



Kalangala 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.

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My appreciation also goes to Kalangala District Team:

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2. Ms. Saawo Harriet- District Natural Resources
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8. Ms. Nalukwago Zam Zuriat- Senior Economist

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

Vulnerability assessment, hazard and risk mapping is an important exercise carried out by OPM in response to The National Policy for Disaster Preparedness and Management (Section 4.1.1) and also targeting to counteract vulnerability at community and local government levels by reducing the impact of the hazards where possible through mitigation, prediction, warning and preparedness.

This report has been prepared in close collaboration and coordination with OPM and other stakeholders. The report is presented in 3 chapters with chapter one detailing the background of the report which comprises of the Government of Uganda moving the disaster management paradigm from the traditional emergency response focus toward one of prevention and preparedness. Here the report highlights the objectives of the exercise as to Collect and analyze the field data using GIS and Develop specific multi-hazard, risk and vulnerability profiles using a standard methodology.

Chapter two highlights the overview of the District and its location which is situated in South western Uganda between longitudes 32°01' East and 32°52' East and latitudes 0°10' South and 1°00' South. The district consists of a series of long, narrow, flat-topped ridges along the islands. They rise to an average altitude of about 1,500 metres a.s.l. The ridges are surrounded and sometimes intersected by low-lying flat plains at about 1,460 metres a.s.l. The district is entirely overlain with ferrallitic soils of sandy loam soils, with dominant colour being red. Kalangala District's mean annual rainfall ranges from 1,125 to 2,250mm; the mean monthly rainfall is 140mm. The rainfall peaks are from March-May and October-November (rainy season). The vegetation is predominantly characterized by medium moist evergreen forests. This vegetation occurs at altitudes ranging from 600 -1,550 metres and forms closed stands rising 30 to 45 metres high, with abundant lianas

Chapter three clearly explains the materials and methods applied in conducting the assessment and here a multidisciplinary approach was adopted for the assessment of multi-hazard, risk and vulnerability profiles production. The approach included; an investigation of socio-economic parameters, biophysical characteristics and spatial analysis of hazards in the district.

Chapter four has findings that encompass multi hazard, risk and vulnerability status of the district. It has been noted that Kalangala District has continuously experienced multi-hazards for over 30 years. The multi-hazards that are experienced in the district can be classified as:

- i. Geomorphological and geological hazards including soil erosion
- ii. Climatological or hydro-meteorological including flash floods, hailstorms, lightning, drought and strong winds
- iii. Ecological or biological hazards including pests, parasites and diseases, human and wildlife conflicts and invasive species
- iv. Technological hazards including water accidents
- v. Environmental hazards including wetland degradation, deforestation, man-made fires and land conflicts
- vi. Pysco-social hazards including drug abuse

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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
OPM	:	Office of the Prime Minister
NFA	:	National Forestry Authority
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 result into 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 moving 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 atlas of hazard, risk and vulnerability conditions in the country that will guide mainstreaming of Disaster and Risk Management in development planning and contingency planning at national and local levels.

From 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 group 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 “Carryout 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 of the consultancy

The objectives of the assignment were to:

- 1) Collect and analyze field data using GIS in close collaboration and coordination with OPM in Kalangala 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 Kalangala District

Kalangala District is situated in Southwestern Uganda between longitudes 32°01' East and 32°52' East and latitudes 0°10' South and 1°00' South. It shares boundaries with Mpigi and Wakiso Districts in the North, Mukono District in the East, the United Republic of Tanzania in the South, Masaka and Rakai Districts in the West (5 year district development plan, 2014-2020). The District consists of a series of long, narrow, flat-topped ridges along the islands. They rise to an average altitude of about 1,500 metres a.s.l. The ridges are surrounded and sometimes intersected by low-lying flat plains at about 1,460 metres a.s.l. In general, the Islands are gently elevated from the waterside (lake-shore) surrounding them, and culminating into an undulating flat formation at the summit points. The hill slopes are relatively steep in the range of 8 to 25 percent, the gradient of lower slopes often decreases to form almost flat facets, some of which identifies ancient like terraces. The highest point is at Kalangala Town Council, Buggala Island, which is at 1,552 metres above sea level. Other islands such as Buyovu and Bunyama, among others, are elevated to above 1,490 metres above sea level (5 year district development plan, 2014-2020)

The district is entirely overlain with ferralitic soils of sandy loam soils, with dominant colour being red. These soils are undifferentiated and are represented by dominant Ssesse 'red' and Ssesse 'brown' soils. The other three soil types with limited occurrence are Sango, Kinyu and Kikwayu series (5 year District Development Plan, 2014-2020). Kalangala District's mean annual rainfall ranges from 1,125 to 2,250mm; the mean monthly rainfall is 140mm. The rainfall peaks are from March-May and October-November (rainy season). Sunshine and Radiation: The average sunshine is 6.1hrs per day. The maximum sunshine per day is 7.3 hrs and minimum sunshine per day is 5.8 hrs, which explains the average hours of sunshine per day. The total sunshine per annum is 2200 hrs. Radiation is 450 calories per centimetre squared per day (450 cal/cm² per day).

Temperature: The mean annual maximum temperature ranges from 25.0°C – 27.5°C and the mean annual minimum temperature ranges from 17.5°C – 18.0°C.

Humidity: There is considerably high rate of evaporation over the surface of Lake Victoria, which is estimated to be 3-5 mm per day (hence an average of about 120mm per month and 1460mm per annum). Since the prevailing winds drift across the lake throughout the year from east to west, the climate around the Islands is greatly conditioned. The mean annual vapour pressure is 20.5 mill-bars (5 year District Development Plan, 2014-2020). The vegetation is predominantly characterized by medium moist evergreen forests. This vegetation occurs at altitudes ranging from 600 -1,550 metres and forms closed stands rising 30 to 45 metres high, with abundant lianas. Grasses are generally absent or are broad-leaved and fire-sensitive. The vegetation, however, can further be distinguished under four major zones, that is aquatic, lake-side, grassland and upper forest zone consisting of dense and impenetrable canopy with numerous shrubs in the ground stratum (5 year District Development Plan, 2014-2020).

Seventy three percent of the currently working persons (aged 10years and above) are engaged in agricultural related economic activities of which fishing is the most dominant industry, taking on nearly 60 percent of the total currently working persons. A total of 7500 households are involved in crop farming of some kind. In most parts, agriculture is in form of subsistence farming. Commercial farming is still negligible in most Islands but more pronounced on Buggala Bubembe and Bunyama Islands in form of oil palm growing. Forty nine percent of the farming households grow cassava, the most common crop. Twenty three percent of the total households are involved in subsistence farming. The district has 1200 households keeping some kind of farm animals, the most common one are cross and indigenous breeds of cattle, goats and pigs, the latter being the most commonly reared. 1450 households keep some kind of poultry, with local chicken being the most common. Nearly 90 percent of all households keeping poultry have the local breed (5 year District Development Plan, 2014-2020).

CHAPTER THREE

3.1 Materials and methods

3.1.1 Multi-hazard, risk and vulnerability profile assessment

3.1.2 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.

3.1.3 Data collection

3.1.4 Socio economic investigation

The socio economic assessment of 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: Mugoye and Bufumira. 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 characterised the exposure agents, including multi-hazards, elements at risk and their spatial dimension.

3.1.5 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 dataset included GPS coordinates while the secondary datasets were 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 standard 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)
8	Pests, Parasites and diseases	Based on major crop and livestock enterprise

The frequency and severity of multi-hazards, risks and vulnerability levels were categorized based on key informant interviews and expertise as follows:

Table 3: Multi-hazard severity classes/levels

Classes	Ranges (%)
Extremely/very high	90-100
High	60-89
Moderate	30-59
Low	10-29
Very low	0-9

3.1.6 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. This profile was certified by the District representative 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 Kalangala District can be classified as:

- vii. Geomorphological and geological hazards including soil erosion
- viii. Climatological or hydro-meteorological including flash floods, hailstorms, lightning, drought and strong winds
- ix. Ecological or biological hazards including pests, parasites and, human and wildlife conflicts and invasive species
- x. Technological hazards including water accidents
- xi. Environmental hazards including wetland degradation, deforestation, man-made fires and land conflicts
- xii. Pysco-social hazards including drug abuse

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



Plate 1: Lulamba primary school on Lulamba Island in Bufumira Sub County

3.2.2 Strong winds

The strong winds are normally experienced throughout the year. The devastating winds 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 Lake Victoria, 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 (Plate I). 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 led to low crop yields, loss of life and property, increase in the occurrences of diseases, multiplication of invasive water weeds and low income levels etc. The most severe impacts have been reported in all the Sub-counties.

