



THE REPUBLIC OF UGANDA

Kisoro 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 Management Officer and the team of consultants (GIS/DRR specialists); Dr. Bernard Barasa, and Mr. Nsiimire Peter, who provided technical support.

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

My appreciation also goes to Kisoro 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, to floods, landslides, human and animal disease, pests, animal attacks, earthquakes, fires, conflicts etc. Stakeholder engagements were done through Focus Group Discussions (FGDs) and key informant interviews guided by checklist tools (Appendix I). At district level Key Informants included District Agricultural Officer, District Fisheries Officer and Extension Officers while at sub-county level key informants included: Sub-county and parish chiefs, community Development mobilizers and health workers.

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

Participatory GIS

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

Geo-referencing and ground-truthing

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

Data analysis and integration

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

Data verification and validation

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 Kisoro district were classified as:

- Geomorphological or Geological hazards including landslides, rock falls, soil erosion and earthquakes.
- 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 Kisoro district has over the past two decades increasingly experienced hazards including landslides, rock falls, soil erosion, floods, drought, hailstorms, strong winds, lightening, crop pests and diseases, livestock pests and diseases, human disease outbreaks, vermin, wildlife animal attacks, invasive species, bush fires, road accidents and land conflicts putting livelihoods at increased risk. Landslides and floods were identified as most serious problems in Kisoro district with almost all sub-counties being vulnerable to the hazards. This is due to its rugged terrain with a slope percentage rise (20+) which makes it vulnerable to landslides, 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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LIST OF ACRONYMS

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



DEFINITION OF KEY TERMS

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

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

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

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

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

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

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

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

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

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

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

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

INTRODUCTION

1.1 Background

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

Since 2013, 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 Kisoro district in Southwestern 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 Kisoro District, Southwestern Uganda.

1.2.2 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 Kisoro 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 Kisoro District. Section 3 focuses on the methodology employed. Section 4 elaborates the Multi-hazard, Risks and Vulnerability profile and Coping strategies for Kisoro district. Section 5 describes Conclusions and policy related recommendations.

OVERVIEW OF KISORO DISTRICT

2.1 Location

Kisoro District is located in the extreme South Western Uganda and forms the meeting point of the three countries of Uganda, Democratic Republic of Congo (DRC) and Rwanda. The District lies between longitudes 29° 35" and 29° 50" East and latitudes 1° 44" 1° 23" South. It is bordered by the Republic of Rwanda to the South, the Democratic Republic of Congo to the West, Kanungu District to the North and Kabale District to the East. It has 13 sub-counties and 1 Town Council namely; Bukimbiri, Busanza, Chahi, Kanaba, Kirundo, Muramba, Murora, Nyabwishenya, Nyakabande, Nyakinama, Nyarubuye, Nyarusiza and Nyundo sub-counties and Kisoro Town Council (Figure 1).

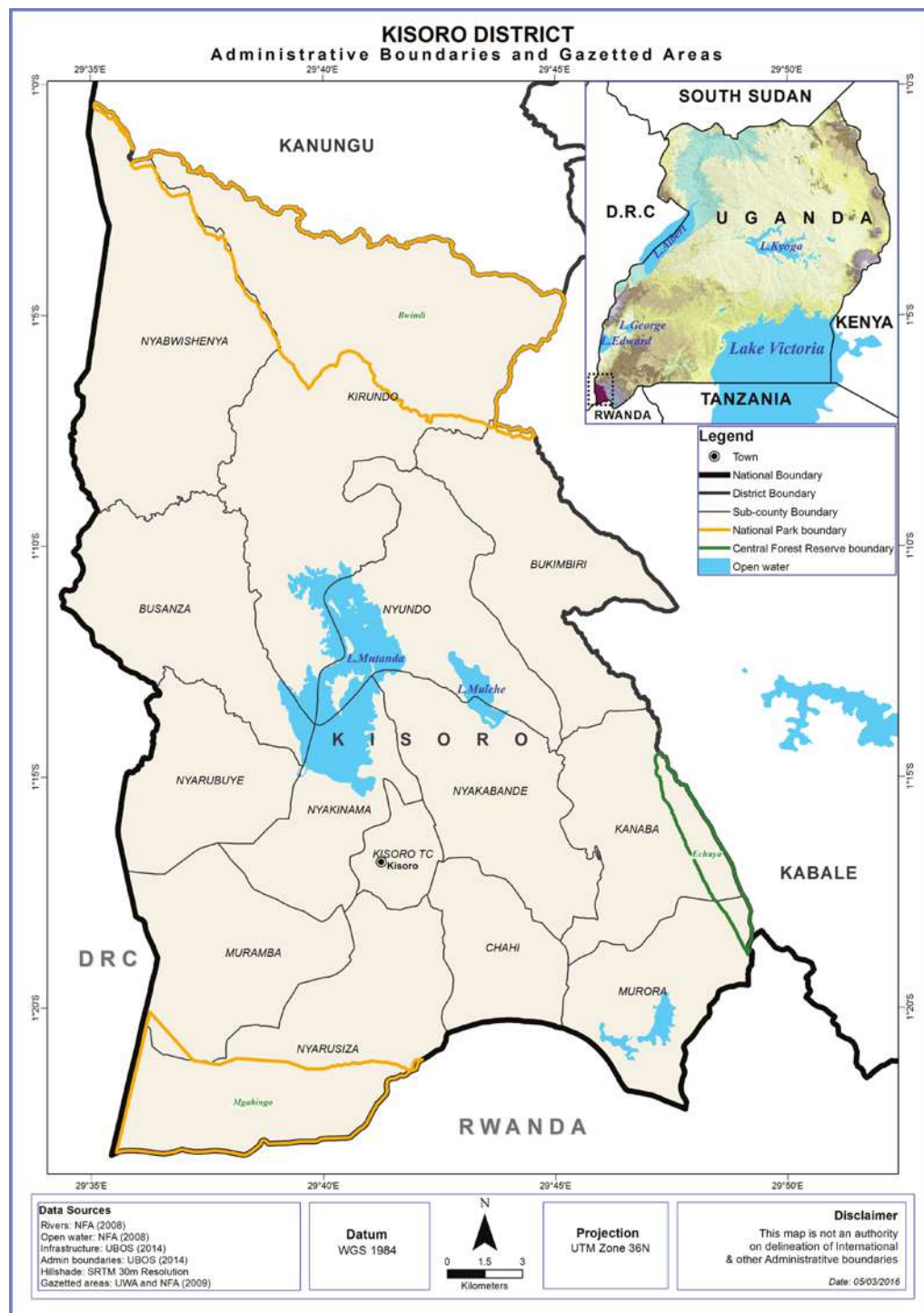


Figure 1: Administrative Boundaries and Gazetted areas, Kisoro District

2.1.1 Geomorphology

The District lies on an average altitude of 1,981m above sea level and can be categorized into two topographical zones, the southern lowlands and the northern highlands. The southern part, which is lowland, is interrupted by the volcanic ranges of Muhabura (4127m), Mgahinga (3475m) bordering the republic of Rwanda and Sabyinyo (3645m) bordering Democratic Republic of Congo. The Northern part is predominantly hilly with very steep slopes and narrow valleys (Figure 2).

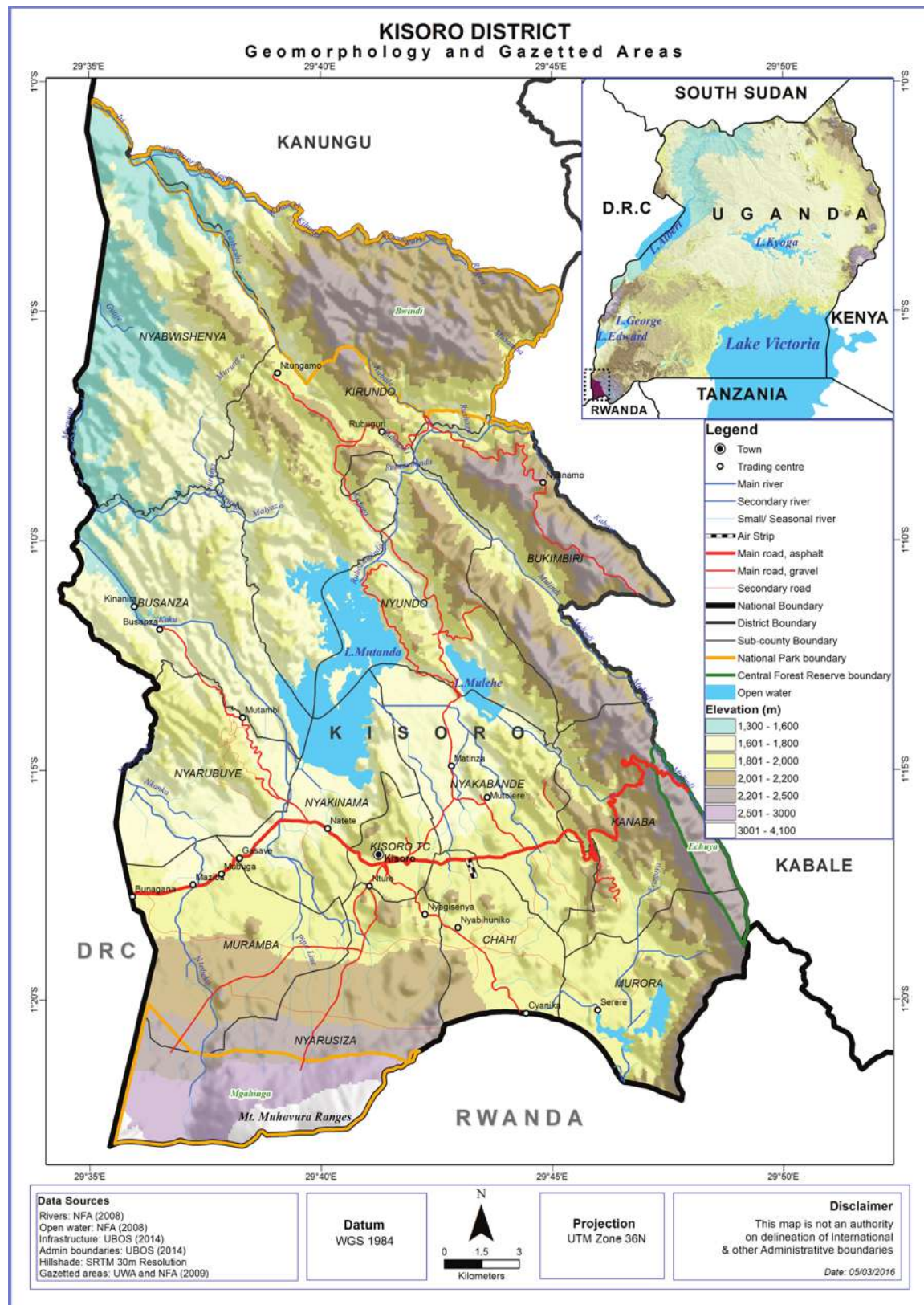


Figure 2: Geomorphology, Kisoro District

2.1.2 Geology and soils

Four main soil types characterize the district including ferraltic, eutrophic, non-hydromorphic and papyrus peat soils (Figure 3). These soils were formed as a result of geological and geomorphological process. The soils are fertile. They can support and sustain high populations if soil fertility management and soil and water conservation practices are employed.

Ferraltic soils

These are deep soils very old with poor fertility, as they also have a weak soil structure and are generally found on hill slopes of Nyabwishenya, Busanza, Bukimbiri, Kirundo and some parts of Nyarubuye.

Eutrophic soils

These are soils of volcanic origin and have a high potential for agricultural production when they are not exhausted. Their natural fertility is high because of the nutrients found in the parent material. This type is commonly found in the southern part of the district including Chahi, Nyakabande, Muramba, Murora, Nyarusiza, Nyakinama, and Nyarubuye sub counties.

Non-hydromorphic soils

These are very productive with high humus content when properly managed. They have a high water holding capacity but are easily affected by drought. These are predominantly found around Mount Sabyinyo.

Papyrus peat soils

These are wetland soils containing peat derived from humified residues of swamp plants, mainly papyrus mixed with fairly high proportions of clay sediments derived from the steep hill slopes bordering the valleys. Papyrus peat soils are mainly found in Bukimbiri, Busanza, Murora, Kirundo, Nyundo, part of Nyarubuye, Nyakinama and Nyakabande sub counties.

