THE REPUBLIC OF UGANDA

Kiboga 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 Ogwang Jimmy, Disaster Preparedness 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 Database programmer.

My appreciation also goes to Kiboga District Team.
The entire body of stakeholders who in one way or another yielded valuable ideas and time to support the completion of this exercise.

Hon. Hilary O. Onek
Minister for Relief, Disaster Preparedness and Refugees

EXECUTIVE SUMMARY

The multi-hazard vulnerability profile 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, floods, landslides, human, animal and crop diseases, pests, wildlife animal attacks, earthquakes, fires and conflicts among others. 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 Environment Officer, District Production Officer and District Agricultural Officer while at Sub-county level key informants included: Sub-county and parish chiefs and Community Development Officers.

FGDs were carried out in four purposively selected sub-counties that were ranked with the highest vulnerability. FGDs comprising of an average of 12 respondents (crop farmers, local leaders and cattle keepers) were conducted at Dwaniro, Lwamata and Bukomero Sub-counties and Kiboga Town council. 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 hazards prone areas on the Hazard base maps. This was done during the FGDs and participants were requested through a participatory process to develop a community hazard profile map.

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 Mbarara 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 Kiboga 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 Kiboga district has over the past two decades increasingly experienced hazards including; landslides, 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, water accidents and land conflicts putting livelihoods at increased risk. Drought and floods were identified as most serious problems in Kiboga district with almost all sub-counties being vulnerable to the hazards. This could be due to its location in the cattle corridor which is associated with prominent dry spells and droughts, but also the area is relatively flat with slope percentage rise (0-2) which is 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 relevant Ministries coordinated by OPM 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 provide staff with necessary logistics.

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

DEFINITION OF KEY TERMS

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

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

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

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

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

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

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

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

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

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

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

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

INTRODUCTION

1.1 Background

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 deaths, property damage and losses of livelihood. With the increasing negative effects of hazards that accompany population growth, development and climate change, public awareness and pro-active engagement of the whole spectrum of stakeholders in disaster risk reduction, are becoming critical.

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

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

This final draft report details methodological approach for HRV profiling and mapping for Kiboga District in Central Uganda.

1.2 Objectives of the study

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

1.2.1 Main objective

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

1.2.3 Specific Objectives

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

  i. Collect and analyze field data generated using GIS in close collaboration and coordination with OPM.

  ii. Develop District specific multi-hazard risk and Vulnerability profile using a standard methodology.

iii. Preserve the spatial data to enable use of the maps for future information.

iv. Produce age and sex disaggregated data in the HRV maps.

1.3 Scope of Work

Through UNDP's Project: *"Strengthening Capacities for Disaster Risk Management and Resilience Building"* the scope of work entailed following:

i. Collection of field data using GIS in close collaboration and coordination with OPM in Kiboga district and quantify them through a participatory approach on a scale of "not reported/ not prone", "low", "medium" and "high".

ii. Analysis of field data and review the quality of each hazard map which should be accompanied by a narrative that lists relevant events of their occurrence. Implications of hazards in terms of their effects on stakeholders with the vulnerability analysis summarizing the distribution of hazards in the district and exposure to multi-hazards in sub-counties.

iii. Compilation of the entire district multi-hazard, risk and vulnerability HRV Profiles in the time frame provided.

iv. Generating complete HRV profiles and maps and developing a database for all the GIS data showing disaggregated hazard risk and vulnerability profiles to OPM and UNDP.

1.4 Justification

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

1.5 Structure of the Report

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

OVERVIEW OF KIBOGA DISTRICT

2.1 Location

Kiboga District is located between coordinates: 0° 55' 03.0" N and 31° 45' 36.0" E in the Central region of Uganda and was formed in 1991. Kiboga District is bordered by Nakaseke District to the Northeast and East, Mityana District to the South, Mubende District to the Southeast, and Kyankwanzi District to the Northwest. The district has 6 sub-counties and 2 town councils. These include: Bukomero, Kibiga, Dwaniro, Kapeke, Muwanga, and Lwamata sub-counties and Bukomero and Kiboga Town Councils (Figure 1).
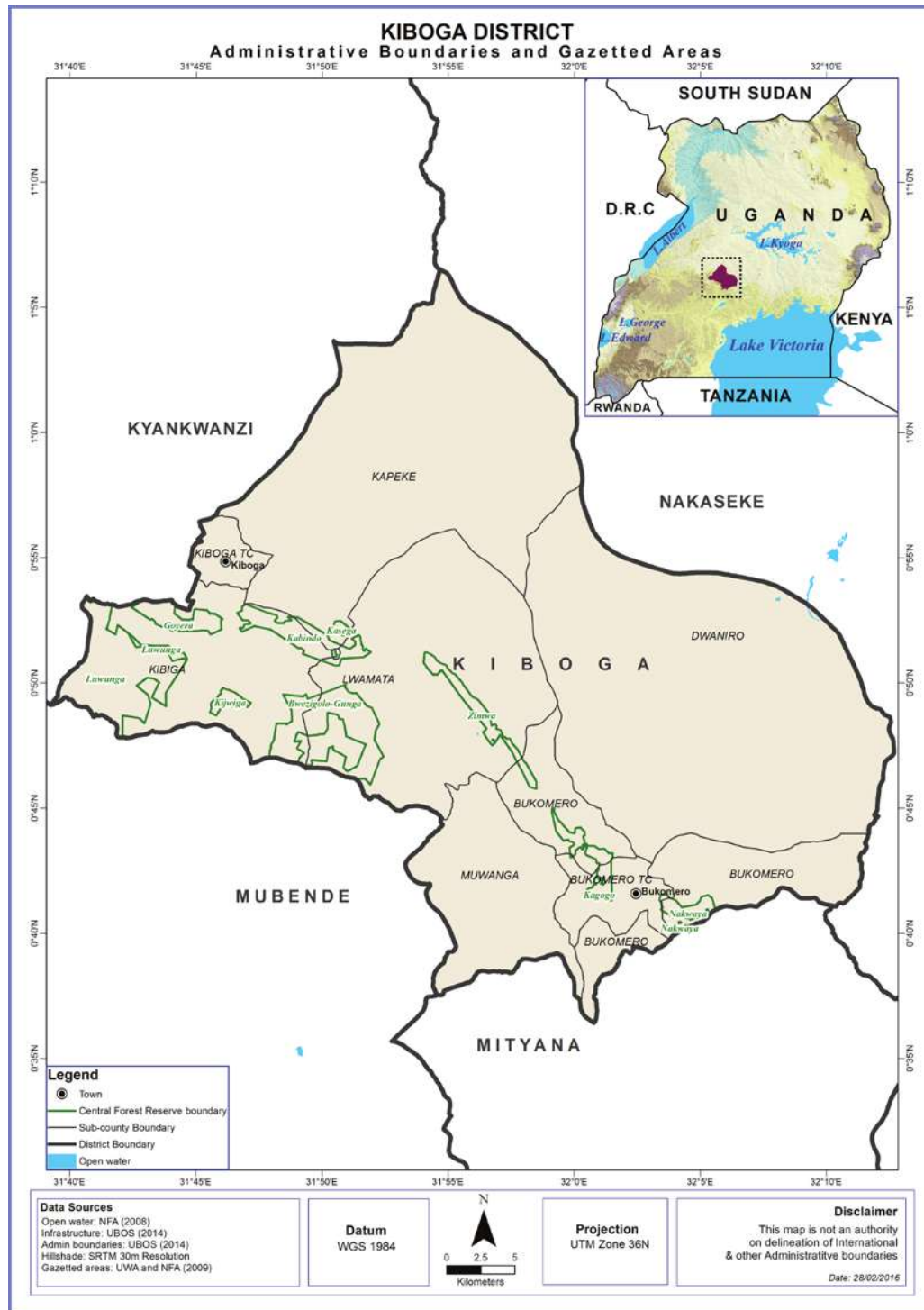
Figure 1: Administrative Boundaries and Gazetted areas, Kiboga District

2.1.1 Geomorphology

The district has highland areas which are deeply incised with steep slopes. They form prominent ridges which eventually merge into shallow depressions. Therefore, the district landscape can be grouped into two distinctive topographic zones namely: Undulating topography (flat - bottomed valleys) and dissected plateaux, characterized by permanent/seasonal wet grasslands, swamps, bushland, swamp forests and other areas with impact drainage and papyrus together with reeds and sedges (Figure 2).
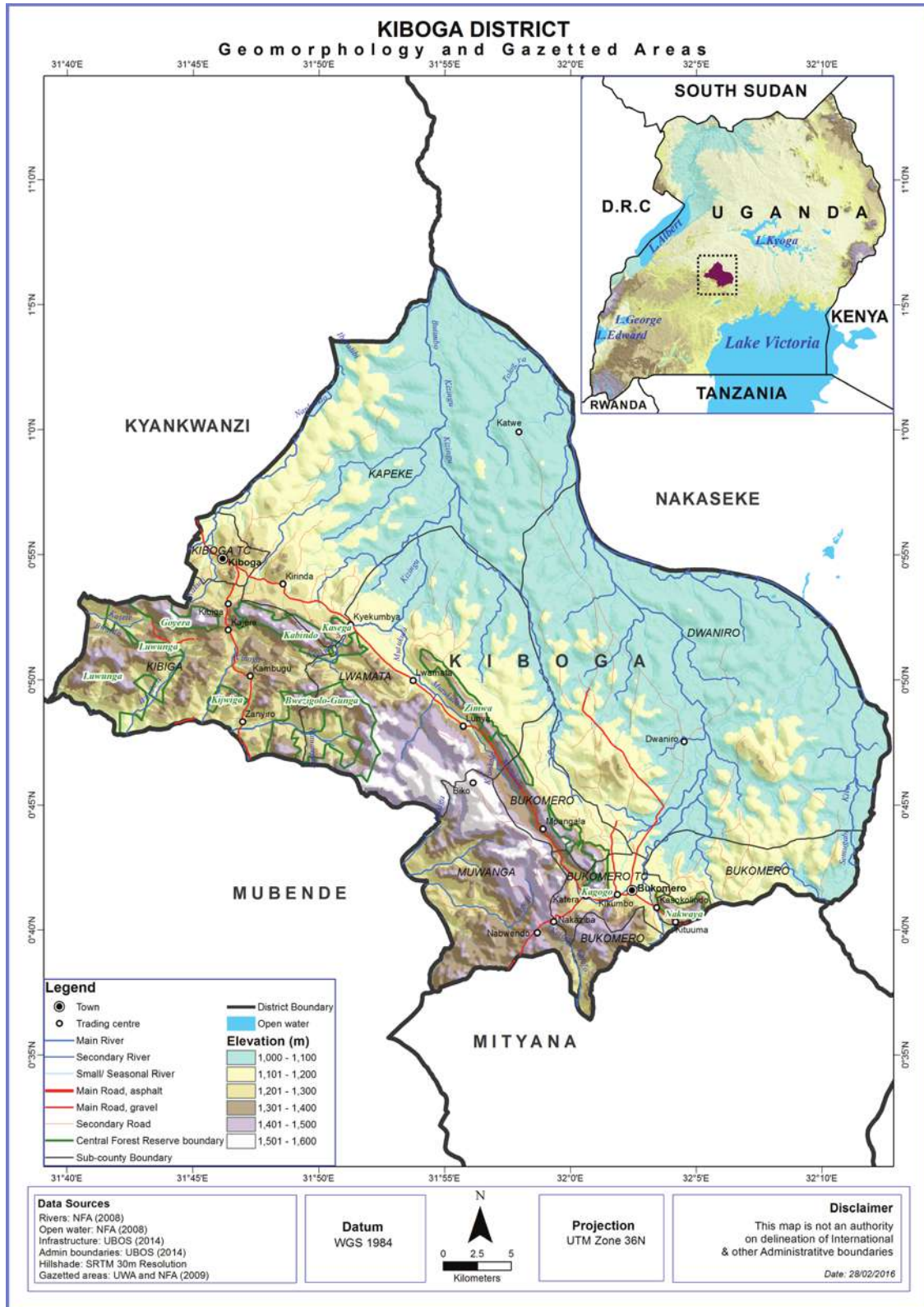
Figure 2: Geomorphology, Kiboga District

2.1.2 Geology

Kiboga soils are categorised according to their genetic systems forming three categories, i.e. ferralsols, hydromorphic and lithosols soils. Kiboga district is mainly underlain by ferrasols, usually termed as Fellallitic soils. They are deep soils with little differentiation in clearly defined horizons with fine granular structures, often molded into large coherent clods which are friable and porous. These soils are dominant in Kiboga Town Council. Hydromorphic soils occupy Lwamata, Bukomero Town Council and Bukomero sub-county and these mainly constitute undifferentiated river aluminium dominated by grey and yellow sandy clays. Lithosols exist in the parts of Kibiga and Muwanga sub-county and are generally weakly developed, soils without genetic horizons. These soils are stony and underlain by a solid genetic rock. They are particularly young products of recent weathering (Figure 3).
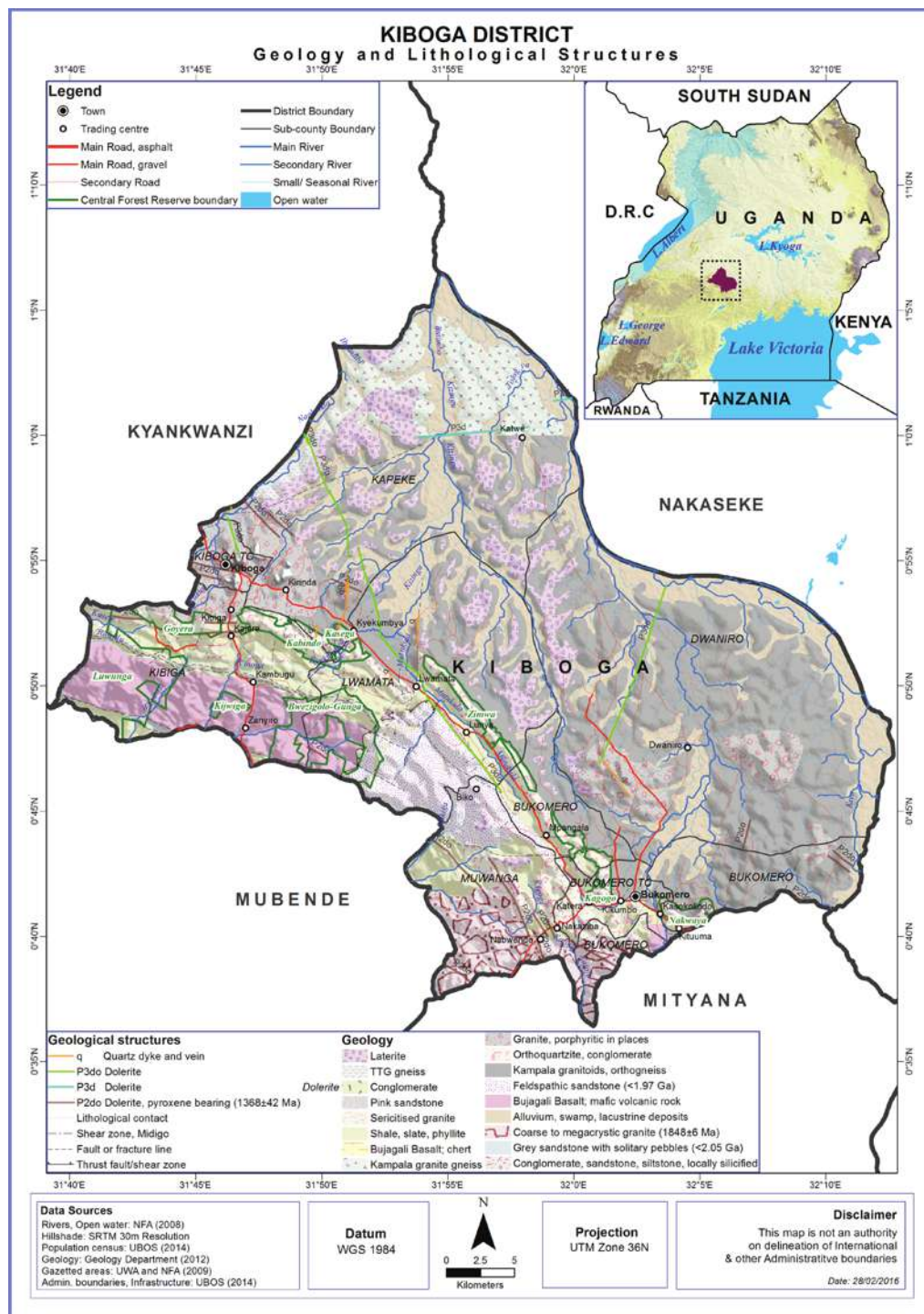
Figure 3: Geology and Lithological Structures, Kiboga District

