited for more site risk and vulnerability study. Four broad vulnerability areas were participatory identified in the district, these being social, economic, environmental and physical components. In each of these vulnerability components, participants characterized the exposure agents, including multi-hazards, elements at risk and their spatial dimension.

3.1.1.2.2 Spatial analysis

A series of spatial datasets were collected, pre-processed and processed to extract information on the magnitude and distribution of hazards, risks and vulnerability. The primary and secondary datasets were collected and collated prior to information extraction. The primary data include GPS coordinates while the secondary dataset included satellite images, land use/cover maps, digital elevation model, population and hydrological maps.

The utilised datasets used to create multi-hazards, risks and vulnerability maps are here indicated below:

Table 1: Sources of spatial datasets obtained and utilised in the study

No	Datasets	Sources	Period
1	Population	UBOS	2014
2	Roads	UNRA	2009
3	Land use/cover	NFA	2010
4	Hydrography	MWE	2010
5	Wetlands	MWE	2009
6	Protected areas	NFA	1990
7	Soil	NARO	2013
8	Trading centres	NFA	2014
9	Digital Elevation Model (30m)	SRTM	2014

The identified multi-hazards were mapped following standards procedures and methods for acceptability and reasonable output. Some of the analytical procedures are stated here below:

Table 2: Multi-hazard analytical detailed description of procedures

No	Multi hazards	Procedures
1	Flood inundation	Yang et al. (2006)
2	Soil erosion	Fistikoglu & Harmancioglu (2002)
3	Land conflicts	Homer-Dixon (1994)
4	Strong winds	Bunting & Smith (1993)
5	Invasive species	Venette et al. (2010)
6	Road accidents	Kamijo et al. (2000)
7	Lightning	Yokoyama (2002)

3.1.1.2.3 Validation

The hazard, risk and vulnerability prone areas were identified and studied in the field. The Spectra Precision handheld Global Positioning System (model: Mobile Mapper 20) units were used to map the hotspot and vulnerable areas. The field compiled profile was validated by the representative district government officials in a validation workshop held in Jinja District from 27th June – 1st July, 2016.

3.2 Multi-hazard assessment

3.2.1 Introduction

The multi-hazards that are experienced in Pallisa District can be classified as:

i. Geomorphological and geological hazards including soil erosion
ii. Climatological or hydro-meteorological including flash floods, hailstorms, drought and strong winds
iii. Ecological or biological hazards including crop pests/animal parasites and diseases, and invasive species
iv. Technological hazards including road accidents
v. Environmental hazards including wetland degradation and land conflicts

The comprehensive information on the frequency, severity and distribution of multi-hazards is presented here below in a chronological episodes order.

3.2.2 Flash floods

Pallisa district experiences flash floods that destroy several acres of crops and properties. The district has 8 small lakes, 13 wetlands systems and lies in the Lake Kyoga floodplain. Erratic/heavy rainfall, wetland degradation, poor drainage and deforestation are the major causes of flash floods in the district. Political pronouncements and weak enforcement of environmental laws promote degradation of the wetlands. The district experiences a bi-modal of rainfall pattern. The floods occur in the months of April-May and September-November of each year. The rainfall patterns are largely influenced by natural conditions of sea surface temperatures in the eastern and central equatorial Pacific Ocean, and the warming of sea surface temperatures in the western sector of equatorial Indian Ocean.

The wetlands are degraded to create cultivable fields for paddy rice growing and establish settlements. In their happening, the wetland vegetation is deforested resulting into excess water not being absorbed. The massive cultivation of rice with the application of poor farming methods is causing blockage of stream channels that cause excess water to inundate. The nature of clay soil

type which exhibits hard soil structure does not easily allow runoff water to percolate resulting into stagnation of water.

The characteristics of flash floods is associated with water logging of rice fields, increment in water borne diseases (malaria, typhoid, cholera etc), submergence of roads and houses etc. However, seasonal predictions show that the district has a high chance of receiving near normal rains. The factors that contribute to the vulnerability of households include: ignorance, sub-standard agro inputs, and weak enforcement of wetland policies among others.

The adverse effects of flash floods were reduced income for farmers, reduced yield, increased prices of staple food, illness, destruction of water wells, displacement of families, destruction of roads, loss of human life, property and livestock and breakdown of hygiene and sanitation facilities. The flash flood phenomenon severely affects all the sub counties in Pallisa District (Figure 2).

Plate 1: Pallisa to Tirinyi road submerged by flash floods in Limoto wetland

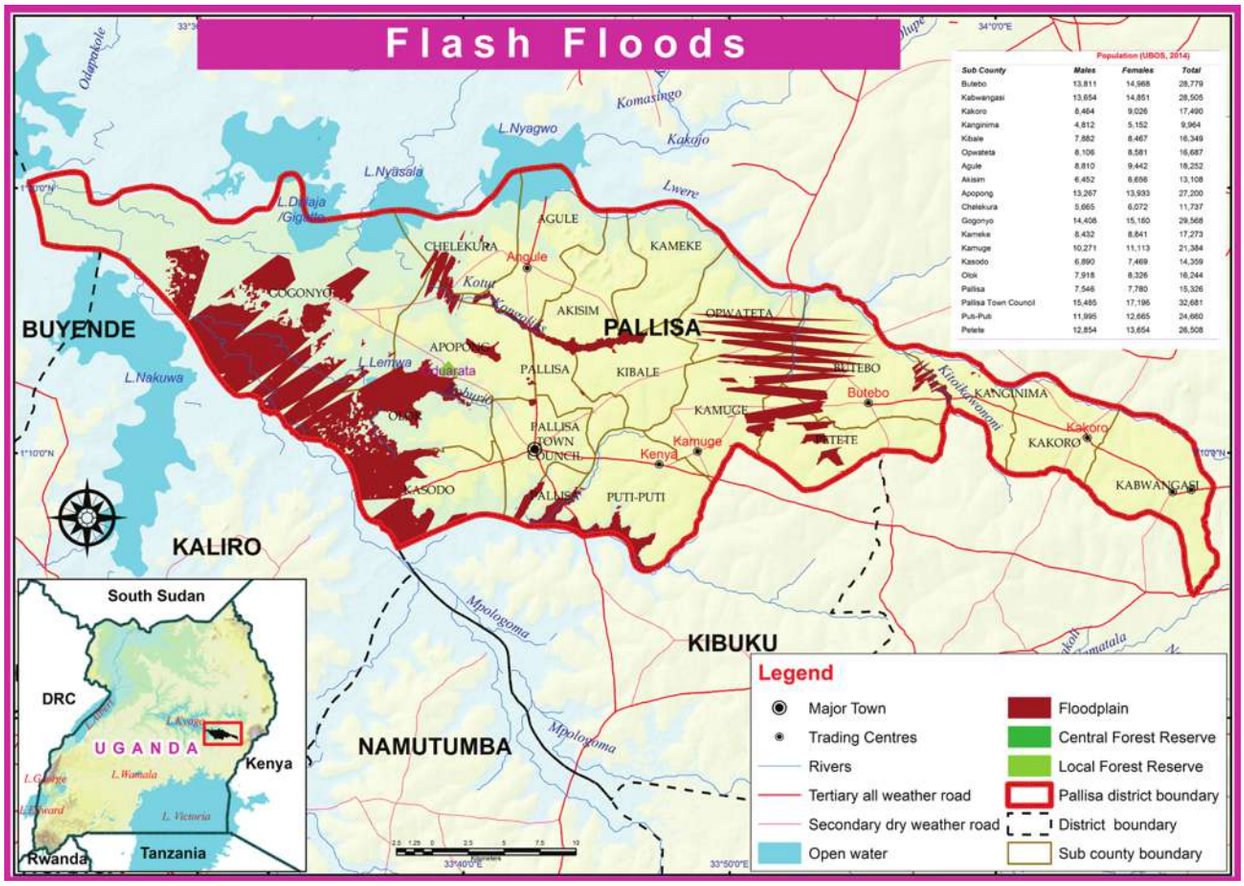

Figure 2: Flood inundation risk map

3.2.3 Crop pests/animal parasites and diseases

The occurrence, severity, frequency and distribution of crop pests/animal parasites and diseases are high as compared to the last 10 years in the district. In crop production, the farmers are engaged in the growing of cassava, beans, groundnuts, rice, potatoes, millet, maize and bananas as food and cash crops. However, their production has drastically reduced over time due to increasing and emergence of new crop pests and diseases.