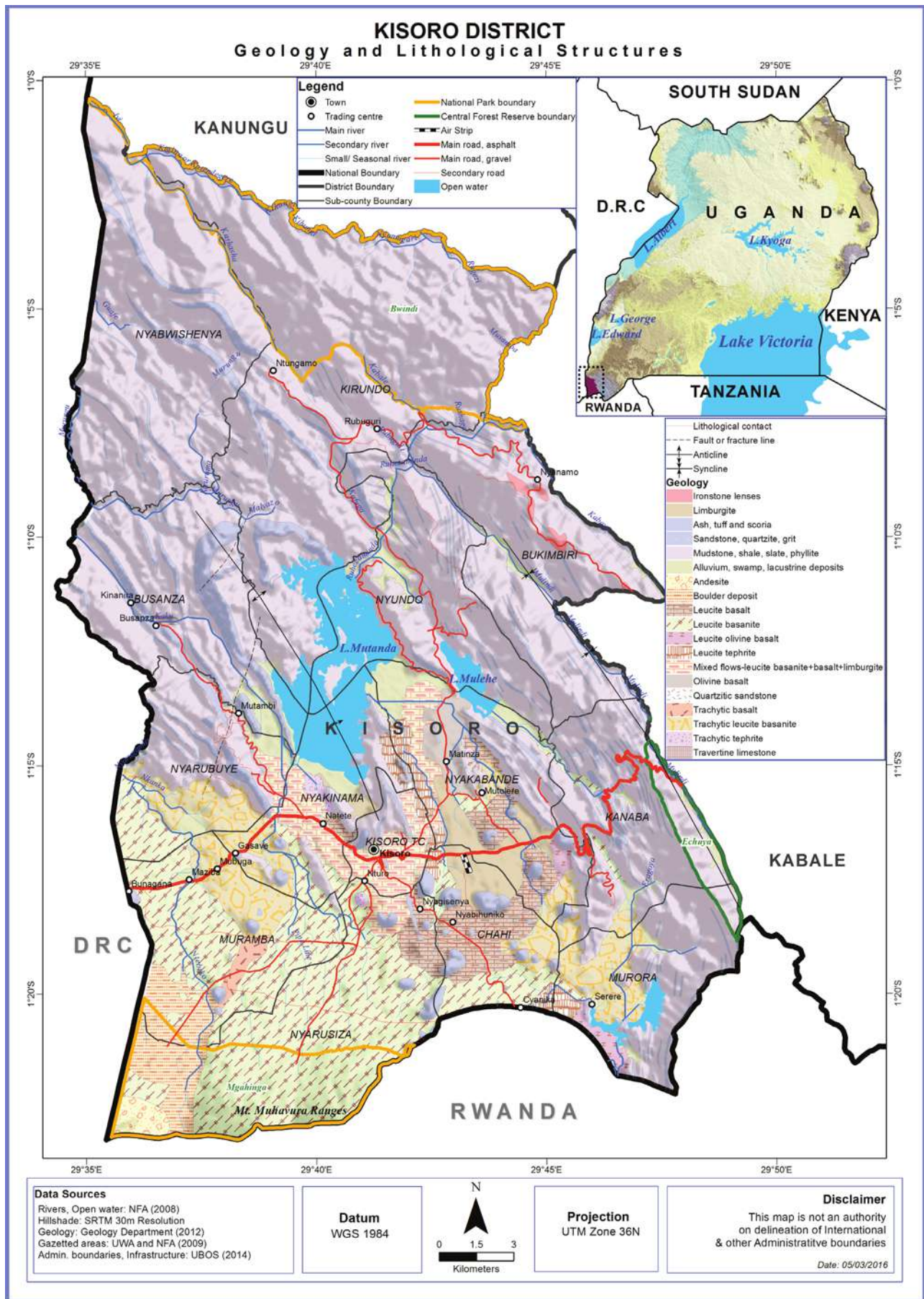


Figure 3: Geology and Lithological Structures, Kisoro District

2.1.3 Vegetation and Land use Stratification

According to Kisoro DEAP (2002), most of the vegetation cover was probably dominated by the forests in the past. However, these have been cleared as a result of the high population pressure. Remnants of these are found only in the protected areas of Bwindi Impenetrable National Park (BINP), Mgahinga Gorilla National park (MGNP) and Echuya forest reserve (Figure 4). The district has three characteristic vegetation zones;

High altitude forest (moist montane)

This is where we find the volcanic soils of Mgahinga: Gorilla National Park. The forest is not pure stand but rather interspersed with Bamboo (*Arundinaria alpina*) shoots of which form 60% of the food for the gorillas. The bamboo zone of Echuya forest reserve is found at exceptionally low altitudes where it represents a colonizing community.

Forest /Savanna Mosaic

This is found at altitudes of 2100-3000m above sea level. These are mainly remnants of previous moist montane forest with gradual links to savanna and woody shrub patches at lower levels towards the central plains. This vegetation has suffered a lot of encroachment as a result of human activities. Grass species abundant in this Mosaic are *Pennisetum purpureum*, *Hyperhenia* spp. and *Themeda triandra*.

Swamp forest and wetlands

Swamp forests are of two types namely the permanent swamp forest where water does not dry up even in the dry seasons and the seasonal swamps that dry up at certain times. Forrest swamps are dominant in the Nyakinama, Nyabwishenya, and Murora, Kirundo, Busanza and Nyakabande sub-counties.

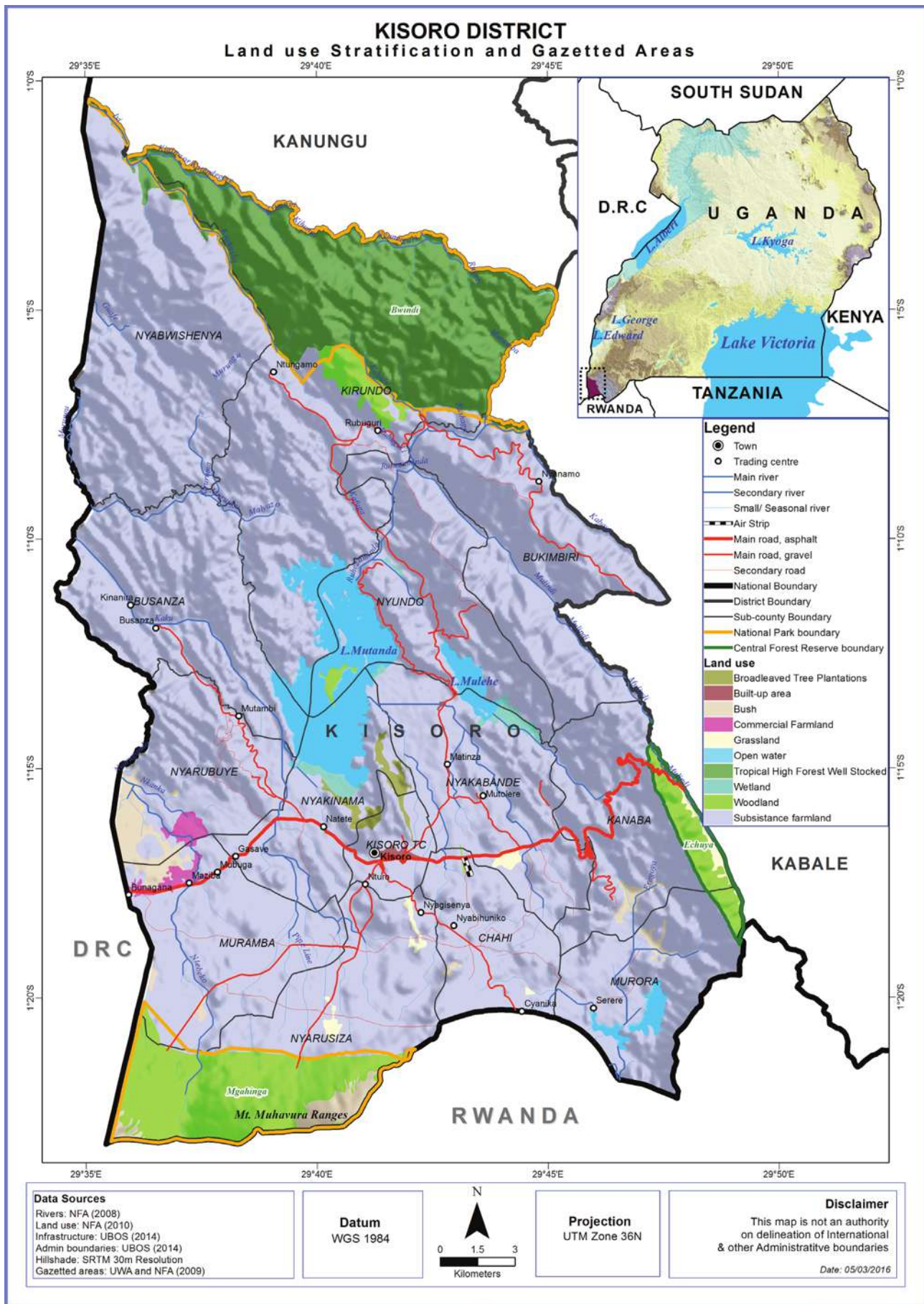


Figure 4: Land use stratification, Kisoro District

2.1.4 Temperature and Humidity

Kisoro district is at high altitude, hence having relatively low temperatures. The mean maximum temperature of 23°C - 25°C in the dry season and mean minimum temperature 9.7 - 12.6°C and relative humidity between 80% and 90% that falls to about 40% in the dry season.

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 Kisoro. 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 99 days at 0600 hours, and 27 days at 1200 hours, respectively, at Kisoro. The general conclusion from these climatic figures is that for most of the year, Kisoro district experiences moderate to strong and gusty winds, increasing in the afternoon.

2.1.6 Rainfall

Rain fall determines the planting periods, therefore with two rainy seasons in Kisoro district, there are two planting seasons. Two rainy seasons are experienced between January and May, first rainy season and second rainy season between August and December (Figure 5). The district experiences extreme weather conditions usually termed La Nina and El nino phenomena. The impact of this being crop failure and fluctuations in levels of surface and ground water.

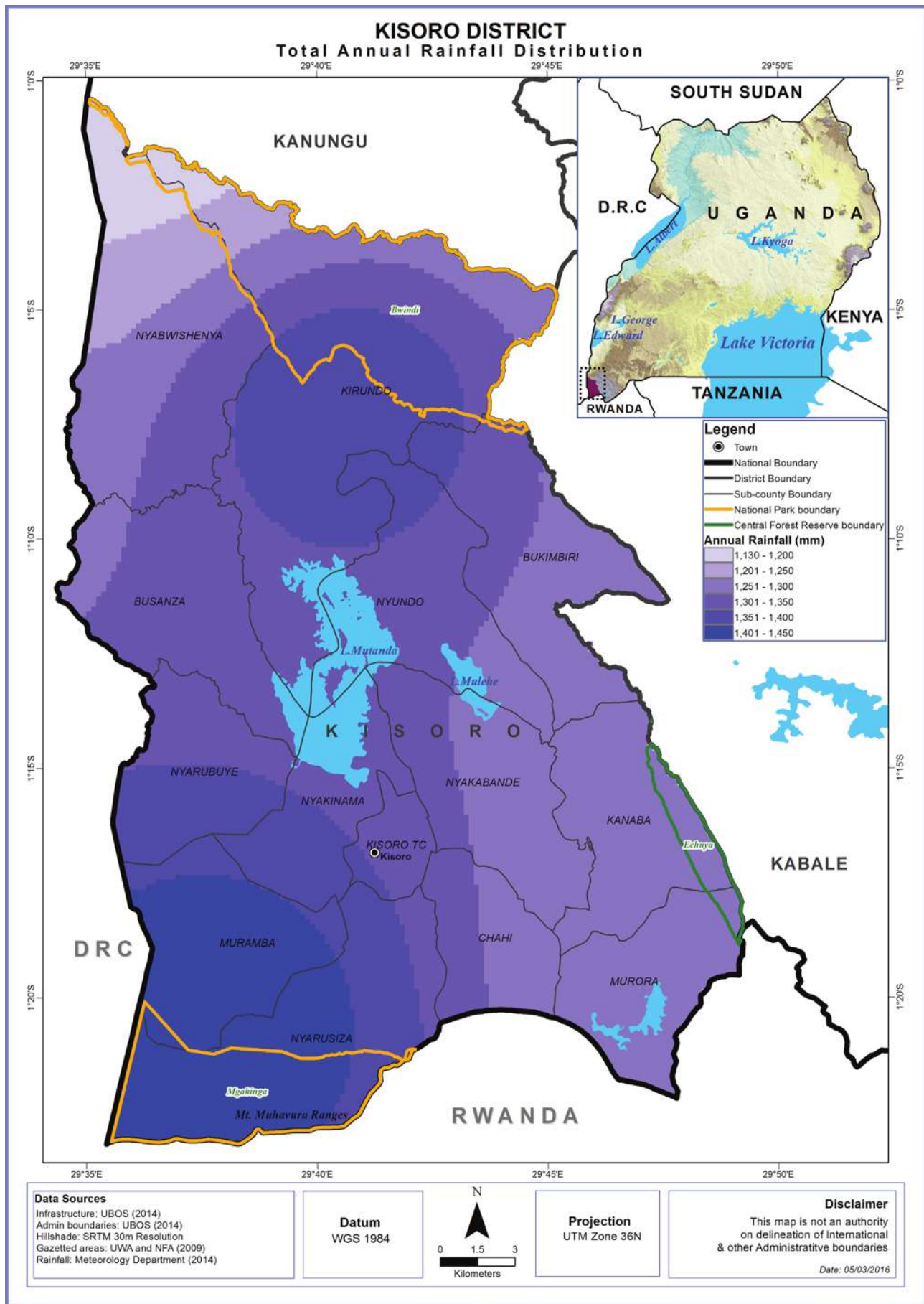


Figure 5: Total Annual Rainfall Distribution, Kisoro District

2.1.7 Hydrology

Kisoro District has both surface and underground water sources. Open water bodies and swamps cover 28.3km² (National Biomass study, 1995) and 9.8km² of the District Area respectively. The district has lakes Mutanda, Mulehe, Chahafi, Kayumbu and a Crater Lake on Mt. Muhabura. There is a network of permanent swamps, which include; Rugezi, Kabiranyuma, and Nyakagezi in the South. The Northern part has Ruhezamyenda and Murungu rivers.

2.1.8 Population

According to the National Population and Housing Census (2014) results, Kisoro District had a total population of 287,179 people. Results also showed that most of the people in Kisoro District reside in rural areas (269,618 (93.9%)) compared to (17,561 (6.1%)) who reside in urban centers. The gender distribution was reported to be males: 128,741 (44.8%) and females: 158,438 (55.2%). About 98.9% (284,031) of the population form the household population and only 1.1% (3,148) is Non-household. Muramba sub-county had the highest population of 36,355 people while Nyundo town sub-county had the least population of 13,245 people (Figure 6). Table 1 shows the population distribution per sub-county for the different gender.

