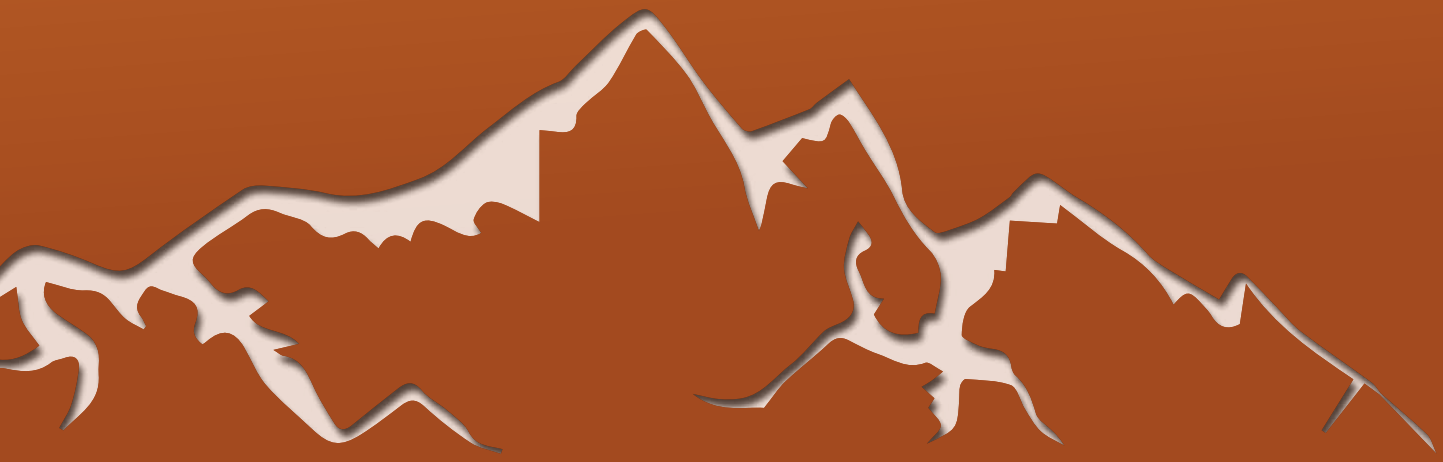
THE REPUBLIC OF UGANDA

District Multi-hazard, Risk and Vulnerability Profile for Mbarara District



Acknowledgement

On behalf of office of the Prime Minister, I wish to express sincere appreciation to all of the key stakeholders who provided their valuable inputs and support to this hazard, risk and vulnerability mapping exercise that led to the production of comprehensive district hazard, risk and vulnerability profiles for the South Western districts which are Isingiro, Kamwenge, Mbarara, Rubirizi and Sheema.

I especially extend my sincere thanks to the Department of Disaster Preparedness and Management in Office of the Prime Minister, under the leadership of Mr. Martin Owor - Commissioner Relief, Disaster Preparedness and Management and Mr. Gerald Menhya - Assistant Commissioner Disaster Preparedness for the oversight and management of the entire exercise. The HRV team was led by Ms. Ahimbisibwe Catherine - Senior Disaster Preparedness Officer, Nyangoma Immaculate - Disaster Preparedness Officer and the team of consultants (GIS/DRR Specialists): Mr. Nsiimire Peter and Mr. Nyarwaya Amos who gathered the information and compiled this document are applauded.
Our gratitude goes to the UNDP for providing funds to support the Hazard, Risk and Vulnerability Mapping. The team comprised of Mr. Gilbert Anguyo, Disaster Risk Reduction Analyst, Mr. Janini Gerald and Mr. Ongom Alfred for providing valuable technical support in the organization of the exercise.
My appreciation also goes to the District Teams:

1. Isingiro District: Mr. Bwengye Emmanuel – Ag. District Natural Resources Officer, Mr. Kamoga Abdu - Environment Officer and Mr. Mukalazi Dickson - District Physical Planner.
2. Kamwenge District: Mr. Bakesigaki Stephen – District Fisheries Officer, Mr. Balaam Asiimwe - District Planner, Mr. Twinomujuni Expedito- Clerk to Council and Mr. Ahimbisibwe Vincent – District Physical Planner.
3. Mbarara District: Mr. Tumwesigye Robert Ag. District Agriculture Officer, Mr. Katungye Francis – District Probation Officer, Mr. Lubega Kazooba – Senior Health Educator.
4. Rubirizi District: Mr. Murungi Ritah – Ag. District Natural Resurces Officer, Yeyambe Steven – Forest Ranger, Mr. Tinkamanyire Jonan – Physical Planner, Mr. Tumushabe Nelson – Lands Officer, Mr. Kabandize Nicholas – Student on Intern (Natural Resources Department).
5. Sheema District: Mr. Tumushabe J. – Production Coordinator, Mr. Mugume Francis – District Health Inspector, Mr. Komujuni Barbarah – Ag. Senior Lands officer, Mr. Turyatunga Patrick – Environment officer.
6. 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 Management

Table of Contents

Acknowledgement ..... **i**
List of Figures iv
List of Tables v
List of Plates v
List of Acronyms vi
Definition of Key Concepts vii

EXECUTIVE SUMMARY ..... **viii**
Preliminary spatial analysis viii
Stakeholder engagements viii
Participatory GIS ix
Geo-referencing and ground-truthing ix
Data analysis and integration in GIS ix
Data verification and validation ix

CHAPTER ONE **1**
INTRODUCTION **1**
1.1 Background 1
1.2 Objectives of the study 1
1.2.1 Main objective 1
1.2.2 Specific Objectives 2
1.3 Scope of Work and Deliverables 2
1.4 Justification 2

CHAPTER TWO **5**
MBARARA DISTRICT MULTI-HAZARD, RISKS AND VULNERABILITY PROFILE **5**
2.1 Overview of Mbarara District 5
2.1.1 Geomorphology 5
2.1.2 Geology 7
2.1.3 Vegetation and Land use Stratification 9
2.1.4 Temperature and Humidity 11
2.1.5 Wind 11
2.1.6 Rainfall 11
2.1.7 Hydrology 13
2.1.8 Population 13
2.1.9 Economic activities 13