The high pest and disease incidences in crops is mainly attributed to changes in weather patterns, deforestation, trans-boundary movement, soil exhaustion, type of crop grown (cereals), poor farming methods, high costs of pesticides, substandard pesticides and poor storage facilities. The changes in weather patterns favours the life cycle of pests that continuously destroy crops resulting into persistent food shortage. On the other hand poor farming methods are attributed to poverty, attitude, ignorance and poor mind-sets. The crop pests and diseases are associated with crop destruction, stunted growth, early rotting and farmer ignorance on better farming methods.

The factors that have contributed to the vulnerability of farmers include: lack of resistant planting materials, substandard pesticides and limited extension services. The adverse effects have resulted into low crop yields, low income levels, build-up of pests and soil degradation among others. Some of the notable pests and diseases are indicated here below (table 1). The effects of pests and diseases were evident in all the sub counties (figure 3).

Table 3: Major pests and diseases

No	Crops	Pests and diseases
1	Cassava	Cassava brown streak disease, cassava mosaic
2	Groundnuts	Groundnut rosette, Leaf miner
3	Maize	Stem borers, maize smurt, maize streak, striga
4	Sorghum	Sorghum midge, stem borers, sorghum shoot fly, striga
5	Cowpeas	Aphids
6	Soybean	Web worm, rust
7	Bananas	Banana Bacterial Wilt, banana weevils, sigatoka
8	Tomatoes	Tomato Blight
9	Rice	Stem borers, rice yellow mortal virus
10	Beans	Aphids
11	Citrus	Rot, fruit-fly, hard scab
12	Coffee	Coffee wilt disease, coffee twig borer
13	Mangoes	Fruit flies

In livestock production, Pallisa District lies in an endemic Tsetse and Trypanosomiasis zone. The occurrences of parasites and diseases was basically caused by communal grazing, ignorance, poor on-farm management, deforestation, mixing of livestock due to limited pasture fields, wetland degradation, animal movement, grazing along road reserves and reduced surface water quality.

The parasites and diseases are associated with low milk yield, low meat products, slow growth in livestock and encroachment of marginal lands such as wetlands among others. The predictability of the parasites and diseases is on the increase each year. The livestock keepers are apparently vulnerable due to sub-standard pesticides, high prices of inputs, unreliable weather patterns, limited extension services, water and pasture.

The adverse effects of livestock parasites and diseases include: loss of livestock, reduced household income levels, illness and human death. Some of the notable parasites and diseases included ticks, tsetse flies, worms, mites in poultry, New castle, Swine fever, Nagana, East Coast fever, foot and mouth disease among others. The livestock parasite and disease incidences are reported in all the sub counties (figure 3).

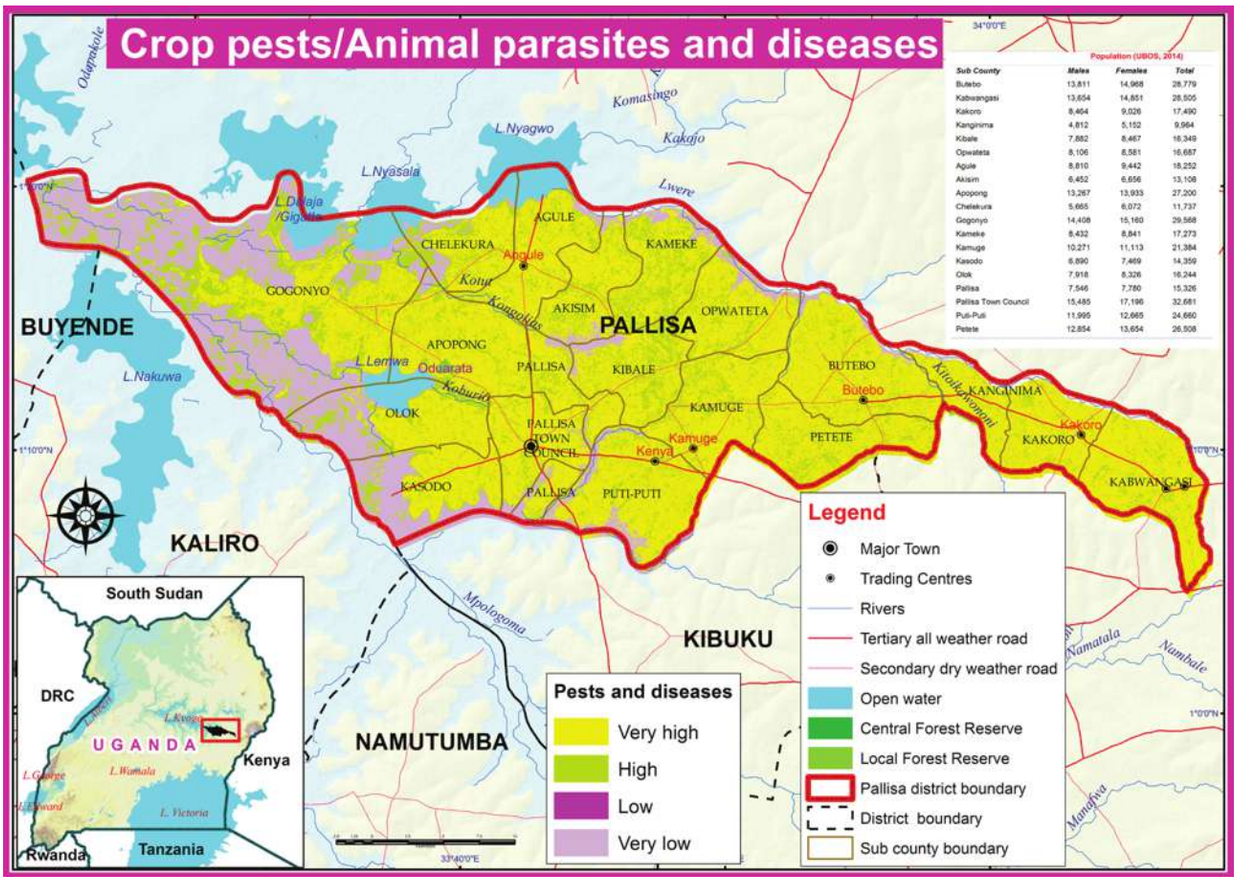

Figure 3: Crop pests/animal parasites and diseases risk map

3.2.4 Soil erosion

The soil erosion has affected the integrity of farmlands, wetlands and water sources in the district. The main soil erosion types common in the district include reel, gulley and sheet erosion. Soil erosion is principally triggered by poor farming methods, over grazing, deforestation, poor land use planning, poor maintenance of roads and intensive rainfall events.

The occurrence of soil erosion is associated with the washing away of top soil, falling of crops, siltation and road destructions. The events are common and widespread during the rainy season. The famers are vulnerable to the severity of soil erosion due to lack of agricultural inputs, over cultivation, clearance of natural land cover and reduced soil fertility.

The adverse effects of soil erosion experienced in the district include: reduced crop yields, low income levels, land abandonment, reduction in the quality and quantity of surface water sources, high costs of transport, increased incidences of pests and diseases, land conflicts, introduction of new invasive species and food insecurity. The occurrences and severity of soil erosion equally affects all the sub counties in the district (figure 4).