Table 1: Population Distribution in Kisoro District

<i>Sub-County</i>	HOUSEHOLDS		POPULATION		
	<i>Number</i>	<i>Average Size</i>	<i>Males</i>	<i>Females</i>	<i>Total</i>
Bukimbiri	3,225	4.8	7,215	8,191	15,406
Busanza	3,976	4.5	7,649	10,320	17,969
Chahi	4,096	4.7	8,704	10,540	19,244
Kanaba	3,409	4.7	7,291	8,735	16,026
Kirundo	4,419	4.5	8,986	11,051	20,037
Kisoro Town Council	4,168	3.8	8,409	9,152	17,561
Muramba	8,457	4.3	15,385	20,970	36,355
Murora	4,233	4.6	8,497	10,803	19,300
Nyabwishenya	2,909	5.2	6,992	8,141	15,133
Nyakabande	5,783	4.5	12,126	14,363	26,489
Nyakinama	4,552	4.5	9,426	11,225	20,651
Nyarubuye	4,408	4.4	8,655	10,845	19,500
Nyarusiza	6,785	4.4	13,228	17,035	30,263
Nyundo	2,615	5.1	6,178	7,067	13,245

Source: UBOS Census 2014

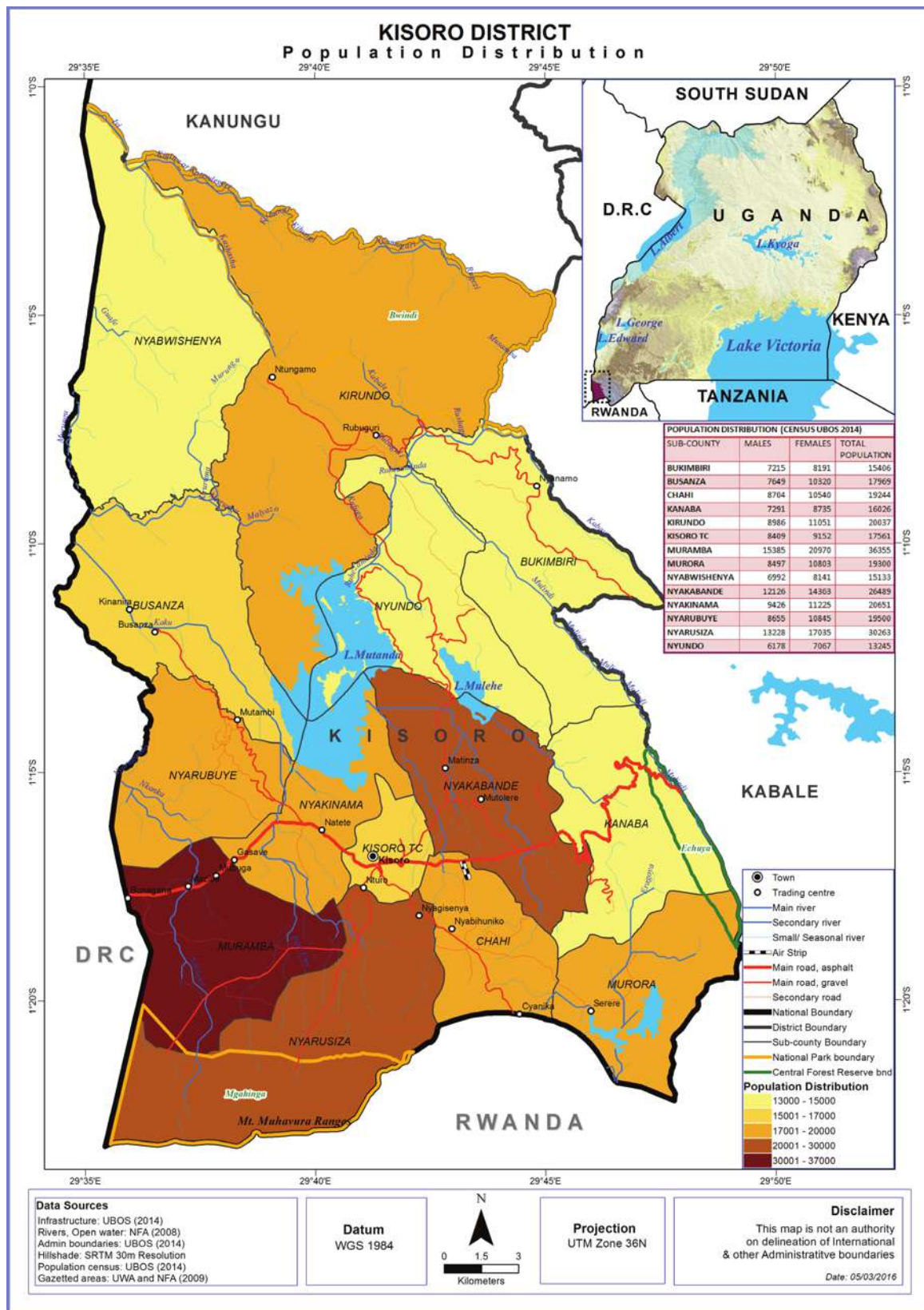


Figure 6: Population Distribution, Kisoro District

2.1.9 Economic activities

Majority of the population is mainly involved in subsistence agriculture for survival and grow crops like Irish potatoes, beans, peas, maize, sorghum, millet, wheat, sweat potatoes and also rear animals such as goats, sheep, cows, rabbit, cattle 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, to floods, landslides, human and animal disease, pests, animal attacks, earthquakes, fires, conflicts etc. Stakeholder engagements were done through Focus Group Discussions (FGDs) and key informant interviews guided by checklist tools (Appendix I). At district level, One Key Informant Interview comprising of five respondents (District Agricultural Officer, District Fisheries Officer and 3 Sub-county Extension Officers) was held at Kisoro District Headquarters (29.69799E; -1.28336S). At sub-county level Key informants included: Sub-county and parish chiefs, community Development mobilizers and health workers.

FGDs were carried out in four purposively selected sub-counties that were ranked with highest vulnerability. FGDs comprising of an average of 12 respondents (crop farmers, local leaders, nursing officers, police officers and cattle keepers) were conducted at Kanaba Sub-county (29.77300E; -1.29700S), Nyakabande Sub-county (29.75400E; -1.29200S), Nyabwishenya Sub-county (29.63500E; -1.09400S) and Kirundo Sub-county (29.68900E; -1.12600S). 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 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.

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 Kisoro district, hazards were classified following main controlling factors:

- i. Geomorphological or Geological hazards including landslides, rock falls and soil erosion
- ii. Climatological or Meteorological hazards including floods, drought, hailstorms, strong winds and Lightning
- iii. Ecological or Biological hazards including crop pests and diseases, livestock pests and diseases, human epidemic diseases, vermin attacks and wildlife animal attacks,
- iv. Human induced or Technological hazards including bush fires, road accidents land conflicts.

4.1 Geomorphological and Geological Hazards

4.1.1 Landslides, rock falls and soil erosion

Results from the participatory assessments indicated that landslides, mudslides, rock falls and soil erosion are a common occurrence in Kisoro district during the rainy season as very steep hill sides have been cultivated. In the district terraces are poorly managed and soils are always washed down into the valleys after a heavy down pour. Participants reported that landslides block roads, destroy houses and crops such as beans, maize, Irish potatoes, sweet potatoes and onions. In November 2015, landslides destroyed onion gardens and houses in Muhindura and Kagezi parishes, Kanaba sub-county. In another incident, the Kisoro – Rutaka road was blocked by landslides in December 2015. The other most affected sub-counties are; Nyarubuye, Nyakabande, Nyundo, Nyabwishenya, Kirundo and Bukimbiri landslides are a common occurrence in the rainy season as very steep hillsides have been cultivated. 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).



Plate 1: Landslides, rock falls and soil erosion hot spot in Kanaba Sub-county

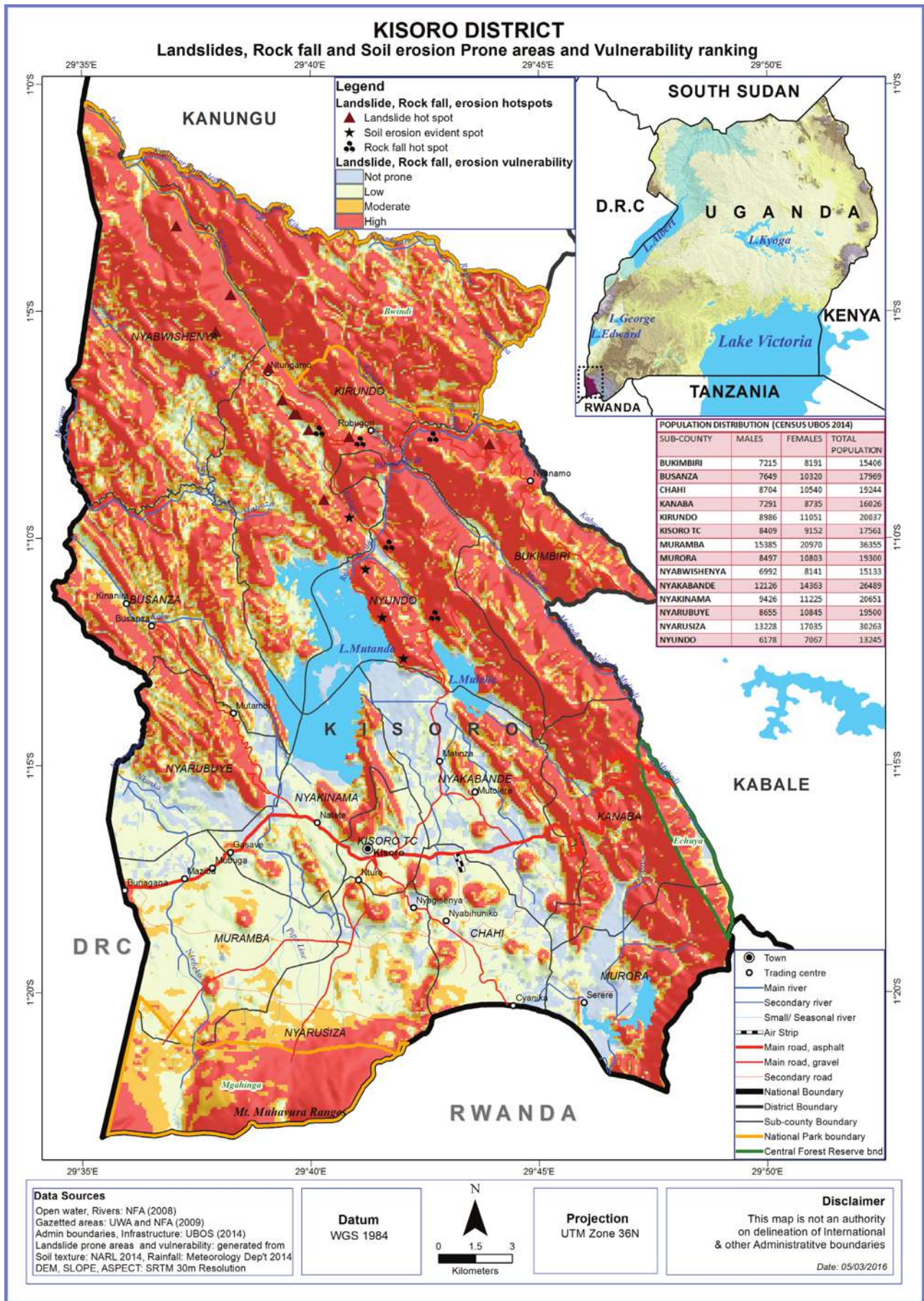


Figure 7: Landslides, rock falls and soil erosion, Kisoro District

4.1.2 Earthquakes and faults

Participants in the focus group discussions indicated that Kisoro district experiences earth tremors once or twice a year. It was observed that these earth tremors are not serious and thus do not cause any damage to houses (Figure 8).

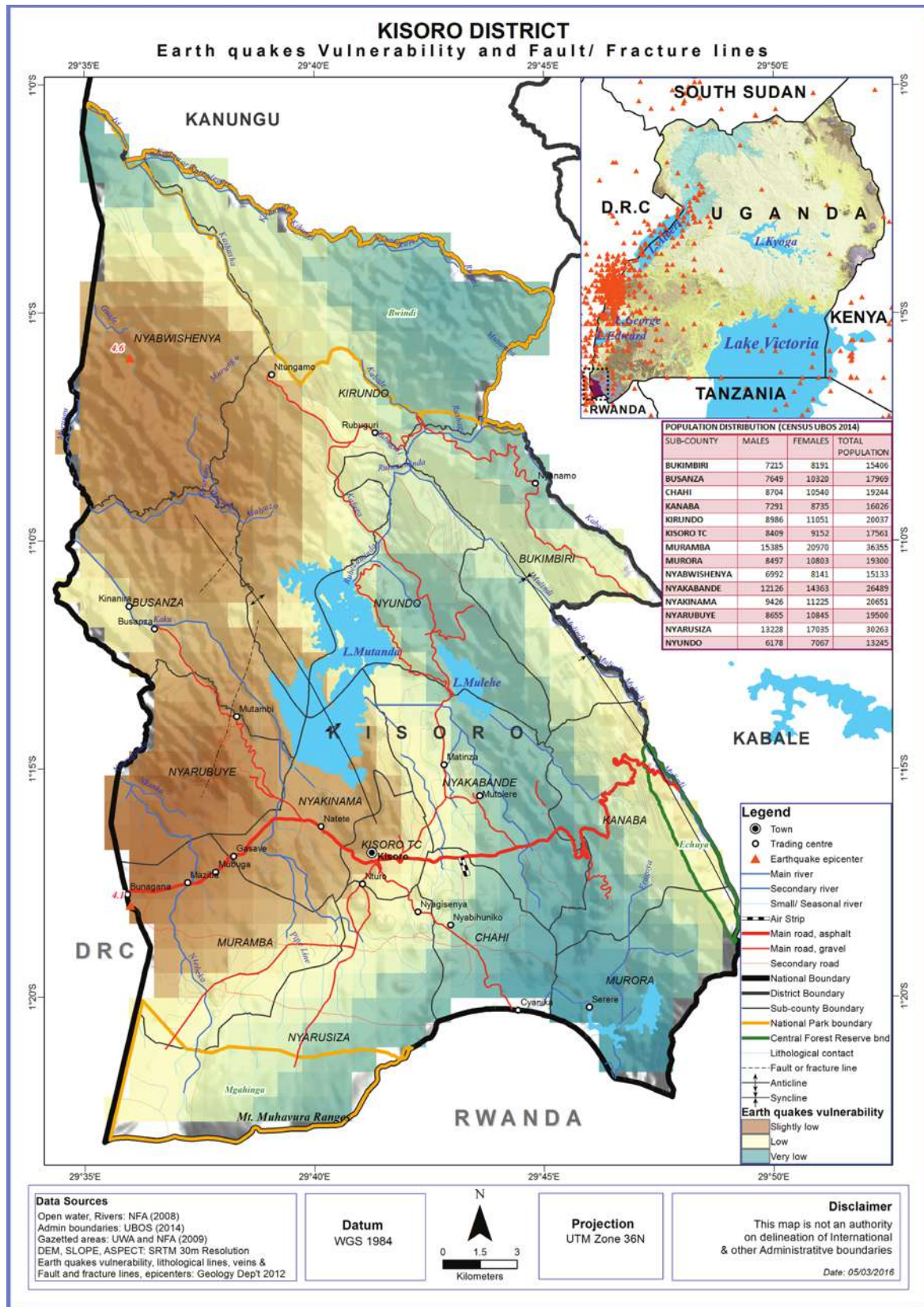


Figure 8: Earthquakes Vulnerability and Fault lines, Kisoro District

4.2 Climatological and Meteorological Hazards

4.2.1 Floods

Participants in the focus group discussions indicated that flooding in Kisoro district mainly occurs down in the valleys. Floods were reported to have increased due to heavy wetland and lakeshore degradation. It was reported that in November 2015, crops were submerged in the low land villages of Chahafi and Chibumba parishes in Murora sub-county. Participants also reported that the construction of the Kabale – Kisoro road caused excessive siltation and flooding of Kyagenje wetland in Kanaba sub-county. The culvert at Kagano has created a very deep gully as a result of soil erosion and one person died while crossing it in 2015. The other most affected sub-counties are; Busanza, Nyundo, Nyarusiza, Muramba and Nyakabande. This information was integrated with the spatial modelling using socio-ecological spatial data i.e. Soil texture (data for National Agricultural Research Laboratories – Kawanda (NARL) 2014, Rainfall (Meteorology Department 2014), Digital Elevation Model (DEM), SLOPE, ASPECT (30m resolution data from SRTM Shuttle Radar Topography Mission (SRTM) to generate flood susceptibility map (Figure 9).