2.2 METHODOLOGY **15**
2.2.1 Collection and analysis of field data using GIS 15

2.2.2 Develop District Specific multi-hazard risk and Vulnerability Profiles 16
2.2.3 Preserve the Spatial data to enable future use of the maps 16

2.4 RESULTS FROM MULTI-HAZARD RISK, VULNERABILITY MAPPING 17
2.4.1 Multi-hazards 17
2.4.2 Geomorphological or Geological Hazards 18
2.4.3 Climatological or Meteorological Hazards.....22
2.4.4 Ecological or Biological Hazards.....28
2.4.5 Human Induced and Technological Hazards 38

2.5 COPING STRATEGIES 44

2.6 VULNERABILITY PROFILES 46

2.7 GENERAL CONCLUSIONS AND RECOMMENDATIONS.....51
2.7.1 Conclusions 51
2.7.2 Appendix I 61

List of Figures

Figure 1: Location of Study Area 3
Figure 2: Administrative Units and Geomorphology, Mbarara District 6
Figure 3: Geology and Lithological Structures, Mbarara District 8
Figure 4: Land use Stratification, Mbarara District 10
Figure 5: Rainfall Distribution, Mbarara District 12
Figure 6: Population Distribution, Mbarara District 14
Figure 7: Landslides, Rock falls, Soil erosion prone areas, Mbarara District 19
Figure 8: Earth quakes Vulnerability, Fault lines, Mbarara District 21
Figure 9: Flood prone areas and Ranking, Mbarara District....23
Figure 10: Drought prone areas and Ranking, Mbarara District....25
Figure 11: Hailstorms, strong winds, lightening and Ranking, Mbarara District 27
Figure 12: Crop Pests and Diseases Vulnerability, Mbarara District 29
Figure 13: Livestock Pests and Diseases Vulnerability, Mbarara District 31
Figure 14: Human Disease Outbreaks Vulnerability, Mbarara District....33
Figure 15: Vermin, Wild-life animal attacks vulnerability, Mbarara District 35
Figure 16: Invasive Species Ranking, Mbarara District....37
Figure 17: Bush fires prone areas Ranking, Mbarara District....39
Figure 18: Environmental Degradation Ranking, Mbarara District 41
Figure 19: Road Accidents Vulnerability, Mbarara District....43

List of Tables

Table 1: Population Distribution in Mbarara District 13
Table 2: Coping strategies to the Multi-hazards in Mbarara District 45
Table 3: Components of vulnerability in Mbarara District 47
Table 4: Vulnerability Profile for Mbarara District 49
Table 5: Hazard Risk Assessment 50

List of Plates

Plate 1: Focus Group Discussion in Rubaya Sub-county 54

List of Acronyms

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
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
UTM	Universal Transverse Mercator
WGS	World Geodetic System

Definition of Key Concepts

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).

EXECUTIVE SUMMARY

The multi-hazard vulnerability profile outputs from this assessment for the five districts (Isingiro, Kamwenge, Mbarara, Rubirizi and Sheema) was a combination of spatial modeling using socio-ecological spatial layers, socio-economic, and meteorological data etc.) 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 GIS environment (ArcGIS 10.1).

Stakeholder engagements

Stake holder 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. Hazard, risk and vulnerability assessment was done using a stack of methods including participatory approaches such as Participatory GIS (PGIS), Focus Group Discussions (FGDs), key informant interviews, transect drives as well as spatial and non-spatial modelling. Key informant interviews and Focus Group Discussions were guided by a checklist (Appendix 1 and 2). Key Informant Interviews for District officers included: Districts Natural Resources Officers, Environment Officers, Wetland Officers, Forest Officers, Production and Marketing Officers, Veterinary Officers, Health Inspectors. At sub-county level Key informants for this assessment included: Sub-county and parish chiefs, community Development mobilizers and health workers.

Participatory GIS

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

Geo-referencing and ground-truthing

Ground-truthing and geo-referencing was done 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 were classified using a participatory approach on a scale of “not reported/ not prone”, “low”, “medium” and “high”, consistent with the methodology specified in Annex 3.

Data analysis and integration in GIS

Data analysis and spatial modeling 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 the districts were classified as:

- Geomorphological or Geological hazards including landslides, rock falls, soil erosion and earth quakes.
- Climatological or Meteorological hazards including floods, drought, hailstorms, strong winds and lightening
- 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 all the five district have 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. Drought and flooding were identified

as most serious problem in Isingiro, Kamwenge, Sheema and Mbarara districts with almost all sub-counties being vulnerable to the hazards. This could be due to the location of the districts in cattle corridor which as associated with prominent dry spells and droughts, but the area is also relatively flat with slope percentage rise (0-2) which is very prone to flooding in case of heavy rains. Landslides, rock falls and soil erosion were identified as most serious problem in Rubirizi districts with almost all sub-counties being vulnerable to the hazard except the rift valley flat plains.

The limited adaptive capacity (and or/resilience) and high sensitivity of households and communities in the districts increase their vulnerability to hazard exposure necessitating urgent external support. To counteract 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, 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 recommended policy actions targeting vulnerability reduction include:

- Improved enforcement of policies aimed at enhancing sustainable environmental health.
- Quickly review the animal diseases control act because of low penalties given to defaulters.
- Establishment of systems to motivate support of political leaders toward government initiatives and programmes aimed at disaster risk reduction.
- Increased awareness campaigns aimed at sensitizing farmers/communities on disaster risk reduction initiatives and practices.
- Revival of disaster committees at the district levels
- Periodic maintenance of feeder roads to reduce on traffic accidents
- Relocation of communities in the affected areas in the district by government
- Promotion of drought and disease resistant crop seeds
- Increase funding in the disaster and environmental departments

- Removal taxes on the importation of lightening conductors
- Support establishment of disaster early warning systems
- Increase funding and staff to monitor wetland degradation and non-genuine agro-inputs
- Improve the communication channel between the disaster department and local Communities
- Office of the prime minister should decentralize their activities at the district level
- Tree planting along road reserves
- Fund and equip recruited extension works
- Government should allocate funds aimed at disaster preparedness and management at district levels
- Removal of taxes on the importation of lightening conductors
- Support establishment of a disaster risk early warning systems

CHAPTER ONE

INTRODUCTION

1.1 Background

Uganda has over the past years experienced frequent disasters that range from drought, to floods, landslides, human and animal disease, 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 proactive engagement of the whole spectrum of stakeholders in disaster risk reduction, are becoming critical.