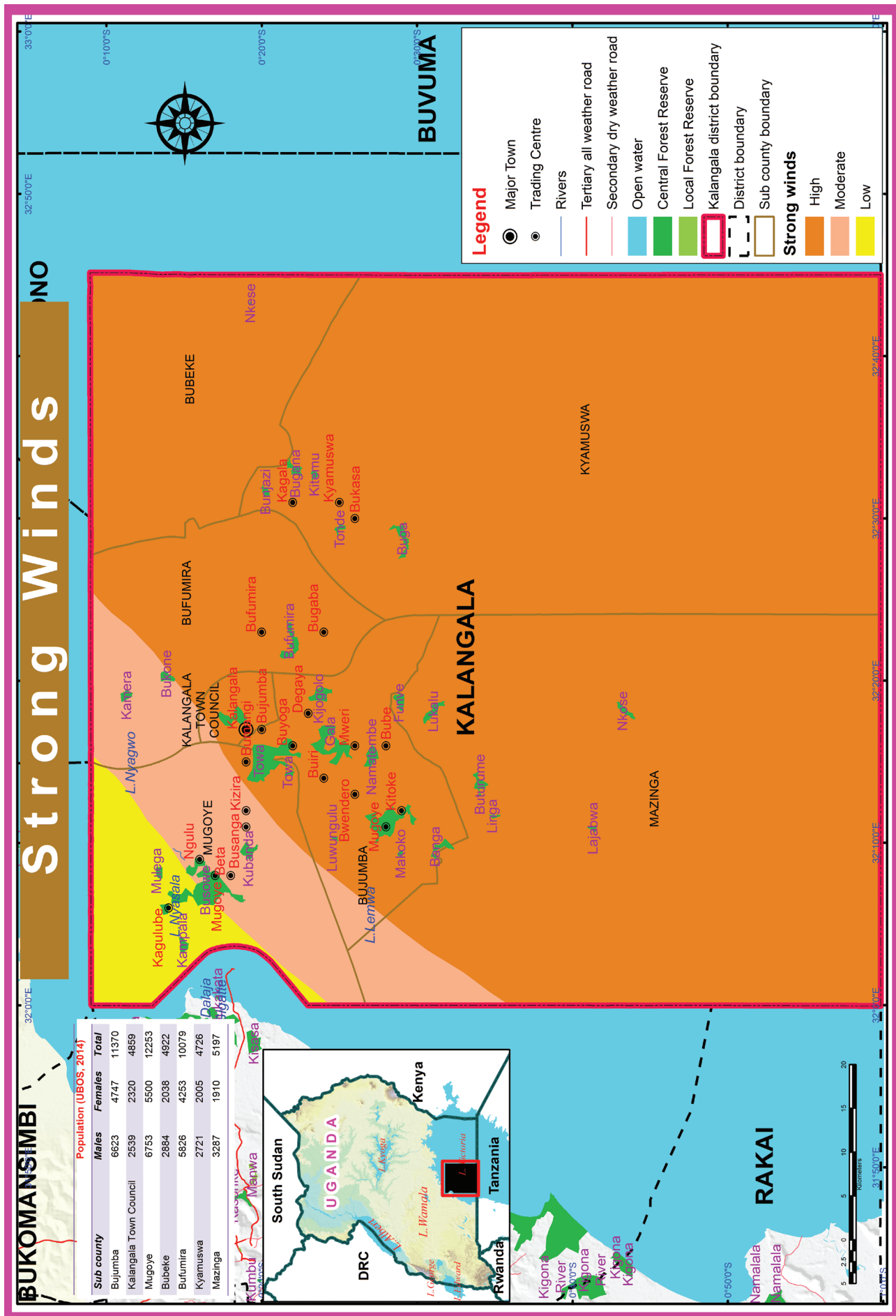


Figure 2: Strong winds levels



3.2.3 Water accidents

Water accidents claim a number of lives in the District of recent than before. The water accidents are largely caused by strong winds and Hippos in the water bodies.

Water accidents are associated with deaths, injuries, disabilities and arrests among others. The incidences are more frequent during the festive seasons such as Christmas and Easter, election days and at the start and closure of schools. The factors that contribute to the vulnerability of households to water accidents are; weak enforcement of marine laws, poor mechanical conditions of boats and cruises, submerged rocks, drug abuse, human wildlife conflicts, untrained boat swains, night movements among others.

The notable effects of water accidents include: loss of human life and livestock, illness, disabilities, loss of property and documentation. The accident incidents are reported in all the Sub-counties throughout the year (figure 3).

3.2.4 Pests, parasites and diseases

The occurrence, severity, frequency and distribution of pests, 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, oil palm 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.



Plate 2: Cassava mosaic at Nakatiba landing site in Bujjumba Sub County

The high pre-and post-harvest pest and disease incidences in crops is mainly attributed to changes in weather patterns, deforestation, inadequate extension services, inadequate regulation and surveillance, 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 famine and 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 (Plate 2).

The factors that have contributed to the vulnerability of farmers include: poor seedlings, substandard pesticides, limited extension services and low adaptive rate to new technologies. The adverse effects include 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 4). The effects of pests and diseases were evident in all the Sub-counties (figure 4).

Table 4: Major pests and diseases

No	Crops	Pests and diseases
1	Cassava	Cassava brown streak disease, cassava mosaic
2	Groundnuts	Groundnut rosette, Leaf minner
3	Maize	Stem borers, maize smurt, maize streak
4	Cowpeas	Aphids
5	Soybean	Web worm, rust
6	Bananas	Banana Bacterial Wilt, banana weevils, sigatoka
7	Tomatoes	Tomato Blight
8	Rice	Stem borers, rice yellow mortal virus
9	Beans	Aphids
10	Coffee	Coffee wilt disease, coffee twig borer

In livestock production, Kalangala 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 every other year. The livestock keepers are apparently vulnerable due to Sub-standard pesticides, 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, loss of revenue to the District, 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 4).

3.2.5 Soil erosion

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 rill, gully 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, siltation of water sources and destruction of infrastructure including roads and bridges. The events are common and widespread during the rainy season. The farmers are vulnerable to the severity of soil erosion due to poor farming methods, and land shortage which lead to cultivation of steep slopes and low lying flood prone areas.

The adverse effects of soil erosion experienced in the District include: low 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, loss of landscape beauty, land conflicts, introduction of new invasive species and famine. The occurrences and severity of soil erosion equally affects all the Sub-counties in the District (figure 5).

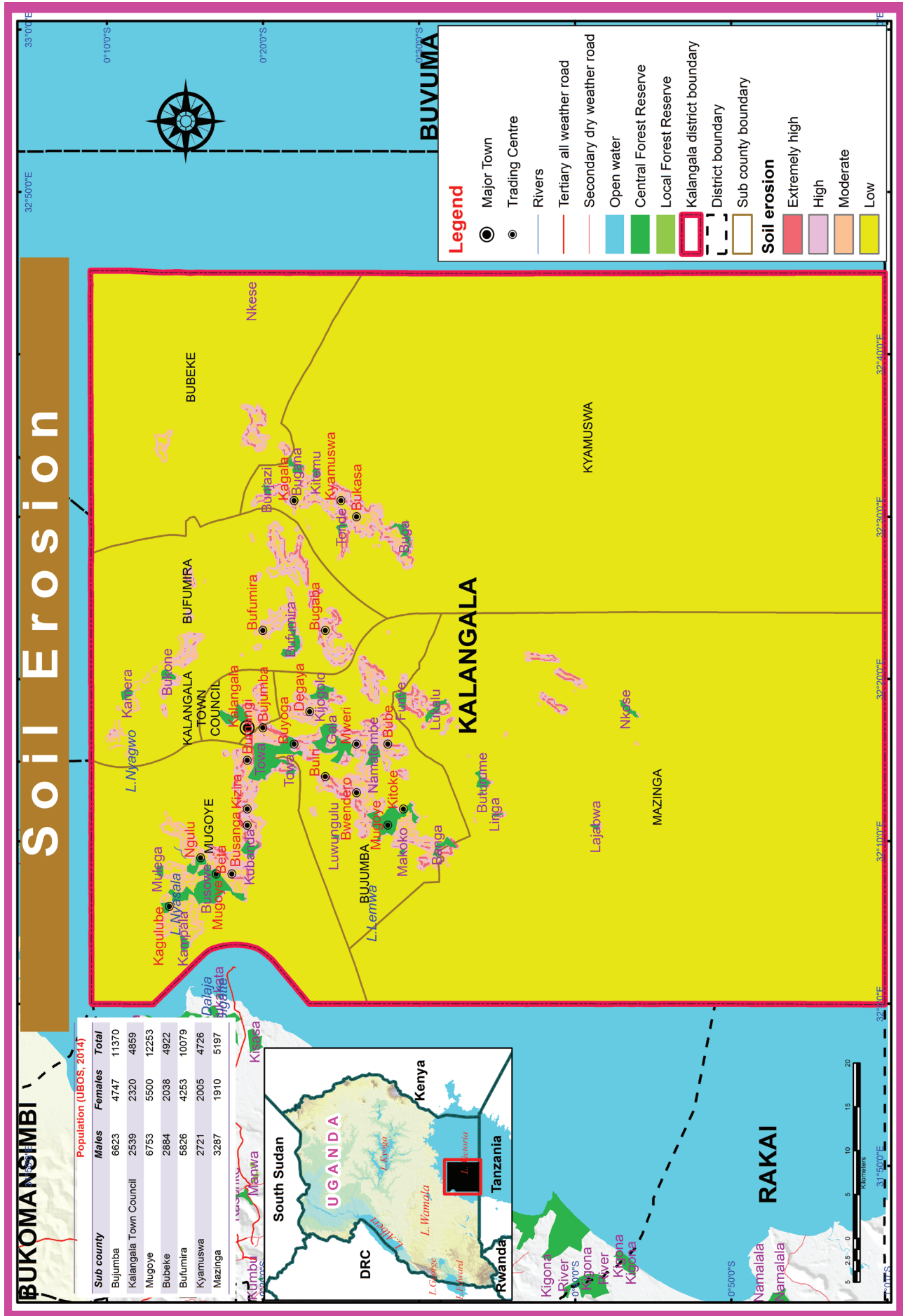


Figure 5: Soil erosion prone areas

3.2.6 Deforestation

Deforestation is perceived as the cutting of trees for wood and timber purposes. This has mainly affected Kalangala District because most of the trees have been wiped away in search for land for settlement caused by the high birthrates and migration, charcoal and timber products, farm land since the soils have lost their fertility and commercialization of agriculture, corruption and weak laws that are not adhered to or enforced to protect forest reserves and private forests (Plate 3).

The factors that contribute to the vulnerability include weak enforcement of forestry laws, high population growth rates, drought and reduced soil fertility among others in the District.