Plate 2: Flooding hot spot in Kyagenje wetland, Kanaba Sub-county

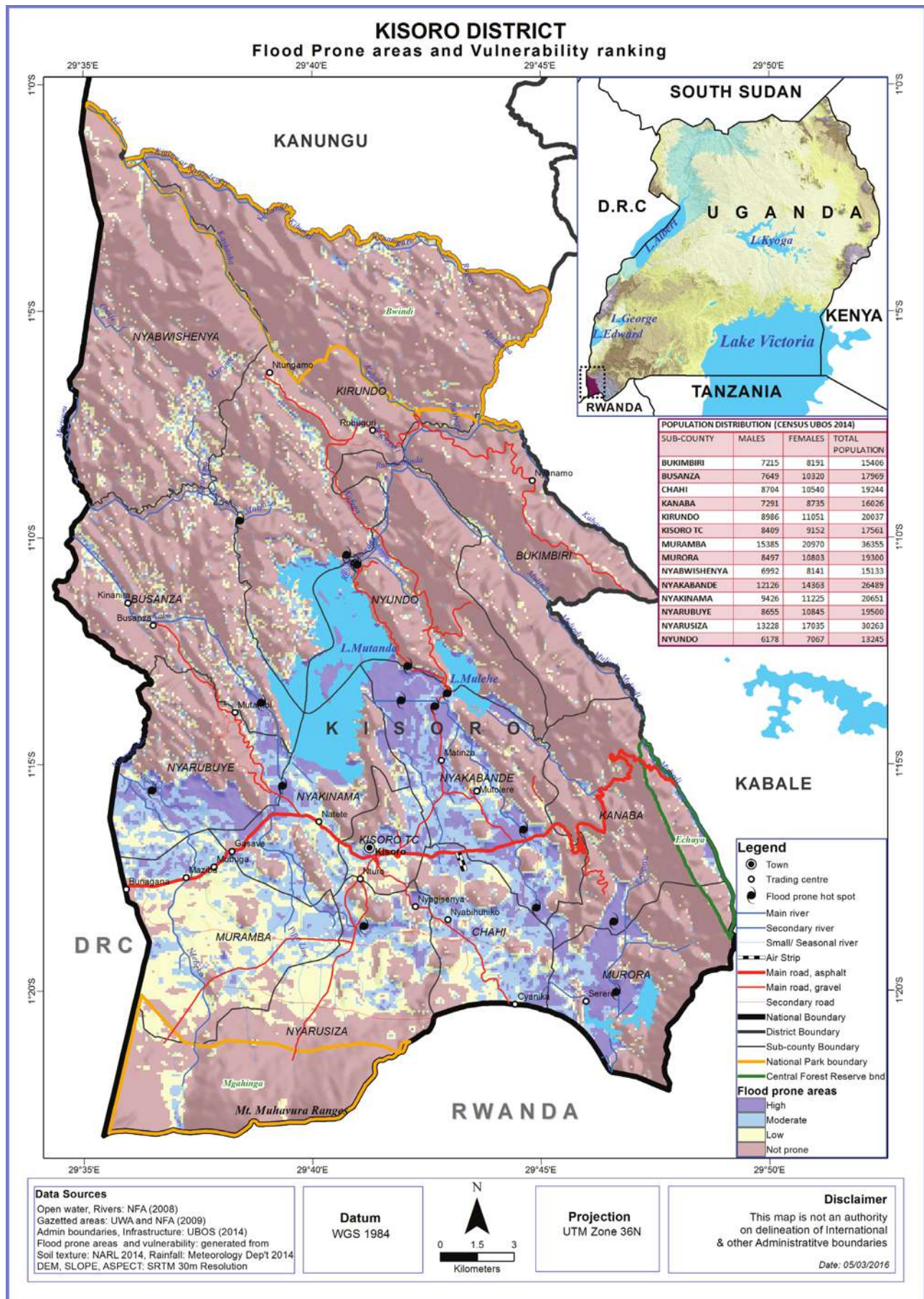


Figure 9: Flood Prone Areas and Vulnerability Ranking, Kisoro District

4.2.2 Drought

Results from participatory assessments indicated that droughts in form of dry spells without rain used not to be a serious problem Kisoro district. However, of recent there have been changes in weather patterns in the district due to human activities like deforestation and conversion of wetlands into agricultural land. Crops such as onions, climbing beans and cabbages are affected by these dry spells. This information was integrated with spatial modelling using socio-ecological spatial data i.e. Rainfall and Temperature (Uganda National Meteorological Authority, 2014) using the Standardized Precipitation Index (SPI) to generate drought vulnerability map (Figure 10).

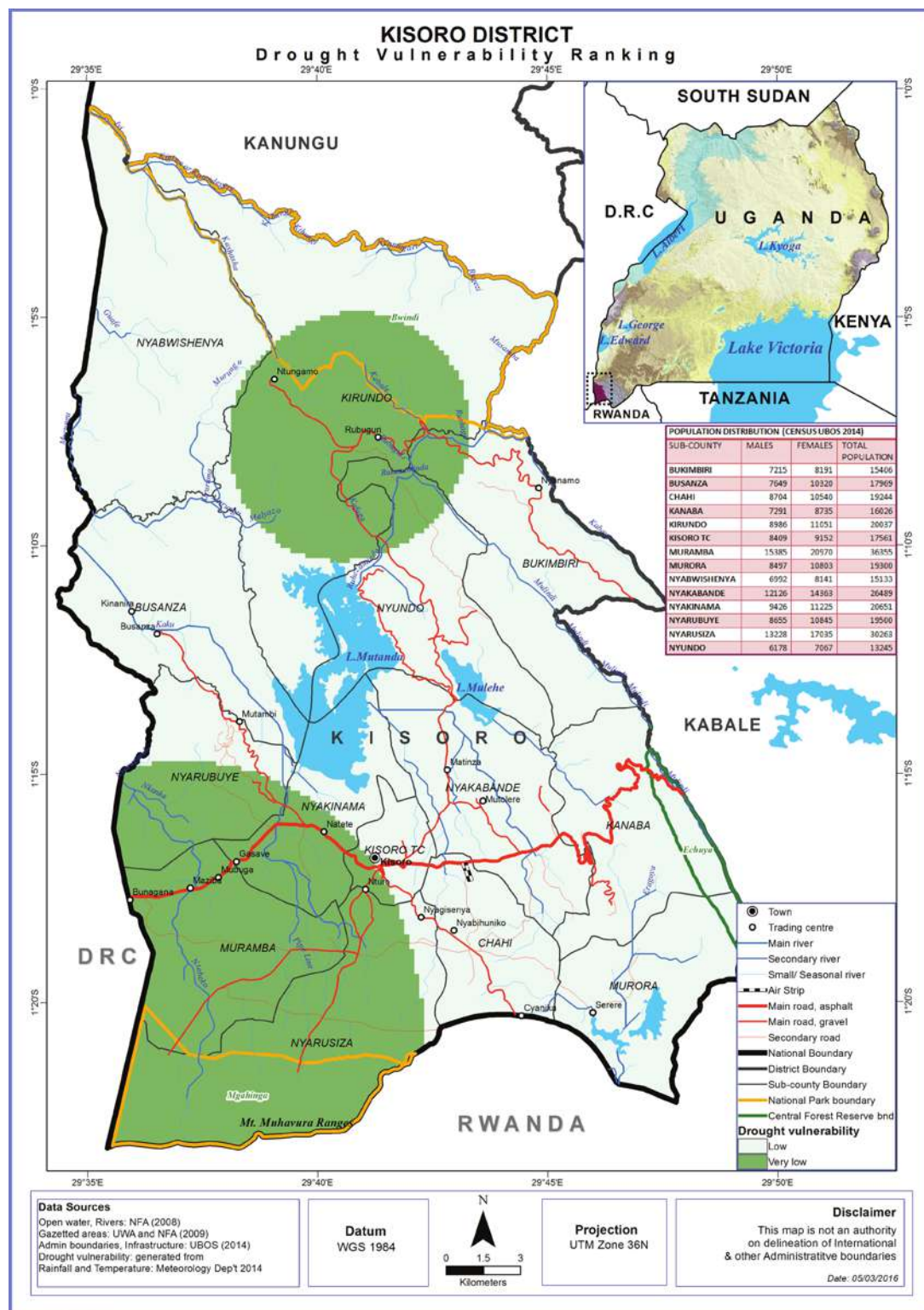


Figure 10: Drought Vulnerability Ranking, Kisoro District

4.2.3 Hailstorms

Participatory assessments through the focus group discussions indicated that hailstorms are experienced during heavy rains. It was reported that hailstorms are a common occurrence in the sub-counties of Nyarusiza, Nyakinama, Muramba, Nyakabande and Busanza. Participants observed that hailstorms destroy crops including bananas, beans, sweet potatoes, cassava, Irish potatoes and maize (Figure 11).

4.2.4 Strong winds

Results from participatory assessments showed that strong winds occur in the rainy seasons. Participants reported that strong winds blow off roof tops of houses and schools and cause logging of banana plantations and tree falls. The most affected sub-counties are; Nyarusiza, Nyakinama, Muramba, Nyakabande and Busanza (Figure 11).

4.2.5 Lightning

Lightning is a sudden high-voltage discharge of electricity that occurs within a cloud, between clouds, or between a cloud and the ground. The distribution of lightning on Earth is far from uniform. The ideal conditions for producing lightning and associated thunderstorms occur where warm, moist air rises and mixes with cold air above. Participants indicated that Lightning was a common occurrence in Kisoro district. It is reported that of recent in 2015, 2 people were killed by Lightning in Bigina village, Kisoro town council. Another incident happened in December 2014 when 5 children were killed by Lightning in Gisasa village, Kanaba sub-county. 1 person was also killed by Lightning in Bunagana parish, Muramba sub-county (Figure 11).

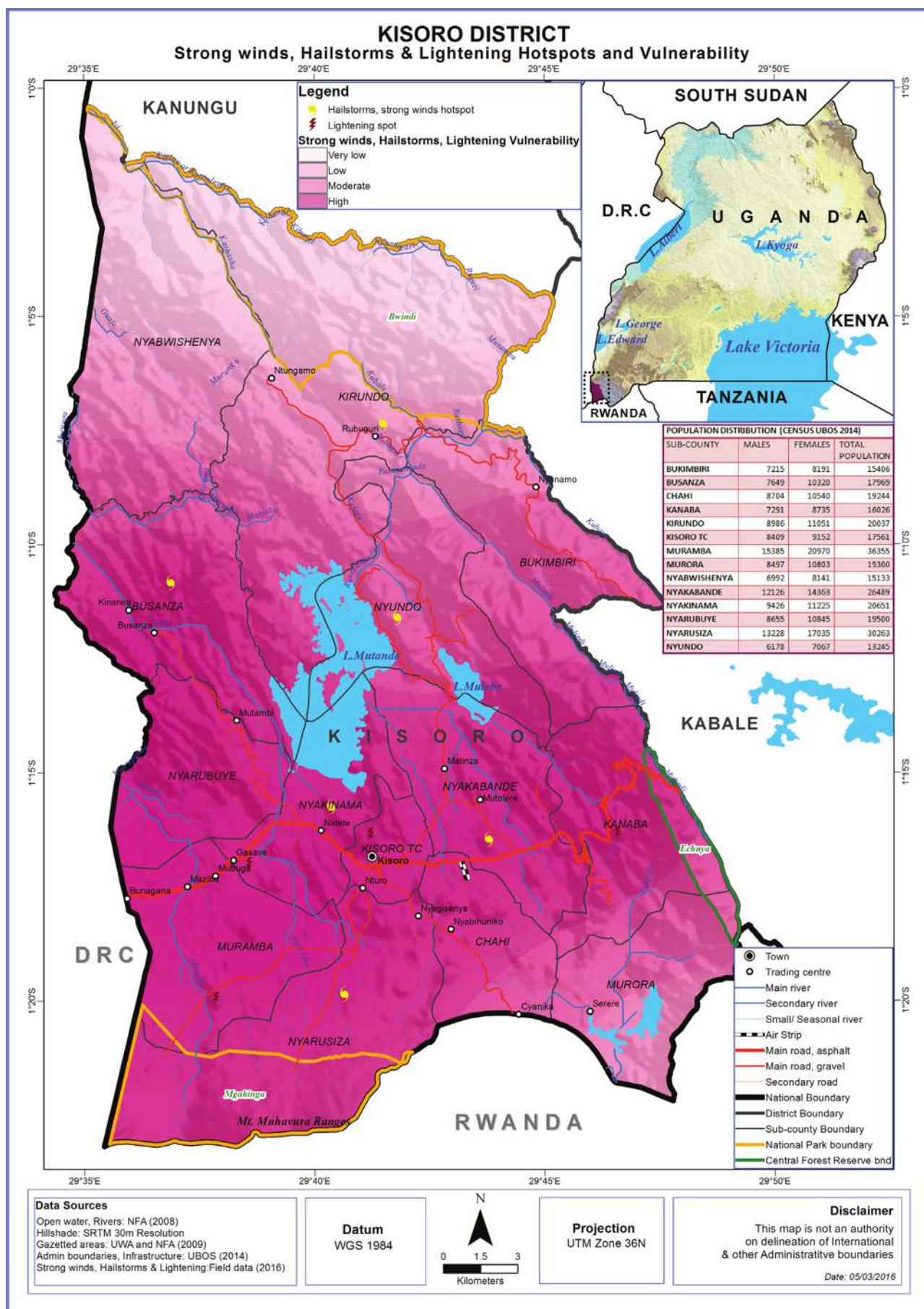


Figure 11: Strong winds, Hailstorms and Lightning Hotspots and Vulnerability, Kisoro District

4.3 Ecological and Biological Hazards

4.3.1 Crop Pests and Diseases

Results from participatory assessments indicated that Kisoro district is vulnerable to crop pests and diseases. The most reported crop pests and diseases include; late blight, early blight, bacterial wilt, leaf miner, viral attack and millipedes in Irish potatoes, blotch disease in onions, maize borer, maize lethal necrosis mainly affected Murora and Nyakabande and maize streak in maize, smuts in sorghum, bean root rot, leaf rust and anthracnose in beans, coffee leaf rust, coffee berry disease in coffee, red spider mite in tea and banana bacterial wilt in bananas. The tea plantations in the sub-counties of Kirundo, Bukimbiri, Busanza and Nyabwishenya are severely affected by the red spider mite. Figure 12 shows crop pests and diseases vulnerability in Kisoro district.