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

From 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 exercise above, local government officials and community members actively participated in the 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 inception report details methodological approach for HRV profiling and mapping for 5 districts in Western Uganda in response to a call by UNDP to engage an Individual Consultant to facilitate the process. The districts under consideration include Isingiro, Kamwenge, Mbarara, Rubirizi and Sheema.

1.2 Objectives of the study

The following main and specific objectives of the study are indicted:

1.2.1 Main objective

The main objective of the study is to develop District Hazard, Risk and Vulnerability Profiles for Isingiro, Kamwenge, Mbarara, Rubirizi and Sheema Districts in Western Uganda (Figure 1).

1.2.2 Specific Objectives

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

i. Collect and analyse field data generated using GIS in close collaboration and coordination with OPM in Isingiro, Kamwenge, Mbarara, Rubirizi and Sheema districts.
ii. Develop district specific multi hazard risk and Vulnerability profiles 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 and Deliverables

The consultant understands that UNDP through the Project "Strengthening Capacities for DRM and Resilience Building" will contract the following work:

i. Collection of field data using GIS in close collaboration and coordination with OPM Isingiro, Kamwenge, Mbarara, Rubirizi and Sheema districts and quantify them through a participatory approach on a scale of "not reported", "low", "medium" and "high", consistent with the methodology specified in Annex 3.
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 multiple 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 for all the districts visited 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 semiarid 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."

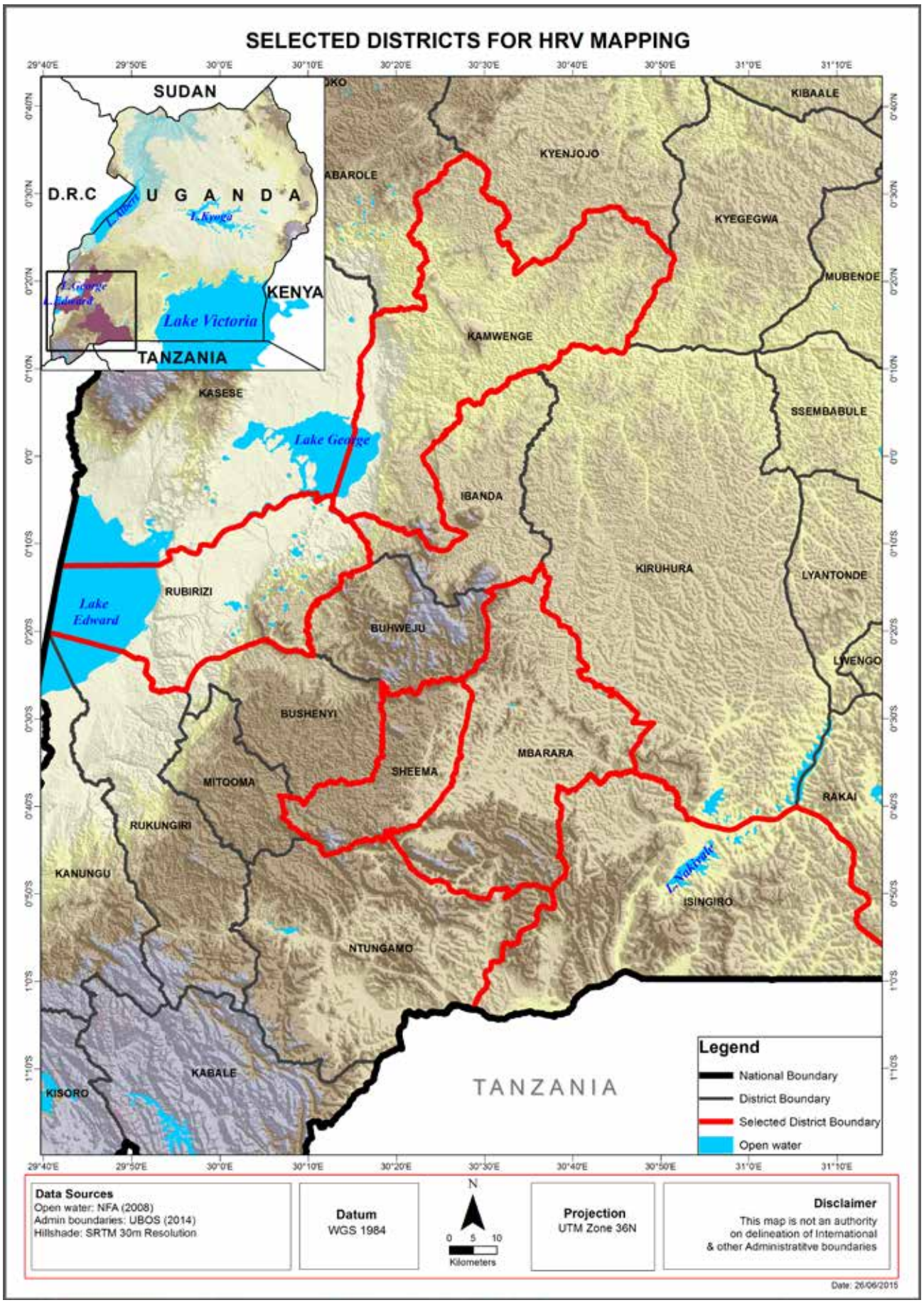


Figure 1: Location of Study Area

1.5 Structure of the Report

This Report is organized into Two Chapters: Chapter 1 provides Introduction on the assignment. Chapter 2 elaborates on the overview and the Multi-hazard, Risks and Vulnerability profiles of Mbarara District detailing their extent and policy implications

CHAPTER TWO

MBARARA DISTRICT MULTI-HAZARD, RISKS AND VULNERABILITY PROFILE

2.1 Overview of Mbarara District

Mbarara District is located between coordinates: 0^0 49'S, 30^0 19'E and 0^0 10'S, 30^0 46'E in Western Uganda. Mbarara District is bordered by Ibanda District to the north, Kiruhura District to the northeast, Buhweju District to the Northwest, Sheema District to the west, Ntungamo District to the south and Isingiro District to the Southeast. The district has 11 sub-counties, 1 Municipality with 6 Divisions. Sub-counties include: Bubaare, Bukiiro, Kagongi, Kashare, Rubaya, Rubindi, Rwanyamahembe, Bugamba, Mwizi, Ndeija and Rugando sub-counties. The 6 Divisions in Mbarara Municipality include: Biharwe, Kakiika, Kakoba, Kamukuzi, Nyakayojo and Nyamitanga Divisions.