2.1.3 Vegetation and Land use Stratification

Kiboga District is fairly uniform in accordance to the ecosystems that characterize the area in relation to climate, altitude and influence of settlements. The district is covered by thicket savannah communities, with communities on sites with impending drainage as: bush land, woodland and swamps (Figure 4).
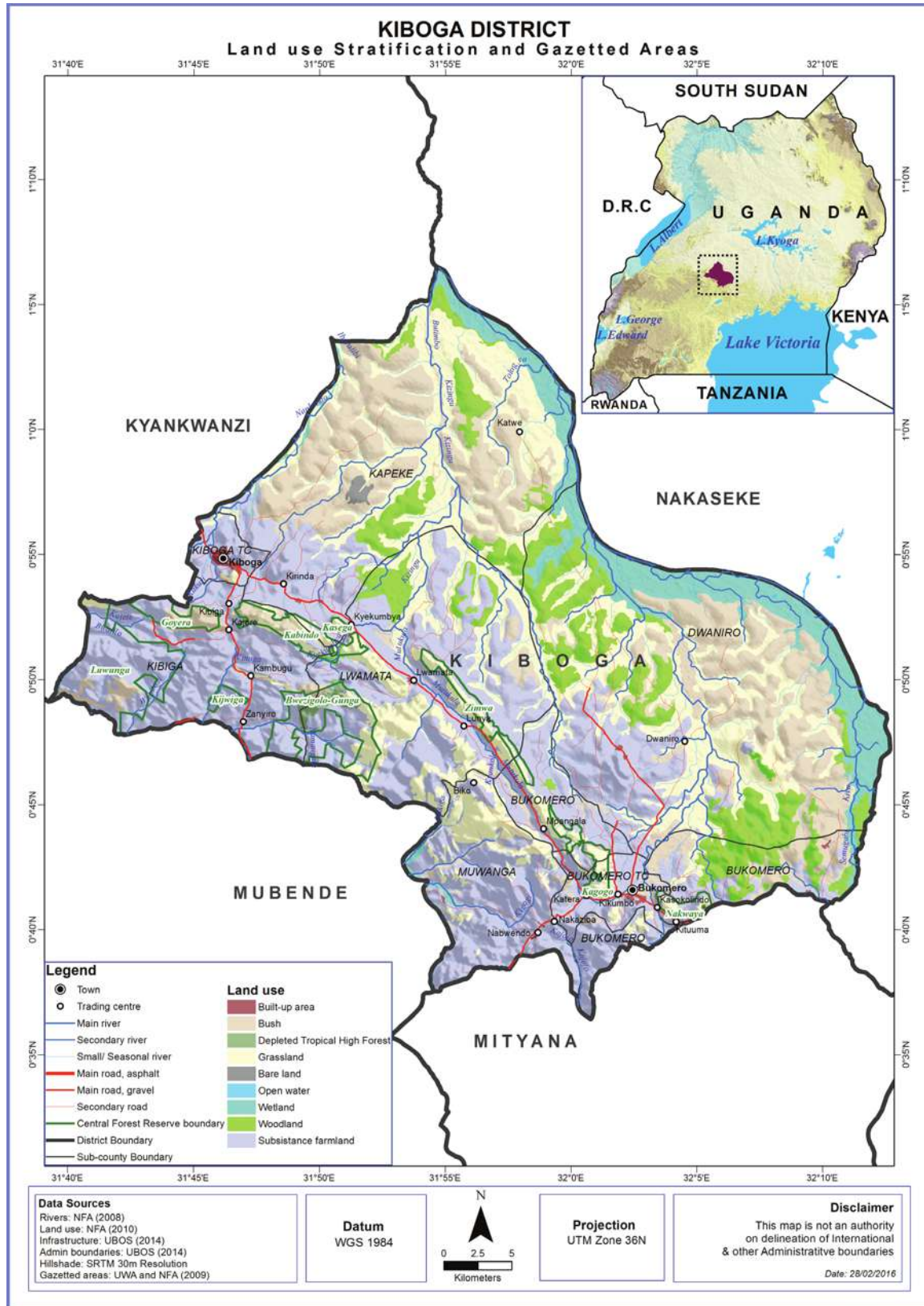
Figure 4: Land use Stratification, Kiboga District

2.1.4 Temperature and Humidity

The District generally records mean monthly maximum temperatures between 25°C and 29°C.

2.1.5 Wind

The long-term wind speed records from the East African Meteorological Department (1975) indicate average annual wind speeds of 3 knots and 5 knots at 0600 hours and 1200 hours, for Kiboga. The wind speed values indicated, therefore, represent conditions of moderate to strong or turbulent conditions. The average number of calms experienced in the area, are indicated to be experienced for 99days at 0600 hours, and 27 days at 1200 hours, respectively, at Kiboga. The general conclusion from these climatic figures is that for most of the year, Kiboga district experiences moderate to strong and gusty winds, increasing in the afternoon.

2.1.6 Rainfall

Kiboga District receives a total rainfall of about 1190 to 1244 mm per annum. Wetter months are April-May and September-October, with two dry spells in June-July and December-January (Figure 5).
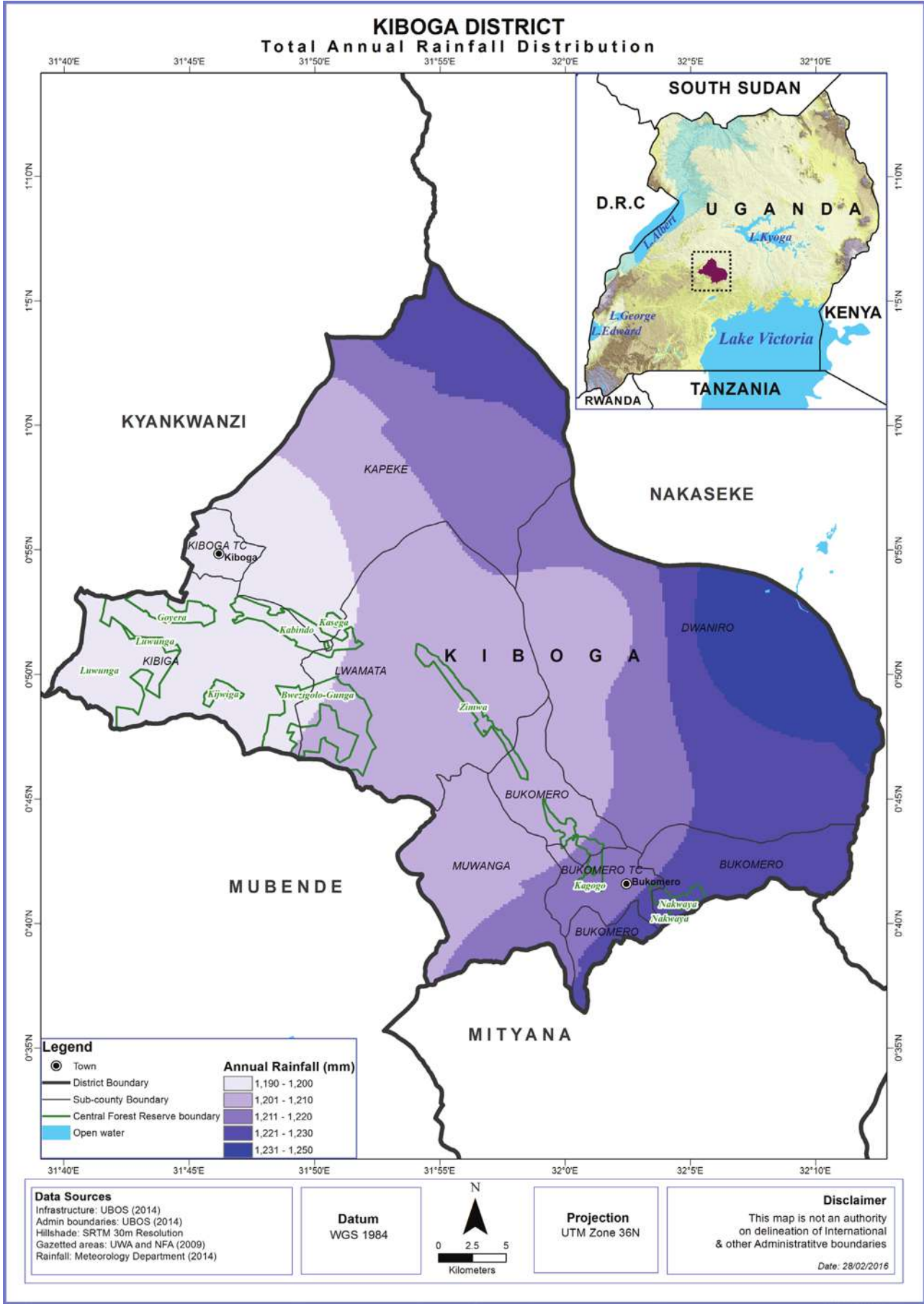
Figure 5: Total Annual Rainfall Distribution, Kiboga District

2.1.7 Hydrology

Kiboga district is mainly drained by rivers and streams which form its boundaries. These rivers are; River Mayanja to the East and Kitumbi River to the South West. The rivers flow towards the North-western direction from highlands in the Southern part of the district. The drainage forms a dendritic drainage pattern with numerous branching streams. The drainage has been impeded in some areas and as a result, seasonal and permanent swamps (wetlands) have formed along these major river systems. Seasonal wetlands are common during and shortly after rainy seasons.

The boundaries of Kiboga District are formed/marked by 2 major rivers. River Mayanja, a tributary of River Kafu forms the Eastern boundary of the District. The origin of River Mayanja is in Bukomero - Kateera area and is fed by numerous streams like Baralibi which flows from Kiboga to Mayanja, Other streams include: Nakayenga, Mutukula, Kawondogolo in Kiboga Town Council.

2.1.8 Population

According to the National Population and Housing Census (2014) results, Kiboga District had a total population 148,606 people. Results also showed that most of the people in Kiboga District reside in rural areas (115,344 (77.6%) compared to (33,262 (22.4%) who reside in urban centers. The gender distribution was reported to be males: 75,339 (50.7%) and females: 73,267 (49.3%). About 97.4% (144,770) of the population form the household population and only 2.6% (3,836) is Non-household. Lwamata sub-county had the highest population of 28,151 people while Dwaniro town council had the least population of 12,534 people (Figure 6). Table 1 shows the population distribution per sub-county for the different gender.

Table 1: Population Distribution in Kiboga District

	HOUSEHOLDS		POPULATION		
Sub-County	*Number*	*Average Size*	*Males*	*Females*	*Total*
Dwaniro	2412	4.8	6995	5539	12434
Kapeke	3252	4.7	8324	7610	15934
Kibiga	5975	4.3	12994	12742	25686
Kiboga Town Council	5249	3.6	9344	10237	19581
Lwamata	6605	4.2	14213	13938	28151
Muwanga	4067	4.4	9052	8931	17983
Bukomero	3391	4.4	7766	7290	15056
Bukomero Town Council	3157	4	6701	6980	13681

Source: UBOS Census 2014
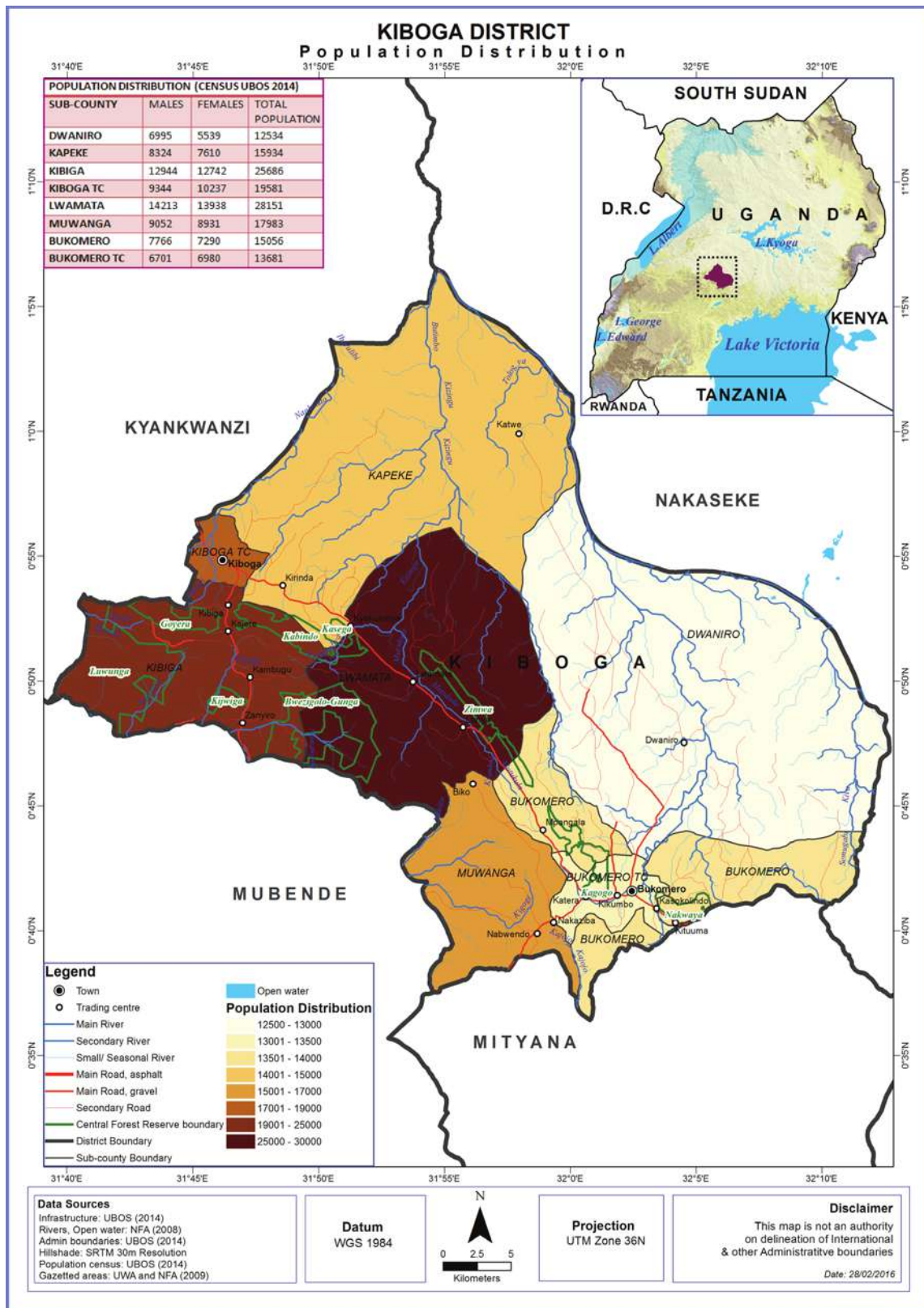
Figure 6: Population Distribution, Kiboga District

2.1.9 Economic activities

Majority of the population in Kiboga District engages in subsistence and commercial agriculture where cultivation of maize, cassava, beans, bananas, sweet potatoes and coffee is dominant. A considerable number of the population is also involved in livestock production especially rearing cattle, goats and pigs.