Plate 3: Banana plantation affected by banana bacterial wilt in Nyundo Sub-county

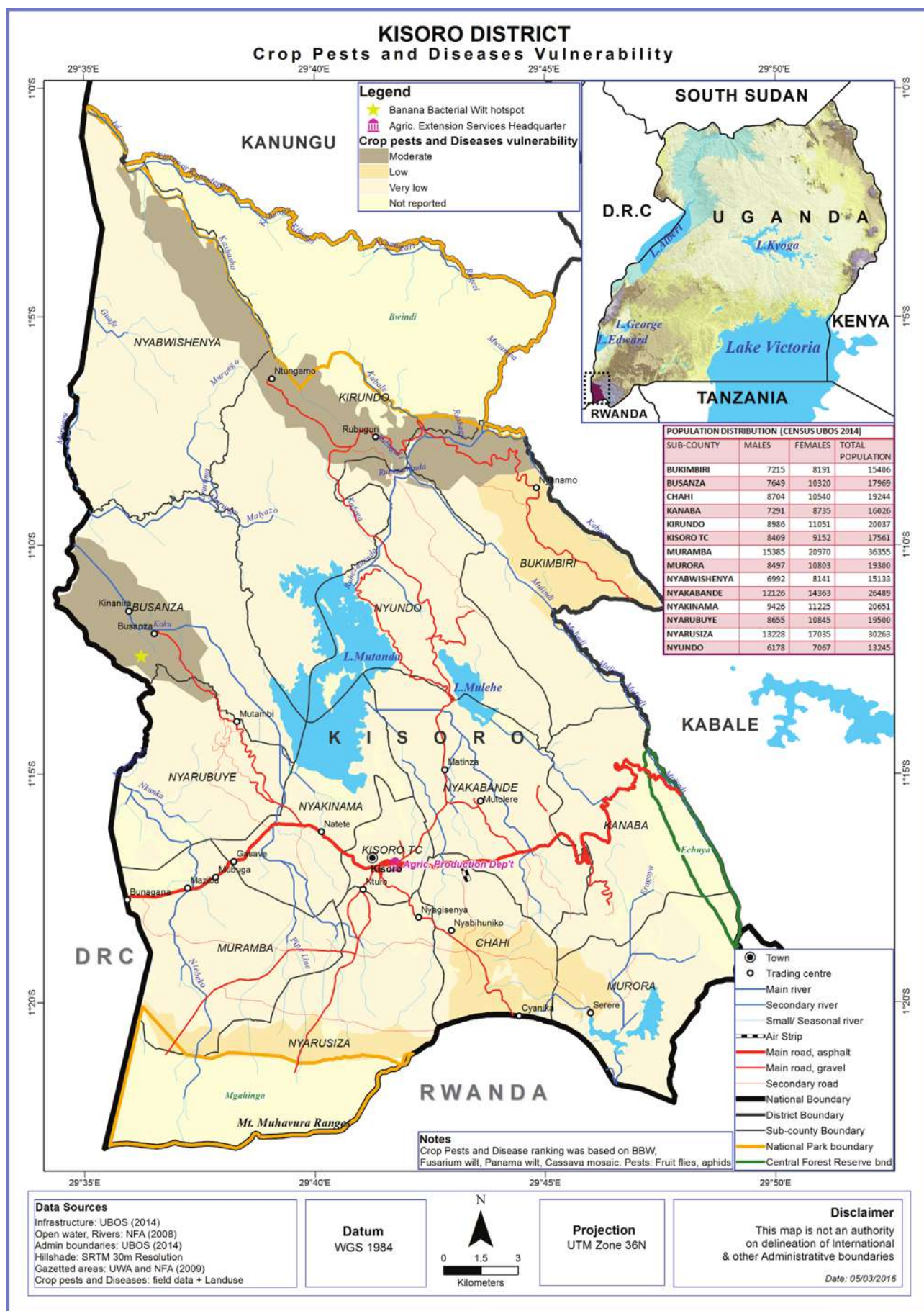


Figure 12: Crop Pests and Diseases Vulnerability, Kisoro District

4.3.2 Livestock Pests and Diseases

The most common pests and diseases that affect livestock in Kisoro district include; tick borne diseases mainly east coast fever, Anaplasmosis and trypanosomiasis, cattle worm infections, bacterial and viral infections like black quarter, anthrax, foot and mouth disease and brucellosis in cattle, mange, pink eye and worm infections in goats, Newcastle disease, coccidiosis and fowl typhoid in poultry and worm infection and African swine fever in pigs. These diseases that affect livestock are mainly in the sub-counties of Kirundo, Bukimbiri, Busanza, Nyakinama and Nyabwishenya. Figure 13 shows livestock pests and diseases vulnerability in Kisoro district.

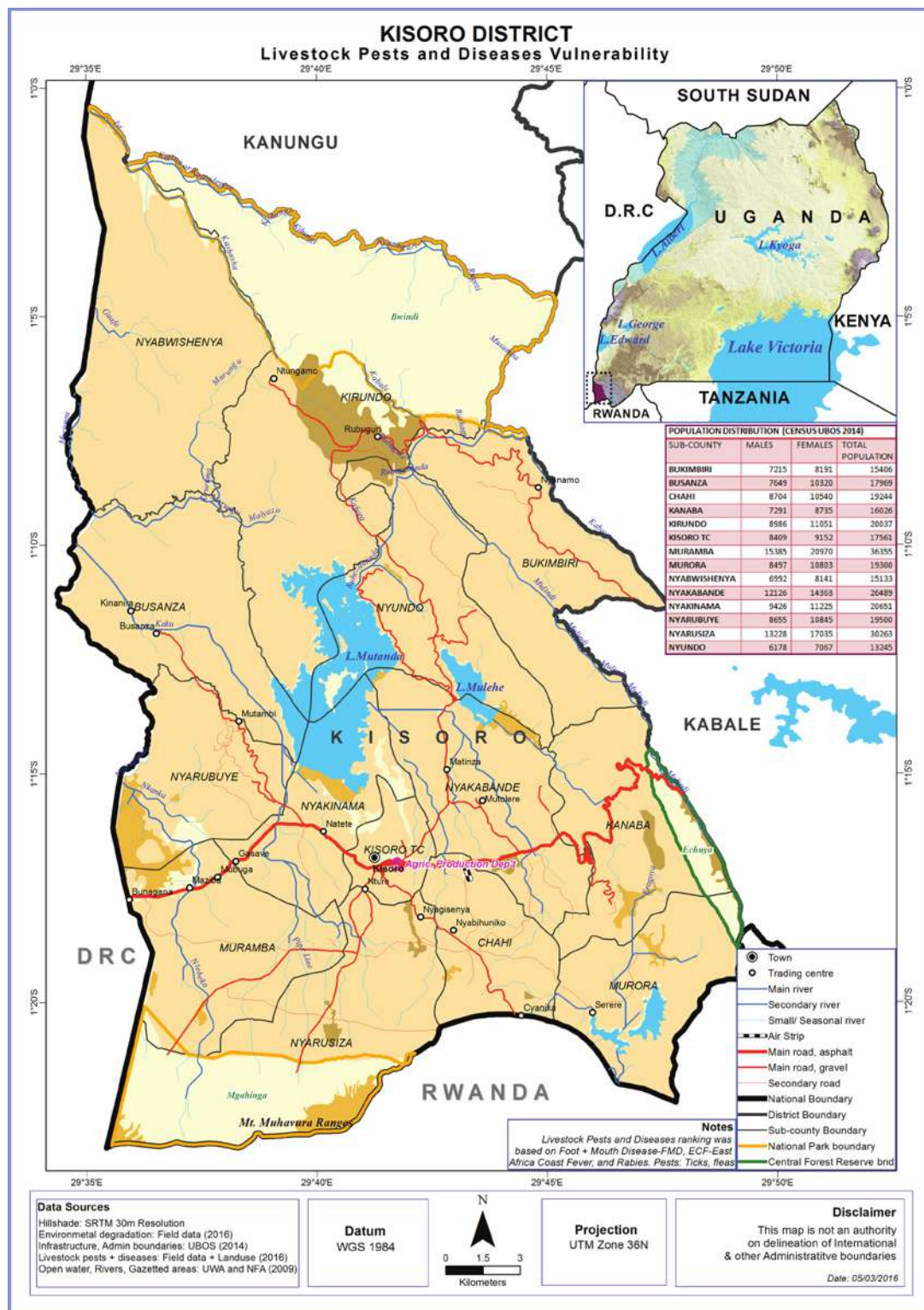


Figure 13: Livestock Pests and Diseases Vulnerability, Kisoro District

4.3.3 Human Diseases

Participatory assessments indicated that the most common disease epidemics experienced in Kisoro district are; malaria, dysentery, cholera, respiratory tract diseases and diarrhea which account for 75% of morbidity and mortality. Other common diseases are malnutrition, ear infections, maternal health related conditions, skin diseases and HIV/AIDS (Figure 14). The prevalence rates of HIV/AIDS were reported to be high in Kisoro town council. High influx of immigrants (Rwandese and Congolese) could be reason for prevalence rates of HIV/AIDS were reported to be high in Kisoro Municipality.

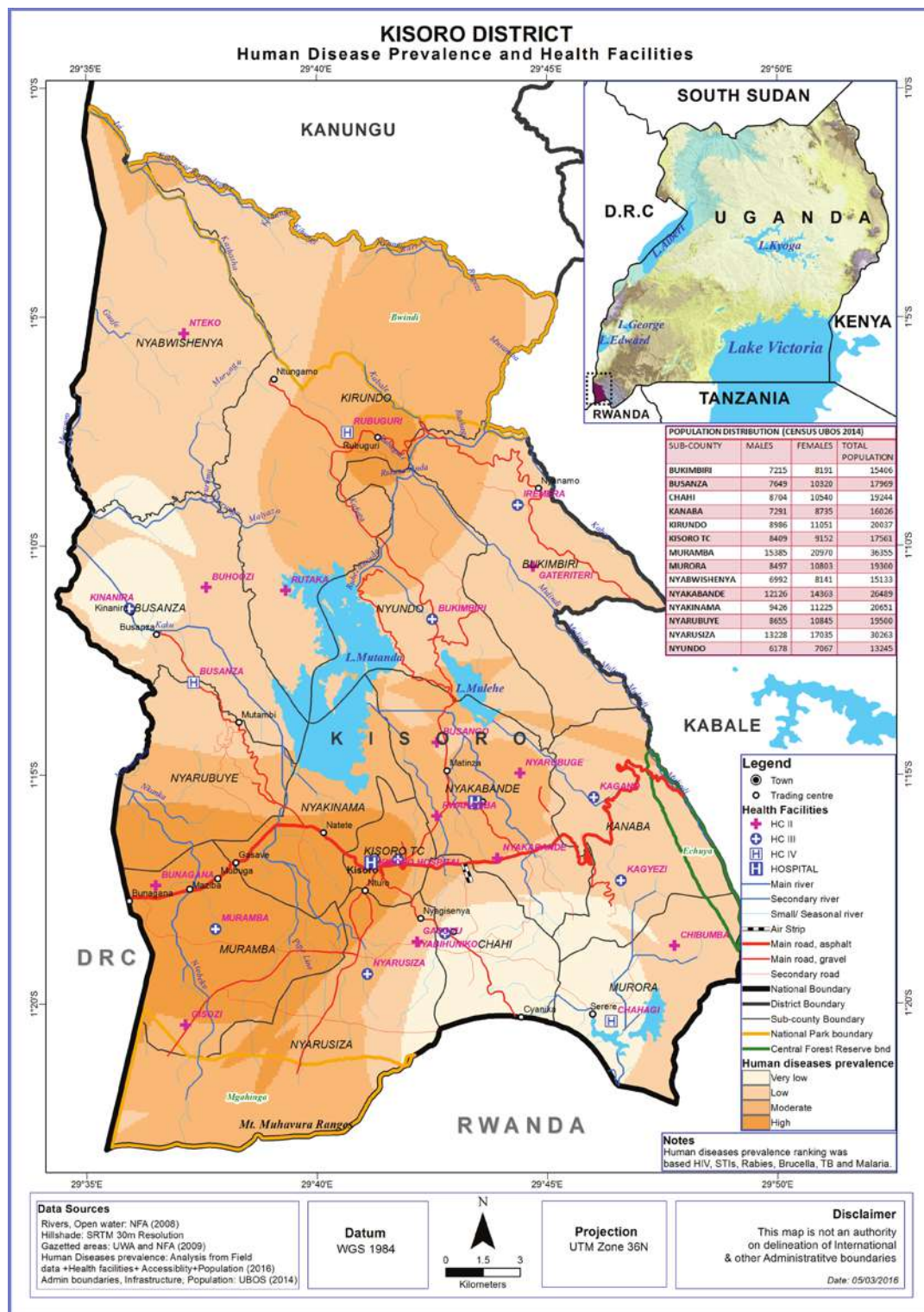


Figure 14: Human Diseases Prevalence and Health Facilities, Kisoro District

4.3.4 Vermin and Wildlife Animal Attacks

In Kisoro district, human-wildlife conflicts are a pertinent issue for those communities surrounding Mgahinga and Bwindi Impenetrable National Parks and Echuya forest reserve. It is common occurrence for wildlife like buffalos, elephants and gorillas that do not know the park boundaries to leave the parks in search for food thereby destroying crops therefore, increasing the food insecurity problem in the communities. These are referred to as problem animals and communities therefore can do nothing to protect their produce since the law does not allow them to harm these animals. However, baboons and bush pigs are referred to as vermin and the community can kill them in defense of their property. The most affected sub-counties are; Kanaba, Nyabwishenya, Nyarusiza, Chahi and Kirundo. Figure 15 shows vermin and wildlife animal conflicts and vulnerability in Kisoro district.