2.1.1 Geomorphology

Mbarara District lies between altitudes of 1290m - 2115 m.a.s.l. Areas south of the district around Mwizi, Bugamba and Ndeija sub-counties have the highest altitudes between 1790m – 2115m towards the district border with Ntungamo district. Other high altitude areas are located towards northwest adjacent to border with Buhweju district in Bukiiro, Rubindi and Kagongi sub-counties. Low-lying areas are located towards northeast to adjacent to border with Kiruhura district in Kakiika and Biharwe Divisions and some parts of Kagongi sub-county bordering with Ibanda district. Generally the mid parts of the district have low altitudes ranging between 1290m – 1390m especially along River Rwizi. Figure 2 shows the Administrative boundaries, gazetted areas and geomorphology of Mbarara District.

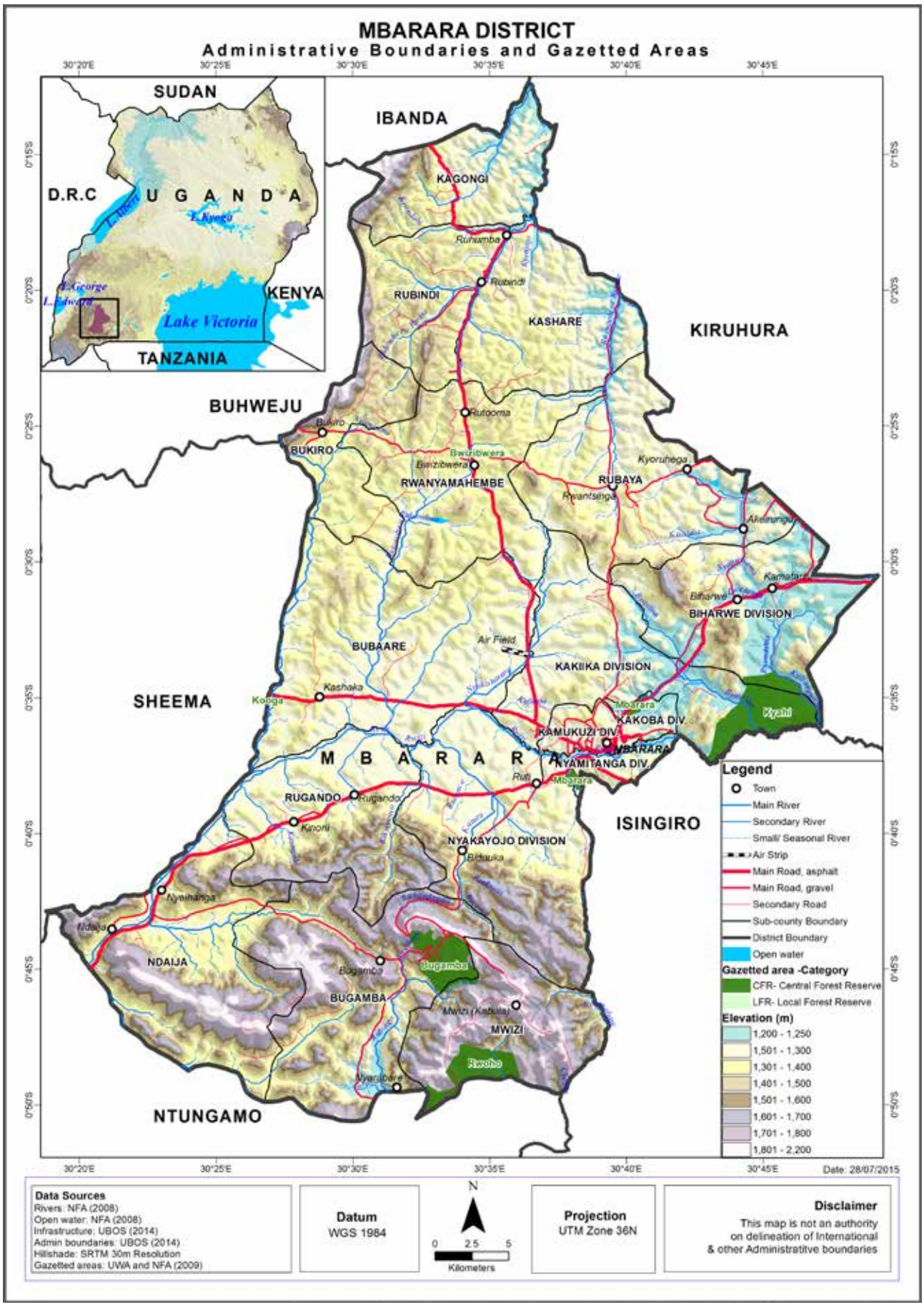


Figure 2: Administrative Units and Geomorphology, Mbarara District

2.1.2 Geology

From the geological mapping undertaken by the Geological Surveys and mines in 2012, the study indicates that biggest area of the district is predominantly mica schist with quartzitic interbeds stretching from Rwampara hills covering the mid part of the district up to Kagongi sub-county in the extreme north bordering with Ibanda district. Areas south of the district (Rwampara hills around Mwizi, Bugamba, Ndeija, Bugando and Nyakayojo Division) are dominated by mudstone, shale, slate and phyllites. Areas along River Rwizi are dominated by Alluvium, sand, silt and gravel especially in the sub-counties of Bugando, Bubaare and Nyakayojo Division. The district also has patches of mudstone, shale and phyllites with oncolite and stromatolite rock patches in Biharwe Division. The district also has Rwamasha granites strewn in Kashare, Rwanyamahembe sub-counties and Kakiika and Kakoba Divisions. Figure 3 shows the geology and lithological structures of Mbarara District.