Plate 3: Forest degradation in Mugoye sub county, Bumangi village

The resultant effects have led to increases in pests and diseases, destruction of habitats and drought. In addition to the loss of biodiversity, water resource conflicts and loss of water quality have been recorded in the District. The activities are prevalent in all the Sub-counties; however there are more severe in Bujumba , Mugoye and Bufumira (figure 6).

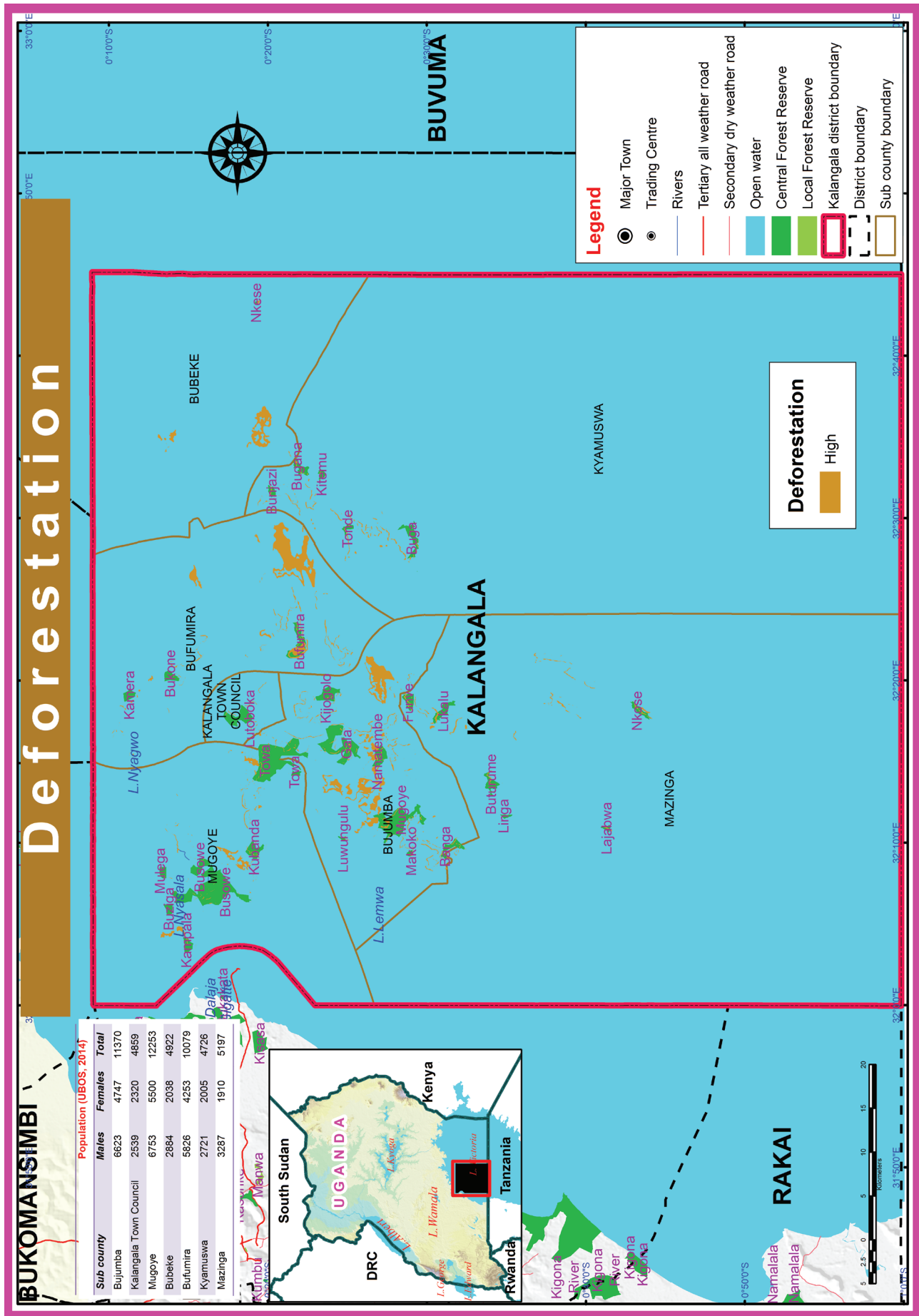


Figure 6: Deforested areas



3.2.7 Lightning

Uganda has one of the highest rates of lightning strike deaths in the world. The incidences are attributed to changes in climate and weather patterns, construction of houses on high grounds, and loss of natural tree cover due to deforestation activities. In particular, the lightning incidences are influenced by the unusual surge of the moist air from the Atlantic Ocean and Congo air-mass that occur during the rainy seasons.

The thunderbolt incidences are associated with the destruction of crops and vegetation, loss of life in human and livestock, heavy downpour and hailstorms. The incidences normally occur at the onset of the rainy season. These are frequent in the months of April-May and September-December of every year. The increase in vulnerability to lightning cases is attributed to deforestation, and shift in seasons.

The strikes have resulted into the loss of household income and loss of property. The deficiencies in soil moisture and water stress are highly reported in all Sub-counties in the District.



Plate 4: Lightning strike

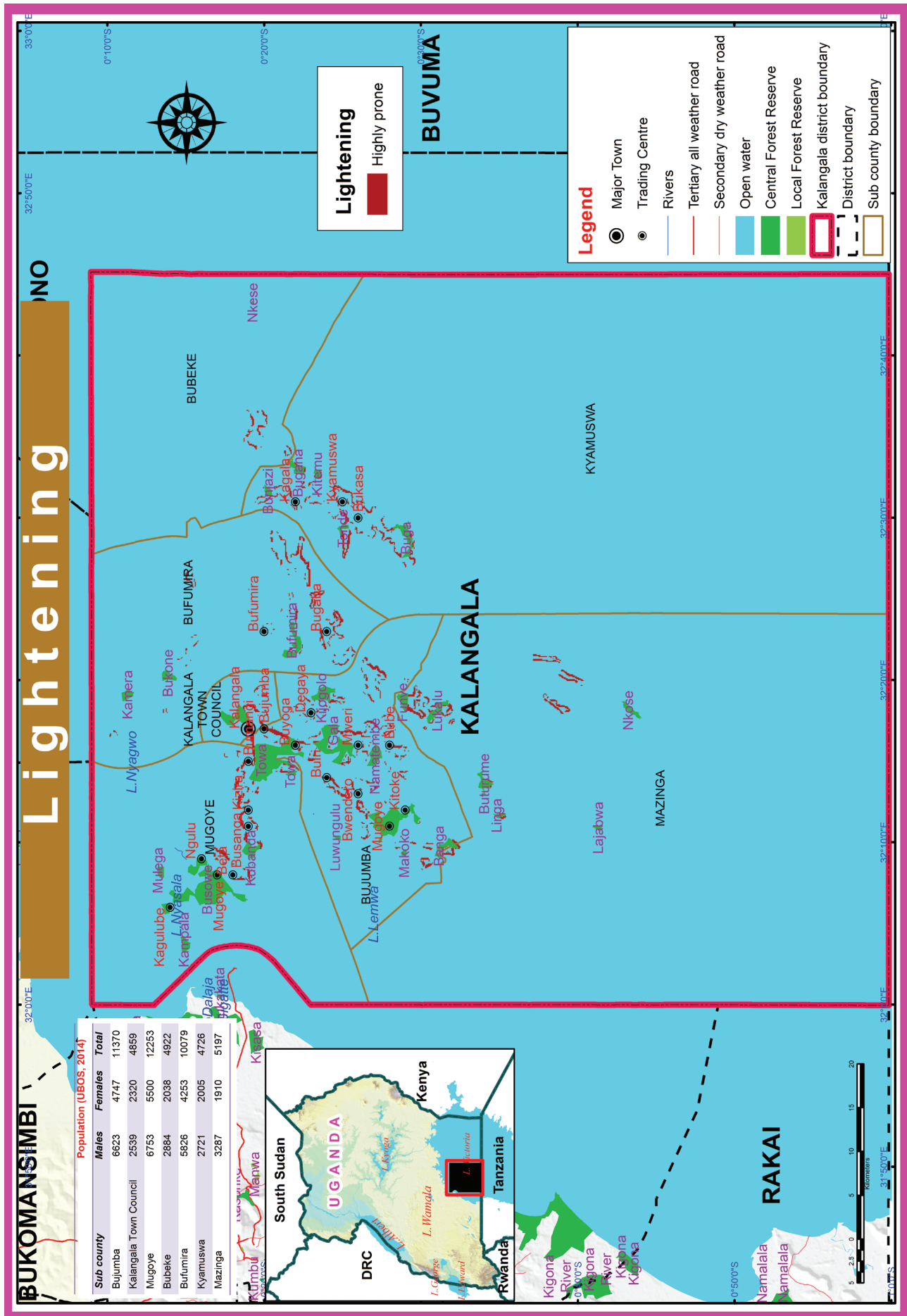


Figure 7: Lightning prone areas

3.2.8 Drug abuse

The type of climate has an impact on the behavior of people. The majority of the people on the island are fish mongers while fewer are engaged in small and large scale farming. The fishermen perceive taking drugs such as marijuana, tobacco etc makes them stronger to withstand the strong winds on the lake and also harvest fish for a longer period of time.

The causes of this perception are attributed to poverty, ignorance and culture. The abuse is associated with death, promiscuity, loss of property, family conflicts and imprisonment. The inadequate enforcement mechanisms of fishing activities on Lake Victoria have exposed the communities to drug abuse vulnerability. The resultant effects include loss of income, increase in criminal cases, illness and loss of revenue among others. Incidences related to drug abuse have been reported throughout the District.