METHODOLOGY

3.1 Collection and analysis of field data using GIS

3.1.1 Preliminary spatial analysis

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

3.1.2 Stakeholder engagements

Stakeholder engagements were carried out in close collaboration with OPM's DRM team and the District Disaster Management focal persons with the aim of identifying the various hazards ranging from drought, floods, landslides, human, animal and crop diseases, pests, wildlife animal attacks, earthquakes, fires and conflicts among others. Stakeholder engagements were done through Focus Group Discussions (FGDs) and Key Informant Interviews guided by checklist tools (Appendix I). At District level, one Key Informant Interview comprising of three respondents (District Environment Officer, District Production Officer and District Agricultural Officer) was held at Kiboga District Headquarters (UTM Zone 36N: 364057E; 100765N). At Sub-county level key informants included: Sub-county and parish chiefs and Community Development Officers.

FGDs were carried out in four purposively selected sub-counties that were ranked with the highest vulnerability. FGDs comprising of an average of 12 respondents (crop farmers, local leaders and cattle keepers) were conducted at Dwaniro Sub-county (UTM Zone 36N: 396819E; 88548N), Lwamata Sub-county (UTM Zone 36N: 377181E; 92190N), Bukomero Sub-county (UTM Zone 36N: 393007E; 76266N) and Kiboga Town council (UTM Zone 36N: 362994E; 101263N). Each Parish of the selected Sub-counties was represented by at least one participant and the selection of participants was engendered. FGDs were conducted with utmost consideration to the various gender categories (women, men) with respect to age groups since hazards affect both men and women though in different perspectives irrespective of age. This allowed for comprehensive representation as well as provision of detailed and verifiable information.

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

3.1.3 Participatory GIS

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

3.1.4 Geo-referencing and ground-truthing

The identified hazard hotspots in the community profile maps were ground-truthed and geo-referenced using a handheld Spectra precision Global Positioning System (GPS) unit, model: Mobile Mapper 20 set in WGS 1984 Datum. The entities captured included: hazard location, (Sub-county and parish), extent of the hazard, height above sea level, slope position, topography, neighboring land use among others (Appendix I). Hazard hot spots, potential and susceptible areas will be classified using a participatory approach on a scale of "not reported/ not prone", "low", "medium" and "high". This information generated through a participatory and transect approach was used to validate modelled hazard, risk and vulnerability status of the district. The spatial extent of a hazard event was established through modelling and a participatory validation undertaken.

3.2 Develop District Specific Multi-hazard Risk and Vulnerability Profiles

3.2.1 Data analysis and integration

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

3.2.2 Data verification and validation

In collaboration with OPM, a five-day regional data verification and validation workshop was organized by UNDP in Mbarara Municipality as a central place within the region. This involved key district DDMC focal persons for the purpose of creating local/district ownership of the profiles.

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

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

RESULTS FROM MULTI-HAZARD RISK, VULNERABILITY MAPPING

4. Multi-hazards

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

In the case of Kiboga District, hazards were classified following main controlling factors:

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

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

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

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

4.1 Geomorphological and Geological Hazards

4.1.1 Landslides, rock falls and soil erosion

Results from the participatory assessments indicated that there weren't any incidences of landslides and rock falls in Kiboga district. However, participants reported minor cases of soil erosion on the bare hills in Lwamata sub-county. This information was integrated with the spatial modelling using socio-ecological spatial data i.e. Soil texture (data for National Agricultural Research Laboratories – Kawanda (NARL) 2014, Rainfall (Meteorology Department 2014), Digital Elevation Model (DEM), SLOPE, ASPECT (30m resolution data from SRTM Shuttle Radar Topography Mission (SRTM) to generate Land slide, rock falls and soil erosion vulnerability map (Figure 7).
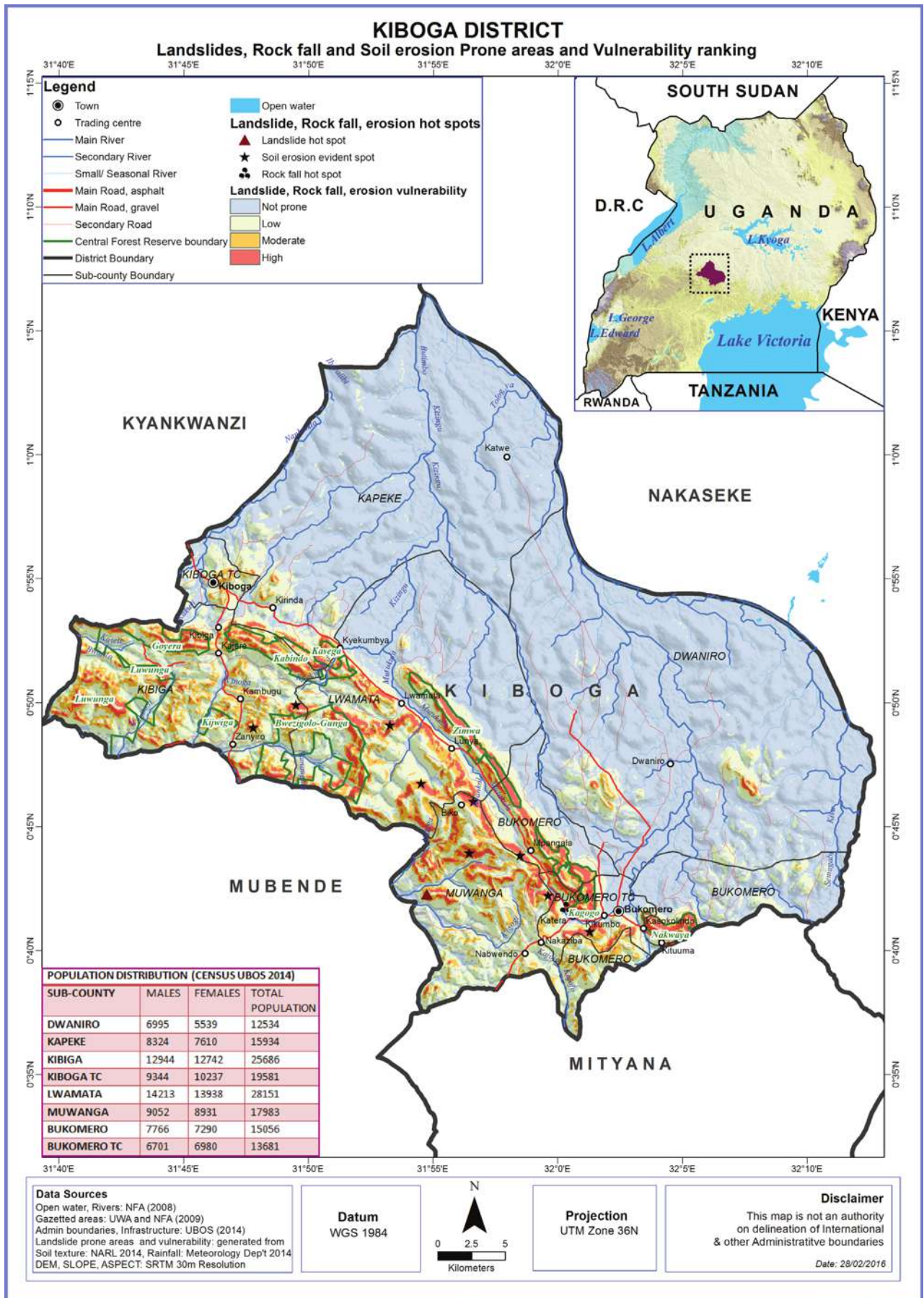
Figure 7: Landslides, Rock fall, Soil erosion Prone areas, Kiboga District

4.1.2 Earthquakes and faults

Participants of the focus group discussion indicated that earthquakes weren't a serious problem in Kiboga District. However, it was observed that the entire district only experiences minor tremors. Figure indicates areas where faults exist as vulnerable areas where earthquakes have more impact and the ranking is dependent on the distance from the faults and lithological veins (Figure 8).
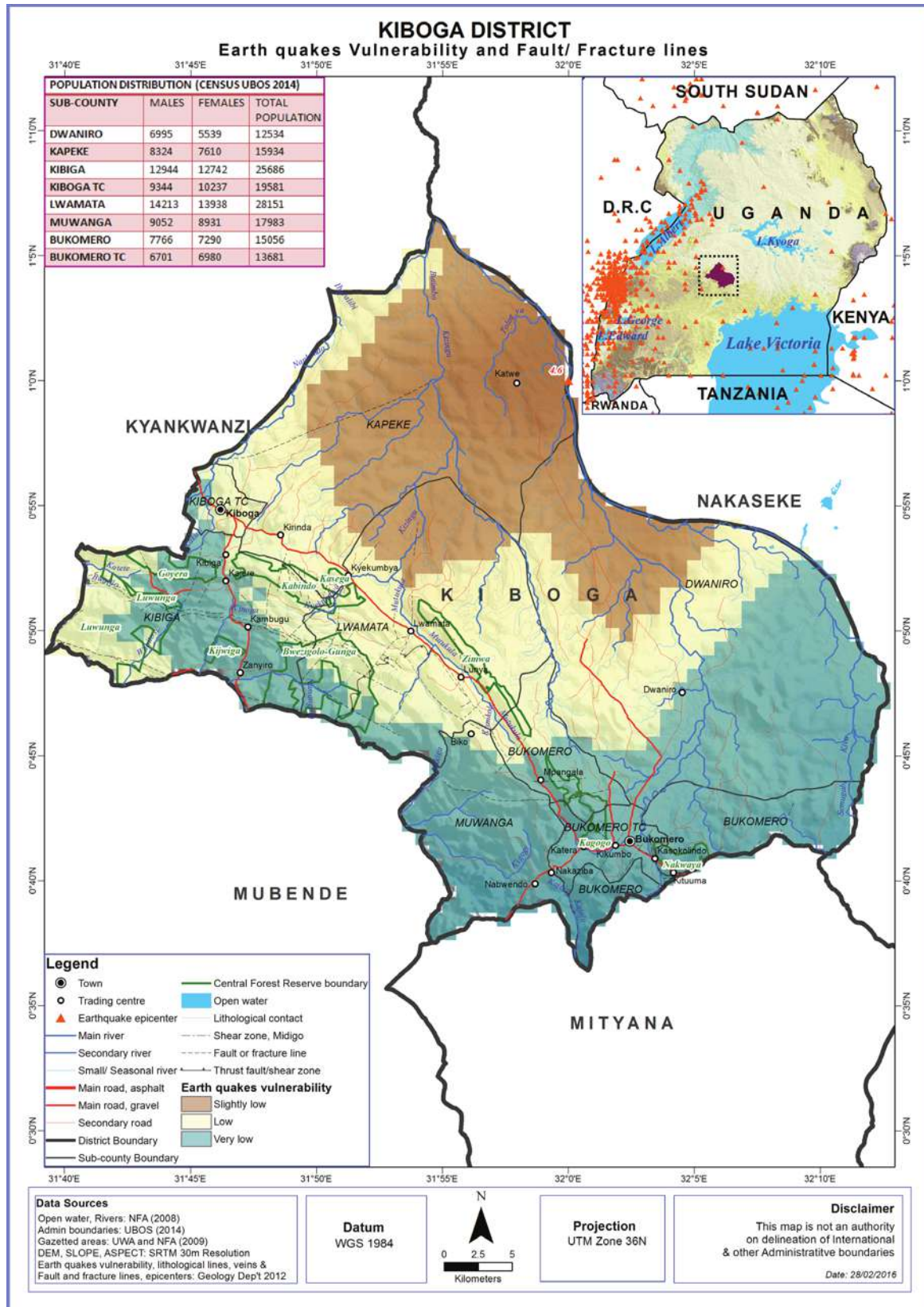
Figure 8: Earthquakes Vulnerability, Fault lines, Kiboga District

4.2 Climatological and Meteorological Hazards

4.2.1 Floods

Results from the focus group discussions revealed that floods usually occur in the low lying areas especially during the rainy seasons. Participants observed that floods wash away and at times submerge crops such as beans, sweet potatoes and maize thus causing food insecurity and considerable economic losses. Incidences houses collapsing due to flooding were reported in Kyekumbya parish, Lwamata sub-county. It was also reported that Nakayenga wetland in Kiboga town council was prone to flooding every wet season. The other most affected sub-counties are; Kapeke and Dwaniro. This information was integrated with the spatial modelling using socio-ecological spatial data i.e. generated from Soil texture (data for National Agricultural Research Laboratories – Kawanda (NARL) 2014, Rainfall (Meteorology Department 2014), Digital Elevation Model (DEM), SLOPE, ASPECT (30m resolution data from SRTM Shuttle Radar Topography Mission (SRTM) (Figure 9).