Plate 2: Eroded section of Gogonyo road, Pallisa District

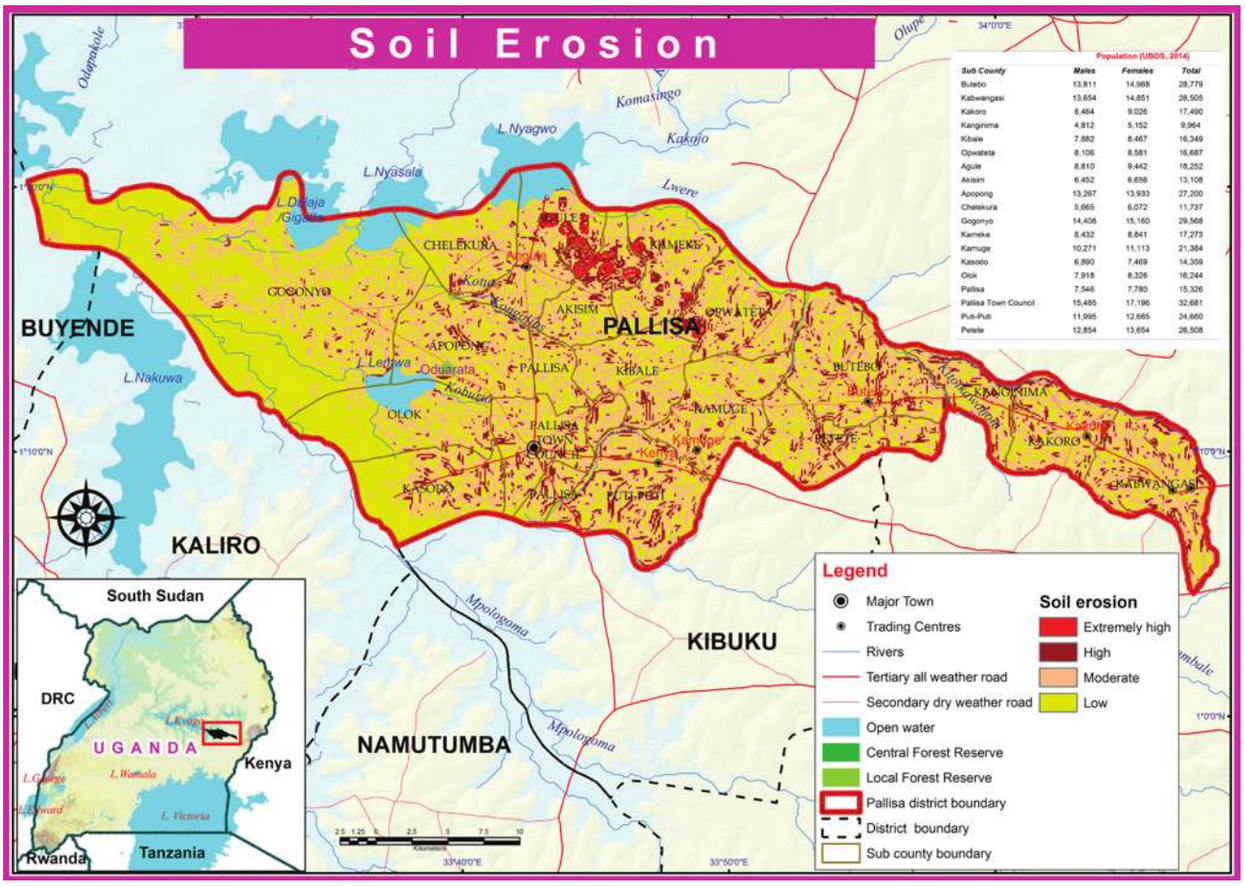

Figure 4: Soil erosion risk map

3.2.5 Wetland degradation

The wetland types found in Pallisa District are classified as papyrus, palms and thickets, bush lands, grasslands, seasonal and permanent subsistence farming (MWE, 2009). The wetland systems are under continual threats from the increasing rate of encroachment for wetland products and services. The wetlands are utilised as livestock grazing fields, extraction of building materials, crop growing, fishing and firewood among others. The major causes of wetland degradation include land shortage, reduced soil fertility, political interference, soil erosion, drought, poor farming methods, assumed ownership, change in land use (paddy rice cultivation), ignorance, resource conflicts, brick making, sand mining, seasonal fires, over harvesting and invasion by invasive species as well as low enforcement of wetlands regulations (Plate 3).

Plate 3: Deforestation in Gogonyo Sub County

The degradation is associated with silting of water bodies, reducing soil nutrients, lowering the water table, resource conflicts and over cultivation. The rates of wetland encroachments are high during the prolonged dry months characterised with low water availability and limited pastures. The factors that have increased the vulnerability of wetlands include limited enforcement mechanism and funds to demarcate the wetland boundaries.

The adverse effects of wetland degradation include subsequent occurrences of flash floods, erratic rains and drought, reduced water quality and quantity in water sources, loss of wetland biodiversity, increased incidences of pests and diseases, loss of property, livestock and human life. It must also be noted that the wetland degradation cases reported are widespread throughout all the sub counties in the district (figure 5).