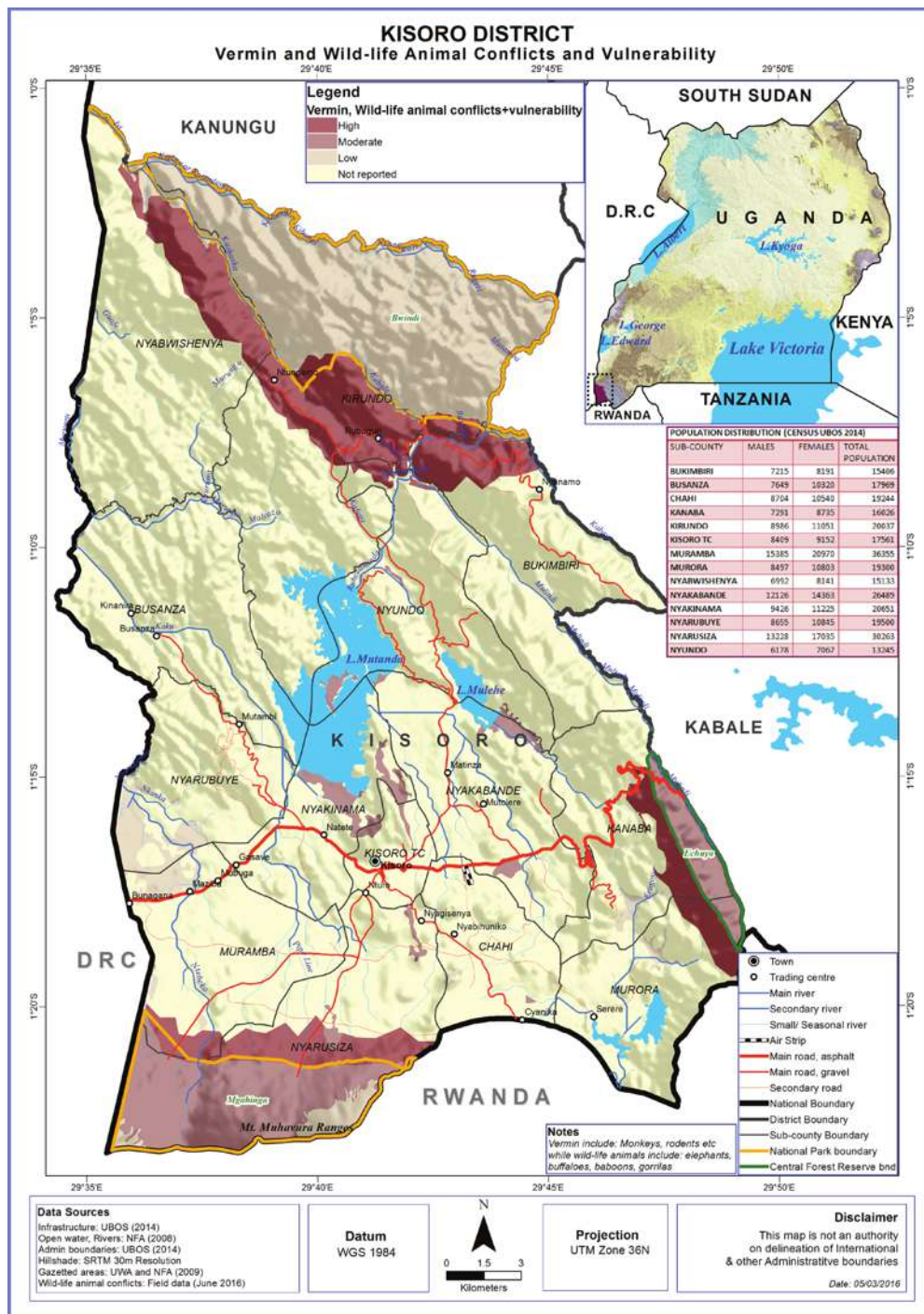


Figure 15: Vermin and Wildlife Animal Conflicts and Vulnerability, Kisoro District

4.3.5 Invasive species

The most common invasive species in Kisoro district were *Lantana camara* and *Parthenium hysterophorus*. It was reported that in 2010, *Lantana camara* had become a serious problem in the district. *Parthenium hysterophorus* usually grows out of hand and colonizes all land, stops other plants from growing, reduces crop and animal production, taints milk and meat in livestock, causes severe skin rash, bronchitis and asthma in humans. It is common in the sub-counties of Nyarusiza and Muramba. Figure 16 shows invasive species prone areas in Kisoro district.



Figure 16: Invasive Species Vulnerability, Kisoro District

4.4 Human Induced and Technological Hazards

4.4.1 Bush fires and Forest fires

Participants in the focus group discussions indicated that bush fires weren't common in Kisoro district. There weren't any serious fire incidences reported in the district. It was reported occasional cases of forest fires occurring in sub-counties neighbouring Bwindi Impenetrable National Park including: Nyabwishenya, Kirundo and Bukimbiri. Figure 17 shows bush/forest fires hotspot areas in Kisoro District.

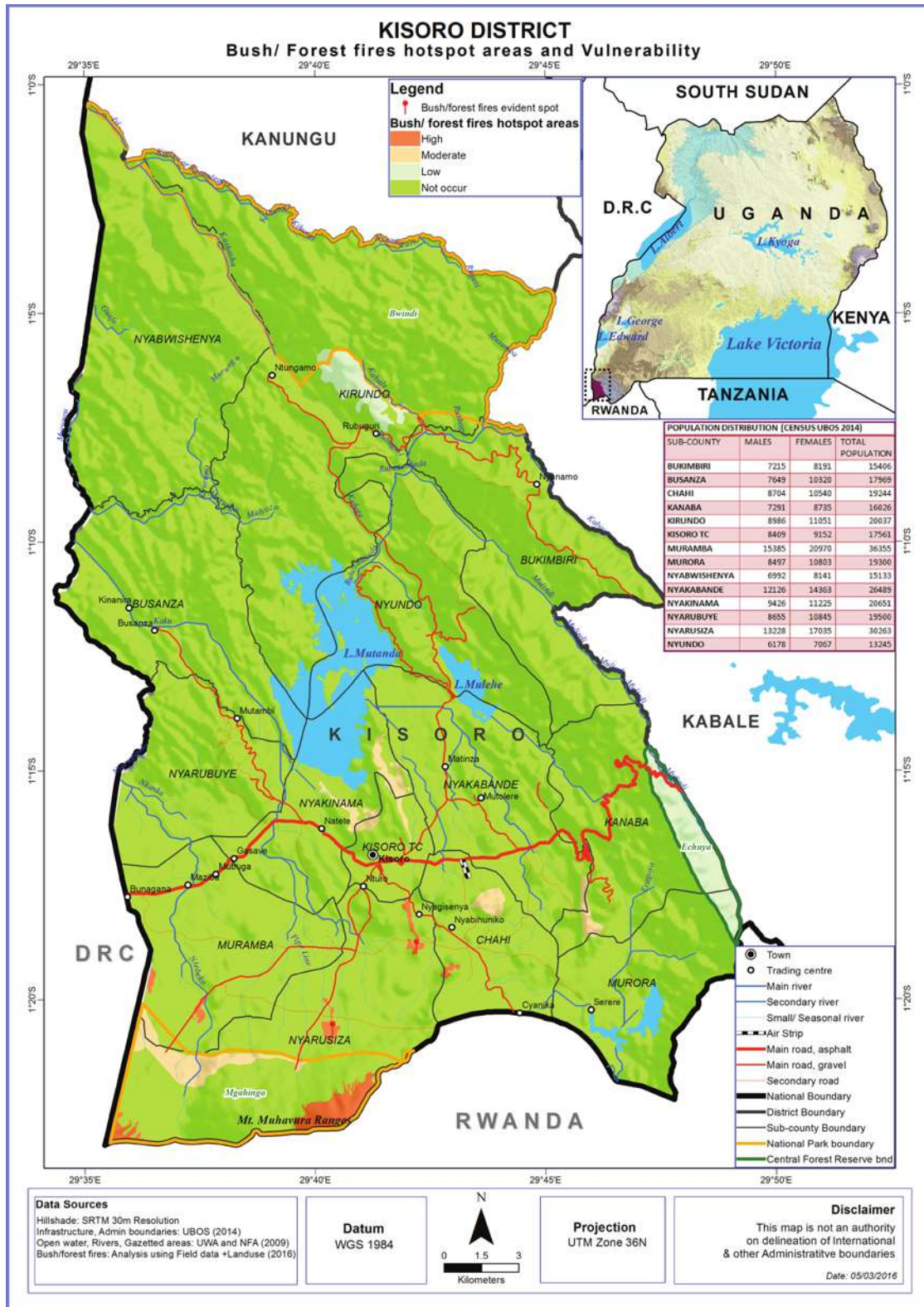


Figure 17: Bush/Forest fires Hot spot Areas and Vulnerability, Kisoro District

4.4.2 Land conflicts

Results from the participatory assessments indicated that land conflicts were common in the entire district. Participants reported that most of these land disputes are usually between family members. Figure 18 shows land conflict prone areas in Kisoro district.

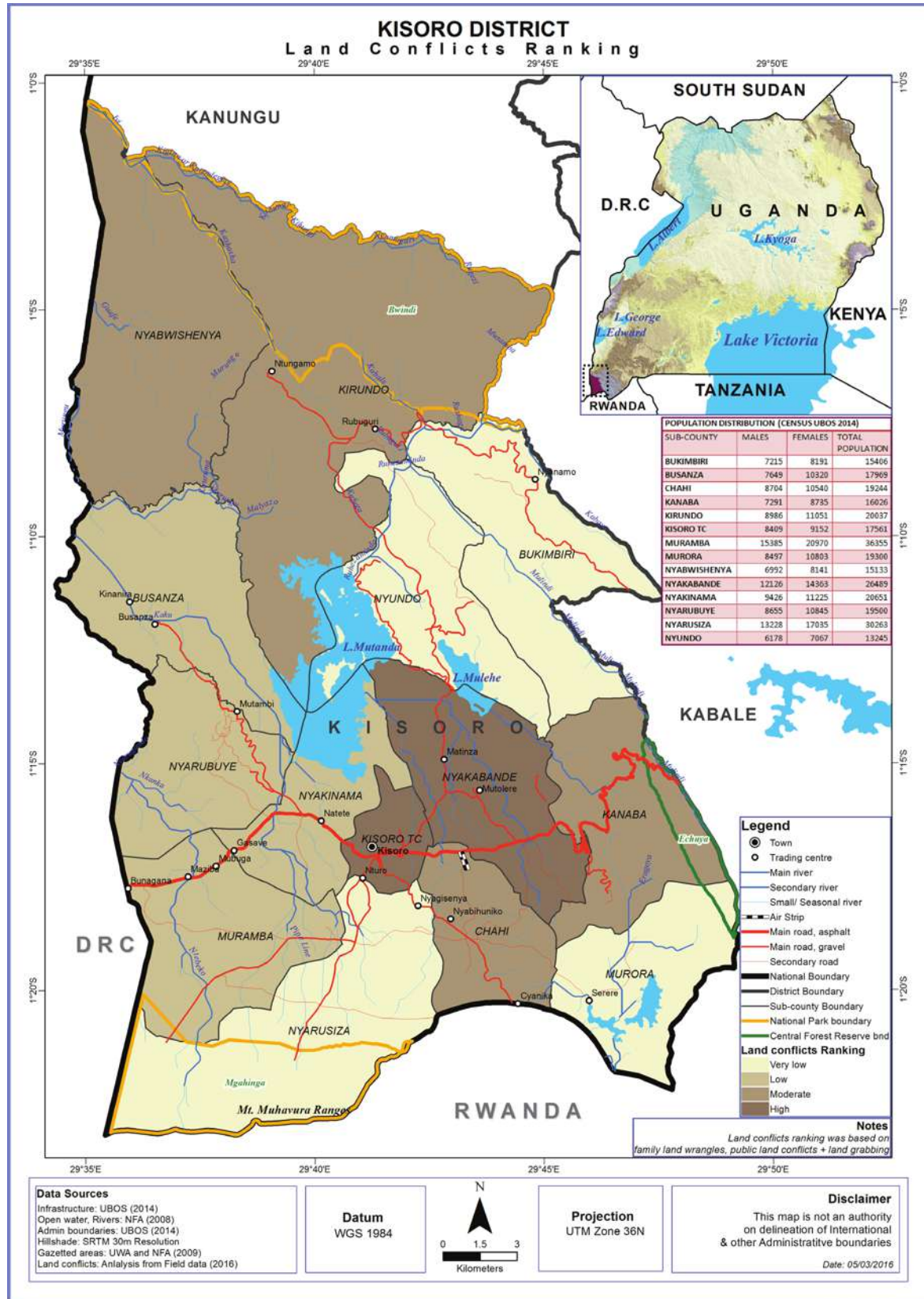


Figure 18: Land Conflicts Ranking, Kisoro District

4.4.3 Environmental Degradation

The most common forms of environmental degradation in Kisoro district are; sand mining in Mucha village, conversion of wetlands into crop land in Rugege wetland, deforestation, tin mining in Mugombero village all in Nyakabande sub-county, Brick making in Busanza, Nyundo and Nyarubuye sub county. Over harvesting of vegetation, has also led to the complete disappearance of permanent cover and silting of Lakes Mulehe and Mutanda. The most affected sub-counties are; Nyundo, Nyarubuye, Murora and Kirundo (Figure 19).