Plate 1: Flooding hot spot in Lwamata Sub-county
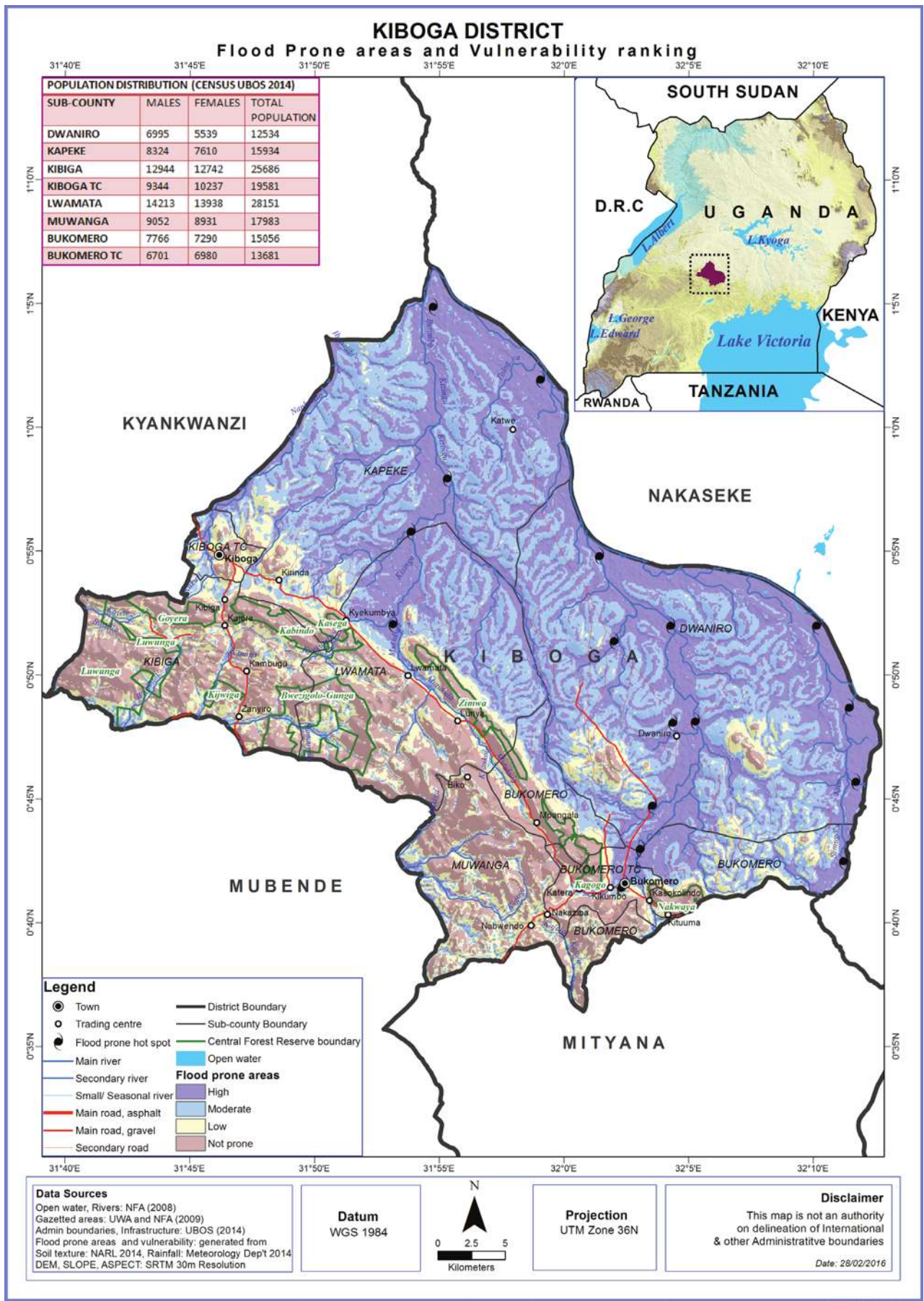
Figure 9: Flood prone areas and Ranking, Kiboga District

4.2.2 Drought

Participatory assessments through focus group discussions indicated that drought was a serious problem in the cattle corridor sub-counties of Kiboga District such as Dwaniro, Kapeke, Lwamata and Bukomero. Participants observed that drought and prolonged dry spells have caused scarcity of water and pastures, low milk and crop production and increased incidences of pests and diseases. The participants also mentioned that termite infestation on pastures is always high in the dry season. It was reported that some households migrate to Rivers Mayanja and Kafu in search of water for their animals during dry seasons. This information was integrated with the spatial modeling using socio-ecological spatial data i.e. generated from Rainfall and Temperature (Uganda National Meteorological Authority, 2014) using the Standardized Precipitation Index (Figure 10).

Plate 2: Impact of drought on maize garden in Lwamata Sub-county
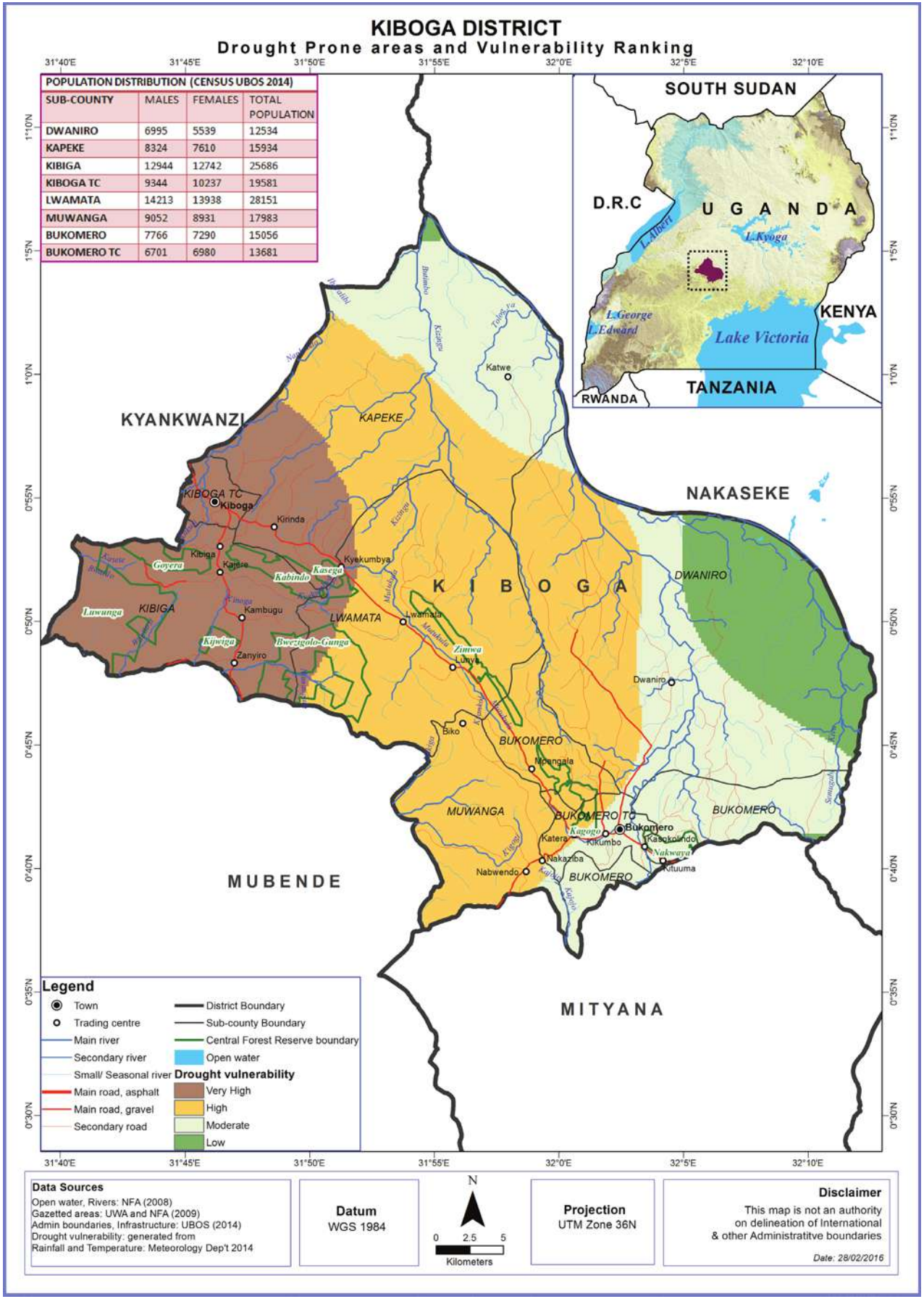
Figure 10: Drought Prone areas and Vulnerability Ranking, Kiboga District

4.2.3 Hailstorms

Results from the participatory assessments showed that Lwamata, Bukomero, and Dwaniro sub-counties and Kiboga Town Council were the most affected by hailstorms in Kiboga District. Participants observed that hailstorms come along with strong winds that destroy crops especially maize, cassava and banana plantations thus causing food insecurity (Figure 11).

4.2.4 Strong winds

The participants of the focus group discussions reported that strong winds are experienced at the onset of the rainy seasons. It was observed that strong winds blow off roof tops of houses and schools and also uproot trees and banana plantations. Lwamata, Bukomero, Dwaniro and Kiboga town council are the most affected.

4.2.5 Lightning

Lightning is a sudden high-voltage discharge of electricity that occurs within a cloud, between clouds, or between a cloud and the ground. The distribution of lightning on Earth is far from uniform. The ideal conditions for producing lightning and associated thunderstorms occur where warm, moist air rises and mixes with cold air above. Results from the participatory assessments indicated that there have been increased incidences of lightning occurrences in Kiboga District. Participants reported that in 2010, lightning killed 15 cows in Sseesa village in Kapeke Sub - county. In Kisweka parish, Lwamata sub-county, 2 cows were killed by Lightning in 2012. Most of the schools in Kiboga District do not have lightning conductors and risk being struck by lightning.
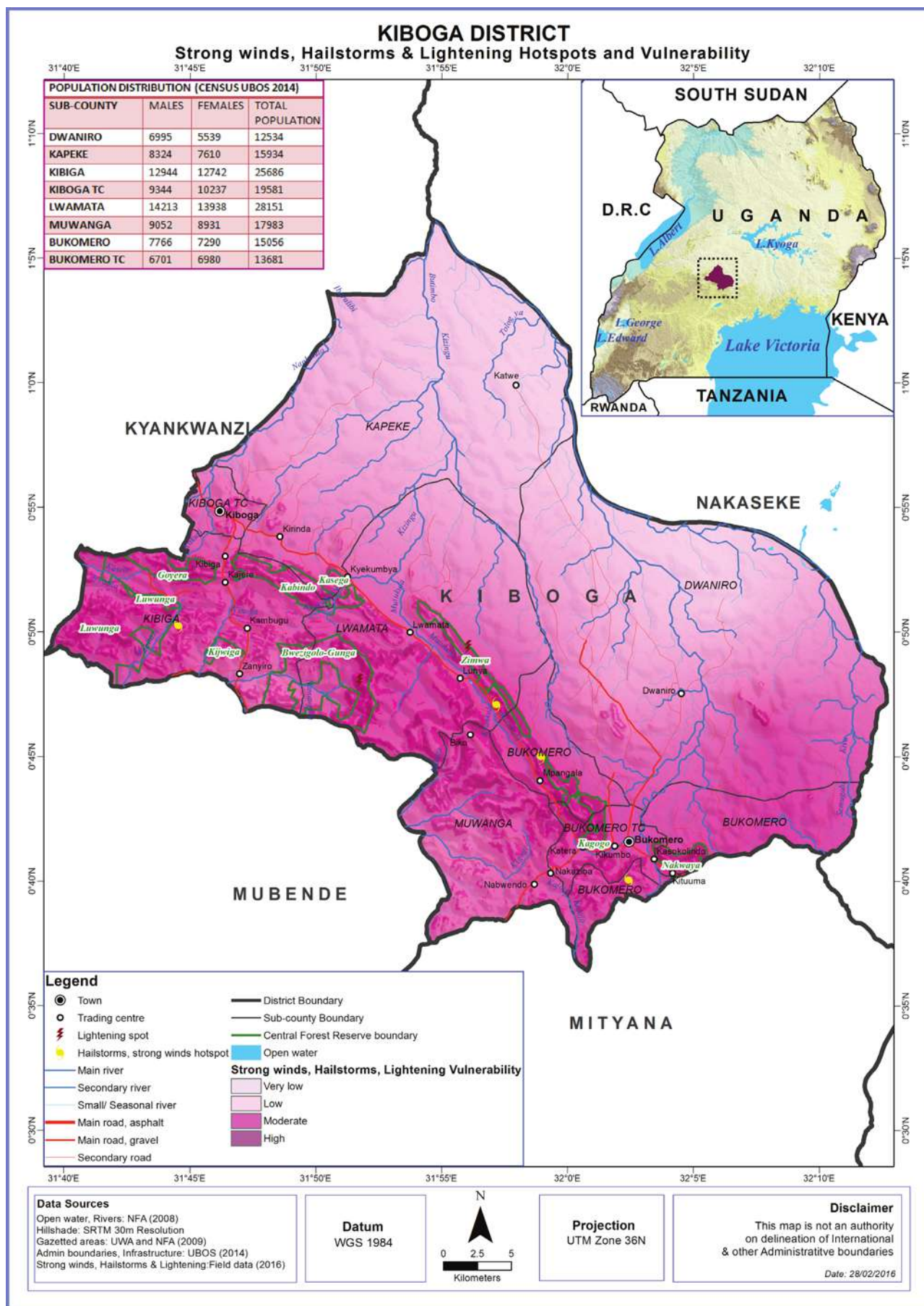
Figure 11: Strong winds, Hailstorms and Lightning Hotspots and Vulnerability, Kiboga District