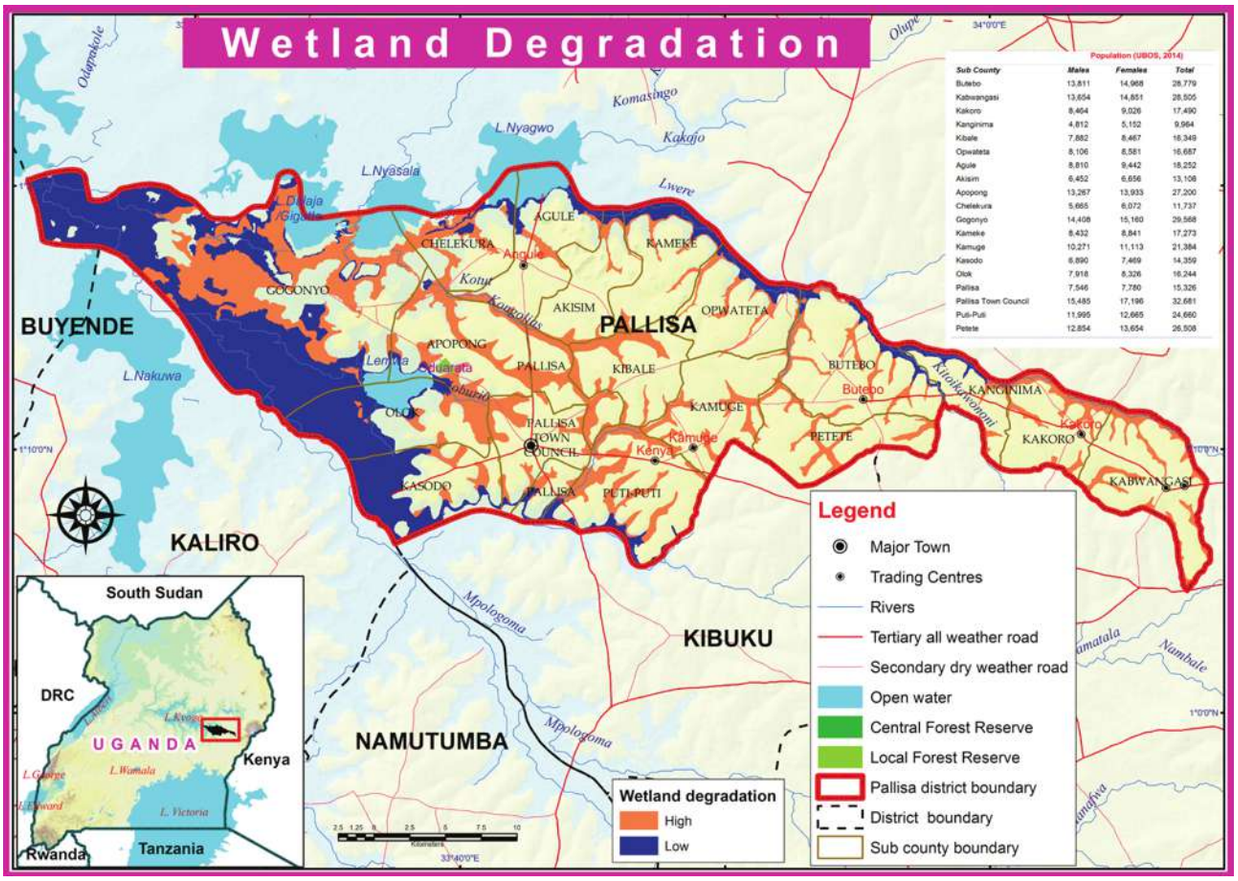

Figure 5: Wetland degradation risk map

3.2.6 Hailstorms

The occurrence and severity of hailstorms are a frequent phenomenon in Pallisa District. The hailstones fall during heavy downpour and these take a period of about 10-30 minutes. The frequency and distribution of hailstorms is primarily caused by changes in the onset of rainy seasons especially after prolonged dry spells, erratic rains and deforestation. Hailstorms are associated with vegetation, crop and property destructions. In addition to increasing surface rainfall runoff, they also clog water channels. The hailstorms are severely predicted to occur during the second rainy season. The deforestation activities have increased the magnitude of severity especially in farmlands and homesteads. The trees are cut for wood fuel for domestic use and brick burning as well as timber for construction. Trees are also cut down to open land for agriculture.

The farmers are vulnerable to the effects of hailstorms due to the massive clearance of trees, limited availability of tree seedlings, unreliable seasonal weather forecasts and limited agro input among others.

The adverse effects of hailstorms are destruction of property for example a classroom blocks at Kanyumu primary school in Butebo Sub County and Oboliso Rock primary school in Kameke Sub County had their roofs blown off in 2011 and 2013 respectively. It also leads to destruction of crops, reduced household income levels, food shortages and loss of life for people and livestock. The episodes affect every sub county in the district (figure 6).

Figure 6: Hailstorms risk map

3.2.7 Drought

Pallisa is one of the districts found in the cattle corridor. The cattle corridor is characterized with low rainfall of between 300-700mm which makes them semi-arid and therefore constituting the dry lands of the country. The experienced drought events are manifested as prolonged dry spells that cause shifts in the onset of rainy seasons.

The frequency and severity of drought episodes are perceived to be caused by changes in the climate pattern, wetland degradation, changes in land use and deforestation. Drought occurrences are associated with deficit soil moisture, reduction of surface water sources, rotting of crops and reliance on imported foods. It is aggravated by low adaptive capacity of farmers and reduced soil fertility. Predictably, the most affected months are those from December – March and July – September of each seasonal calendar.

Notably, the most adverse effects of drought include reduced income for farmers, reduced farm yield, reduced inputs and investment in the agricultural sector. In addition, it causes increased prices of staple food, food insecurity, migration, theft of crops in gardens and illness, loss of livestock. Drought also escalates wetlands and forest degradation because it is during the dry spells that acts like brick making, charcoal burning and digging out mud fish are on the increase. The severity and distribution of drought affects all the sub counties.

3.2.8 Land conflicts

Land conflicts have now become rampant in the district especially over the last 10 years. Most of the land in the district is under unregistered customary ownership with an increasing number of leaseholds and freeholds. The conflicts are between the people and government, communities and institutions and amongst the people themselves owing to the population bomb.

The land conflicts in the district are fuelled by unclear ownership of wetlands, population pressure, customary land ownership, ignorance, unclear administrative and protected area boundaries, absent land lords, land grabbing, unequal distribution of land in families and untitled land. The conflicts are associated with prolonged court cases, displacement of people and low crop and livestock production among others. The land conflicts are more frequent in the populated sub counties in the district. The households are vulnerable to the frequent occurrence of land conflicts due to land ownership rights, land grabbers, unplanned settlements and lack of clear boundaries with the neighbours.

The conflicts have resulted into the migration of people to the neighbouring sub counties and other districts, under development, loss of human life and livestock; and loss of property and income due to court cases. Land conflicts have further resulted into over fragmentation of land for production, reduced levels of production due to prolonged legal battles and court injunctions as well as physical injuries and loss of lives. In addition, the tenure arrangements are associated with over exploitation by several implemented land use options such as overgrazing, bush burning and land fragmentation on the allocated piece of land. The prevalence of land conflicts is widespread in all the sub counties in the district (figure 7).