Plate 4: Sand mining at Mucha village in Nyakabande Sub-county



Plate 5: Brick making in Nyundo Sub-county

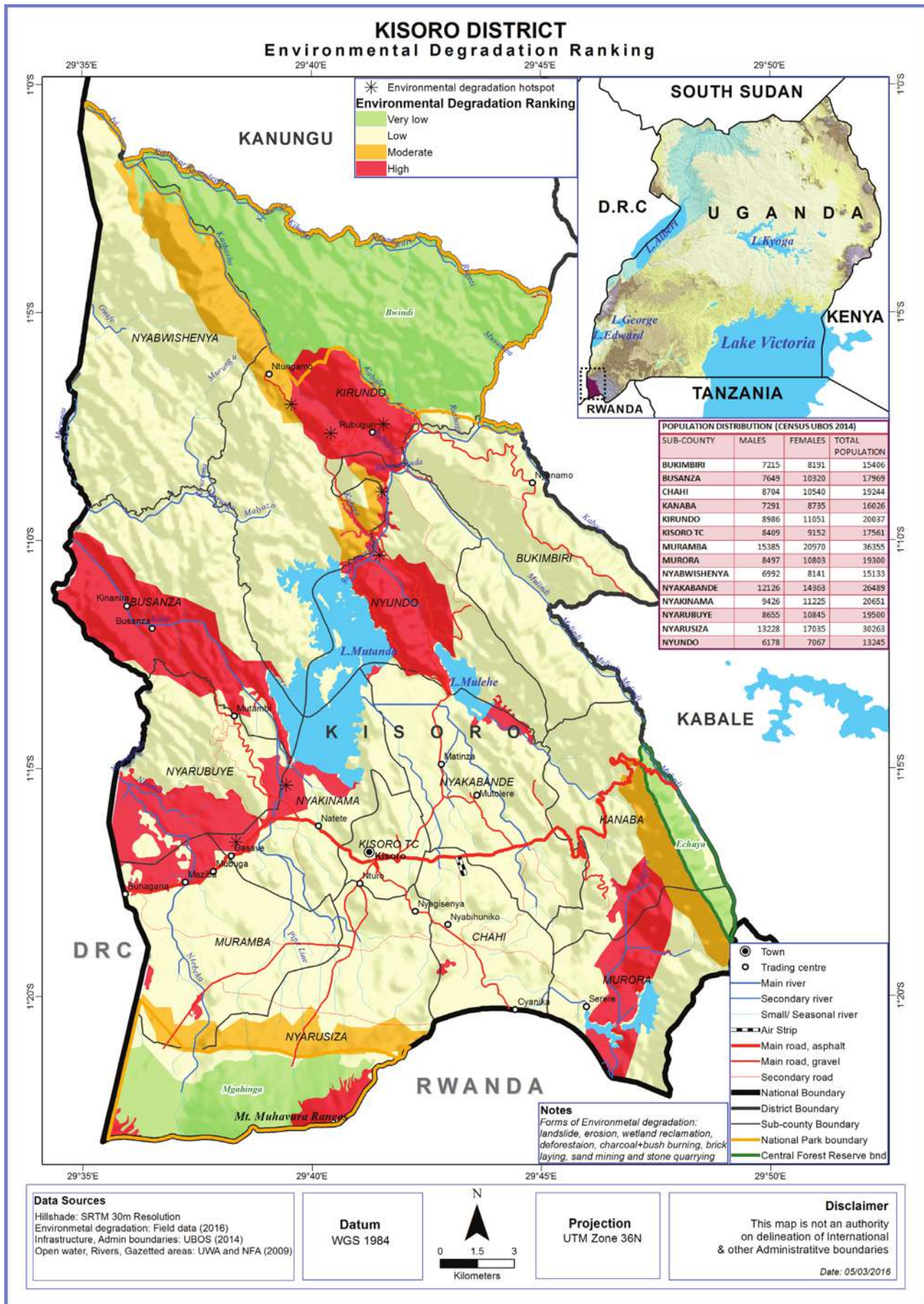


Figure 19: Environmental Degradation Ranking, Kisoro District

4.4.4 Road Accidents and Water Accidents

Participants in the focus group discussions reported that accidents mainly occur on the Kabale-Kisoro highway. Some of these accidents are caused by over speeding and reckless driving yet this road has very many sharp corners and steep sections. The most affected sub-counties are; Nyakabande, Kanaba, Muramba and Nyakinama, Chahi (Kyanika-Rwanda road) and Kisoro Town Council. Water accidents were also reported on the crater lakes of Mutanda and Mulehe. Figure 20 shows road and water accidents hotspots in Kisoro district.

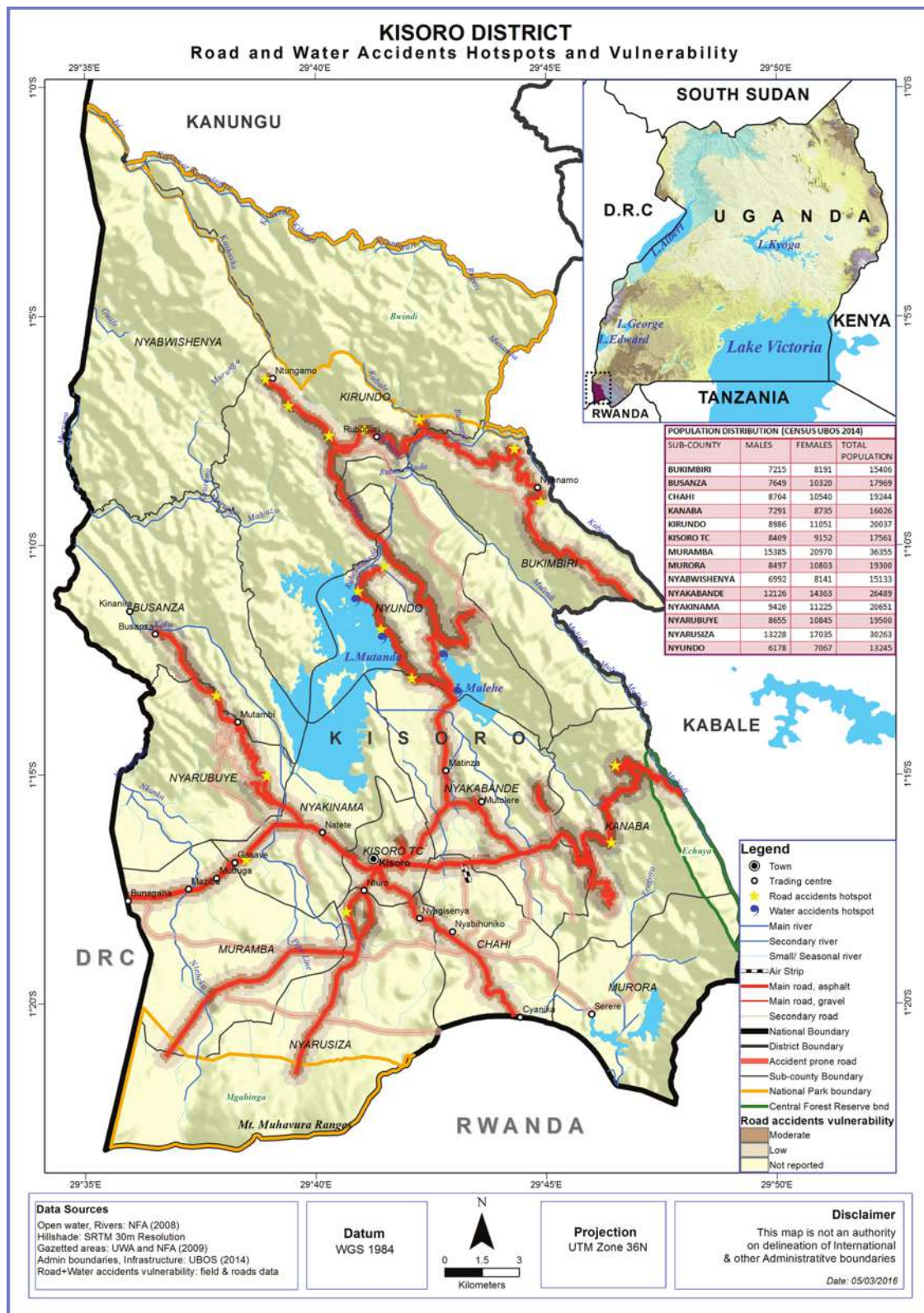


Figure 20: Road and Water Accidents Hot spots and Vulnerability, Kisoro District

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 Kisoro 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 lightening, also create a moderate vulnerability profile in the community (Table 3). Table 4 shows Hazard assessment for Kisoro District.

Table 2: Components of Vulnerability in Kisoro District

Vulnerability	Exposure		Susceptibility		Resilience		
	Hazards	Elements at Risk	Geographical Scale	Susceptibility	Geographical Scale	Coping strategies	
Socio-economic component	Landslides, Rock falls and Soil erosion	<ul style="list-style-type: none"> - Human and livestock adjacent to hill slopes - Crops on hill slopes - Infrastructure e.g. houses, schools, roads adjacent to hill slopes 	Parish	<ul style="list-style-type: none"> - Loss of lives - Complete crop failure - Destruction of infrastructure e.g. homes, and schools 	Parish	<ul style="list-style-type: none"> -Migration -Sensitization by both government and non-governmental agencies 	Parish
	Earth quakes	<ul style="list-style-type: none"> - Infrastructure e.g. houses, schools 	District	<ul style="list-style-type: none"> - Loss of lives - Destruction of Infrastructure e.g. houses, schools 	District	-No much measure so far	District
	Floods	<ul style="list-style-type: none"> - Livestock adjacent to flood plain - Crops on flood plain - Infrastructure e.g. houses, schools, roads adjacent to flood plain 	Parish	<ul style="list-style-type: none"> - Livestock loss - Destruction of crops - Destruction of infrastructure e.g. houses, schools, roads adjacent to flood plain 	Parish	<ul style="list-style-type: none"> -Migration -Sensitization on wetland conservation -Dig trenches 	Parish
	Drought	<ul style="list-style-type: none"> - Livestock - Crops - Human population 	Village	<ul style="list-style-type: none"> - Hunger & poverty - Livestock loss - Crop failure - Shortage of pasture - Shortage of water 	Village	<ul style="list-style-type: none"> -Migration -Sensitization on tree planting -Buy food from elsewhere 	Village
	Hailstorms, strong winds and Lightning	<ul style="list-style-type: none"> - Human and livestock populations - Crops - Infrastructure e.g. houses, schools, health centres 	Parish	<ul style="list-style-type: none"> - Loss of lives - Destruction of crops e.g. houses, schools, roads adjacent to flood plain 	Parish		Parish
	Crop Pests and Diseases	-Crops	District	<ul style="list-style-type: none"> - Complete crop failure 	District	<ul style="list-style-type: none"> - Spraying - Cut and burry affected crops -Sensitization on crop disease management 	District
	Livestock Pests and Diseases	-Livestock (cattle, goats etc.)	District	<ul style="list-style-type: none"> - Loss of livestock - Reduced livestock productivity 	District	<ul style="list-style-type: none"> - Vaccination - Burry and burry animals that have died from infection - Quarantine 	District

Socio-economic component		Human Disease outbreaks	- Human Population	District	- Loss of lives	District	- Mass Immunization - Use of mosquito nets	District
	Invasive species	-indigenous species -Animals	District	- Outcompete the indigenous spp., suppress growth of indigenous spp. - Loss of indigenous spp. - Complete crop Failure - suppress growth of pasture	District	- Cut and burn -Sensitization on Invasive species management	District	
	Bush fires	- Livestock - Crops - Infrastructure e.g. houses, schools	Sub-county	- Loss of livestock - Shortage of pasture - Destruction of crops - Destruction of infrastructure e.g. houses, schools	Sub-county	-Sensitization	Sub-county	
	Road accidents	- Human population - Infrastructure adjacent to accident black spots e.g. houses, schools etc.	Sub-county	- Loss of lives - Destruction of vehicles - Destruction of Infrastructure adjacent to accident black spots e.g. houses, schools etc.	Sub-county	-Humps on roads -Signage on speed limits -Sensitization on traffic rules	Sub-county	
	Land conflicts	- Human population	Village	-Loss of lives -Family violence and break outs	Village	- Community dialogue - District court in charge of land issues	Village	
	Vermin and Wildlife animal attacks	- Human population - Livestock - Crops	Parish	-Loss of lives -Livestock loss -Crop destruction	Parish	- Report to UWA - Guard gardens -Poison -Hunt and kill -Fence water collection points with Wildlife animals	Village	
	Environmental degradation	- Human and livestock populations - Crops - Natural vegetation	Sub-county	-Crop failure -Shortage of pasture -Shortage of water -Decline of water quality	Sub-county	-Sensitization on wetland conservation -Sensitization on tree planting -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		

Environmental component							
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 bury affected crops -Sensitization on crop disease management		
Livestock Pests and Diseases	-Livestock (cattle, goats etc.)	District	- Loss of livestock - Reduced livestock productivity	District	- Vaccination - Bury and burn animals that have died from infection - Quarantine		
Human Disease outbreaks	- Human Population	District	- Loss of lives	District	- Mass Immunization - Use of mosquito nets		
Invasive species	-indigenous species -Animals	District	- Outcompete the indigenous 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	<ul style="list-style-type: none"> - Livestock - Crops - Infrastructure e.g. houses, schools 	Sub-county	<ul style="list-style-type: none"> - Loss of livestock - Shortage of pasture - Destruction of crops - Destruction of infrastructure e.g. houses, schools 	Sub-county	-Sensitization	
Road accidents	<ul style="list-style-type: none"> - Human population - Infrastructure adjacent to accident black spots e.g. houses, schools etc. 	Sub-county	<ul style="list-style-type: none"> - Loss of lives - Destruction of Infrastructure adjacent to accident black spots e.g. houses, schools etc. 	Sub-county	<ul style="list-style-type: none"> -Humps on roads -Signage on speed limits -Sensitization on traffic rules 	
Land conflicts	<ul style="list-style-type: none"> - Human population 	Village	<ul style="list-style-type: none"> -Loss of lives -Family violence and break outs 	Village	<ul style="list-style-type: none"> - Community dialogue - District court in charge of land issues 	
Vermin and Wildlife animal attacks	<ul style="list-style-type: none"> - Human population - Livestock - Crops 	Parish	<ul style="list-style-type: none"> -Loss of lives -Livestock loss -Crop destruction 	Parish	<ul style="list-style-type: none"> - Report to UWA - Guard gardens - Poison -Hunt and kill -Fence water collection points with Wildlife animals 	
Environmental degradation	<ul style="list-style-type: none"> - Human and livestock populations - Crops - Natural vegetation 	Sub-county	<ul style="list-style-type: none"> -Crop failure -Shortage of pasture -Shortage of water -Decline of water quality 	Sub-county	<ul style="list-style-type: none"> -Sensitization on wetland conservation -Sensitization on tree planting -Setting bi-laws 	