4.3 Ecological and Biological Hazards

4.3.1 Crop Pests and Diseases

Participatory assessments through focus group discussions indicated that the entire Kiboga District was vulnerable to crop pests and diseases. Banana and coffee plantations were the most affected by crop pests and diseases. The most prominent crop diseases were banana bacterial wilt, coffee wilt disease, Cassava Brown Streak and cassava mosaic. Participants attributed the massive increases in pests such as the black coffee twig borer, bean weevils, fruit fly and aphids to the Climate change. The sub-counties of Bukomero, Kibiga, Lwamata, Muwanga and Kiboga Town Council were the most affected by crop pests and diseases (Figure 12).
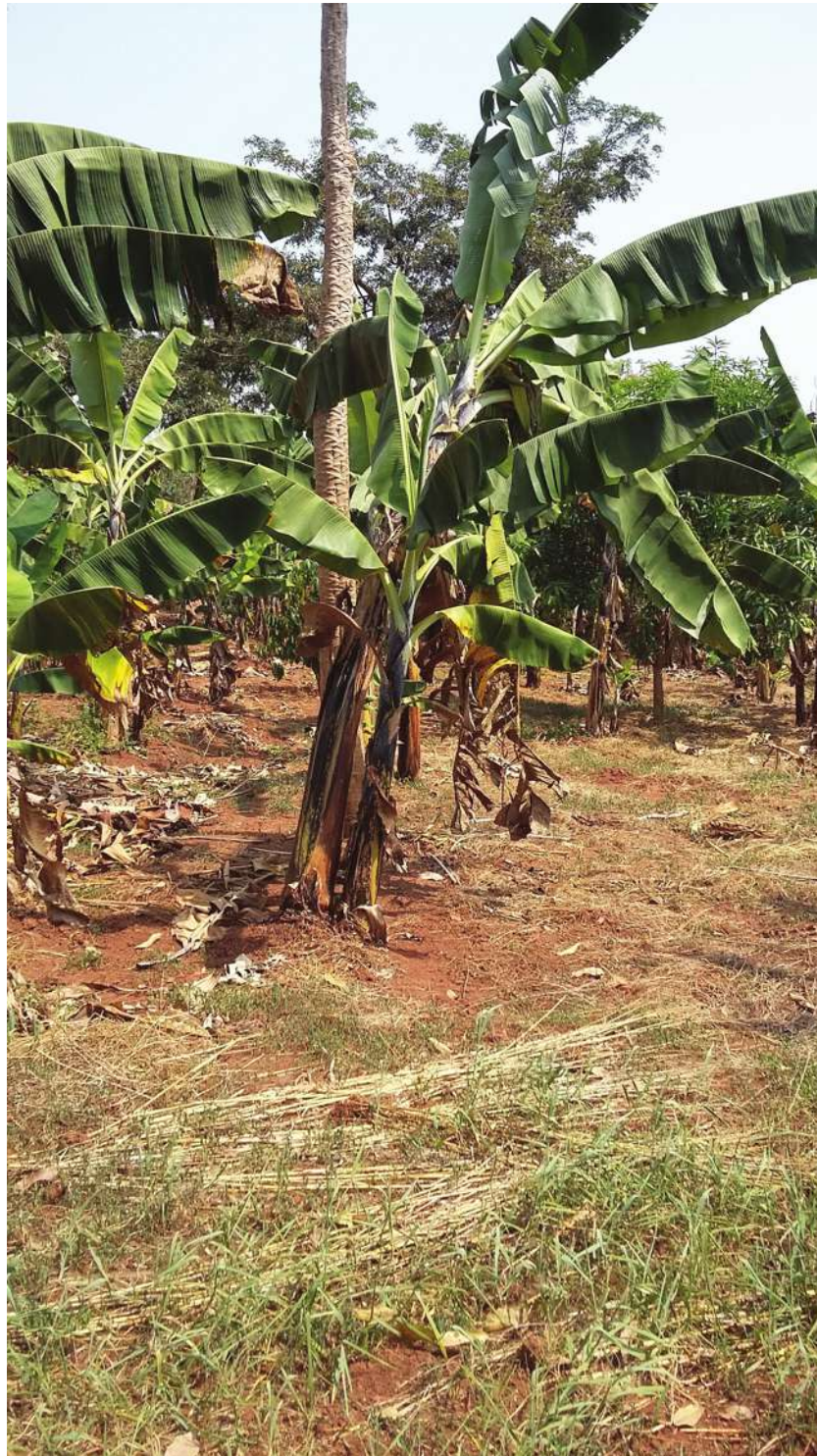
Plate 3: Banana plantation affected by banana bacterial wilt in Lwamata Sub-county
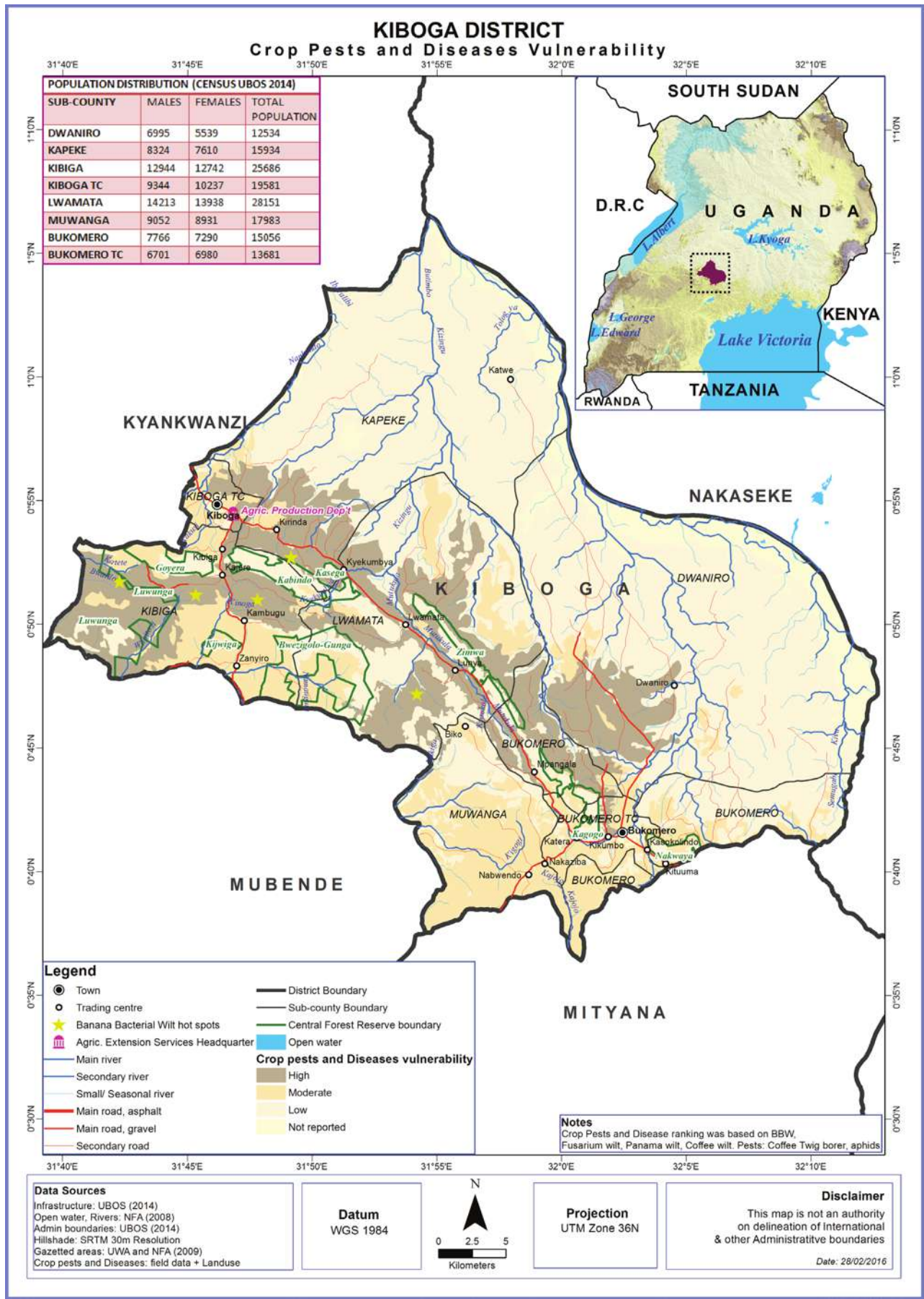
Figure 12: Crop Pests and Diseases Vulnerability, Kiboga District

4.3.2 Livestock Pests and Diseases

Results from the focus group discussions indicated that livestock pests and diseases were a serious problem because part of Kiboga District is located in the cattle corridor. The cattle corridor sub-counties of Dwaniro, Kapeke, Lwamata and Bukomero are prone to livestock diseases including foot and mouth disease, Brucellosis, Contagious Bovine Pleuro-Pneumonia (It has been controlled). It was observed that diseases such as foot rot, lumpy skin disease and tick borne diseases like East coast fever increase during the rainy seasons. Participants revealed that there are high incidences of swine fever in Lwamata sub-county and up 90% of the pigs have died. Also outbreak of Poultry diseases likes New Castle Disease, Fowl typhoid, Fowl Cholera and Gumboro commonly occur (Figure 13).
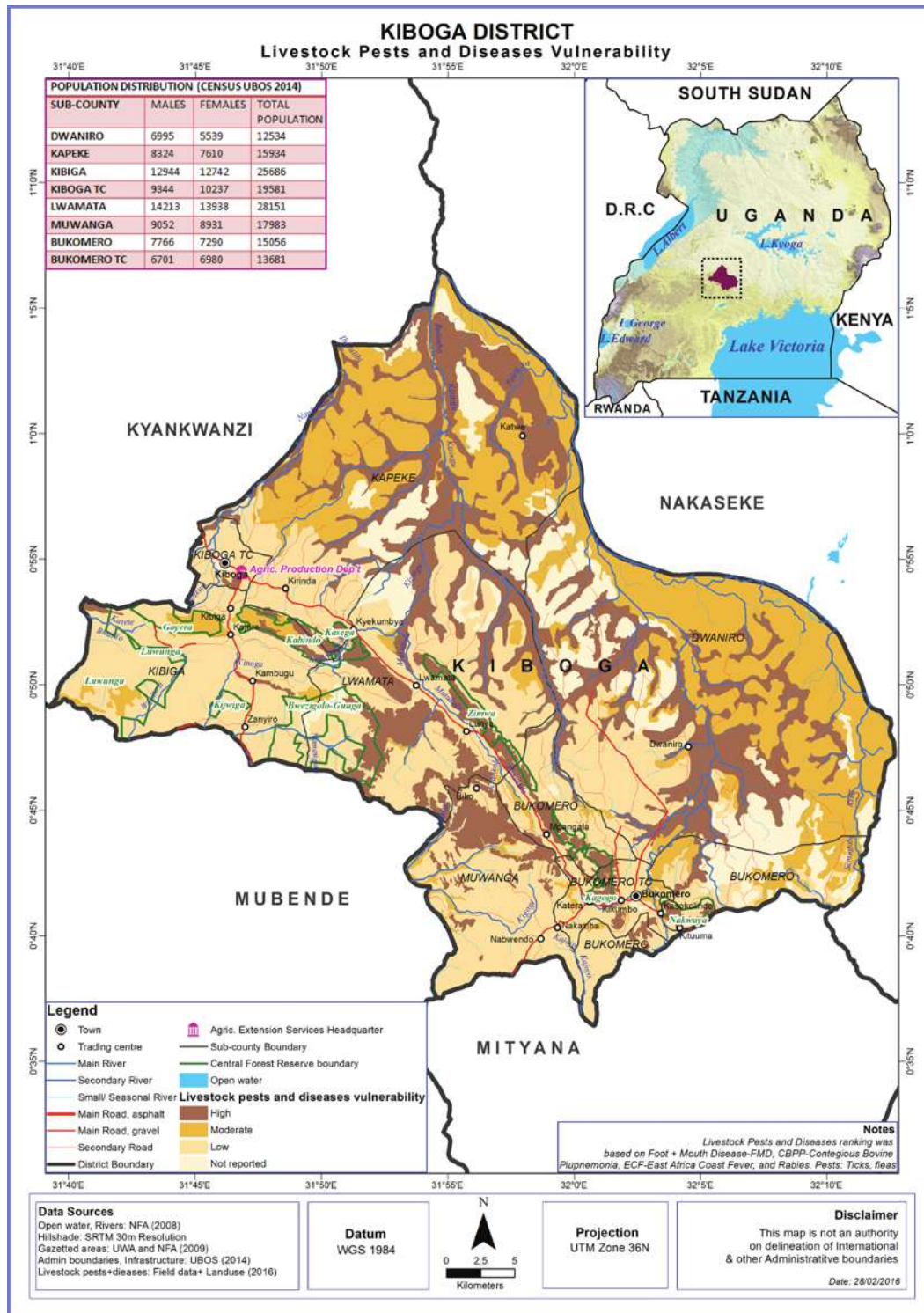
Figure 13: Livestock Pests and Diseases Vulnerability, Kiboga District

4.3.3 Human Disease outbreaks

Participants in the series of focus group discussions held indicated that the most prevalent human diseases in Kiboga District were malaria, brucellosis and HIV/AIDS. It was reported that brucellosis is transmitted from cattle through milk and meat and is common in Lwamata, Kapeke, Dwaniro and Bukomero. Reports indicated that HIV/AIDS prevalence rates were high in Lwamata, Kiboga and Bukomero Town Councils. Results showed that the entire district was affected by malaria (Figure 14).
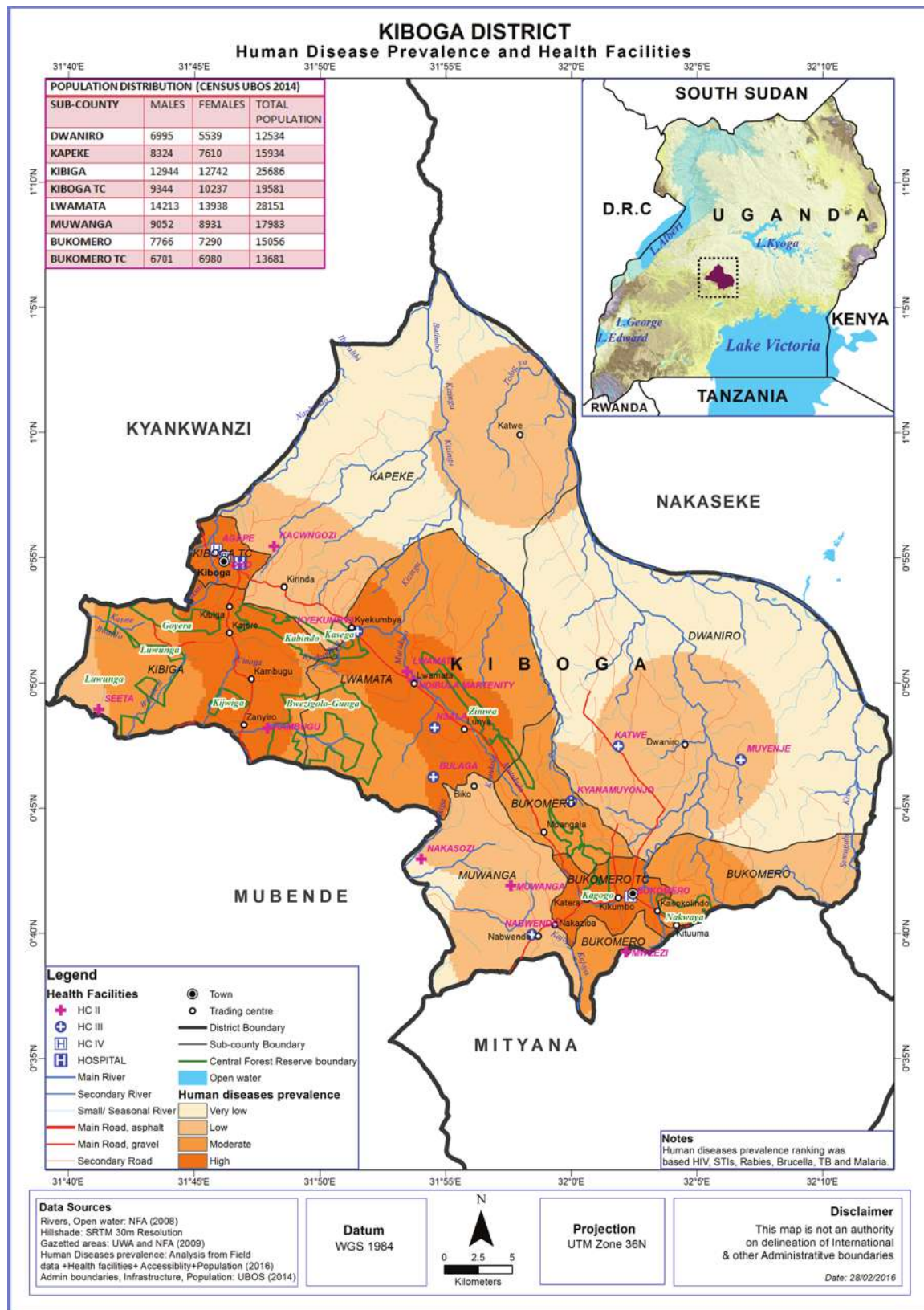
Figure 14: Human Disease Outbreaks Vulnerability, Kiboga District