3.2.9 Wetland degradation

The wetland types found in Kalangala District are characterized as papyrus, palms and thickets, bushlands, grasslands, plantation 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, drought, reduced soil fertility, political interference, soil erosion, drought, poor farming methods, assumed ownership, change in land use, ignorance, resource conflicts, brick making, sand mining, seasonal fires, over harvesting and invasion by invasive species.

The degradation is associated with silting of water bodies, reducing soil nutrients, lowering of 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, drought, increased incidences of pests and diseases, loss of property, livestock and human life. The effects have been reported in the Sub-counties of Bujjumba, Mugoye and Bufumira (figure 8).

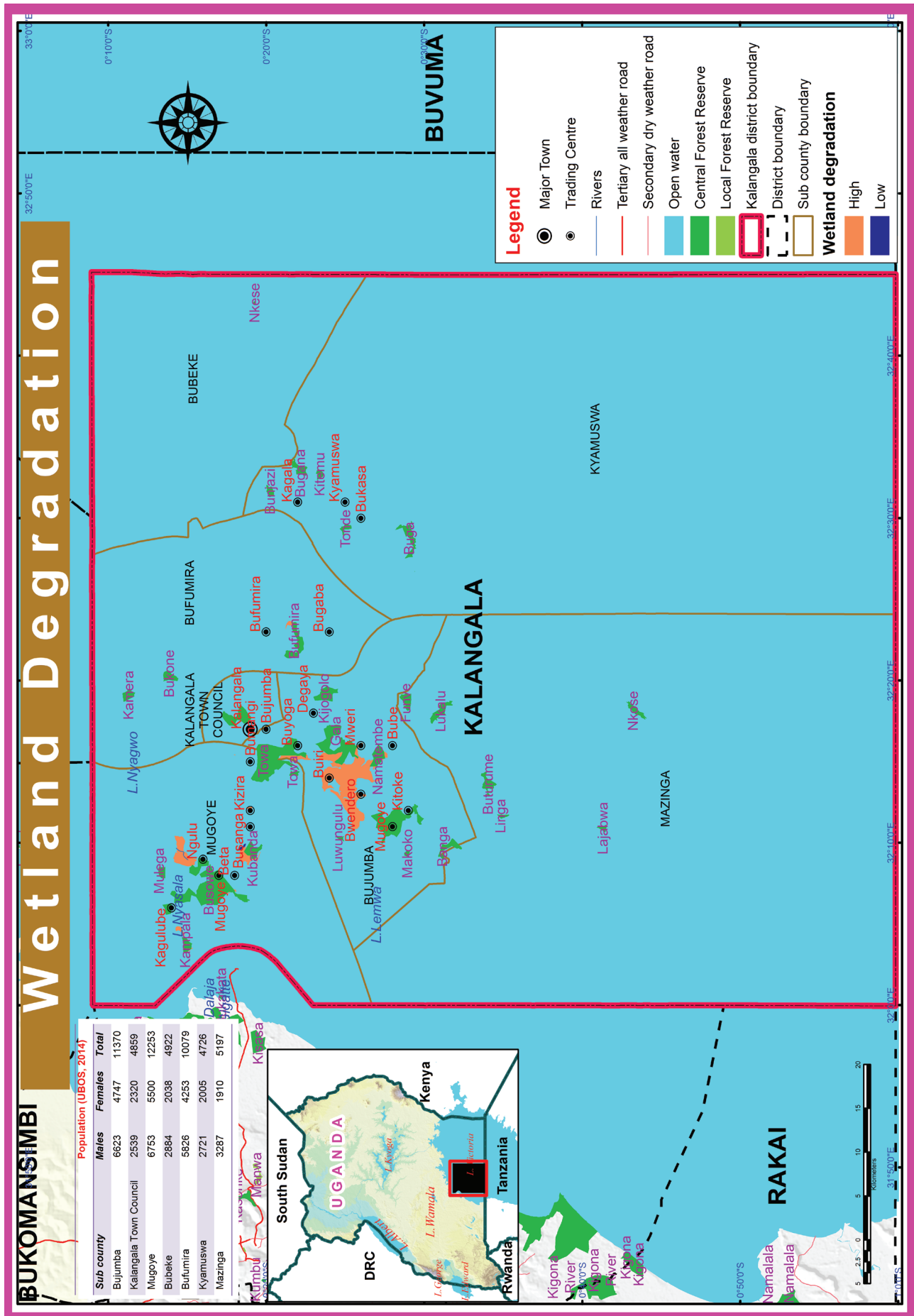


Figure 8: Levels of wetland degradation

3.2.10 Human and wildlife conflicts

The human and wildlife conflicts are apparently on the increase primarily because of changes in weather patterns and increase in demand for land and vegetation related products. For example the high demand for timber has deprived wild animals of their habitats therefore making them to invade farmlands and people's homes in search of food and shelter.

The attacks area characterized by crop destruction, increase in disease incidences, death of wild animals (hippos, crocodile, monkeys etc) and loss of human life. The conflicts are more common during the fishing seasons and crop harvesting period of each year. The factors that contribute to the vulnerability of these conflicts include the type of crops grown, wetland degradation, deforestation, unclear boundaries of protected areas and population pressure.

The encounters have resulted into the loss of household income, reduction in tourism revenue, migration, illness, low crop yields and modification of local climate. The fatalities have been highly reported in Bufumira, Mugoye, and Bujumbura Sub-counties (figure 9).

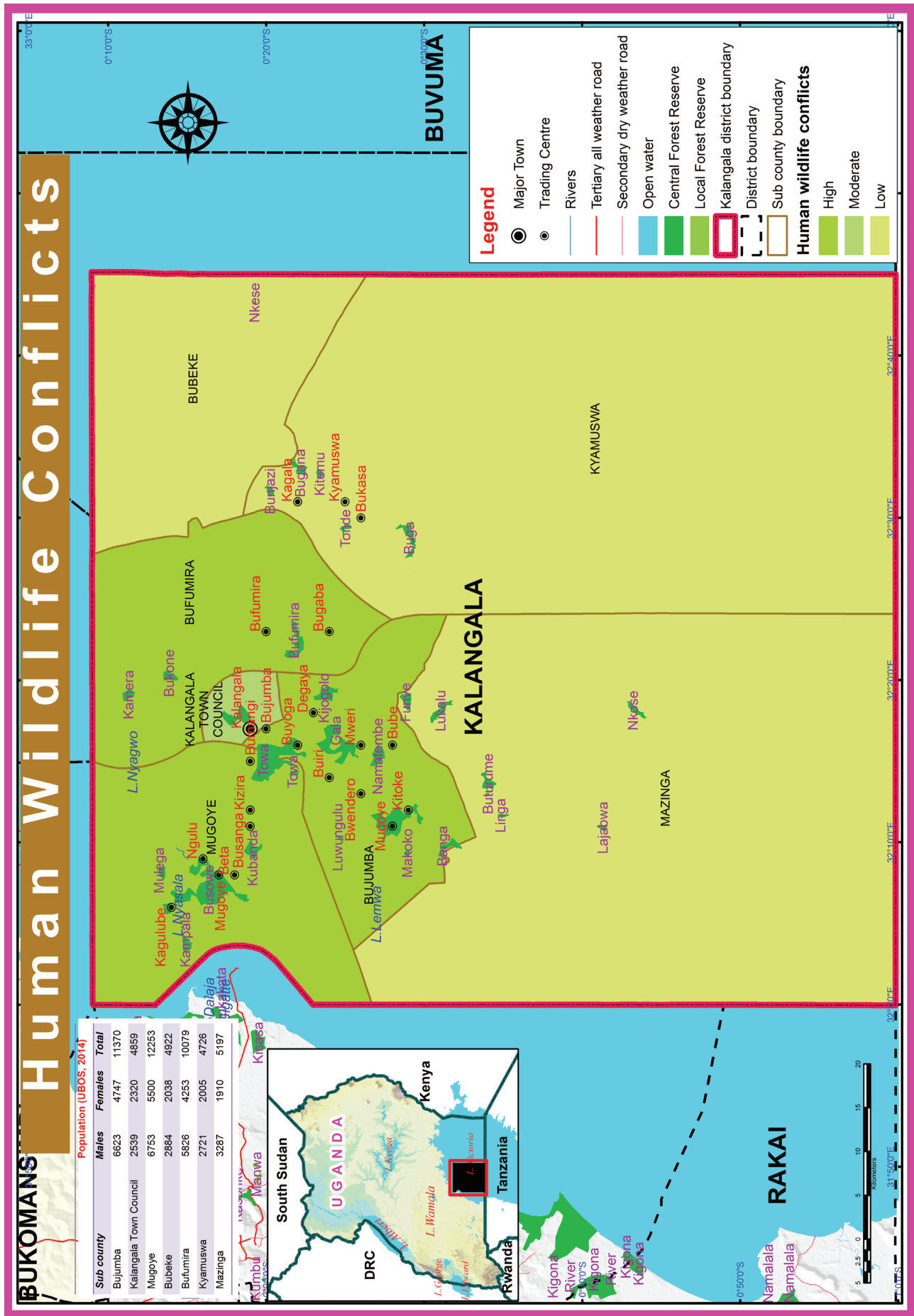


Figure 9: Levels of human wildlife conflicts

3.2.11 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 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 Lantana Camara, among others. On water, the species are spread by strong winds, boat movements, wetland degradation, fishing activities, high seed multiplication and siltation among others. Some of the notable species include water hyacinth and green algae



Plate 5: Water hyacinth at Mwena landing site, Kalangala Town Council

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 alien species is common in all the Sub-counties (figure 10).