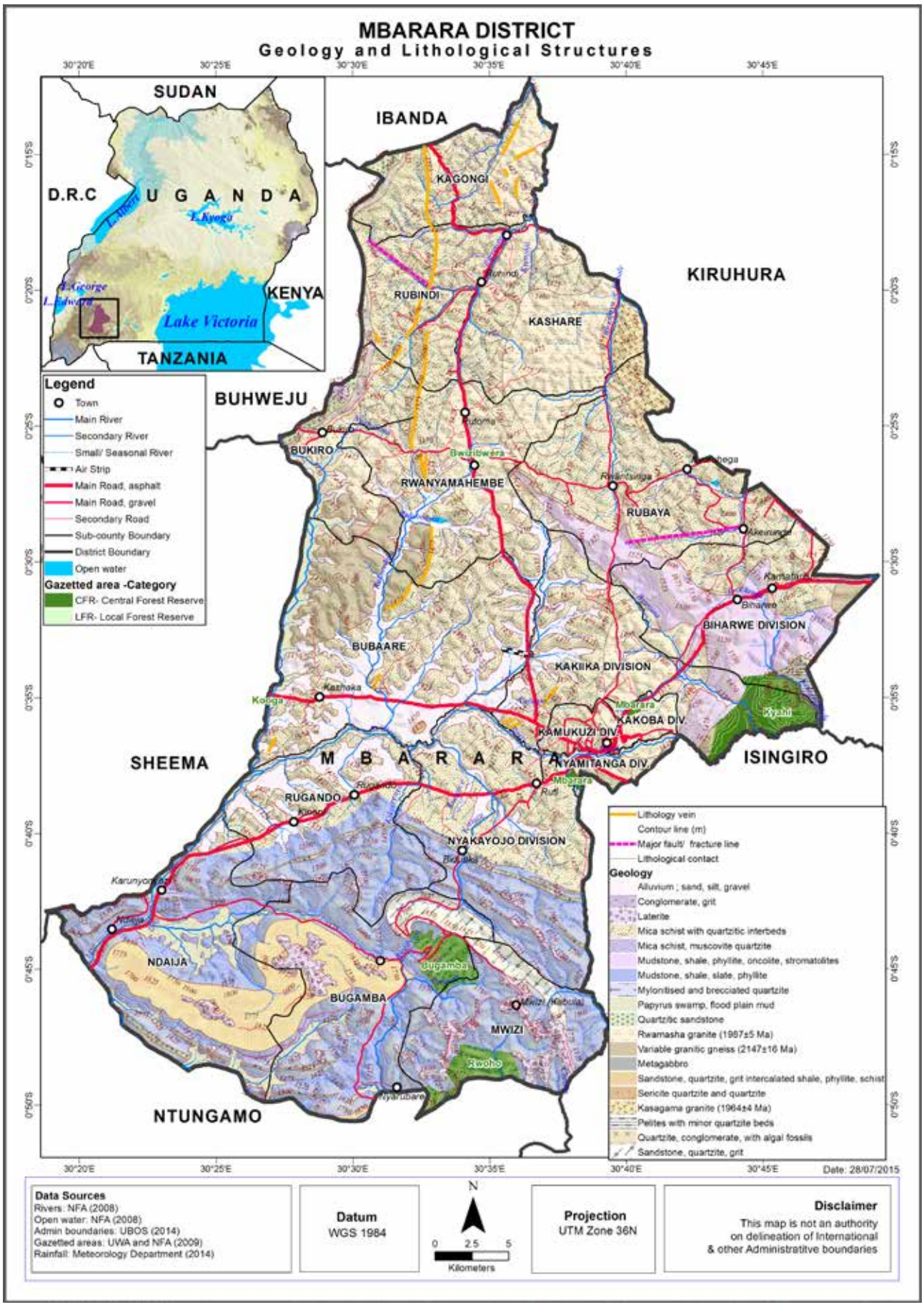


Figure 3: Geology and Lithological Structures, Mbarara District

2.1.3 Vegetation and Land use Stratification

The district has a variety of land use types; however farmlands cover the biggest area characterized by banana and coffee plantation as well as livestock farms. Farmlands exist in all sub-counties of the district. Animal grazing farms are predominantly located in savanna grasslands that provide palatable pasture for the livestock. The district is endowed with three main central forest reserves including Rwoho Central Forest reserves (South of the district bordering with Ntungamo), Kyahi Central Forest reserves south east of the district bordering with Isingiro district) and Bugamba Central Forest reserves (in Bugamba sub-county). The district also has small Forest Reserves that area being depleted including Mbarara, Bwizibwera and Kooga Forest reserves. Vegetation cover in the Forest reserves is predominantly tree plantation such as pine and eucalyptus. Main wetlands exist along River Rwizi and its tributaries in the sub-counties of Ndeija, Bugando, Nyakayojo Division, Nyamitanga and Kakoba Divisions. Other main wetlands exist along tributaries of River Rwizi in Bubaare and Bukiiro sub-counties although most of the wetland vegetation has been converted for cattle grazing and degraded due to sand mining and brick-laying. Built-up areas are mainly in 6 Divisions in Mbarara Municipality including Biharwe, Kakiika, Kakoba, Kamukuzi, Nyakayojo and Nyamitanga Divisions. Figure 4 shows the land use stratification of Mbarara District.