4.3.4 Vermin and Wild-life Animal Attacks

Participatory assessments through focus group discussions revealed that vermin and wildlife animal attacks were not a serious problem in Kiboga District. A few cases where monkeys, wild pigs, squirrels and rats destroy crops were reported in Lwamata and Dwaniro sub-counties. There are so many stray and marauding dogs left behind by people evicted from the forest reserves. These are biting people and eating small ruminants (Figure 15).
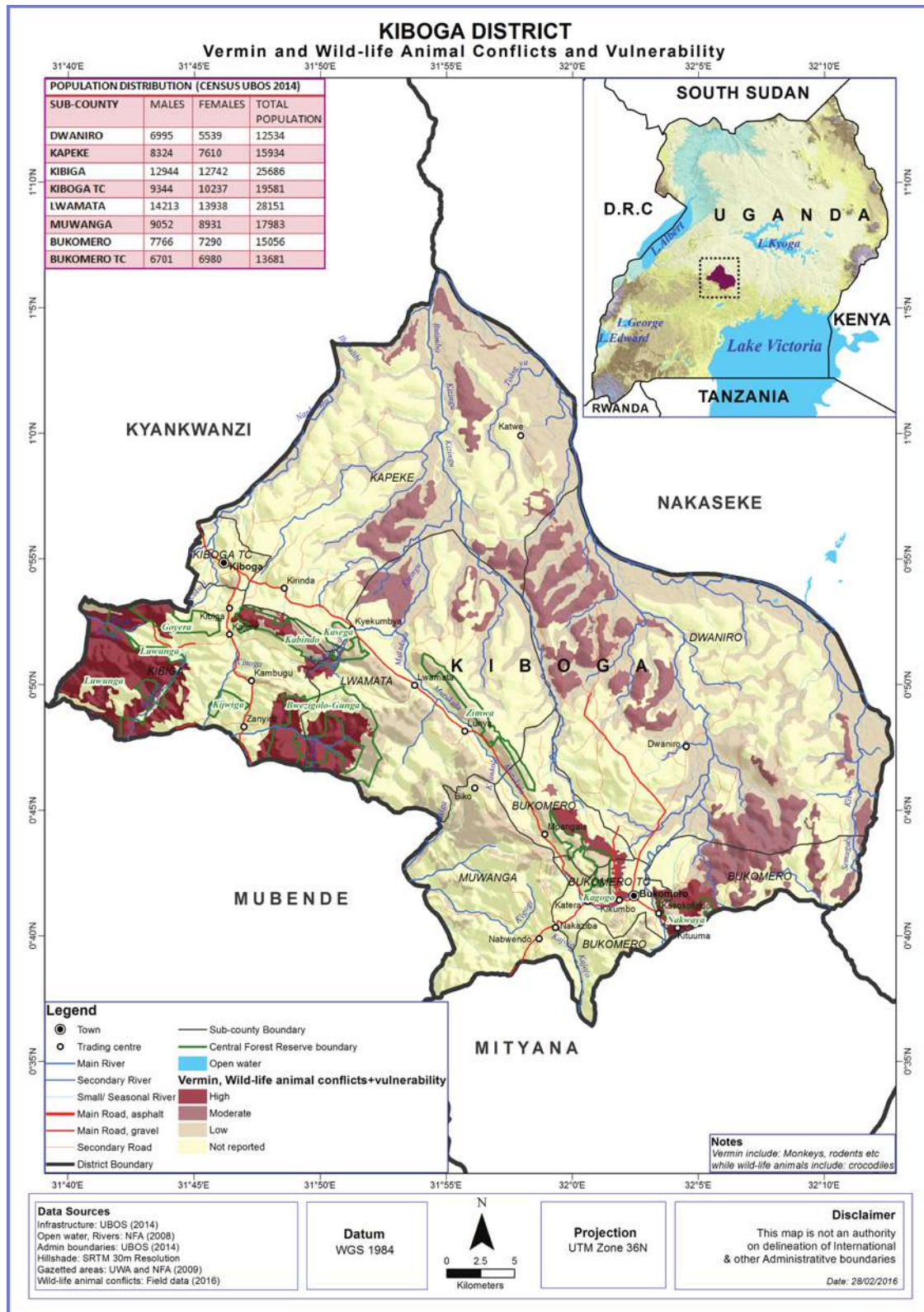
Figure 15: Vermin, Wildlife animal attacks vulnerability, Kiboga District

4.3.5 Invasive species

Results from the discussions indicated that *Lantana camara* and *Amaranthus spp.* were the most reported invasive species in Kiboga District. Participants mentioned that these invasive species normally dominate grazing lands and thus destroy pastures that would have been palatable for animals. *Lantana camara* was dominant in Kapeke, Dwaniro and Bukomero sub-counties (Figure 16).

Plate 4: Amaranthus spp. in Dwaniro Sub-county
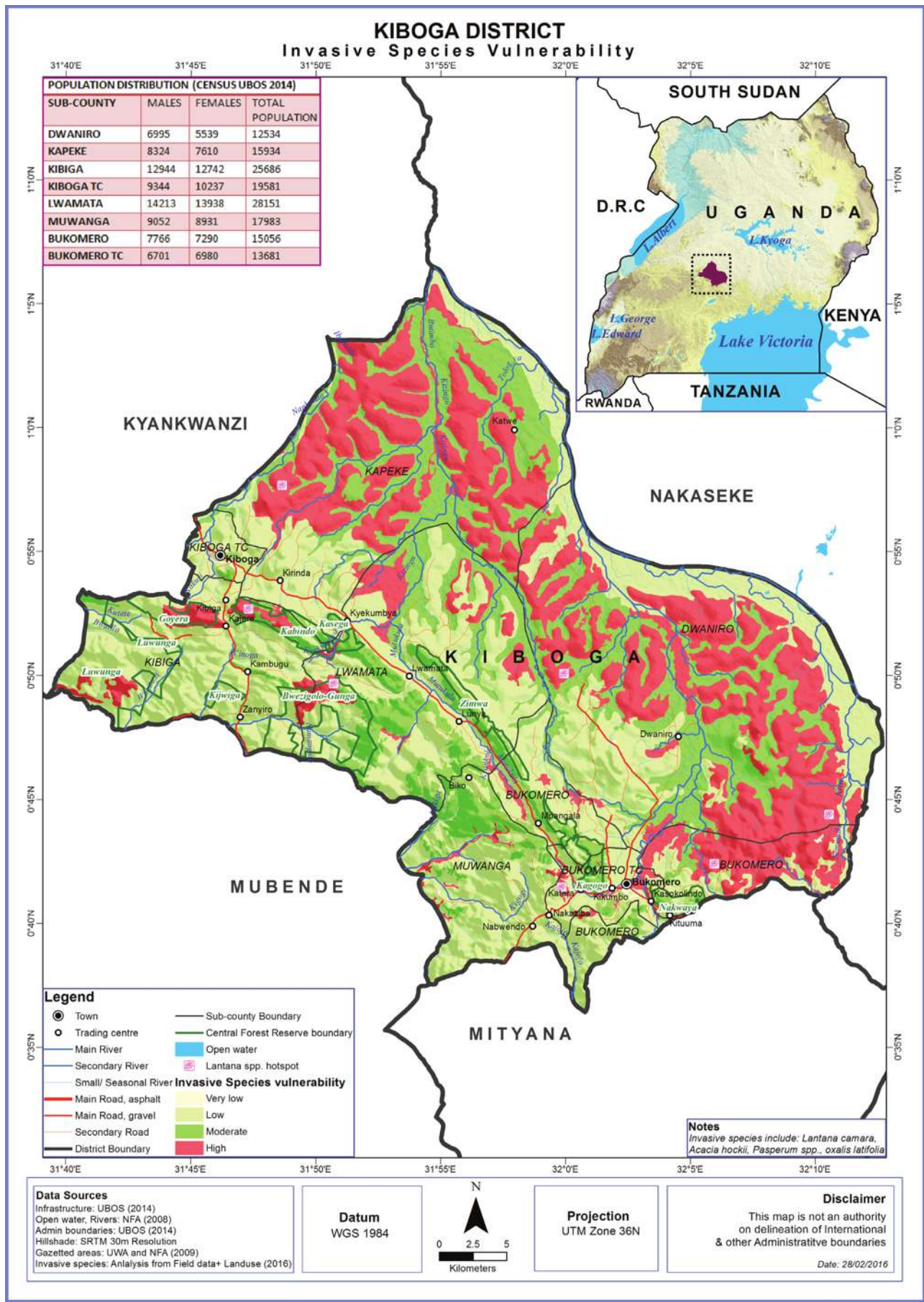
Figure 16: Invasive Species Ranking, Kiboga District

4.4 Human Induced and Technological Hazards

4.4.1 Bush fires

Results from participatory assessments showed that bush burning was a very serious problem in Kiboga District. Participants indicated that cattle keepers particularly in the cattle corridor sub-counties of Dwaniro, Kapeke, Lwamata and Bukomero practice bush burning at the end of the dry seasons for regeneration of fresh pastures at the onset of the rainy season. Some pine plantations were recently burnt in Kyekumbya, and Kasejjere parishes all in Lwamata sub-county, Kibaale, Kajjere and Degeya Parishes in Kibiga Sub – county (Figure 17).

Plate 5: Bush burning in Lwamata Sub-county

KIBOGA DISTRICT
Bush fires hotspot areas and Vulnerability ranking

POPULATION DISTRIBUTION (CENSUS UBOS 2014)

SUB-COUNTY	MALES	FEMALES	TOTAL POPULATION
DWANIRO	6995	5539	12534
KAPEKE	8324	7610	15934
KIBIGA	12944	12742	25686
KIBOGA TC	9344	10237	19581
LWAMATA	14213	13938	28151
MUWANGA	9052	8931	17983
BUKOMERO	7766	7290	15056
BUKOMERO TC	6701	6980	13681

Legend

- ◉ Town
- ○ Trading centre
- ❗ Bush fires evident spot
- Main river
- Secondary river
- Small/ Seasonal river
- Main road, asphalt
- Main road, gravel
- Secondary road
- District Boundary
- Sub-county Boundary
- Central Forest Reserve boundary
- Open water

Bush fires hotspot areas
- High
- Moderate
- Low
- Not occur

Data Sources
Open water, Rivers: NFA (2008)
Gazetted areas: UWA and NFA (2009)
Bush fires: generated from analysing:
Landuse NFA 2010 and ground truthing (2016)
Admin boundaries, Infrastructure: UBOS (2014)

Datum
WGS 1984

N

0 2.5 5
Kilometers

Projection
UTM Zone 36N

Disclaimer
This map is not an authority
on delineation of International
& other Administratitve boundaries

Date: 28/02/2016

Figure 17: Bush fires Hot spot areas and Vulnerability Ranking, Kiboga District

4.4.2 Land conflicts

Participants indicated that land disputes were a serious problem in the entire Kiboga District. Most of the registered land conflicts are between land lords and squatters. It was reported that these conflicts are usually settled in the RDCs office and magistrates court. The sub-counties of Kapeke, Lwamata, Kibiga, Dwaniro, Bukomero and Kiboga Town Councils were the most affected by land disputes (Figure 18).
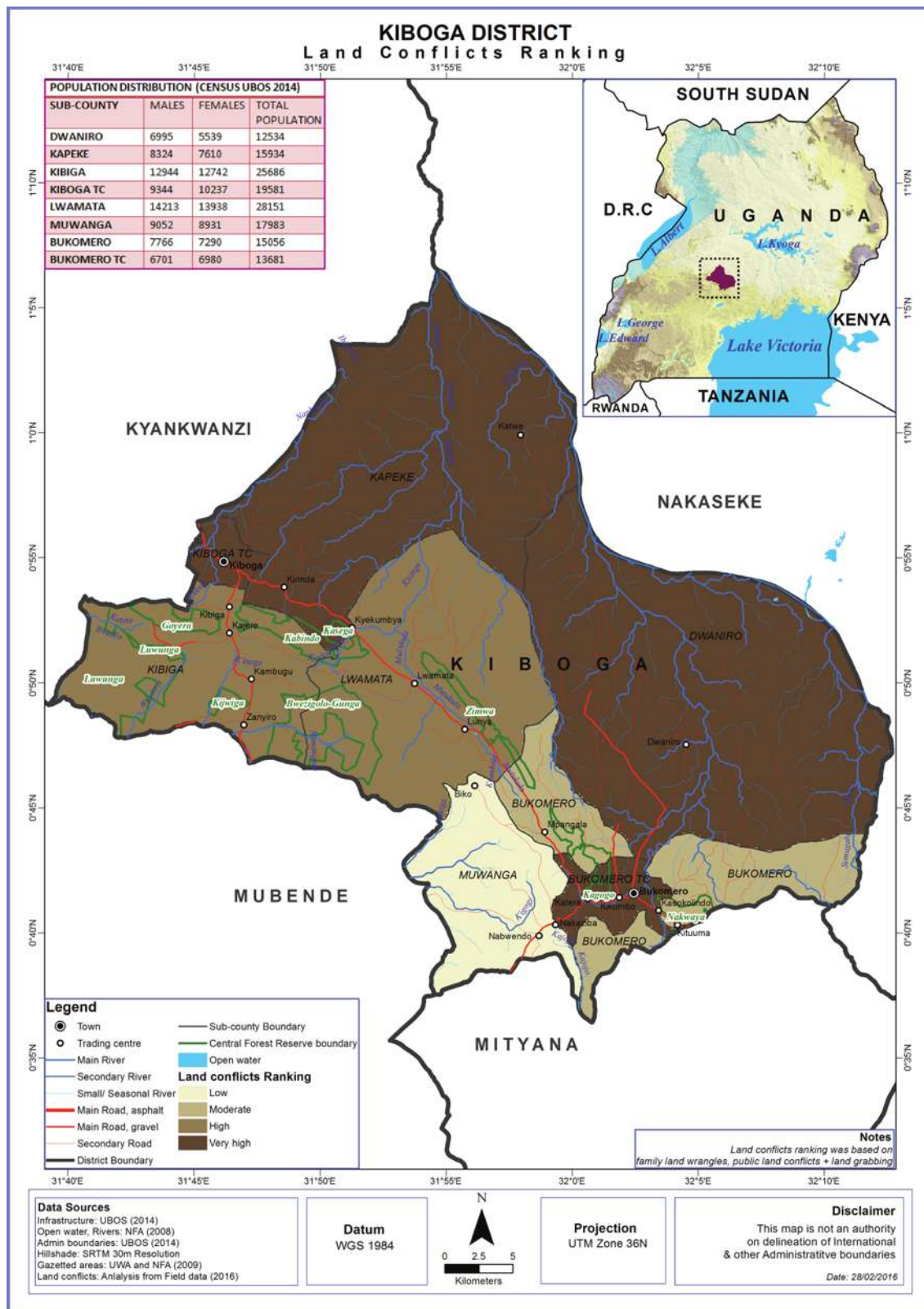
Figure 18: Land Conflicts Ranking, Kiboga District

4.4.3 Environmental Degradation

The most reported forms of environmental degradation in Kiboga District included; stone quarrying, wetland reclamation, brick making, deforestation and overgrazing. Kiboga Town Council was the most affected by these kinds of environmental degradation with the exception of overgrazing which is common in the cattle corridor sub-counties of Kibiga, Lwamata, Dwaniro, Kapeke and parts of Bukomero (Figure 19).