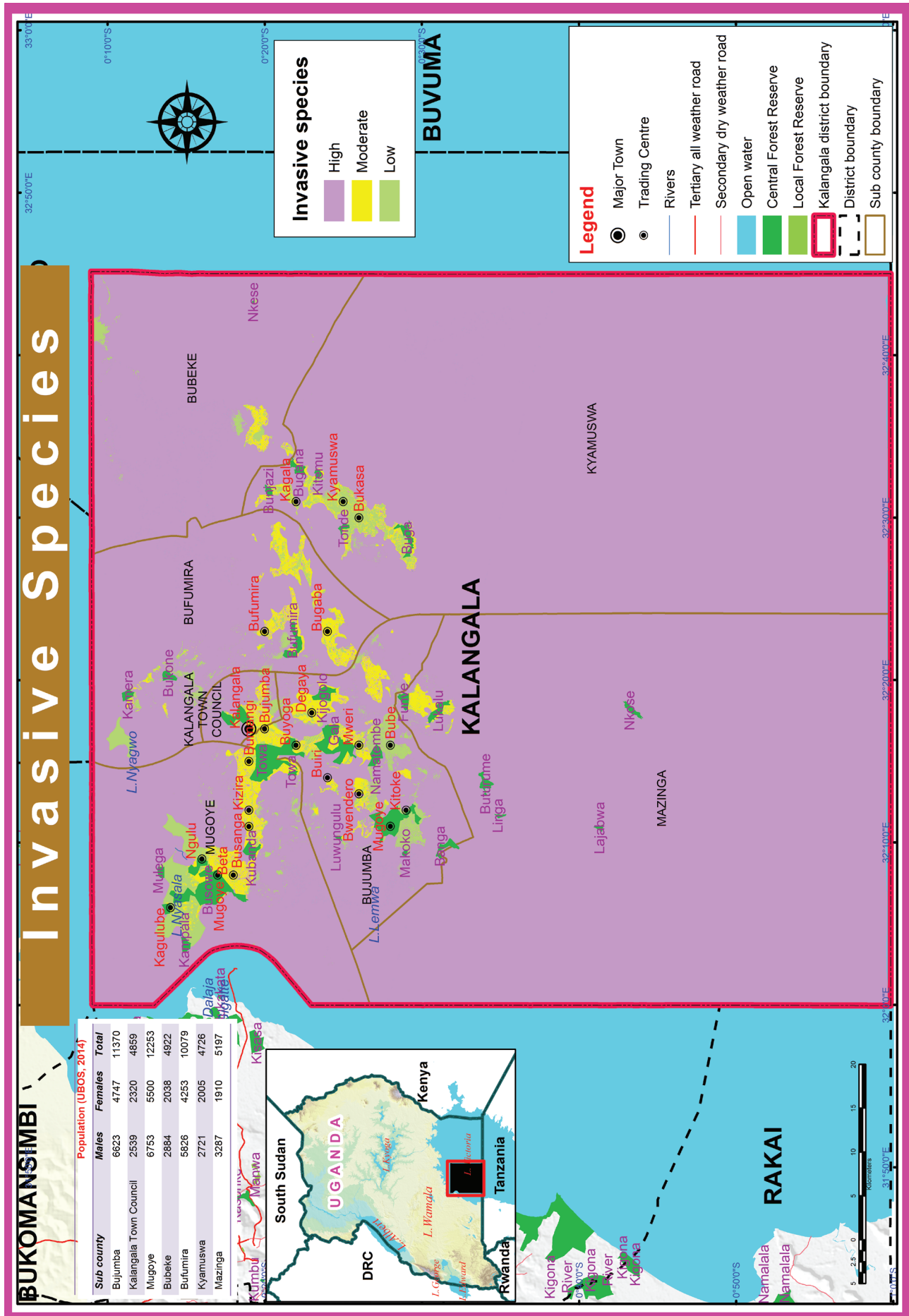


Figure 10: Distribution of invasive species

3.2.12 Man-made fires

The district experiences a series of man-made fires that ravage people's lives and property. The disastrous fires are caused with the aim to cause damage and losses to the offended. The fires are largely caused due to hatred, negligence, electric short circuits and indiscipline. The fires in some cases are triggered by storing inflammable liquids in the houses and unplanned settlements. The scenes are characterized by loss of property, lives and air pollution.

The eventualities are more common in the municipality (e.g. schools, markets, houses, factories etc) than the outskirt areas especially during the dry season. The communities are vulnerable to the fires primarily because of lack of early warning systems, delayed responses by fire brigades, woody building materials, congestion and creation of slums. As a result, the fires have caused loss of income, reduction in municipality revenue and displacement of people among others.

Incidences of man-made fires have are common in all Sub-counties.

3.2.13 Land conflicts

Land conflicts have now become rampant in the District for the last 27 years. The conflicts are between the people and government, communities and cultural institutions and vice versa.

The land conflicts in the District are fuelled by unclear ownership of wetlands, population pressure, customary land ownership, overlapping land policies, 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. Furthermore, 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 eventualities are widely spread in all sub counties (figure 11).

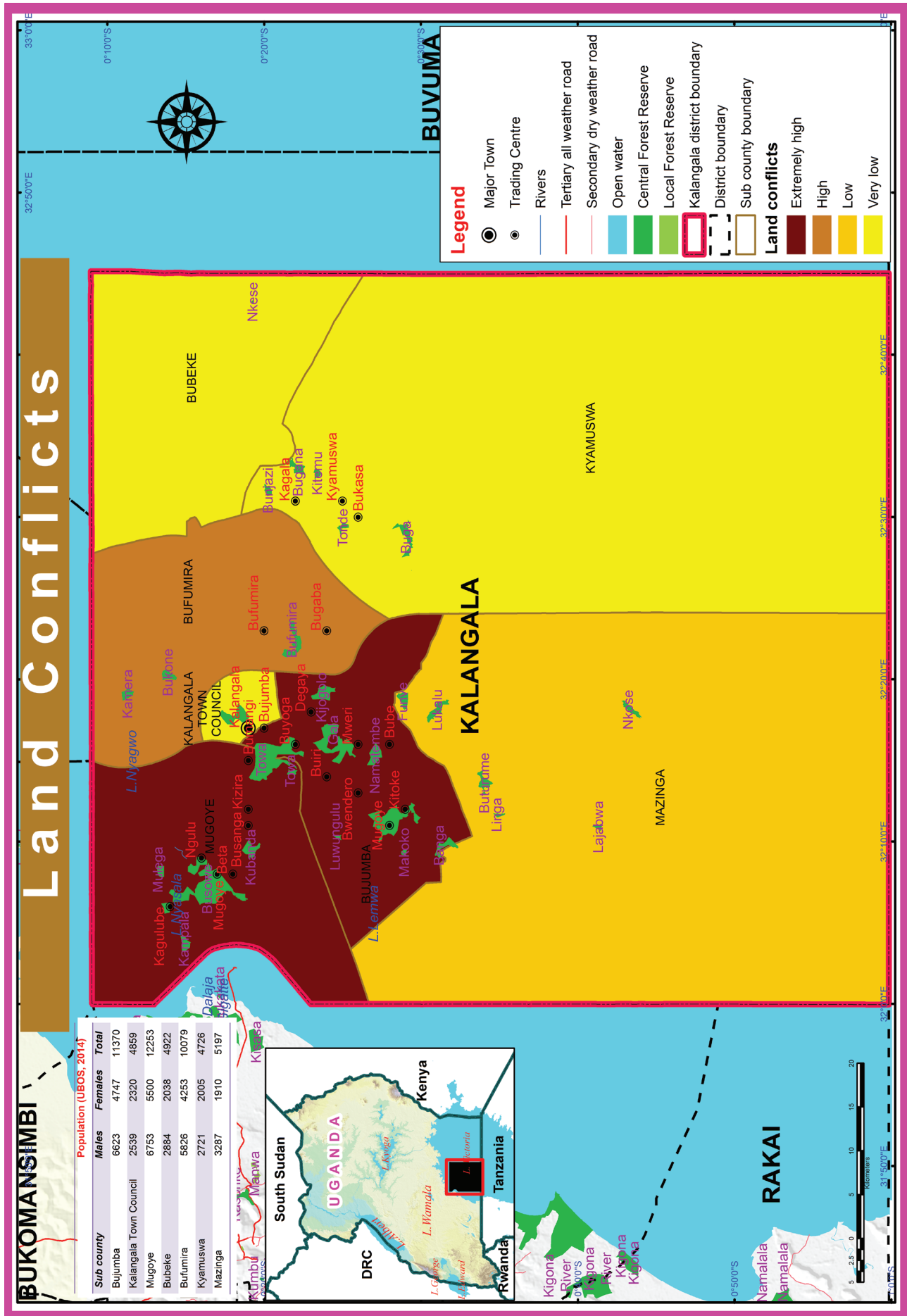


Figure 11: Severity of land conflicts

3.2.14 Hailstorms

The occurrence and severity of hailstorms are a frequent phenomenon in Kalangala District. The hailstones fall during heavy downpour and these take a period of about 10-30minutes. The frequency and distribution of hailstorms is primarily caused by changes in the onset of rainy seasons especially after slight 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 down to acquire timber for brick making and construction.

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 include destruction of property, low household income levels, loss of District revenue, food shortages, loss of human life and livestock. The episodes affect more Mugoye, Bujjumba and Kalangala Town Council (figure 12).