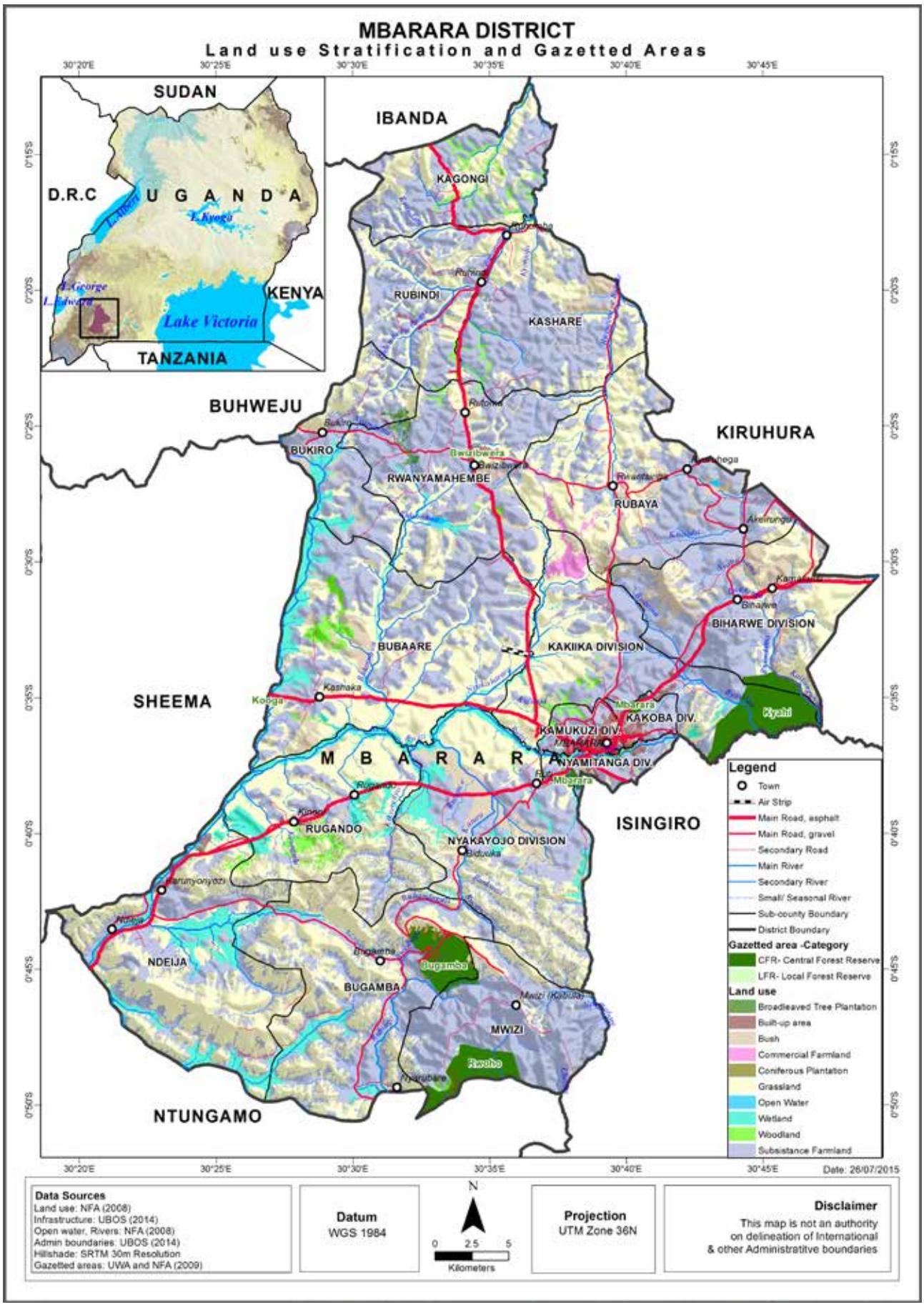


Figure 4: Land use Stratification, Mbarara District

2.1.4 Temperature and Humidity

Mbarara district experiences small annual variation in air temperatures; and the climate may be described as generally hot and humid, with average monthly temperatures varying between 27°C and 31°C. The temperature maximum are consistently above 30°C and sometimes reach 38°C. Average minimum temperatures are relatively consistent and vary between 16°C and 18°C in the hilly areas of Bwizi, Bugamba and Ndeija sub-counties. The relative humidity is higher during rain seasons with maximum levels prevalent in May. The lowest humidity levels occur in dry seasons with minimum levels occurring in December and January. The average monthly humidity is between 60% and 80%.

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 Mbarara. The wind speed values indicated, therefore, represent conditions of moderate to strong or turbulent conditions. The average number of calms experienced in the area, are indicated to be experienced for 99days at 0600 hours, and 27 days at 1200 hours, respectively, at Mbarara. The general conclusion from these climatic figures is that for most of the year, Mbarara experiences moderate to strong and gusty winds, increasing in the afternoon.

2.1.6 Rainfall

Total Annual Rainfall received by Mbarara District ranges between 990mm- 1207mm per annum. Lowest rainfall amounts are experienced in Mbarara Municipality i.e. in Biharwe, Kakiika, Kakoba, Kamukuzi, Nyakayojo and Nyamitanga Divisions with rainfall between about 990mm -1000mm per annum. Highest annual rainfall between 1180mm -1207mm are experienced in Kagongi and Rubindi hills towards border with Buhweju district (Figure 5)