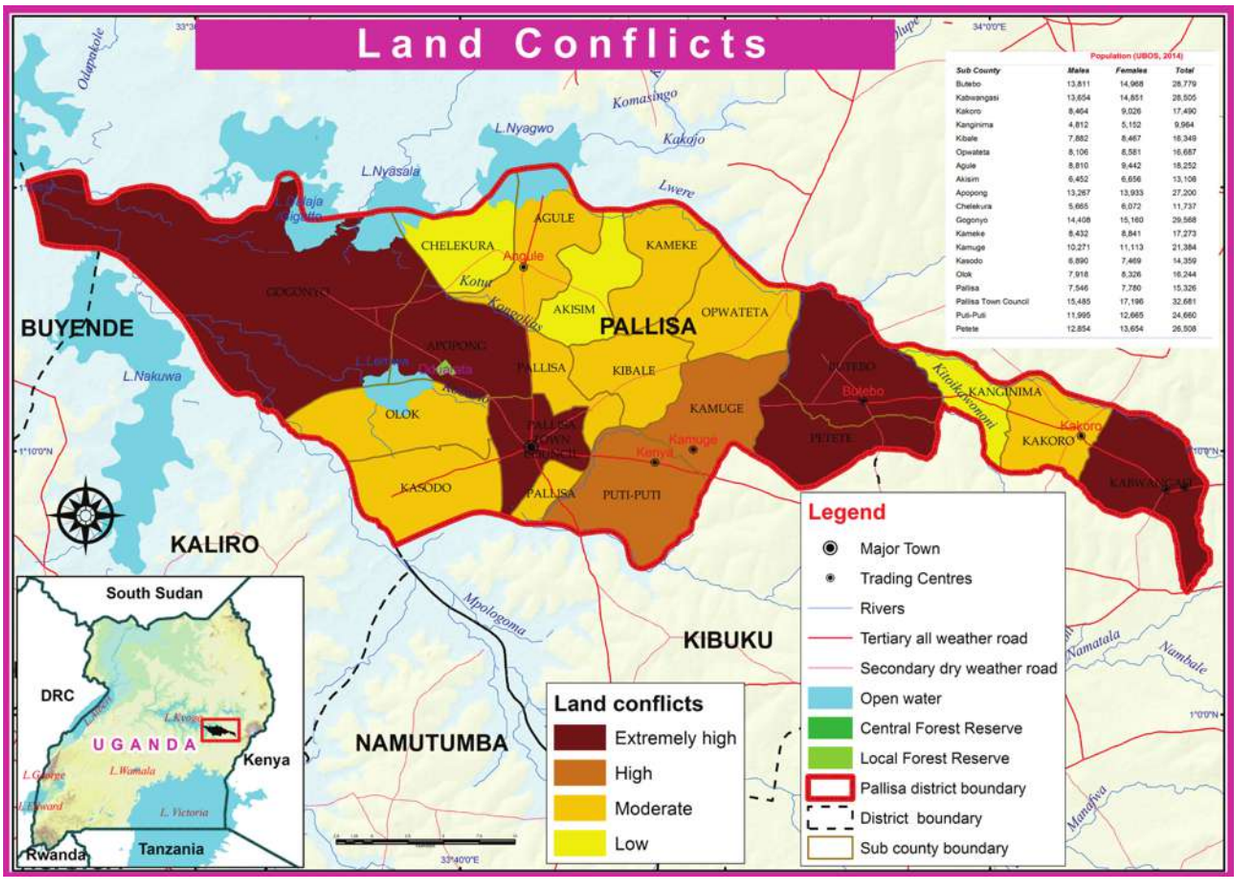

Figure 7: Land conflicts risk map

3.2.9 Road and water accidents

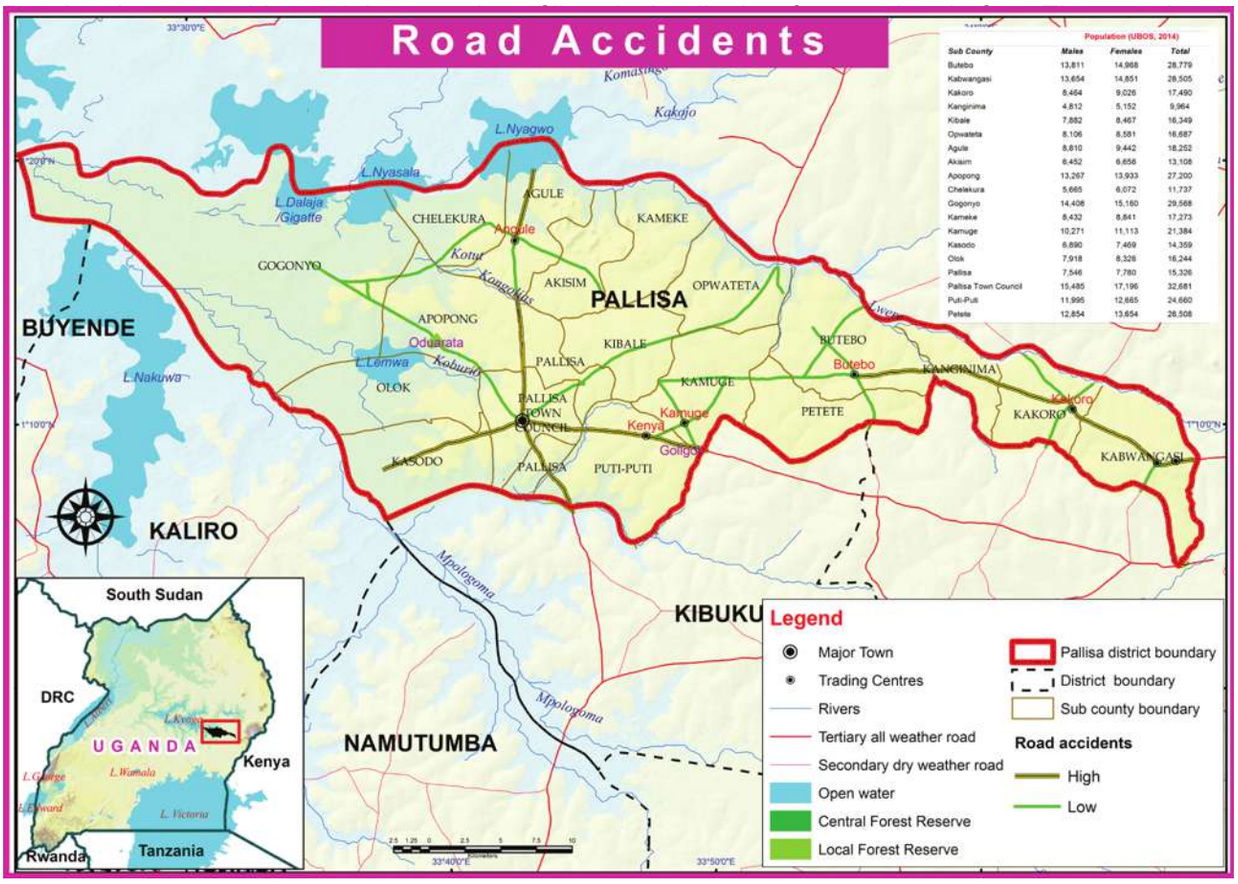

Figure 8: Road Accidents risk map

3.2.10 Invasive species

The occurrence of invasive species in the district is twofold: those that are land and water based. The invasions on land are mainly in farmlands while the water based can be seen on the lakes, ponds and wetlands. The frequency and severity of invasive species are sometimes determined by both natural and anthropogenic factors. In particular, the invasive species on land have evaded the district purely because of changes in weather patterns, reduced soil fertility, poor farming methods, soil erosion, animal movements, wetland degradation, high seed multiplication and dispersion by wind. Some of the notable species include striga “Kayongo”, Lantana Camara, Congress weed (Parthenium hysterophorus) among others. On water, the species are spread by strong winds, boat movements, wetland degradation, fishing activities, high seed multiplication and siltation among others.

Plate 4: Water hyacinth in swamps, Gogonyo sub county

The occurrence of land based species is associated with stunted crop growth, crop failure, frequent weeding, poor yields and land abandonment. The water species are characterised with slow boat movement, migration of fish stocks, high transport costs and water pollution among others. The invasions are high during the rainy season due to the increase in the plant water content that facilitates their high growth.

The adverse effects of land based species include loss of biodiversity, loss of livestock, low income levels, poor crop yields and encroachment of public land among others. On the other hand in water, the species cause illness, loss of biodiversity, depletion of fish stocks, high transport costs and malnutrition among others. The invasion of both species types is more common in Gogonyo Sub County (figure 9).