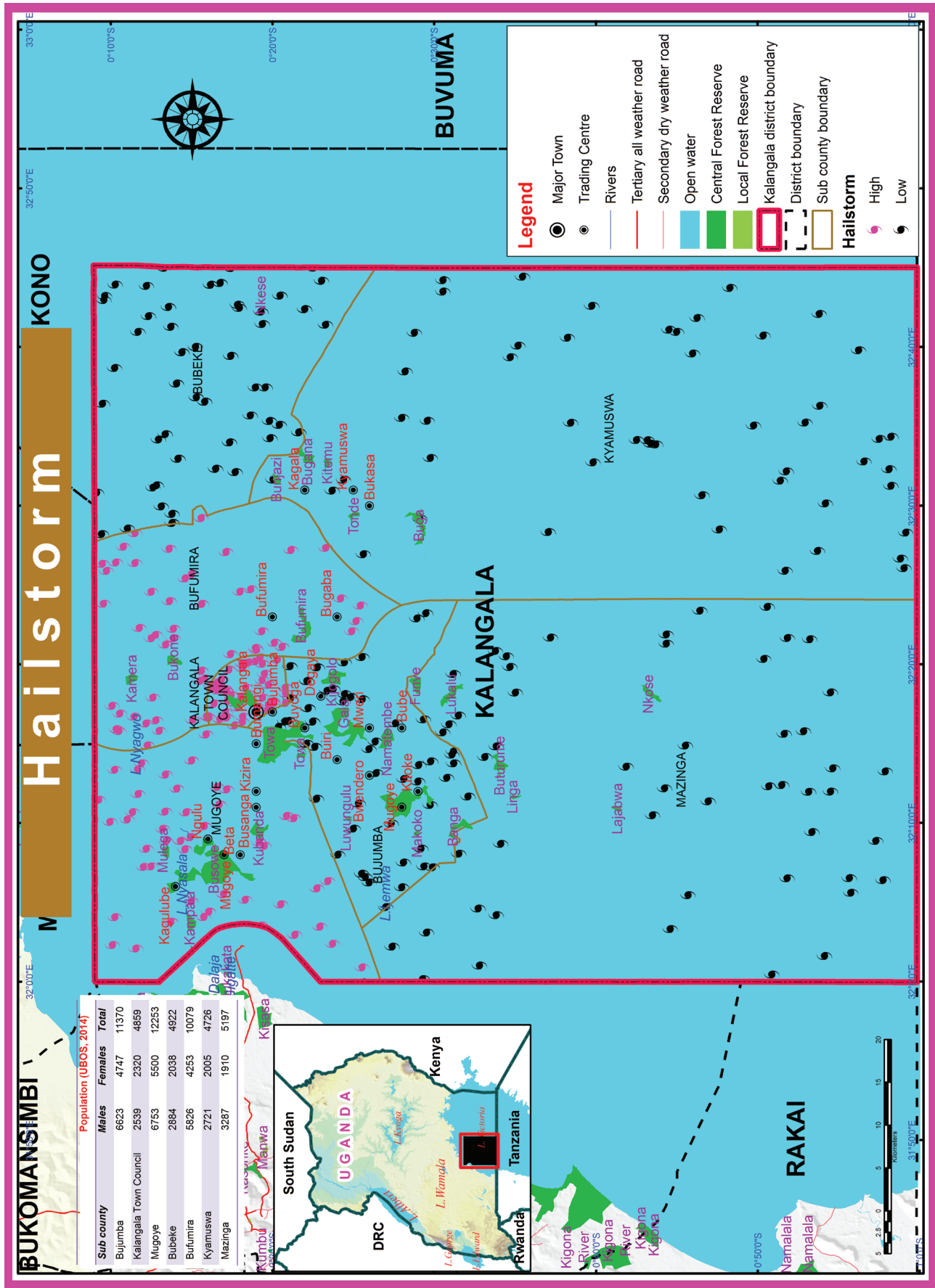


Figure 12: Hailstorms levels



3.2.15 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 5: Multi-Hazard adaptation responses

No	Multi-Hazards	Adaptation Responses	Recommendations
1	Strong winds	<ul style="list-style-type: none"> • Restricted movements • Tree planting • Wearing of life jackets • Use of sea worthy boats • Restricted fishing • Sensitization during peak periods 	<ul style="list-style-type: none"> • Supply of life jackets • Promote better quality branded sea boats • Restrict movement and fishing during peak seasons • More sensitization during peak periods
2	Water accidents	<ul style="list-style-type: none"> • Sensitization on wearing life jackets • Law enforcement by marine officers • Avoiding shallow water infested by crocodiles and hippopotamus 	<ul style="list-style-type: none"> • Training and licensing boatswains • Subsidization of life jackets • Promote better quality branded sea boats • Law enforcement by the marines • Marking and installing lights on rocky hot spots • Involving UWA to trap the wild life • Strengthening, regulating and control of water vessels • Use of anchors
3	Pests/parasites and Diseases	<ul style="list-style-type: none"> • Planting clean seeds and seedlings • Spraying • Vaccination • Treatment • Planting resistant species • Sensitization 	<ul style="list-style-type: none"> • Provision of pesticides and herbicides to farmers at village level • Provision of resistant varieties • Increase sensitization on control measures • More funds in tsetse fly controls • More funds to the natural resource department • Regulation of firm inputs • Establishing demonstration gardens • Recruitment of extension workers
4	Soil erosion	<ul style="list-style-type: none"> • Tree planting • Agro forestry • Sensitization and training • Growing of cover crops • Mulching • Contour ploughing 	<ul style="list-style-type: none"> • Sensitization of the farmers on proper farming methods • Encourage tree planting • Regulations on soil erosion • Training farmers on soil and water conservation
5	Deforestation	<ul style="list-style-type: none"> • Agro forestry • Tree planting • Bi-law enforcement • Sensitization on the dangers of deforestation • Use of renewable energy • Use of energy saving stoves • Collaborative forest management 	<ul style="list-style-type: none"> • Subsidize alternative sources of energy • More agro forestry and boundary tree planting • Promote use of renewable energy • Resettling foreigners who encroach on forests for settlements • Sensitizations and training • Funding the natural resource department • Promoting alternative building materials • Promoting eco-tourism
6	Lightning	<ul style="list-style-type: none"> • Installation of lightning arrestors • Tree planting • Sensitization 	<ul style="list-style-type: none"> • Design thunder bolt structures • Subsidization of lightning arrestors • More relief in the equatorial regions which have the highest potential to lightning due to high electrical charge
7	Drug abuse	<ul style="list-style-type: none"> • Sensitization • Law enforcement 	<ul style="list-style-type: none"> • Sensitization • Law enforcement



No	Multi-Hazards	Adaptation Responses	Recommendations
8	Wetland degradation	<ul style="list-style-type: none"> • Sensitization and training • Eviction of encroachers • Demarcations • Strict monitoring • Collaborative forest and wildlife management • Forming local environment committees • Use of action plans 	<ul style="list-style-type: none"> • More funds to the natural resource department • Control the borders to limit migrants • Strict enforcement of wetland laws • Gazetting and demarcation of wetlands • Evicting people from wetlands • Wetland recovery and restoration
9	Human wildlife Conflicts	<ul style="list-style-type: none"> • Hunting and trapping • Use of scare crows • Involving UWA 	<ul style="list-style-type: none"> • Use of motorized boats • More involvement by UWA • Avoiding shallow waters
10	Invasive species	<ul style="list-style-type: none"> • Uprooting , drying and processing into organic fertilizer • Feed for animals • Biological control using weevils • Raw materials for making crafts 	<ul style="list-style-type: none"> • Intensify the biological control method • More sensitization and training on the control • Provision of hazard control inputs
11	Man-made fires	<ul style="list-style-type: none"> • Sensitization on proper storage of petroleum products • Rural electrification • Use of renewable energy 	<ul style="list-style-type: none"> • Physical planning of structures • Encourage use of renewable energy • More sensitization
12	Land Conflicts	<ul style="list-style-type: none"> • Law courts like Clan, LC's, magistrate courts • Local government leasing land to people • Community policing • Sensitization on land registration • Land registration 	<ul style="list-style-type: none"> • Cancellation of land titles in wetlands • Subsidization of the land registration • Resettling people in the extremes of wetlands • Need for district surveyors • Issuing security of tenure • Increase the land fund • More sensitization on land registration
13	Hailstorms	<ul style="list-style-type: none"> • Physical relief • Provision of planting materials 	<ul style="list-style-type: none"> • Early warning systems

CHAPTER FOUR

4.1 Elements at Risk and Vulnerability assessment

4.1.1 Risk assessment

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

Table 6: Risk assessment of multi-hazards for Kalangala District

	PROBABILITY	SEVERITY OF IMPACTS	RELATIVE RISK	VULNERABLE SUB COUNTIES
	<i>Relative likelihood this will occur</i>	<i>Overall Impact (Average)</i>	<i>Probability x Impact Severity</i>	
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	
Drug abuse	4	4	16	Bujumba, Kalangala Town Council, Mugoye, Bubeke, Bufumira, Kyamuswa, Mazinga
Hail storms	2	3	6	Bujumba, Kalangala Town Council, Mugoye
Man-made fires	2	5	10	Bujumba, Kalangala Town Council, Mugoye, Bubeke, Bufumira, Kyamuswa, Mazinga
Lightning	4	4	16	Bujumba, Kalangala Town Council, Mugoye, Bubeke, Bufumira, Kyamuswa, Mazinga
Pests and diseases	5	5	25	Bujumba, Kalangala Town Council, Mugoye, Bubeke, Bufumira, Kyamuswa, Mazinga
Land conflicts	2	4	8	Bujumba, Kalangala Town Council, Mugoye, Bubeke, Bufumira, Kyamuswa, Mazinga
Strong winds	5	5	25	Bujumba, Kalangala Town Council, Mugoye, Bubeke, Bufumira, Kyamuswa, Mazinga
Invasive species	3	4	12	Bujumba, Kalangala Town Council, Mugoye, Bubeke, Bufumira, Kyamuswa, Mazinga
Water accidents	5	5	25	Bujumba, Kalangala Town Council, Mugoye, Bubeke, Bufumira, Kyamuswa, Mazinga
Soil erosion	4	5	20	Bujumba, Mugoye, Bubeke, Bufumira,
Human wild life conflicts	3	5	15	Bujumba, Mugoye, Bufumira, Kyamuswa
Wetland degradation	5	3	15	Bujumba, Mugoye, Bufumira
Deforestation	4	5	20	Bujumba, Kalangala Town Council, Mugoye, Bubeke, Bufumira, Kyamuswa, Mazinga

Key for Relative Risk

	High
	Moderate
	Low

4.1.2 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 7).