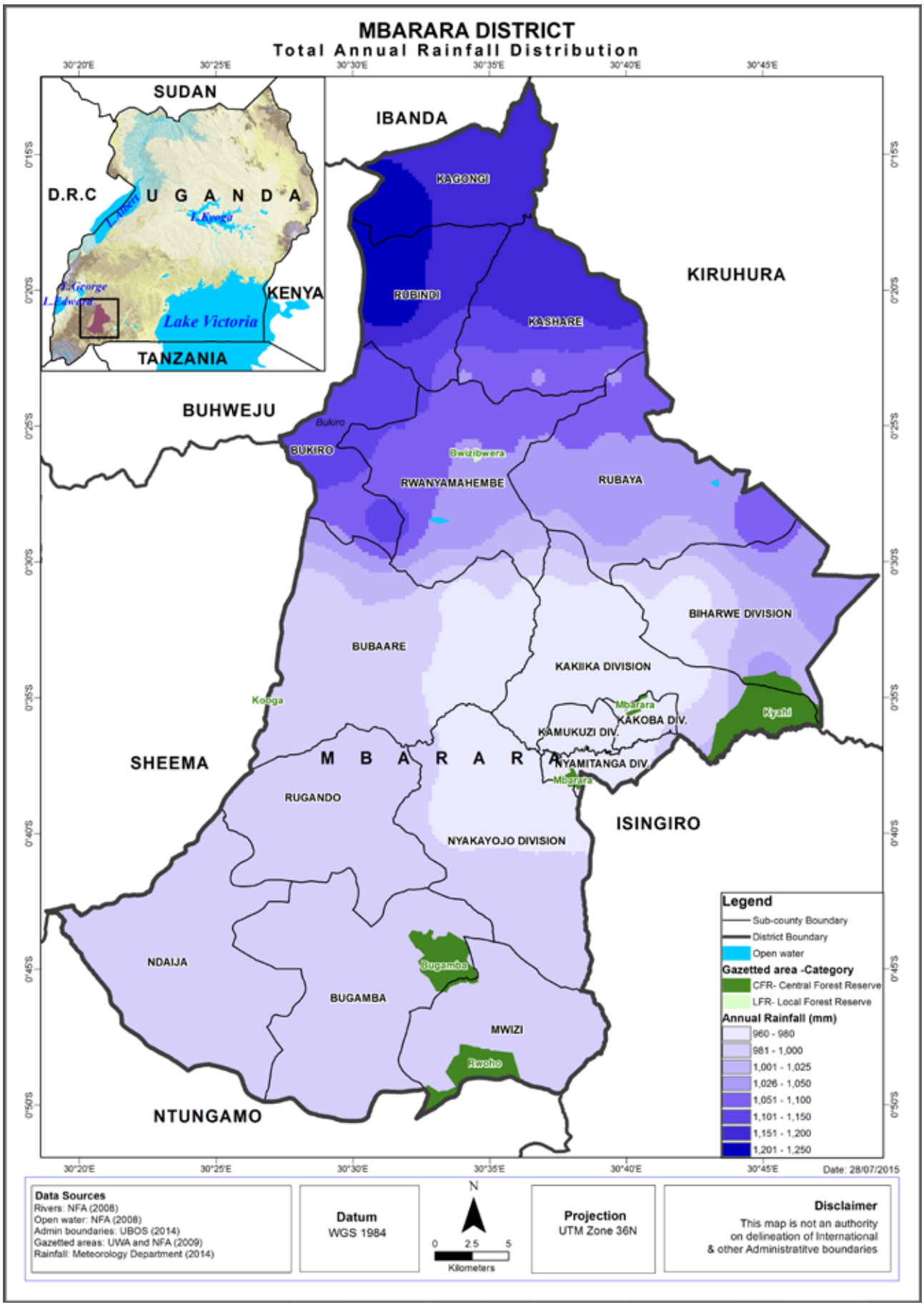


Figure 5: Rainfall Distribution, Mbarara District

2.1.7 Hydrology

Mbarara District lies in the Lake Victoria basin in the Rwizi River catchment. The main surface water body is River Rwizi forming Rwizi River catchment. A great number of tributaries drain into Rwizi River including Nyamirima from Bukiiro hills, Katuru from Nyakayojo Divisions hills, Ndeija river, Byasiina river in Mbarara Municipality, Rukorohwa in Bubaare. Other main rivers include Buzoronga in Rubindi, Bubale in Rubaya and Kashare sub-counties draining north wards of the district and Rubingo in Bugamba sub-county draining southwards. Generally areas along Rwizi river are poorly drained and flood prone. (Figure 39)

2.1.8 Population

According to the National population and housing census 2014 provisional results, Mbarara District had a total population of 474,144. Results also showed that most of the people in Mbarara District reside in rural areas (279,131 (58.8%) compared to (195,013 (41.1%) who reside in urban centers. The gender distribution was reported to be males: 229,901 (48.5%) and females: 244,243 (51.5%). About 97.7% (463,474) of the population form the household population and only 2.3% (10,670) is Non-household. Kakoba Division had the highest population of 55519 people while Kanara sub-county had the least population of 14594 people (Figure 6). Table 1 shows the population distribution per sub-county for the different gender.

Table 1: Population Distribution in Mbarara District

	HOUSEHOLDS		POPULATION		
Sub-County	***Number***	***Average Size***	***Males***	***Females***	***Total***
Biharwe Division	5121	4.2	10732	11209	21941
Bubaare	4979	4.6	11122	11739	22861
Bugamba	7526	4.7	17136	18093	35229
Bukiiro	3105	4.7	6928	7666	14594
Kagongi	4438	4.7	9955	10980	20935
Kakiika Division	5364	3.9	10661	11312	21973
Kakoba Division	16861	3.1	27443	28076	55519
Kamukuzi Division	9813	3.3	16507	17507	34014
Kashare	4798	4.7	10971	12006	22977
Mwizi	7182	4.8	16705	18093	34798
Ndeija	6881	4.5	15176	16363	31539
Nyakayojo Division	8726	4.3	18740	19512	38252
Nyamitanga Division	6536	3.4	11251	12063	23314
Rubaya	3922	4.7	9126	9171	18297
Rubindi	5640	4.3	11746	13014	24760
Rugando	6084	4.4	13201	13626	26827
Rwanyamahembe	6188	4.2	12501	13840	26341

Source: UBOS Census 2014

2.1.9 Economic activities

Majority of the population in Mbarara District engages in subsistence agriculture where cultivation of food crops such as bananas, maize, beans, finger millet, cassava, groundnuts and sweet potatoes is dominant. A considerable number of the households practice livestock production and the animals reared are cattle, goats, sheep, pigs and chicken.