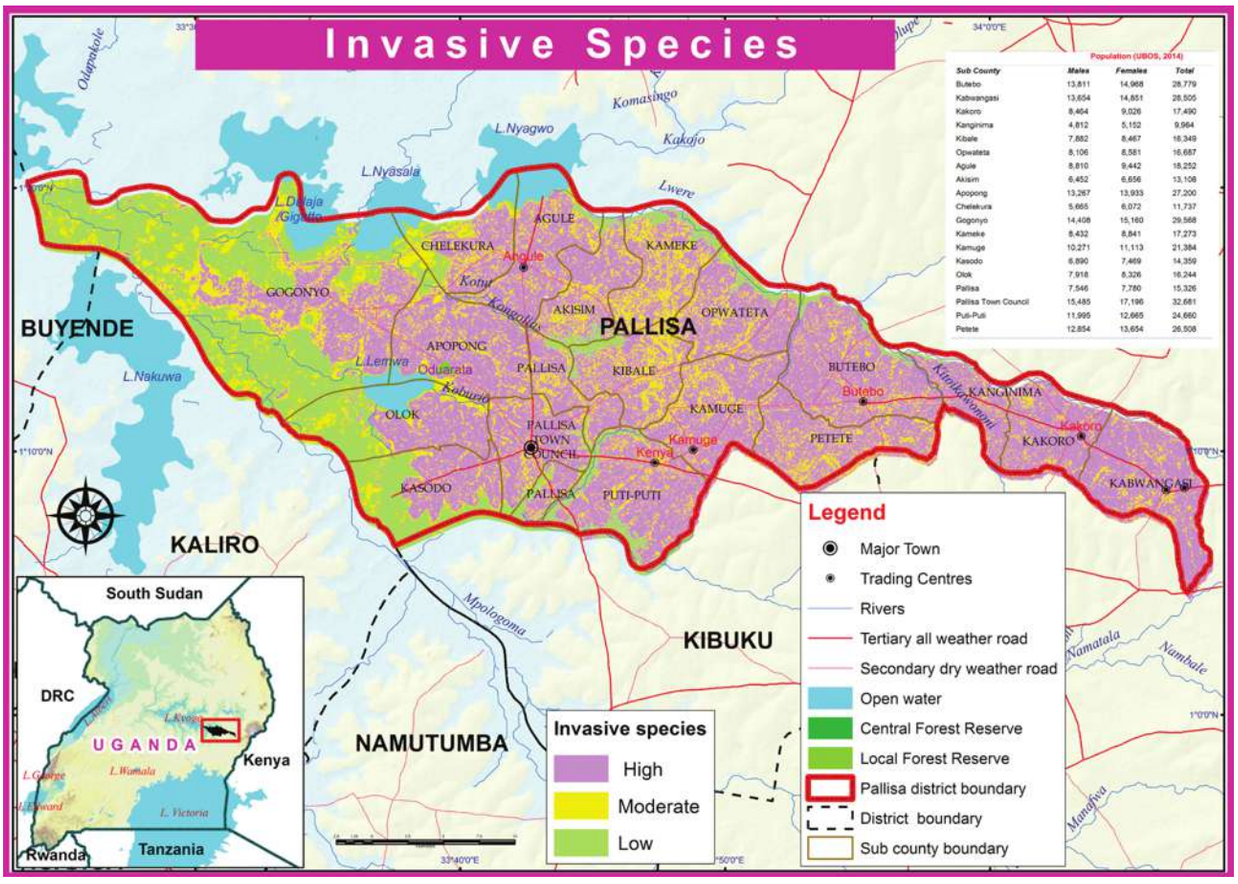

Figure 9: Invasive species risk map

3.2.11 Strong winds

The strong winds are normally experienced at the onset of the rainy season as compared to the dry season. The devastating winds occur during torrential rains and cause significant havoc in the social and economic wellbeing of the communities. The winds have become more rampant and severe simply because of high deforestation rates, presence of water bodies, wetland degradation, changes in the onset of rainy seasons and poor farming methods among others.

The occurrences and severity of strong winds are characterised with heavy showers, falling of crops, high rates of surface runoff, breakage of trees and destruction of houses. The winds are more common during the rainy season especially in the months of July, September and December of each seasonal year. The communities have become vulnerable due to lack of tree seedlings, unreliable seasonal weather forecasts and clearance of vegetation among others.

The strong winds have destroyed crops and property, blocked roads, reduced crop yields and income levels etc. The presence of strong winds is felt in all sub counties but most severe impacts have been reported in the sub counties of Gogonyo, Kasodo, Olok, Chelekura, Agule and Pallisa Town Council (figure10).

Figure 10: Strong winds risk map

3.3 Multi-hazard adaptation responses

According to the key informant interviews and FGDs, indicated here below are responses undertaken by the communities to adapt to the multi-hazards.

Table 4: Multi-hazard adaptation responses

No	Multi-Hazards	Adaptation Reponses	Recommendations
1	Floods	· Channelling water(trenches) · Installation of road culverts · Sensitization	· Tree planting/re-vegetation · Sensitization on wetland degradation and sustainable use of wetlands · Wetland demarcation and zoning · Enforce buffer zone · Promote alternative agricultural practices (horticulture, upland rice, fishing, etc) · Early warning system · Develop and implement communication strategy on production department
2	Drought	· Tree planting · Planting drought resistant crops · Establishment of alternative income generating activities like business · Agro forestry · Food preservation and storage · Planting quick maturing seeds · Practicing conservation agriculture · Rain water harvesting	· Provision of tree seedlings · Food relief to affected communities · Construction of valley dams · Fund irrigation technologies · Diversify sources of livelihood · Construction of food storage facilities · Construction of more boreholes · Law enforcement on wetland degradation · Fund tree planting activities
3	Crop pests/ parasites and Diseases	· Crop rotation · Spraying of vegetables · Vaccination of livestock · Treatment of animals · Using disease resistant varieties · Distribution of nets(mosquito and tsetse flies)	· Subsidizing pesticides and vaccines · Sensitization on control measures · Provide improved breeds · Recruitment of more extension workers · Restrict trans districts boundary animals and birds movement · Construction of valley dams · Regulate agro-suppliers on counterfeit pesticide, herbicides and drugs · Make pesticides accessible and affordable
4	Invasive Species	· Mixed planting · Crop rotation · Uprooting · Planting resistant crops · Sensitization	· More research on invasive species · Planting resistant improved seeds e.g in Maize Longe 7-H to control striga · Enforce regulation on the movement of planting materials (phyto-sanitary regulations)
5	Hailstorms	· Tree planting	· Food and seedlings provision on occurrence · Provision of tree seedlings · Provision of weekly weather forecasts · Avail updated metrological information to the district. · Early warning system.

6	Soil erosion	· Mixed cropping · Tree planting · Crop spacing · Growing of cover crops · Sensitization (farmer visits) · Minimum tillage	· Sensitization of the farmers on proper farming methods · Agro-forestry · Provision of tree seedlings · Subsidize the costs of pesticides and fertilizers · Funding the community outreach department · Soil and water conservation techniques
7	Land Conflicts	· Law courts like Clan, LC's, magistrate courts · Proper demarcation of land · Acquisition of land titles · Sensitization	· Reducing the costs involved in acquiring land titles · Sensitization of the community on land ownership · Consistency in buffering of wetlands, roads as per the act · Popularize the land policy · Quick judgments of land cases · Demystify cultural attitudes on women ownership of land · Translate the land policy and laws into local languages · Develop and implement communication strategy on land
8	Wetland degradation	· Sensitization on the dangers of encroaching wetlands · Wetland demarcation · Tree planting · Upland rice growing · Practicing conservation agriculture	· Provision of highly yielding upland rice · Funding the community outreach department · Strict enforcement of wetland laws · Diversify sources of livelihood e.g. Apiary · Improved irrigation technologies · Demarcation of wetlands and restoration of degraded areas · Water harvesting for agriculture · Introduce alternative agricultural activities like horticulture, upland rice, fishing, etc · Enforce wetland policy and law
9	Road accidents	· Law enforcement · Installation of road signs · Recommendations from the driving school for licence acquisition · Road maintenance · Wearing reflectors and helmets	· Enforcement of traffic laws · Frequent maintenance of roads · Prioritizing the permit licensing sector · Using reputable constructors · Screening boda-boda riders · Check un ethical behaviour of the traffic police · Promote use of protective gear in water and for boda bodas · Improve water transport vessels · Maintain roads and landing sites
10	Strong winds	· Tree planting · Planned constructions	· Provision of tree seedlings · Sensitization of the community on a village level about tree planting · Construction of planned houses · Use winds as source of energy · Early warning system

CHAPTER FOUR

4.1 Risk assessment

This table presents relative risk for hazards to which the communities attached probability and severity scores.