Table 7: 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	30	1986-2016	12	40
2	Land conflicts	18	1998-2016	12	66.6
3	Hailstorms	30	1986-2016	2	6.6
4	Man-made fires	30	1986-2016	12	40
5	Invasive species	26	1992-2016	12	46
6	Human wildlife conflicts	30	1986-2016	12	40
7	Wetland degradation	16	2000-2016	12	75
8	Soil erosion	30	1986-2016	2	6.6
9	Strong winds	30	1986-2016	12	40
10	Drug abuse	30	1986-2016	12	40
11	Lightning	30	1986-2016	2	6.6
12	Water accidents	30	1986-2016	12	40
13	Deforestation	30	1986-2016	12	40

4.1.3 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 Kalangala 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 in form of soil erosion; climatological or hydro-meteorological in the form of hailstorms, lightning, and strong winds; ecological or biological hazards in the form of pests, parasites and diseases, and invasive species; technological hazards in the form of water accidents, man made fires and environmental hazards in the form of wetland degradation, human wildlife conflicts deforestation and land conflicts predispose the community to high vulnerability state in Kalangala district (table 8).

Table 8: Components of vulnerability in Kalangala District

Vulnerability Components	Exposure	Elements at risk	Geographical Scale	Susceptibility	Geographical Scale	Resilience	Geographical Scale
Social components	Hazards	-	-	Potential impacts	-	Coping strategies	-
	Land conflicts	<ul style="list-style-type: none"> Human population Crops 	District	<ul style="list-style-type: none"> Loss of property Displacement of people Retards developments Loss of lives 	District	<ul style="list-style-type: none"> Sensitise people on land developments and land use Clearly demarcating and defining land owner ship Court Acquiring land titles and certificates of occupancy for Bibanja holders 	District
	Drug abuse	<ul style="list-style-type: none"> Human population 	District	<ul style="list-style-type: none"> Crime 	District	<ul style="list-style-type: none"> Sensitise people Law enforcement 	District
	Invasive species	<ul style="list-style-type: none"> Crops Livestock Human population 	District	<ul style="list-style-type: none"> Interfere with water transport. Loss crop yields Decline of fisheries resources Increase in disease out breaks e.g. bilharzia 	District	<ul style="list-style-type: none"> Destruction of weeds through uprooting, burning and slashing Biological control of water hyacinth 	District
	Soil erosion	<ul style="list-style-type: none"> Human population Crops 	Sub county	<ul style="list-style-type: none"> Stunted crop growth Reduced yields Poor crop production Siltation of water bodies Decreased biodiversity Decrease in soil fertility Reduced water quality Destruction of property 	Sub county	<ul style="list-style-type: none"> Tree planting Sensitization Soil and water conservation i.e. bridges, trenches, mulching 	District



	Pests and diseases	<ul style="list-style-type: none"> Human and livestock populations Crops 	District	<ul style="list-style-type: none"> Loss of livestock and humans Reduced livestock productivity Complete crop failure Stunted growth of crops Food insecurity 	District	<ul style="list-style-type: none"> Vaccination Spraying Sensitization Crop rotation Planting disease resistant crops Quarantine Mosquito nets Abandoning farms e.g. coffee farms Destruction of affected crops & animals Alternative income sources Crop rotation 	District
	Hail storms	<ul style="list-style-type: none"> Human and livestock populations Crops 	Sub county	<ul style="list-style-type: none"> Complete crop failure Stunted growth of crops Destruction of houses 	Sub county		District
	Wetland degradation	<ul style="list-style-type: none"> Lakes Crops Human population 	Sub county	<ul style="list-style-type: none"> Flooding Drying of water sources climatic change Diseases Loss of water quality and quantity Loss of grazing grounds Conflicts on water sources 	Sub county	<ul style="list-style-type: none"> Sensitisation Enforcement of wetland laws Demarcation of wetlands Prosecuting culprits to Court Local Wetland management committees Eviction 	District
	Water accidents	<ul style="list-style-type: none"> Human and livestock populations 	District	<ul style="list-style-type: none"> Human deaths Disabilities after injuries 	District	<ul style="list-style-type: none"> Regular guidance by marine officers Life and Reflector jackets Early warning systems Sea worthy boats Trained boats wain 	District



	Human wild life conflicts	<ul style="list-style-type: none"> • Crops • Human and livestock population 	Sub county	<ul style="list-style-type: none"> • Spread of diseases • Tension • Crop loss 	Sub county	<ul style="list-style-type: none"> • Trapping • Hunting • Gazetting natural resources • Involving UWA 	District
	Man made fires	<ul style="list-style-type: none"> • Human and livestock populations 	Sub county	<ul style="list-style-type: none"> • Conflicts and mistrust 	Sub county	<ul style="list-style-type: none"> • Install fire extinguishers • Awareness • Courts of law 	District
	Deforestation	<ul style="list-style-type: none"> • Human and livestock populations 	Sub county	<ul style="list-style-type: none"> • Loss of water quality and quantity • Loss of fuel wood • Loss of construction material (poles and timber) • Decreased rainfall • Loss of medicinal plants • Loss of food 	Sub county	<ul style="list-style-type: none"> • Tree planting • Use alternative sources of fuel like bio gas • Use of energy saving stoves • Awareness • Collaborative forest management • Resurveying of central forest reserves and boundary opening • Forest patrols • Licencing of timber dealers • Promotion of alternative income generating activities 	Sub county
	Lightning	<ul style="list-style-type: none"> • Human and livestock populations • Crops • Infrastructure including homes, schools and hospitals • Natural vegetation including trees 	Sub county	<ul style="list-style-type: none"> • Tension 	Sub county	<ul style="list-style-type: none"> • Install lightning conductors • Witch craft • Planting specific tree species • Awareness creation 	District



	Strong winds	<ul style="list-style-type: none"> Human and livestock populations Crops Infrastructure including homes, schools and hospitals Natural vegetation including trees 	Sub county	<ul style="list-style-type: none"> Increased travel time especially on lakes Accidents Increased plants, human and animal diseases Reduced production deaths 	District	<ul style="list-style-type: none"> Use of support on crops like bananas Tree planting (wind breaks) Observing fishing holidays(July & Aug) Constructing planned houses 	District
Economic component	Invasive species	<ul style="list-style-type: none"> Crops Livestock 	District	<ul style="list-style-type: none"> Low income in the long run as a result of poor yield ,low productivity and diseases High costs of removal Increased costs of production 	District	<ul style="list-style-type: none"> Destruction of weeds through uprooting, burning and slashing Biological control 	District
	Land conflicts	<ul style="list-style-type: none"> Human population 	Sub county	<ul style="list-style-type: none"> Retards personal and community development High court expenses 	Sub county	<ul style="list-style-type: none"> Sensitise people on land developments and land use Clearly demarcating and defining land owner ship Court Securing land tenure Promote use of lower council courts in customary land ownership cases 	District
	Drug abuse	<ul style="list-style-type: none"> Human population 	District	<ul style="list-style-type: none"> Loss of income 	District	<ul style="list-style-type: none"> Sensitise people 	District



	Water accidents	<ul style="list-style-type: none"> Human populations 	District	<ul style="list-style-type: none"> Loss of lives hence low incomes 	District	<ul style="list-style-type: none"> Regular guidance by marine officers Reflector jackets and life jackets Use of sea worthy boats Use well trained boatswain Marking accident hot spots Training rescue teams 	District
	Human wild life conflicts	<ul style="list-style-type: none"> Crops Human and livestock population 	Sub county	<ul style="list-style-type: none"> Loss of income 	Sub county	<ul style="list-style-type: none"> Trapping Hunting Gazetting natural resources Involving UWA Reduce use of wildlife habitats 	District
	Man made fires	<ul style="list-style-type: none"> Human and livestock populations 	Sub county	<ul style="list-style-type: none"> Loss of income Loss of government revenue Increased costs for maintenance 	Sub county	<ul style="list-style-type: none"> Install fire extinguishers Awareness 	District
	Deforestation	<ul style="list-style-type: none"> Human and livestock populations 	Sub county	<ul style="list-style-type: none"> High costs of water treatment High costs of forest produce 	Sub county	<ul style="list-style-type: none"> Tree planting Use alternative sources of fuel like bio gas Use of energy saving stoves Awareness Use alternative sources of construction materials 	Sub county



	Lightning	<ul style="list-style-type: none"> Human and livestock populations Crops Infrastructure including homes, schools and hospitals Natural vegetation including trees 	Sub county	<ul style="list-style-type: none"> Loss of income Loss of government revenue 	Sub county	<ul style="list-style-type: none"> Install lightning conductors Complete ban of sheep and millet growing in Sese Islands-Indigenous knowledge) Planting specific tree species 	District
	Strong winds	<ul style="list-style-type: none"> Human and livestock populations Crops Infrastructure including homes, schools and hospitals Natural vegetation including trees 	Sub county	<ul style="list-style-type: none"> Loss of income Loss of government revenue 	Sub county	<ul style="list-style-type: none"> Use of support on crops like bananas Tree planting Observing fishing holidays(July & Aug) Constructing planned houses 	District
Environmental component	Invasive species	<ul style="list-style-type: none"> Crops Human population Fisheries resources 	Sub county	<ul style="list-style-type: none"> Loss and stunted growth of crops Reduced fisheries resources 	Sub county	<ul style="list-style-type: none"> Destruction of weeds through uprooting, burning and slashing Biological control 	District
	Drug abuse	<ul style="list-style-type: none"> Human population 	District			<ul style="list-style-type: none"> Sensitise people 	District