Table 3: Vulnerability Profile for Kisoro District

	PROBABILITY	SEVERITY OF IMPACTS	RELATIVE RISK	VULNERABLE SUB COUNTIES
	Relative likelihood this will occur	Overall Impact (Average)	Probability x Impact Severity	
Hazards	1 = Not occur 2 = Doubtful 3 = Possible 4 = Probable 5 = Inevitable	1 = No impact 2= Low 3=medium 4 = High	0-1= Not Occur 2-10= Low 11-15=Medium 16-20= High	
Floods	5	4	20	The most affected sub-counties: Busanza, Nyundo, Nyarusiza, Muramba, Kanaba, Murora and Nyakabande
Droughts	3	2	6	Not serious problem
Soil erosion, rock falls and landslides	5	4	20	The most affected sub-counties: Kanaba, Nyarubuye, Nyakabande, Nyundo, Nyabwishenya, Kirundo, Bukimbiri
Hail storms, Lightning and strong winds	4	4	16	The most affected sub-counties: Nyarusiza, Nyakinama, Muramba, Nyakabande, Busanza, Kanaba
Bush fires and Forest fires	4	3	12	The most affected sub-counties: Nyarusiza and Muramba
Crop pests and diseases	4	3	12	The most affected sub-counties: Kirundo, Bukimbiri, Busanza and Nyabwishenya
Livestock pests and diseases	4	3	12	The most affected sub-county: Kirundo
Human Diseases outbreaks	5	3	15	Muramba and Kisoro TC
Land conflicts	4	3	12	All sub-counties
Vermin and Wild-life animal attacks	5	4	20	The most affected sub-counties: Kanaba, Nyabwishenya, Nyarusiza, Chahi, Kirundo
Earthquakes and faults	3	1	3	All sub-counties
Road accidents and Water accidents	4	2	8	The most affected sub-counties: Kisoro TC, Nyakabande, Kanaba, Muramba, Nyakinama, Chahi, Nyundo
Environmental degradation	4	4	16	The most affected sub-counties: Nyundo, Nyarubuye, Kirundo and Murora
Invasive species	4	2	8	The most affected sub-counties: Nyarusiza and Muramba

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	Bukimbiri	Busanza	Chahi	Kanaba	Kirundo	Kisoro TC	Muramba	Murora	Nyabwishenya	Nyakabande	Nyakinama	Nyarubuye	Nyarusiza	Nyundo
Floods	L	H	L	H	L	L	H	H	L	H	L	L	H	H
Drought														
Landslides, Rock falls and Erosion	VH	H	M	VH	H	L	H	M	VH	VH	M	VH	H	VH
Strong winds, Hailstorms and Lightening	L	H	L	H	L	H	H	L	L	H	H	L	H	L
Crop pests and Diseases	H	H	M	M	H	L	L	M	H	L	L	L	M	M
Livestock pests and Diseases	L	L	L	M	H	L	L	L	L	M	L	L	L	L
Human disease outbreaks	L	L	L	M	M	H	H	L	L	M	L	L	L	L
Vermin and Wildlife animal attacks	L	L	H	H	H	L	L	M	M	L	L	L	H	M
Land conflicts	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Bush fires and Forest fires							M						M	
Environmental degradation	M	M	M	M	H	M	M	M	H	M	M	H	M	H
Earthquakes and faults	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Road accidents				M		M	M			M	M			
Invasive species							M						M	

Key

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



4.5.1 Gender and Age groups mostly affected by Hazards

Table 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 Lightening	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 5).

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

No	Multi-Hazards	Coping strategies
1	Geomorphological or Geological	Landslides, Rock falls and Erosion <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • No action, communities think the tremors are minor • Designs of houses (pillars) • Early warning system • Vigilance • Sensitization • Emergency response mechanisms
3	Climatological or Meteorological	Floods <ul style="list-style-type: none"> • Digging up of trenches in the flood plains • Planting trees to control water movement to flood plains • Migration to other areas • Seek for government food aid
4		Drought <ul style="list-style-type: none"> • Leave wetlands as water catchments • Plant trees as climate modifiers • Buy food elsewhere in case of shortage • Buy water from the nearby areas • Food Storage especially dry grains
5		Strong winds, Hailstorms and Lightening <ul style="list-style-type: none"> • 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 • To put on rubber shoes or sandals
6	Ecological or Biological	Crop pests and Diseases <ul style="list-style-type: none"> • Spraying pests • Cutting and burying BBW affected crops • Burning of affected crops • Vigilance
7		Livestock pests and Diseases <ul style="list-style-type: none"> • Spraying pests • Vaccinations • Burying animals that have died from infection • Quarantine
8		Human epidemic Diseases <ul style="list-style-type: none"> • Mass immunisation • Visiting health centres • Use of mosquito nets
9	Vermin and Wild-life animal attacks <ul style="list-style-type: none"> • Guarding the gardens • Poisoning • Hunt and kill • Report to UWA • Hugo group • Mauritius thorns • Plant tea as buffer • Dig trenches • Chain link • Plant red pepper as buffer • Recommend vermin guards 	

10	Ecological or Biological	Invasive species	<ul style="list-style-type: none"> • Uproot • Spray with herbicides (e.g 2-4-D) • Cut and burn • Sensitization on Invasive species management • Blacklisting exotic species
11	Human induced or technological	Land conflicts	<ul style="list-style-type: none"> • Community dialogues • Report to court • Migration • Resettlement • Surveying and titling • Strengthen Land management structures • Sensitization on land ownership • Proper demarcation (live fencing)
12		Bush fires/ Forest fires	<ul style="list-style-type: none"> • Stop the fires in case of fire outbreak • Fire lines (may be constructed, cleared grass) • Fire breaks planted along gardens e.g. euphorbia spp. • Vigilance especially in dry seasons where most burning is done • Bye-laws • Sensitization on dangers of fires
13		Road accidents	<ul style="list-style-type: none"> • Construction of humps • Road Signage including speed limits • Separate lanes on sharp corners • Sensitisation • Widen narrow roads • Plant trees on road reserve, as road guards • Deployment of Traffic officers
14		Environmental degradation	<ul style="list-style-type: none"> • Leave wetlands as water catchments • Plant appropriate tree species as climate modifiers • Sensitization • Bye-laws • Enforcement • Gazette and demarcate wetlands • Restore wetlands and other fragile ecosystems • EIA for new developments • No land titles for wetland areas • Cancellation of existing wetland land titles • Developing land use plans and enforce them • No approval of applications for developments in wetlands by Physical Planning Committees

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 Kisoro district has over the past two decades increasingly experienced hazards including rock falls, soil erosion, floods, drought, hailstorms, strong winds, lightening, crop pests and diseases, livestock pests and diseases, human disease outbreaks, vermin, wildlife animal attacks, invasive species, bush fires and land conflicts putting livelihoods at increased risk. Generally landslides and flooding were identified as most serious problem in Kisoro 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 Kisoro district increase their vulnerability to hazard exposure necessitating urgent external support.

Hazards experienced in Kisoro 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 lightening.
- 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, counteracting vulnerability at community, local government and national levels should be a threefold effort hinged on:

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

5.2 Policy-related Recommendations

The following recommended policy actions targeting vulnerability reduction include:

- i. The government should improve enforcement of policies aimed at enhancing sustainable environmental health.
- ii. The government through MAAIF should review the animal diseases control act because of low

penalties given to defaulters.

- iii. The government should establish systems to motivate support of political leaders toward government initiatives and programmes aimed at disaster risk reduction.
- iv. The government should increase awareness campaigns aimed at sensitizing farmers/ communities on disaster risk reduction initiatives and practices.
- v. The government should revive disaster committees at district level and ensure funding of disaster and environmental related activities.
- vi. The government through UNRA and the District authority should fund periodic maintenance of feeder roads to reduce on traffic accidents.
- vii. The government through OPM and Meteorology department should increase importation of Lightning conductors and also reduce taxes on their importation.
- viii. The government through OPM and Meteorology department should support establishment of disaster early warning systems.
- ix. The government through MWE increase funding and staff to monitor wetland degradation and non-genuine agro-inputs.
- x. The government through OPM should improve communication between the disaster department and local communities.
- xi. The government through MWE should promote Tree planting along road reserves.
- xii. The government through MAAIF should fund and recruit extension workers at sub-county level and also facilitate them.

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APPENDIX I: DATA COLLECTION TOOLS



Key Informant Interview at Kisoro district headquarters



Focus group discussion at Nyakabande Sub-county headquarters

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

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

1. Which crops are majorly grown in your community?
2. Which domestic animals are dominant in your community?
3. What challenges are faced by farmers in your community?
4. Have you experienced landslides and rock falls in the past 10 years in your community?

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

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

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

challenges mentioned?

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

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

46. Have you experienced any epidemic animal disease outbreaks in the past 10 years in your community?
47. Which villages and parishes have been most affected by epidemic animal disease outbreaks?
48. As a way of ranking from Low, Medium, High and Very high, rank the villages and parishes that have been most affected?
49. Specify the epidemic animal disease outbreaks that have majorly affected animals in your community?
50. Which domestic animals are majorly affected by epidemic animal disease outbreaks in your community?
51. In which way are the domestic animals affected by epidemic animal disease outbreaks?
52. Which mitigation practices are being adopted by farmers in a bid to mitigate the above epidemic animal disease outbreaks?

53. What are the relevant government's interventions focusing at helping farmers mitigate the epidemic animal disease outbreaks mentioned?
54. Have you experienced any crop pests and disease outbreaks in the past 10 years in your community?
55. Which villages and parishes have been most affected by epidemic animal disease outbreaks?
56. As a way of ranking from Low, Medium, High and Very high, rank the villages and parishes that have been most affected?
57. Specify the crop pests and disease outbreaks that have majorly affected animals in your community?
58. Which crops are majorly affected by crop pests and disease outbreaks in your community?
59. In which way are the crops affected by crop pests and disease outbreaks?
60. Which mitigation practices are being adopted by farmers in a bid to mitigate the above crop pests and disease outbreaks?
61. What are the relevant government's interventions focusing at helping farmers mitigate the crop pests and disease outbreaks mentioned?
62. Have you experienced any epidemic human disease outbreaks in the past 10 years in your community?
63. Specify the epidemic human disease outbreaks that have majorly affected animals in your community?
64. In which way are the humans affected by epidemic human disease outbreaks?
65. Which mitigation measures have been adopted by local communities in a bid to mitigate the above epidemic human disease outbreaks?
66. What are the relevant government's interventions focusing at helping local communities mitigate the epidemic human disease outbreaks mentioned?
67. Do you have any national park or wildlife reserve in your area of jurisdiction?
68. Have you experienced wildlife attacks in the past 10 years in your community?

69. Which particular villages and parishes have been majorly affected by wildlife attacks in your community?

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

71. What impacts have been caused by wildlife attacks?

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

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

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

75. Are there invasive species in your community?

76. Specify the invasive species in your community?

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

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

79. Which crops or animals are majorly affected by invasive species in your community?

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

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

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

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

83. Have you experienced environmental degradation in your community?

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

- 85.** Which villages and parishes have been most affected by environmental degradation?
- 86.** As a way of ranking from Low, Medium, High and Very high, rank the villages and parishes that have been most affected?
- 87.** What impacts have been caused by environmental degradation?
- 88.** Which measures have been adopted by local communities in a bid to mitigate the above challenges?
- 89.** What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?
- 90.** Have you experienced land conflicts in the past 10 years in your community?
- 91.** Which particular villages and parishes have been majorly affected by land conflicts in your community?
- 92.** As a way of ranking from Low, Medium, High and Very high, rank the villages and parishes that have been most affected?
- 93.** What impacts have been caused by land conflicts?
- 94.** To what extent have the land conflicts affected livelihoods of the local communities in your community?
- 95.** Which conflict resolution measures have been adopted local communities in a bid to mitigate the above challenges?
- 96.** What are the relevant government's interventions focusing at helping local communities mitigate the challenges mentioned?
- 97.** Have you experienced Road accidents in the past 20 years in your community?
- 98.** Which roads have experienced Road accidents?
- 99.** What impacts have been caused by Road accidents?
- 100.** To what extent have the Road accidents affected livelihoods of the local communities in your community?
- 101.** Which conflict resolution measures have been adopted local communities in a bid to mitigate

the above challenges?

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

FOCUS GROUP ATTENDANCE LIST FOR DISTRICT DISASTER RISK MANAGEMENT FOCAL PERSONS

Name of Participant	Designation	Contact
1. Solomon Basaza	District Agricultural Officer	0772698160
2. Ayigabire Beatrice	Sub-county Agricultural Officer	0782404874
3. Bilungi Dennis	Sub-county Agricultural Officer	0775344614
4. Munezero Alice	Sub-county Agricultural Officer	0782128669
5. Mubangizi Emmanuel	Sub-county Agricultural Officer	0774442616
6. Byiringiro Charles	District Fisheries Officer	0782193123
7. Nyirabuntu Lillian	Sub-county Agricultural Officer	0788102295

FOCUS GROUP DISCUSSION ATTENDANCE LIST FOR LOCAL COMMUNITIES

Name of Participant	Village/Parish	Contact
1. Nizeye Joseph	Kanaba	0772557161
2. Kankwanzi Gloria	Nyakabande	0786999143
3. Safari Alex	Nyakabande	0789867567
4. Ntirikwira Benon	Nyakabande	-
5. Niyibizi Jovia	Nyakabande	-
6. Nyiraneza	Nyakabande	-
7. Bahima Syprian	Kirundo	0785257725
8. Tugume Sylvestri	Kirundo	0784669827
9. Turyatemba Bernard	Kirundo	0777751278
10. Hakizimana Charles	Kirundo	0779383337
11. Kasigwa Emmanuel	Kirundo	0785642740
12. Tumuheirwe John	Kirundo	0782838389
13. Kabahoze Pascal	Kirundo	0777801618

SPATIAL DATA COLLECTION SHEET FOR HAZARD VULNERABILITY AND RISK MAPPING

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



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

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