Plate 6: Brick-laying and stone quarrying activities in Lwamata sub-county
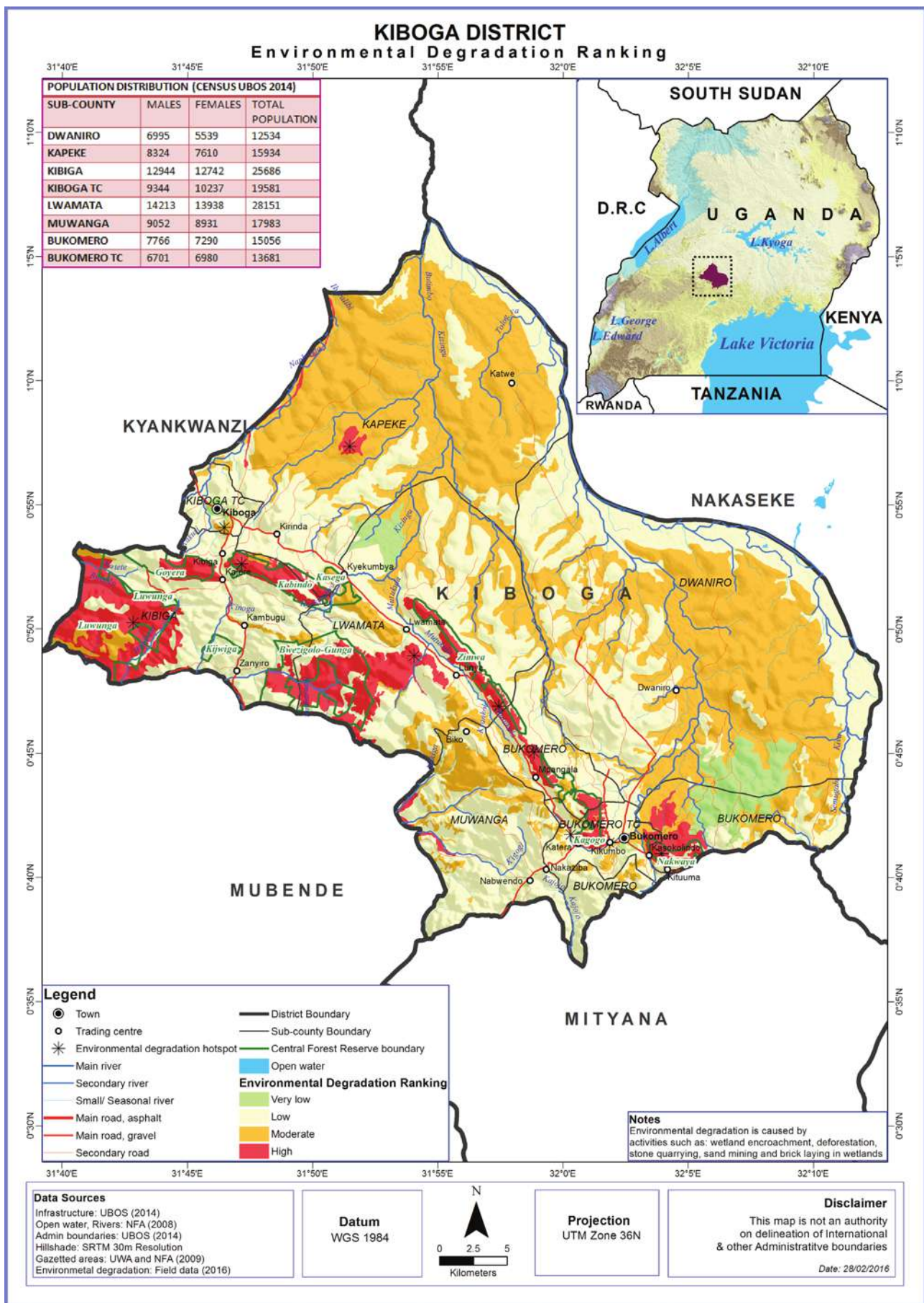
Figure 19: Environmental Degradation Ranking, Kiboga District

The map contains the following text elements:

KIBOGA DISTRICT
Environmental Degradation Ranking

POPULATION DISTRIBUTION (CENSUS UBOS 2014)

SUB-COUNTY	MALES	FEMALES	TOTAL POPULATION
DWANIRO	6995	5539	12534
KAPEKE	8324	7610	15934
KIBIGA	12944	12742	25686
KIBOGA TC	9344	10237	19581
LWAMATA	14213	13938	28151
MUWANGA	9052	8931	17983
BUKOMERO	7766	7290	15056
BUKOMERO TC	6701	6980	13681

Legend

- Town
- Trading centre
- Environmental degradation hotspot
- Main river
- Secondary river
- Small/ Seasonal river
- Main road, asphalt
- Main road, gravel
- Secondary road
- District Boundary
- Sub-county Boundary
- Central Forest Reserve boundary
- Open water

Environmental Degradation Ranking
- Very low
- Low
- Moderate
- High

Notes
Environmental degradation is caused by activities such as: wetland encroachment, deforestation, stone quarrying, sand mining and brick laying in wetlands

Data Sources
Infrastructure: UBOS (2014)
Open water, Rivers: NFA (2008)
Admin boundaries: UBOS (2014)
Hillshade: SRTM 30m Resolution
Gazetted areas: UWA and NFA (2009)
Environmetal degradation: Field data (2016)

Datum
WGS 1984

Projection
UTM Zone 36N

0 2.5 5
Kilometers

Disclaimer
This map is not an authority on delineation of International & other Administratitve boundaries

Date: 28/02/2016

4.4.4 Road Accidents

It was reported that road accidents such as head on collisions and vehicles overturning were common along the Kampala - Hoima highway. Some of the black spots along this highway are Buswabulongo, Kitutumuzi and Kawawa villages in Lwamata sub-county. A number of bodaboda accidents were also reported in Kiboga Town Council especially at Petro city petrol station. Participants also complained that the trenches along the road in Kiboga Town Council are a problem to pedestrians since most of them fall in them quite often (Figure 20).
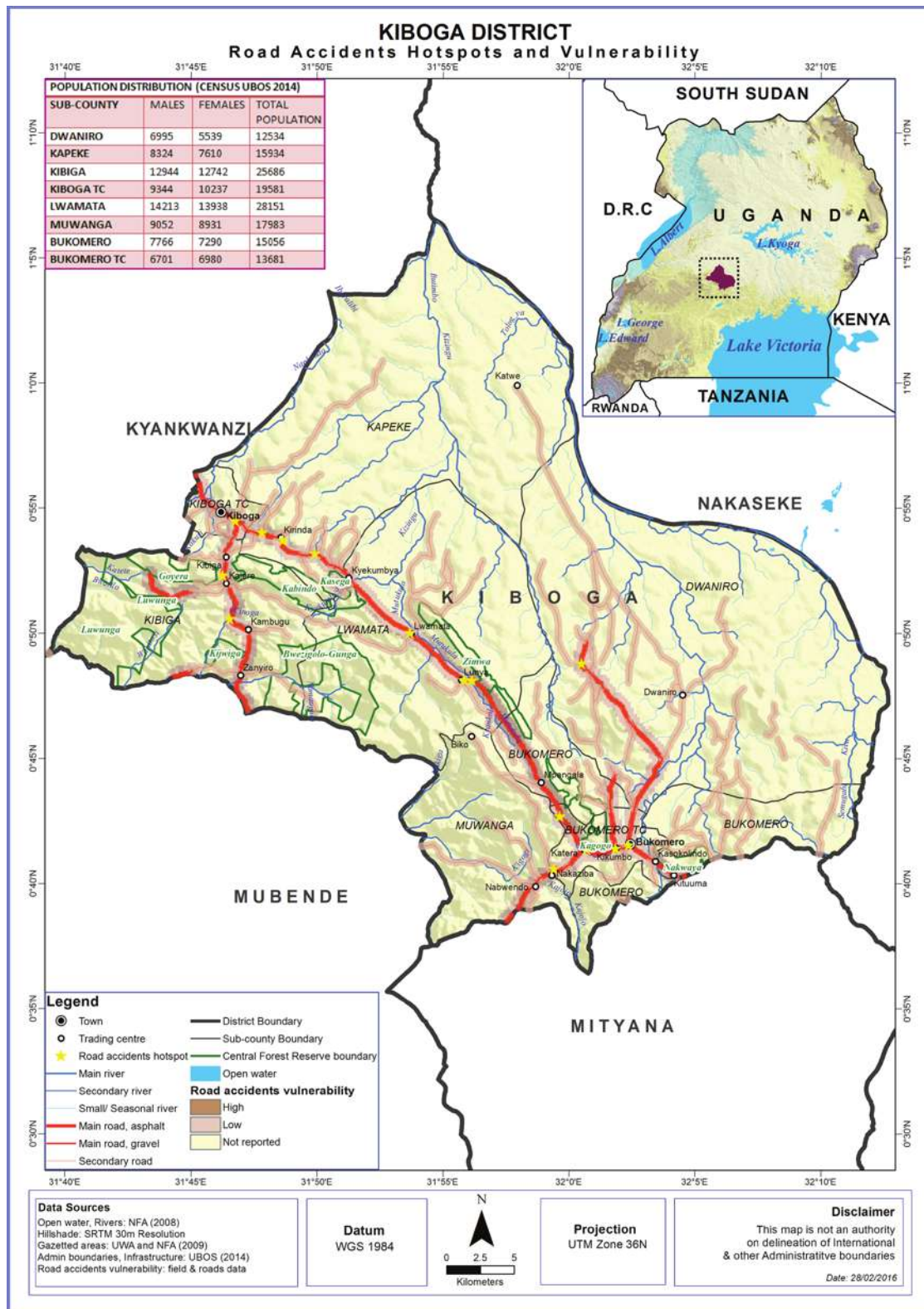
Figure 20: Road Accidents Hot spots and Vulnerability, Kiboga District

4.5 VULNERABILITY PROFILE

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

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

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

Table 2: Components of Vulnerability in Kiboga District

Vulnerability	Exposure			Susceptibility		Resilience	
Hazards	Elements at Risk	Geographical Scale		Susceptibility	Geographical Scale	Coping strategies	Geographical Scale
Landslides, Rock falls and Soil erosion	- Human and livestock adjacent to hill slopes - Crops on hill slopes - Infrastructure e.g. houses, schools, roads adjacent to hill slopes	Parish		- Loss of lives - Complete crop failure Destruction of infrastructure e.g. homes, and schools	Parish	-Migration -Sensitization by both government and non-governmental agencies	Parish
Earth quakes	- Infrastructure e.g. houses, schools	District		- Loss of lives - Destruction of Infrastructure e.g. houses, schools	District	-No much measure so far	District
Floods	- Livestock adjacent to flood plain - Crops on flood plain - Infrastructure e.g. houses, schools, roads adjacent to flood plain	Parish		- Livestock loss - Foot rot - Destruction of crops - Destruction of infrastructure e.g. houses, schools, roads adjacent to flood plain	Parish	-Migration -Sensitization on wetland conservation -Dig trenches	Parish
Drought	- Livestock - Crops - Human population	Village		- Hunger & poverty - Livestock loss - Crop failure - Shortage of pasture - Shortage of water - Spread of livestock epidemics - Livestock mortalities	Village	-Migration -Sensitization on tree planting -Buy food from elsewhere	Village
Hailstorms, strong winds and Lightning	- Human and livestock populations - Crops - Infrastructure e.g. houses, schools, health centres	Parish		- Loss of lives - Destruction of crops - Destruction of infrastructure e.g. houses, schools, roads adjacent to flood plain	Parish		Parish
Crop Pests and Diseases	-Crops	District		- Complete crop failure	District	- Spraying - Cut and burry affected crops -Sensitization on crop disease management	District
Socio-economic component							
Livestock Pests and Diseases	-Livestock (cattle, goats etc.)	District		- Loss of livestock - Reduced livestock Productivity -Reduced incomes	District	- Vaccination - Burry and burn animals that have died from infection - Quarantine	District

Hazard	- Human Population	Level	- Loss of lives	Level	Mitigation measures	Level
Human Disease outbreaks		District	- Loss of lives	District	- Mass Immunization - Use of mosquito nets	District
Invasive species	-indigenous species -Animals	District	- Outcompete the indigenous spp., suppress growth of indigenous spp - Loss of indigenous spp. - Complete crop Failure - suppress growth of pasture -some are poisonous to livestock	District	- Cut and burn -Sensitization on Invasive species management - Spray with herbicides e.g 2,4 D	District
Bush fires	- Livestock - Crops - Infrastructure e.g. houses, schools	Sub-county	- Loss of livestock - Shortage of pasture - Destruction of crops - Destruction of infrastructure e.g. houses, schools -Loss of lives	Sub-county	-Sensitization - Fire control measures: firebreaks, fire lines and fire fighting equipments	Sub-county
Road accidents	- Human population - Infrastructure adjacent to accident black spots e.g. houses, schools etc.	Sub-county	- Loss of lives - Destruction of vehicles - Destruction of Infrastructure adjacent to accident black spots e.g. houses, schools etc.	Sub-county	-Humps on roads -Signage on speed limits -Sensitization on traffic rules	Sub-county
Land conflicts	- Human population	Village	-Loss of lives -Family violence and break outs -retards development	Village	- Community dialogue - District court in charge of land issues	Village
Vermin and Wildlife animal attacks	- Human population - Livestock - Crops	Parish	-Loss of lives -Livestock loss -Crop destruction	Parish	- Report to UWA and Vermin Officer - Guard gardens -Poison -Hunt and kill -Fence water collection points with Wildlife animals	Village
Environmental degradation	- Human and livestock populations - Crops - Natural vegetation	Sub-county	-Crop failure -Shortage of pasture -Shortage of water -Decline of water quality -increased incidences of env't related diseases	Sub-county	-Sensitization on wetland conservation -Sensitization on tree plating -Setting bi-laws	Sub-county
Landslides, Rock falls and Soil erosion	- Human and livestock adjacent to hill slopes - Crops on hill slopes - Infrastructure e.g. houses, schools, roads adjacent to hill slopes	Parish	- Loss of lives - Complete crop failure - Destruction of infrastructure e.g. homes, and schools	Parish	-Migration -Sensitization by both government and non-governmental agencies	

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

Environmental component

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

Table 3: Vulnerability Profile for Kiboga District

Hazards	PROBABILITY	SEVERITY OF IMPACTS	RELATIVE RISK	VULNERABLE SUB COUNTIES
	Relative likelihood this will occur	*Overall Impact (Average)*	*Probability x Impact Severity*	
Hazards	*1 = Not occur* *2 = Doubtful* *3 = Possible* *4 = Probable* *5 = Inevitable*	*1 = No impact* *2= Low* *3=medium* *4 = High*	*0-1= Not Occur* *2-10= Low* *11-15=Medium* *16-20= High*	
Floods	5	4	20	The most affected sub-counties are; Dwaniro, Kapeke and Lwamata in order of severity.
Droughts	5	4	20	The most affected sub-counties are; Kibiga, Kapeke ,Kiboga T.C, Lwamata, Muwanga, Bukomero and Bukomero T.C
Soil erosion, rock falls and landslides	4	2	8	The most affected sub-counties are; Kibiga,Lwamata and Muwanga.
Hail storms, Lightning and strong winds	4	4	16	The most affected sub-counties are; Kibiga,Lwamata, Muwanga and Bukomero.
Bush fires	5	4	20	The most affected sub-counties are;Dwaniro, Kapeke, Lwamata and Muwanga.
Crop pests and diseases	4	3	12	The most affected sub-counties are; Kibig, Lwamata and Bukomero.
Livestock pests and diseases	5	4	20	The most affected sub-counties are; Dwaniro, Kapeke and Lwamata.
Human Diseases outbreaks	5	3	15	The most affected are; Kiboga, Bukomero T.Cs, Kibiga and Lwamata sub-counties.
Land conflicts	4	4	16	The most affected are; Kiboga and Bukomero T.Cs, Dwaniro and Kapeke sub-counties.
Vermin and Wild-life animal attacks	3	3	9	The most affected sub-counties are; Kibiga and Lwamata.
Earthquakes and faults	2	1	2	All sub-counties.
Road accidents	4	2	8	The most affected are; Kiboga, Bukomero T.Cs and Lwamata sub-counties.
Environmental degradation	4	4	16	Kibiga, Lwamata and Bukomero but less in Muwanga sub-county.
Invasive species	4	4	16	The most affected are; Dwaniro, Kapeke and Lwamata sub-counties.