	Land conflicts	<ul style="list-style-type: none"> • Crops • Human population 	District	<ul style="list-style-type: none"> • Destruction of crops 	District	<ul style="list-style-type: none"> • Sensitise people on land developments and land use • Clearly demarcating and defining land owner ship • Court 	District
	Wetland degradation	<ul style="list-style-type: none"> • Lakes • Crops • Human population 	District	<ul style="list-style-type: none"> • Loss of bio diversity • Drying of water resources • climate change 	District	<ul style="list-style-type: none"> • Sensitisation through radios • Enforcement of wetland laws • Demarcation of wetlands • Prosecuting culprits to Court • Wetland management committee • Eviction 	District
	Soil erosion	<ul style="list-style-type: none"> • Human population • Crops • Soil micro organisms 	Sub county	<ul style="list-style-type: none"> • Loss of vegetation cover including trees and crops • Land degradation (reduced soil fertility) • Loss of soil biodiversity • Destruction of infrastructure e.g roads • Siltation and sedimentation of water bodies 	Sub county	<ul style="list-style-type: none"> • Tree planting • Sensitization • Soil and water conservation i.e. bridges, trenches 	District
	Pests and diseases	<ul style="list-style-type: none"> • Human and livestock populations • Crops 	District	<ul style="list-style-type: none"> • Loss of crops and animals 	District	<ul style="list-style-type: none"> • Vaccination • Spraying • Sensitization • Crop rotation • Planting disease resistant crops • Quarantine 	District



	Hailstorms	<ul style="list-style-type: none"> Human and livestock populations Crops 	District	<ul style="list-style-type: none"> Loss of vegetation cover including trees and crops 	District	Early response system	District
	Human wild life conflicts	<ul style="list-style-type: none"> Crops Human and livestock population 	Sub county	<ul style="list-style-type: none"> Destruction of crops 	Sub county	<ul style="list-style-type: none"> Trapping Hunting Gazetting natural resources Involving UWA Awareness 	District
	Man made fires	<ul style="list-style-type: none"> Human and livestock populations 	Sub county	<ul style="list-style-type: none"> Pollution 	Sub county	<ul style="list-style-type: none"> Install fire extinguishers Awareness 	District
	Lightning	<ul style="list-style-type: none"> Human and livestock populations Crops Infrastructure including homes, schools and hospitals Natural vegetation including trees 	Sub county	<ul style="list-style-type: none"> Destroy natural vegetation and crops 	Sub county	<ul style="list-style-type: none"> Install lightning conductors Complete ban of sheep and millet growing in Sese Islands) Planting specific tree species 	District
	Strong winds	<ul style="list-style-type: none"> Human and livestock populations Crops Infrastructure including homes, schools and hospitals Natural vegetation including trees 	Sub county	<ul style="list-style-type: none"> Destruction of crops 	Sub county	<ul style="list-style-type: none"> Use of support on crops like bananas Tree planting Observing fishing holidays (July & Aug) Constructing planned houses 	District



	Deforestation	<ul style="list-style-type: none"> Human and livestock populations 	Sub county	<ul style="list-style-type: none"> Loss of biodiversity Loss of water catchment areas, Reduced carbon sink Reduction in wind breaks Increased runoff Siltation and sedimentation of water bodies 	Sub county	<ul style="list-style-type: none"> Tree planting Use alternative sources of fuel like bio gas Use of energy saving stoves Awareness Enforcing laws Collaborative forest management Alternative sources of construction materials 	Sub county
Physical components	Invasive species	<ul style="list-style-type: none"> Crops Livestock Fisheries resources Human population 	District	<ul style="list-style-type: none"> Low fish production Harbours snakes, snails and crocodiles Blocks transport 	District	<ul style="list-style-type: none"> Destruction of weeds through uprooting, burning and slashing Spraying Biological control 	District
	Drug abuse	<ul style="list-style-type: none"> Human population 	District	<ul style="list-style-type: none"> Human death Diseases Accidents 	District	<ul style="list-style-type: none"> Sensitise people Law enforcement 	District
	Pests and diseases	<ul style="list-style-type: none"> Human and livestock populations Crops 	District	<ul style="list-style-type: none"> Loss of livestock and humans Complete crop failure Stunted growth of crops 	District	<ul style="list-style-type: none"> Vaccination Spraying Sensitization Crop rotation Planting disease resistant crops Quarantine Mosquito nets Abandoning farms e.g. coffee farms Destruction of effected crops& animals Alternative income sources 	District

	Wetland degradation	<ul style="list-style-type: none"> Lakes Crops Human population Fisheries resources 	District	<ul style="list-style-type: none"> Drying of water sources Bio diversity destruction 	District	<ul style="list-style-type: none"> Sensitisation through radios Enforcement of wetland laws Demarcation of wetlands 	District
	Soil erosion	<ul style="list-style-type: none"> Human population Crops livestock 	District	<ul style="list-style-type: none"> Stunted crop growth Siltation of water bodies Decreased biodiversity Destruction of property and infrastructure 	District	<ul style="list-style-type: none"> Tree planting Sensitization Soil and water conservation i.e. bridges, trenches, mulching, diversion channels 	District
	Water accidents	<ul style="list-style-type: none"> Human and livestock populations 	District	<ul style="list-style-type: none"> Human deaths Loss of property 	District	<ul style="list-style-type: none"> Regular guidance by marine officers Construction of humps and road signs Reflector, life jackets, seat belts and helmets Spot checks for alcoholism Marking of accident hot spots Use of worthy boats and engines 	District
	Hailstorms	<ul style="list-style-type: none"> Human and livestock populations Crops 	District	<ul style="list-style-type: none"> Loss of livestock Deaths in humans 	District	<ul style="list-style-type: none"> Early warning systems 	District
	Land conflicts	<ul style="list-style-type: none"> Human population Crops Livestock 	Sub county	<ul style="list-style-type: none"> Loss of property Displacement of people Deaths 	Sub county	<ul style="list-style-type: none"> Sensitise people on land developments and land use Clearly surveying, demarcating and defining land owner ship Court Acquiring land titles 	District



	Human wild life conflicts	<ul style="list-style-type: none"> • Crops • Human and livestock population 	Sub county	<ul style="list-style-type: none"> • Death of people • Destruction of property • Spread of diseases • Tension 	Sub county	<ul style="list-style-type: none"> • Trapping • Hunting • Gazetting natural resources • Involving UWA • Collaborative wildlife management 	District
	Man made fires	<ul style="list-style-type: none"> • Human and livestock populations 	Sub county	<ul style="list-style-type: none"> • Destruction of crops • Loss of property • Deaths 	Sub county	<ul style="list-style-type: none"> • Install fire extinguishers • Awareness • 	District
	Lightning	<ul style="list-style-type: none"> • Human and livestock populations • Crops • Infrastructure including homes, schools and hospitals • Natural vegetation including trees 	Sub county	<ul style="list-style-type: none"> • Death and injury of human and livestock • Destroy properties 	Sub county	<ul style="list-style-type: none"> • Install lightning conductors • Indigenous knowledge (complete ban of sheep and millet growing in Sseese Islands) • Planting specific tree species 	District
	Strong winds	<ul style="list-style-type: none"> • Human and livestock populations • Crops • Infrastructure including homes, schools and hospitals • Natural vegetation including trees 	Sub county	<ul style="list-style-type: none"> • Destruction of crops and properties 	Sub county	<ul style="list-style-type: none"> • Use of support on crops like bananas • Tree planting • Observing fishing holidays(July & Aug) • Constructing planned houses 	District



Conclusion and recommendation

it was established that Kalangala District has over the last 20 years increasingly experienced multi-hazards including , invasive species, strong winds, pests and diseases for humans, crops and livestock, soil erosion, land conflicts, lightning, deforestation, burning, wetland degradation, water accidents and hailstorms putting livelihoods at increased risk. The limited adaptive capacity (and or/resilience) and high sensitivity of households and communities in Kalangala District increase their vulnerability to multi-hazard exposure necessitating urgent external support.

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

- i. Geomorphological and geological hazards including soil erosion
- ii. Climatological or hydro-meteorological including , hailstorms, lightning, and strong winds
- iii. Ecological or biological hazards including human, crop, animal parasites and diseases, human and wildlife conflicts and invasive species
- iv. Technological hazards including water accidents
- v. Environmental hazards including wetland degradation, deforestation, man-made fires and land conflicts
- vi. Pysco-social hazards including drug abuse

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

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 (clouds of disasters)
- v. Improve the communication channel between the Disaster Department and local communities
- vi. Establish a mechanism to minimise human-wildlife conflicts around Lake Victoria
- vii. Compensate individual victims of wildlife attacks
- viii. Office of the prime minister should decentralise their activities at the District level

- ix. OPM should strengthen the District Disaster Management Committees by developing guidelines and trainings
- x. Establishment of disaster contingency fund at the district levels
- xi. Fund and equip recruited extension workers
- xii. Establish a fund aimed at Disaster Preparedness and Management at District levels
- xiii. Increase funding and staff to monitor wetland degradation and non-genuine agro-inputs
- xiv. Support establishment of a disaster risk early warning system at community level
- xv. Provide support in form of free seedlings to promote afforestation and reforestation programmes



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