Table 5: Risk assessment of multi-hazards for Pallisa District

	PROBABILITY	SEVERITY OF IMPACTS	RELATIVE RISK	VULNERABLE SUB COUNTIES
	Relative likelihood this will occur	*Overall Impact (Average)*	*Probability x Impact Severity*	
Multi-hazard	*1=Not occur 2=Doubtful 3 = Possible 4=Probable 5 = Inevitable*	*1 = Very Low 2= Low 3= Moderate 4 = High 5= Very High*	*1-10 = Low 11-20 =Moderate 21-25 = High*	
Floods	5	5	25	Butebo, Kabwangasi, Kakoro, Kanginima, Kibale, Opwateta, Agule, Akisim, Apopong, Chelekura, Gogonyo, Kameke, Kamuge, Kasodo, Olok, Pallisa, Puti-Puti, Petete
Droughts	4	5	20	Butebo, Kabwangasi, Kakoro, Kanginima, Kibale, Opwateta, Agule, Akisim, Apopong, Chelekura, Gogonyo, Kameke, Kamuge, Kasodo, Olok, Pallisa, Pallisa Town Council, Puti-Puti, Petete
Hail storms	4	4	16	Butebo, Kabwangasi, Kakoro, Kanginima, Kibale, Opwateta, Agule, Akisim, Apopong, Chelekura, Gogonyo, Kameke, Kamuge, Kasodo, Olok, Pallisa, Pallisa Town Council, Puti-Puti, Petete
Soil erosion	4	5	20	Butebo, Kabwangasi,Kakoro, Kanginima, Kibale, Opwateta, Agule, Akisim, Apopong, Chelekura, Gogonyo, Kameke, Kamuge, Kasodo, Olok, Pallisa, Pallisa Town Council, Puti-Puti, Petete
Crop pests/ anima parasites and diseases	5	5	25	Butebo, Kabwangasi, Kakoro, Kanginima, Kibale, Opwateta, Agule, Akisim, Apopong, Chelekura, Gogonyo, Kameke, Kamuge, Kasodo, Olok, Pallisa, Pallisa Town Council, Puti-Puti, Petete
Land conflicts	4	4	16	Butebo, Kabwangasi, Kakoro, Kanginima, Kibale, Opwateta, Agule, Akisim, Apopong, Chelekura, Gogonyo, Kameke, Kamuge, Kasodo, Olok, Pallisa, Pallisa Town Council, Puti-Puti, Petete
Strong winds	3	3	9	Butebo, Kabwangasi, Kakoro, Kanginima, Kibale, Opwateta, Agule, Akisim,Apopong, Chelekura, Gogonyo, Kameke,Kamuge, Kasodo, Olok,Pallisa, Pallisa Town Council, Puti-Puti, Petete
Invasive species	3	3	9	Gogonyo
Road accidents	3	3	9	Butebo, Kabwangasi, Kakoro, Kanginima, Kibale, Opwateta, Agule, Akisim, Apopong, Chelekura, Gogonyo, Kameke, Kamuge, Kasodo, Olok,Pallisa, Pallisa Town Council, Puti-Puti, Petete

Wetland degradation	5	5	25	Butebo, Kabwangasi, Kakoro, Kanginima, Kibale, Opwateta, Agule, Akisim, Apopong, Chelekura, Gogonyo, Kameke, Kamuge, Kasodo, Olok, Pallisa, Pallisa Town Council,Puti-Puti,Petete

Key for Relative Risk

	High
	Moderate
	Low

4.2 Occurrence and frequency of multi-hazards

The table below shows the years in record and recurrence intervals of multi-hazards reported by the respondents in the district (table 6).

Table 6: Frequency of multi-hazards

No	Multi-hazard	Number of Events (last 30 years)	No. years in record	Recurrence Interval per year (months/ seasons)	Hazard Frequency (%) Chance/year
1	Pests and diseases	1986-2016	30	12	40
2	Drought	2013-2016	3	2	66
3	Hailstorms	2011-2016	7	2	28
4	Invasive species	2000-2016	16	12	75
5	Wetland degradation	2005-2016	11	12	109
6	Soil erosion	1986-2016	30	12	40
7	Strong winds	1999-2016	7	2	28
8	Land conflicts	2006-2016	10	12	120
9	Floods	2011-2016	7	2	28
10	Road accidents	1986-2016	30	12	40

4.3 Elements at Risk and Vulnerability assessment

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 for Pallisa district was assessed based on exposure, susceptibility and adaptive capacity at sub county and district levels highlighting their sensitivity to multi-hazards. 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.

The assessment reveals that geomorphological and geological hazards inform of soil erosion; climatological or hydro-meteorological in the form of flash floods, hailstorms, drought and strong winds; ecological or biological hazards in the form of crop pests/animal parasites and diseases, and invasive species; technological hazards in the form of road accidents and environmental hazards in the form of wetland degradation and land conflicts predispose the community to high vulnerability state in the Pallisa district (table 7).

4.1.1 Table 7: Components of vulnerability in Pallisa District

Vulnerability Components	Exposure	-		Susceptibility	-	Resilience	
	Hazards	Elements at risk	Geographical Scale	Potential impacts	Geographical Scale	Coping strategies	Geographical Scale
Social components	Land conflicts	· Human population	District	· Death of people · Displacement of people · Retardation of development	District	· Sensitise people on land ownership, developments and use · Clearly demarcating and defining land owner ship · Demystify cultural attitudes on women's ownership of land · Expedite resolution of land cases in court	District
	Invasive species	· Crops · Fish	Sub county	· Stunted growth of crops · Reduced pasture quality	District	· Planting resistant crops like Maize(Longe 10) to resist striga · Uprooting · Control movement of plant materials	District
	Pests and diseases	· Human and livestock populations · Crops	District	· Loss of livestock · Reduced livestock productivity · Complete crop failure like citrus, mangoes · Stunted growth of crop	District	· Vaccination · Spraying especially for cotton, mangoes and citrus · Sensitization · Crop rotation · Tsetse fly traps · Quarantine affected areas	District
	Hail storms	· Human and livestock populations · Crops	District	· Loss of livestock · Complete crop failure · Stunted growth of crops	District	· Construction of houses styles that's cannot be easily affected by hail storms · Tree planting around settlements	District
	Wetland degradation	· Lakes · Crops · Human population	District	· Low production of rice · Low water table especially for boreholes · Conflicts between rice growers and herds men	District	· Sensitisation on sustainable use · Enforce environmental policies and laws · Demarcate and zone wetlands	District
	Road accidents	· Human and livestock populations	District	· Human and livestock deaths · Disabilities after injuries · Loss of personal documents like Ids, passports	District	· Regular guidance by traffic offers · Construction of humps and road signs · Check un ethical behaviour of traffic police · Promote use of protective gear in water	District
	Water logging	· Human and livestock populations · Crops · Infrastructure including roads	District	· Loss of lives · Stunted growth of crops · Destruction of roads	Sub county	· Sensitization on how to safely use wetlands · Plan settlements to avoid prone areas · Check safety of hygiene and sanitation facilities	District

Economic component	Invasive species	· Crops	Sub county	· Low income in the long run as a result of poor yield and low productivity · high costs of removal · increased costs of production	Sub county	· Planting resistant crops like Maize(Longe 10) to resist striga · Check movement of planting materials	District
	Land conflicts	· Human population	District	· Delayed implementation of personal as well community development projects · Loss of lives	District	· Law suits in courts of law · Translation of land policy and law into local languages · Popularize land policy and law	District
	Pests and diseases	· Human and livestock populations · Crops .	District	· Loss of income · Loss of government revenue · Increased expenditure on pesticides and drugs	District	· Vaccination · Spraying · Enforce regulations against sub-standard breeds · Impose standards on agro dealers · Proper seed storage and preservation	District
	Hailstorms	· Human and livestock populations · Crops	District	· Loss of income · Loss of government revenue	District	· Plan construction of strong houses · Relief and planting materials to the affected	District
	Drought	· Human and livestock populations · Crops	Sub county	· Loss of income due to low productivity · Loss of government revenue	District	· Planting early maturing crops · Early warning · Tree planting · Food reserves · Plant drought resistant crops · Provision of water for production	District
	Road and water accidents	· Human populations	District	· Loss of lives	District	· Enforce Traffic laws · Building humps on roads · Establish and equip causality units at the Pallisa hospital and HCs IV · Construct and maintain roads · Promote use of improved boats · Regulate activities of boda bodas · Enforce laws against reckless driving and riding	District
	Water logging	· Human and livestock populations · Crops · Natural vegetation · Infrastructure including roads	Sub county	· Loss of income · Loss of government revenue	District	· Dig trenches · Tree planting/re-vegetation · Provide appropriate tree seedlings · Open drainage channels in urban settings and roads	District
	Wetland degradation	· Crops · Human and livestock population	District	· -Loss of biodiversity · -Reduced water quality · -Increased incidences of water borne diseases	District	· Tree planting along the wetland area · Awareness · Introduce alternative activities like cage fishing, horticulture, upland rice, bee keeping, etc · Enforce regulations on wetland use · Restoration of degraded wetlands	District