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

Key for Relative Risk

■	High
■	Medium
■	Low
	Not reported/ Not prone

Table 4: Hazard Risk Assessment

Hazard	Dwaniro	Kapeke	Kibiga	Kiboga Town council	Lwamata	Muwanga	Bukomero	Bukomero Town council
Floods	H	H	L	M	H	L	M	M
Drought	VH	VH	VH	VH	H	H	H	H
Landslides, Rock falls and Erosion	L	L	M	L	M	M	L	L
Strong winds, Hailstorms and Lightning	L	L	H	L	H	H	H	L
Crop pests and Diseases	L	L	H	M	H	VH	H	L
Livestock pests and Diseases	VH	VH	L	L	VH	M	M	L
Human disease outbreaks	M	M	H	H	H	M	M	H
Vermin and Wildlife animal attacks	M	M	H		H			
Land conflicts	H	H	M	H	M	M	M	H
Bush fires	H	H	M	M	H	H	M	M
Environmental degradation	M	M	H	H	H		H	H
Earthquakes and faults	L	L	M	L	M	M	M	L
Road accidents	L	L	L	H	H	L	H	H
Invasive species	H	H	M	L	H		M	L

Key

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

4.5.1 Gender and Age groups mostly affected by Hazards

Table 5: Gender and age groups mostly affected by hazards

Hazard	Gender and Age mostly affected
Drought	Affects mostly women and children since most water wells dry up increasing distance for fetching water
Erosion	All age groups and gender are affected
Hailstorms Lightning	All gender and age groups Children in schools are mostly affected
Crop pests and Diseases	All gender and age groups
Livestock pests and Diseases	African swine fever affects mostly women as most pigs belong to women but overall all groups are equally affected
Human disease outbreaks	Malaria mostly women and children HIV especially prominent in girl child Diarrhea and pneumonia in children
Vermin and Wildlife animal attacks	All gender and age groups
Land conflicts	All gender and age groups
Bush fires	All gender and age groups
Environmental degradation	All gender and age groups
Road accidents	All gender and age groups

4.5.2 Coping Strategies

In response to the various hazards, participants identified a range of coping strategies that the community employs to adjust to, and build resilience towards the challenges. The range of coping strategies are broad and interactive often tackling more than one hazard at a time and the focus of the communities leans towards adaptation actions and processes including social and economic frameworks within which livelihood and mitigation strategies take place; ensuring extremes are buffered irrespective of the direction of climate change and better positioning themselves to better face the adverse impacts and associated effects of climate induced and technological hazards (Table 2).

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

No	Multi-Hazards		Coping strategies
1	Geomorphological or Geological	Landslides, Rock falls and Erosion	• Migration to safe areas • Terracing/ contour farming • Plant trees to control water movement on hill slopes • Mulching in banana plantations • Plant grass in banana plantations on hill slopes • Removal of stones from banana farmlands
2		Earthquakes and faults	• No action, communities think the tremors are minor
3	Climatological or Meteorological	Floods	• Digging up of trenches in the flood plains • Planting trees to control water movement to flood plains • Migration to other areas • Seek for government food aid
4		Drought	• Leave wetlands as water catchments • Plant trees as climate modifiers • Buy food elsewhere in case of shortage • Buy water from the nearby areas • Food Storage especially dry grains • Construction of Dams and Valley tanks • Adoption of climate smart agriculture
5		Strong winds, Hailstorms and Lightning	• Plant trees as wind breakers • Use of stakes against wind in banana plantations • Use of ropes to tire banana against wind • Installation of Lightning conductors • Stay indoors during rains • Changing building designs and roof types • Removal of destroyed crops • Request for aid from the Office of the Prime Minister • Installation of Lightning conductors on newly constructed schools

6	Ecological or Biological	Crop pests and Diseases	• Spraying pests • Cutting and burying BBW affected crops • Burning of affected crops • Vigilance • Sensitization of farmers
7		Livestock pests and Diseases	• Spraying pests • Vaccinations • Burying animals that have died from infection • Quarantine • Sensitization of farmers
8		Human epidemic Diseases	• Mass immunisation • Visiting health centres • Use of mosquito nets • Routine sensitizations
9		Vermin and Wild-life animal attacks	• Guarding the gardens • Poisoning • Hunt and kill • Report to UWA and Vermin Officer • Plant red pepper • Dig trenches around garden
10		Invasive species	• Uproot • Cut and burn • Sensitization on Invasive species management • Spray with herbicides
11	Human induced or technological	Land conflicts	• Community dialogues • Report to court • Migration
12		Bush fires	• Stop the fires in case of fire outbreak • Fire lines (may be constructed, cleared grass) • Fire breaks planted along gardens e.g. euphorbia spp. • Vigilance especially in dry seasons where most burning is done • Popularise the use of fire beaters • Set up by laws
13		Road accidents	• Construction of humps • New road has Signage including speed limits • Sensitisation
14		Environmental degradation	• Leave wetlands as water catchments • Plant trees as climate modifiers • Sensitization

GENERAL CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

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

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

Hazards experienced in Kiboga District can be classified as:

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

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

  iii. Ecological or Biological hazards including crop pests and diseases, livestock pests and diseases, human disease outbreaks, vermin and wildlife animal attacks and invasive species.

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

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

  i.   Reducing the impact of the hazard where possible through; mitigation, prediction, 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.

5.2 Policy-related Recommendations

The following recommended policy actions targeting vulnerability reduction include:

  i.   The government should improve enforcement of policies aimed at enhancing sustainable environmental health.

ii.   The government through MAAIF should review the animal diseases control act because of low penalties given to defaulters.

iii.   The government should establish systems to motivate support of political leaders toward government initiatives and programmes aimed at disaster risk reduction.

iv.   The government should increase awareness campaigns aimed at sensitizing farmers/ communities on disaster risk reduction initiatives and practices.

v.   The government should revive disaster committees at district level and ensure funding of disaster and environmental related activities.

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

vii.   The government through MAAIF and the District Production should promote drought and disease resistant crop seeds.

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

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

x.   The government through MWE increase funding and staff to monitor wetland degradation and non-genuine agro-inputs.

xi.   The government through OPM should improve communication between the disaster department and local communities.

xii.   The government through MWE should promote Tree planting along road reserves.

xiii. The government through MAAIF should fund and recruit extension (facilitate them) works at sub-county level.

References

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APPENDIX I: DATA COLLECTION TOOLS

Key informant interview at Kiboga district Production Office

Focus group discussion at Dwaniro Sub-county

FOCUS GROUP DISCUSSION GUIDE FOR DISTRICT DISASTER RISK MANAGEMENT FOCAL PERSONS

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

No.	Name of Participants	Designation	Contact	Signature

Introduction

i. You have all been requested to this session because we are interested in learning from you. We appreciate your rich experiences and hope to use them to strengthen service delivery across the district and the country as whole in a bid to improve access to information on Hazards and early warning.

ii. There is no "right" or "wrong" answers to any of the questions. As a Focus Group Discussion leader, I will try to ask all people here today to take turns speaking. If you have already spoken several times, I may call upon someone who has not said as much. I will also ask people to share their remarks with the group and not just with the person beside them, as we anxious to hear what you have to say.

iii. This session will be tape recorded so we can keep track of what is said, write it up later for our report. We are not attaching names to what you have to what is said, so whatever you say here will be anonymous and we will not quote you by name.

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

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

1. Which crops are majorly grown in your area of jurisdiction?

2. Which domestic animals are dominant in your area of jurisdiction?

3. What challenges are faced by farmers in your area of jurisdiction?

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

5. Which villages, parishes or sub-counties have been most affected by landslide and rock falls?

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

7. Which crops are majorly affected by landslides and rock falls in your area of jurisdiction?

8. In which way are the crops affected by landslides and rock falls?

9. Which domestic animals are majorly affected by landslides and rock falls in your area of jurisdiction?

10. In which way are the domestic animals affected by landslides and rock falls?

11. Which agricultural practices are being adopted by farmers in a bid to mitigate the above challenges?

12. What are the relevant government's interventions focusing at helping farmers mitigate the challenges mentioned?

13. Do you have any earth faults or earth cracks as lines of weakness in your area of jurisdiction?

14. Have you experienced any earth quakes in the past 10 years in your area of jurisdiction?

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

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

17. What impacts have been caused by earth quakes?

18. To what extent have the earth quakes affected livelihoods of the local communities in your area of jurisdiction?

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

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

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

21. Have you experienced floods in the past 10 years in your area of jurisdiction?

22. Which villages, parishes or sub-counties have been most affected by floods?

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

24. Which crops are majorly affected by floods in your area of jurisdiction?

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

26. Which domestic animals are majorly affected by floods in your area of jurisdiction?

27. In which way are the domestic animals affected by floods?

28. Which agricultural practices are being adopted by farmers in a bid to mitigate the above challenges?

29. What are the relevant government's interventions focusing at helping farmers mitigate the challenges mentioned?

30. Have you experienced drought in the past 10 years in your area of jurisdiction?

31. Which villages, parishes or sub-counties have been most affected by drought?

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

33. Which crops are majorly affected by drought in your area of jurisdiction?

34. In which way are crops affected by drought?

35. Which domestic animals are majorly affected by drought in your area of jurisdiction?

36. In which way are the domestic animals affected by drought?

37. Which agricultural practices are being adopted by farmers in a bid to mitigate the above challenges?

38. What are the relevant government's interventions focusing at helping farmers mitigate the challenges mentioned?

39. Have you experienced hailstorms or Lightning in the past 10 years in your area of jurisdiction?

40. Which villages, parishes or sub-counties have been most affected by hailstorms or lightning?

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

42. What impacts have been caused by hailstorms or lightning?

43. To what extent have the hailstorms or Lightning affected livelihoods of the local communities in your area of jurisdiction?

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

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

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

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

47. Which villages, parishes or sub-counties have been most affected by epidemic animal disease

outbreaks?

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

49. Specify the epidemic animal disease outbreaks that have majorly affected animals in your area of jurisdiction?

50. Which domestic animals are majorly affected by epidemic animal disease outbreaks in your area of jurisdiction?

51. In which way are the domestic animals affected by epidemic animal disease outbreaks?

52. Which mitigation practices are being adopted by farmers in a bid to mitigate the above epidemic animal disease outbreaks?

53. What are the relevant government's interventions focusing at helping farmers mitigate the epidemic animal disease outbreaks mentioned?

54. Have you experienced any crop pests and disease outbreaks in the past 10 years in your area of jurisdiction?

55. Which villages, parishes or sub-counties have been most affected by epidemic animal disease outbreaks?

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

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

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

59. In which way are the crops affected by crop pests and disease outbreaks?

60. Which mitigation practices are being adopted by farmers in a bid to mitigate the above crop pests and disease outbreaks?

61. What are the relevant government's interventions focusing at helping farmers mitigate the crop pests and disease outbreaks mentioned?

62. Have you experienced any epidemic human disease outbreaks in the past 10 years in your area of jurisdiction?

63. Specify the epidemic human disease outbreaks that have majorly affected animals in your area of jurisdiction?

64. In which way are the humans affected by epidemic human disease outbreaks?

65. Which mitigation measures have been adopted by local communities in a bid to mitigate the above epidemic human disease outbreaks?

66. What are the relevant government's interventions focusing at helping local communities mitigate the epidemic human disease outbreaks mentioned?

67. Do you have any national park or wildlife reserve in your area of jurisdiction?

68. Have you experienced wildlife attacks in the past 10 years in your area of jurisdiction?

69. Which particular villages, parishes or sub-counties have been majorly affected by wildlife attacks in your area of jurisdiction?

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

71. What impacts have been caused by wildlife attacks?

72. To what extent have the wildlife attacks affected livelihoods of the local communities in your area of jurisdiction?

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

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

75. Are there invasive species in your area of jurisdiction?

76. Specify the invasive species in your area of jurisdiction?

77. Which villages, parishes or sub-counties have been most affected by invasive species in your area of jurisdiction?

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

79. Which crops or animals are majorly affected by invasive species in your area of jurisdiction?

80. In which way are the crops or animals affected by invasive species?

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

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

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

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

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

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

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

87. What impacts have been caused by environmental degradation?

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

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

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

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

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

93. What impacts have been caused by land conflicts?

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

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

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

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

98. Which roads have experienced Road accidents?

99. What impacts have been caused by Road accidents?

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

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

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

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

104. Which particular villages, parishes or sub-counties have been majorly affected by bush and or forest fires in your area of jurisdiction?

105. As a way of ranking from Low, Medium, High and Very high, rank the villages, parishes or sub-

counties that have been most affected?

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

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

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

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

FOCUS GROUP DISCUSSION GUIDE FOR LOCAL COMMUNITIES

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

No.	Name of Participants	Village/ Parish	Contact	Signature

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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?

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11. Which agricultural practices are being adopted by farmers in a bid to mitigate the above challenges?

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13. Do you have any earth faults or earth cracks as lines of weakness in your community?

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76. Specify the invasive species in your community?

77. Which villages and parishes have been most affected by invasive species in your community?

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

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

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

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98. Which roads have experienced Road accidents?

99. What impacts have been caused by Road accidents?

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

community?

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

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

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

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

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

106. To what extent have the serious bush and or forest fires affected livelihoods of the local communities in your community?
107. Which mitigation measures have been adopted local communities in a bid to mitigate the above challenges?

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

FOCUS GROUP ATTENDANCE LIST FOR DISTRICT DISASTER RISK MANAGEMENT FOCAL PERSONS

Name of Participant	Designation	Contact
1. Karuhogo Emmanuel	Senior Environment Officer	0772389745
2. Akudo Patrick	District Agricultural Officer	0772565982
3. Dr. Atikoro J.	District Production Officer	0772897150

FOCUS GROUP DISCUSSION ATTENDANCE LIST FOR LOCAL COMMUNITIES

Name of Participant	Village/Parish	Contact
1. Isabirye Mathias	Kawanda	0785492000
2. Nakiyingi Monica	Kawanda	0774129671
3. Arinaitwe Christine	Kawanda	0782321343
4. Nassazi Annet	Kawanda	0774617276
5. Ssekanjakko Ibrahim	Lwamata	0779206634
6. Nakkazi Coster	Kasejjere	0782566050
7. Maseruka David	Ssinde	0774158300
8. Wamala Vincent	Kisweeka	0776058169
9. Sensalire Joseph	Mataagi	0751980539
10. Sserunjogi Siraje	Dwaniro	0701650260
11. Kakuru Wilson	Dwaniro	0753795300
12. Rurungi Robert	Dwaniro	0783883143
13. Mazungu Moses	Dwaniro	0777070046
14. Ndyabagye Alex	Dwaniro	0781108696
15. Nabukenya Zaamu	Dwaniro	0777760155
16. Mwiine Emmanuel	Dwaniro	0789998883

17. Rwamazuuru James	Dwaniro	0782580374
18. Musole Sam	Dwaniro	0756228320
19. Senyonjo Edmond	Kiboga Ward	0774985511
20. Kirunda Moses	Kiboga Ward	0782303352
21. Nnannyana Josephine	Kiboga Ward	0774726083

Name of Participant	**Village/Parish**	**Contact**
22. Kabuye Martin	Bamusuuta	0772630752
23. Mbaziira Merab	Kiboga Ward	0782558371

SPATIAL DATA COLLECTION SHEET FOR HAZARD VULNERABILITY AND RISK MAPPING

| Observer Name:

Date: | District:

Sub- county:

Parish:

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

Area Description (Susceptibility ranking: landslide, mudslide, erosion, flooding, drought, hailstorms, lightning, cattle disease outbreaks, human disease outbreaks, land conflicts, wildlife conflicts, bush fires, earthquakes, faults/ cracks, pictures, any other sensitive features)

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

THE REPUBLIC OF UGANDA

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