Environmental component	Invasive species	· Crops · Human population	Sub county	· Loss and stunted growth of crops	District	· Planting resistant crops like Maize (Log 10) to resist striga. · Avoid introducing harmful species	District
	Pests and diseases	· Human and livestock populations · Crops	District	· Loss of crops and animals	District	· Vaccination · Spraying · Use of organic methods of pests and disease control · Promote use of varieties resistant to pests and diseases	District
	Hailstorms	· Human and livestock populations · Crops	District	· Loss of vegetation cover including trees and crops	District	· Proper disposal of materials damaged by hailstorm · Tree planting	District
	Drought	· Human and livestock populations · Crops	District	· Wetland reclamation and/or degradation	District	· Support from government · Planting early maturing crops · Enhance water conservation practices · Promote water harvesting · Re vegetation of water catchments	District
	Water logging	· Human and livestock populations · Crops · Natural vegetation · Infrastructure including roads	District	· Loss of bio diversity · Destruction of crops	District	· Dig trenches · Use proper technology in constructing hygiene and sanitation facilities in prone areas · Control water borne diseases	District
Physical components	Invasive species					· Planting resistant crops like Maize (Log 10) to resist striga	
	Pests and diseases	· Human and livestock populations · Crops	District	· Loss of livestock · Reduced livestock productivity · Complete crop failure · Stunted growth of crops	District	· Vaccination · Use of mosquito nets · Culling off affected crops and animals · Quarantine · Use of tsetse fly traps · Indoor residual spraying	District
	Hailstorms	· Human and livestock populations · Crops	District	· Loss of livestock · Complete crop failure · Stunted growth of crops	District		District
	Drought	· Human and livestock populations · Crops	District	· Loss of vegetation cover · Lowering of water levels in dams and lakes · Increased dust levels · Death of livestock · Scarcity of water · Proliferation of livestock diseases · Limited pasture	District	· Support from government · Planting early maturing crops · Relief and planting materials to the affected · Small scale irrigation · Water harvesting	District
	Water logging	· Human and livestock populations · Crops · Natural vegetation · Infrastructure including roads	Sub county	· Loss of lives · Stunted growth of crops · Destruction of homes · Outbreaks of diseases, cholera	District	· Migration · Dig trenches · Planning settlements · Controlled grazing · Drainage in urban settings and roads	District
	Wetland degradation	· Crops · Human and livestock population	District	· -Loss of biodiversity · -Reduced water quality · -Increased incidences of water borne diseases	District	· Tree planting along the wetland area · Awareness · Restoration of degraded areas · Alternative means of livelihood · Law enforcement	District

CONCLUSION AND RECOMMENDATION

It was established that Pallisa district has over the last 30 years increasingly experienced multi-hazards including floods, drought, invasive species, strong winds, pests and diseases for crops and livestock, soil erosion, land conflicts, wetland degradation, road accidents and hailstorms putting livelihoods at increased risk. The limited adaptive capacity (and or/resilience) and high sensitivity of households and communities in Pallisa district increase their vulnerability to multi-hazard exposure necessitating urgent external support.

The multi-hazards that are experienced in Pallisa District can be classified as:

i. Geomorphological and geological hazards including soil erosion
ii. Climatological or hydro-meteorological including; flash floods, hailstorms, drought and strong winds
iii. Ecological or biological hazards including; crop pests/animal parasites and diseases, and invasive species
iv. Technological hazards including road accidents
v. Environmental including; wetland degradation and land conflicts

However, reducing vulnerability at community, local government and national levels should be a threefold effort hinged on:

i. Reducing the impact of the hazard where possible through mitigation, prediction, early 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
iv. Design new policies and programmes to address discrepancies in disaster issues
v. Develop and implement the disaster communication strategy

Recommended policy actions that should target vulnerability reduction include:

i. Improved enforcement of policies aimed at enhancing sustainable environmental health;
ii. Increased awareness campaigns aimed at sensitizing farmers/communities on disaster risk reduction initiatives and practices.
iii. Revival of disaster risk committees at the district levels
iv. Support extensive research on the occurrence and frequency of disasters prior to disaster management
v. Improve the communication channel between the disaster department and local communities
vi. Office of the prime minister should decentralise their activities at the district level
vii. OPM should strengthen the district disaster committees by developing guidelines and trainings
viii. Fund and equip recruited extension works
ix. Establish a fund aimed at disaster preparedness and management at district levels
x. Increase funding and staff to monitor wetland degradation and non-genuine agro-inputs
xi. Support establishment of a disaster risk early warning systems
xii. Provide support in form of free seedlings to promote afforestation and reforestation programmes
xiii. OPM should divest all their activities to the districts and remain the coordinating center and supervisor

REFERENCES

Bunting, W. F., & Smith, B. E. (1993). A guide for conducting convective windstorm surveys. US Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Scientific Services Region.

Fistikoglu, O., & Harmancioglu, N. B. (2002). Integration of GIS with USLE in assessment of soil erosion. Water Resources Management, 16(6), 447-467.

Homer-Dixon, T. F. (1994). Environmental scarcities and violent conflict: evidence from cases. International security, 19(1), 5-40.

Kamijo, S., Matsushita, Y., Ikeuchi, K., & Sakauchi, M. (2000). Traffic monitoring and accident detection at intersections. IEEE transactions on Intelligent transportation systems, 1(2), 108-118.

Venette, R. C., Kriticos, D. J., Magarey, R. D., Koch, F. H., Baker, R. H., Worner, S. P., & De Barro, P. J. (2010). Pest risk maps for invasive alien species: a roadmap for improvement. BioScience, 60(5), 349-362.

Yang, J., Townsend, R. D., & Daneshfar, B. (2006). Applying the HEC-RAS model and GIS techniques in river network floodplain delineation. Canadian Journal of Civil Engineering, 33(1), 19-28.

Yokoyama, S. (2002, October). Lightning detection and lightning protection of power systems in Japan. In Transmission and Distribution Conference and Exhibition 2002: Asia Pacific. IEEE/PES (Vol. 1, pp. 546-551). IEEE.

Pallisa district development plan 2015- 2020

APPENDIX I: DATA COLLECTION TOOLS

FOCUS GROUP DISCUSSION GUIDE FOR DISTRICT DISASTER RISK MANAGEMENT FOCAL PERSONS

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

No.	Name of Participants	Designation	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?

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

85. Which villages and parishes have been most affected by environmental degradation?

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

87. What impacts have been caused by environmental degradation?

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

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91. Which particular villages and parishes have been majorly affected by land conflicts in your community?

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

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

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

103. Have you experienced any serious bush and or forest fires in the past 10 years in your community?

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

105. What impacts have been caused by serious bush and or forest fires?

106. To what extent have the serious bush and or forest fires affected livelihoods of the local communities in your community?

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

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

SPATIAL DATA COLLECTION SHEET FOR HAZARD VULNERABILITY AND RISK MAPPING

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

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

Sub- county:

Parish:

Village:</td><td colspan="4">Coordinates</td></tr>
<tr><td>X:</td><td colspan="3"></td></tr>
<tr><td>Y:</td><td colspan="3"></td></tr>
<tr><td>Altitude</td><td colspan="3"></td></tr>
<tr><td colspan="2">Slope characterization</td><td colspan="2">Bio-physical characterization</td><td colspan="3">Vegetation characterization</td><td 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 colspan="2"></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 colspan="2"></td></tr>
<tr><td>Aspect (e.g N, NE…)</td><td></td><td>Rainfall</td><td></td><td>Shrubs cover (%)</td><td colspan="2"></td></tr>
<tr><td>Elevation (e.g high, low…)</td><td></td><td>Drainage</td><td></td><td>Grass / Herbs cover (%)</td><td colspan="2"></td></tr>
<tr><td>Slope curvature (e.g concave, covex…)</td><td></td><td>Temperature</td><td></td><td>Bare land cover</td><td colspan="2"></td></tr>
<tr><td colspan="7">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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