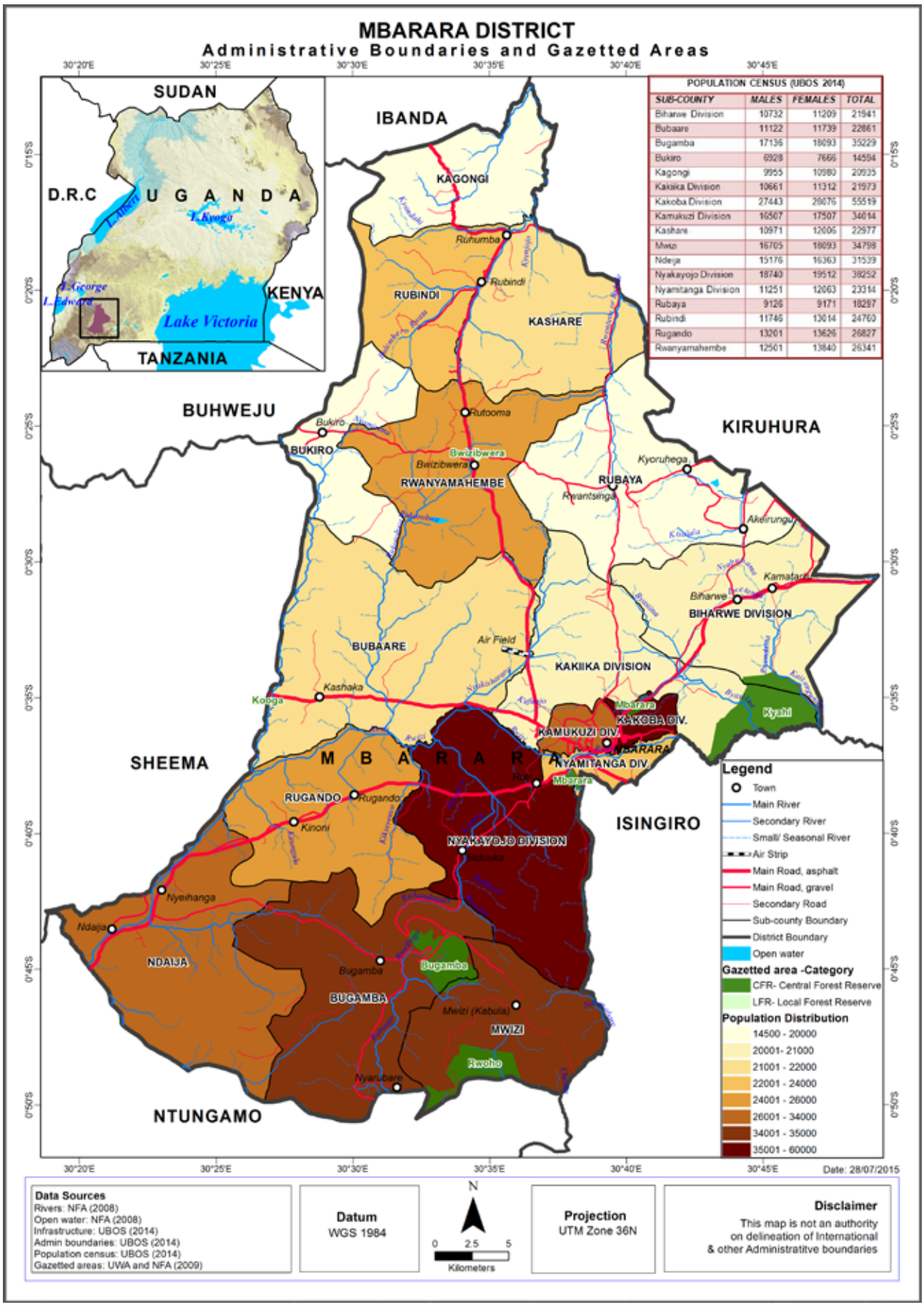


Figure 6: Population Distribution, Mbarara District

2.2.0 METHODOLOGY

2.2.1 Collection and analysis of field data using GIS

2.2.1.1 Preliminary spatial analysis

Hazard prone areas' base maps were generated basing on several numerical models and guidelines using existing environmental and socio-ecological spatial layers, socio-economic data, and meteorological data, etc.) in a GIS environment (ArcGIS 10.1).

2.2.1.1 Stakeholder engagements

Stake holder 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. Hazard, risk and vulnerability assessment was done using a stack of methods including participatory approaches such as Participatory GIS (PGIS), Focus Group Discussions (FGDs), key informant interviews, transect drives as well as spatial and non-spatial modelling. Key informant interviews and Focus Group Discussions were guided by a checklist (Appendix 1 and 2). Key Informant Interviews for District officers included: Districts Natural Resources Officers, Environment Officers, Wetland Officers, Forest Officers, Production and Marketing Officers, Veterinary Officers, Health Inspectors. At sub-county level Key informants for this assessment included: Sub-county and parish chiefs, community Development mobilizers and health workers. One Key Informant Interview comprising of four respondents (Agriculture officer, District Probation officer and Senior Health Educator) was held at Mbarara District Headquarters (UTM, 237631; 9932535).

Focus Group Discussions were carried out in at least five purposively selected sub-counties that were ranked with highest vulnerability. 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. Three FGDs comprising of an average of 12 respondents (crop farmers, local leaders, nursing officers, police officers and cattle keepers) were conducted at Bugamba Sub-county (UTM, 223831; 9917574), Rubaya Sub-county (UTM, 241152; 9948274) and Mwizi Sub-county (UTM, 233166; 9914977). Each Parish of the selected Sub-counties was represented by at least one participant and the selection of participants was engendered. 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.

2.2.1.2 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.

2.2.1.3 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 III). Hazard hot spots, potential and susceptible areas will be classified using a participatory approach on a scale of "not occur", "low", "medium" and "high", consistent with the methodology specified in Annex 3. 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.

2.2.2 Develop District Specific multi-hazard risk and Vulnerability Profiles

2.2.2.1 Data analysis and integration

From the verification of the Hazard prone areas base maps developed basing on several numerical models and guidelines for existing environmental and socio-ecological spatial layers .Final HRV maps will be generated in the GIS environment for each district up to sub-county level and parish level where possible. This is because at a small scale such as at sub-county level, the population could be facing as many hazards as can be listed and so it becomes inappropriate to do the profiling at that small scale. For each of the 5 target districts, specific hazard, risk and vulnerability profiles will be analyzed, discussed and presented in the report and maps.

2.2.2.2 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.

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

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

2.4.0 RESULTS FROM MULTI-HAZARD RISK, VULNERABILITY MAPPING

2.4.1 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 Mbarara 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 lightening
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.

2.4.2 GEOMORPHOLOGICAL OR GEOLOGICAL HAZARDS

2.4.2.1 Landslides, rock falls and soil erosion

Multi-hazard, risk and vulnerability assessment was done through participatory approaches and Key Informant interviews were held with the Mbarara District Agriculture officer, District Probation officer and Senior Health Educator. Focus Group Discussions were held in Bugamba Sub-county (UTM, 223831; 9917574), Rubaya Sub-county (UTM, 241152; 9948274) and Mwizi Sub-county (UTM, 233166; 9914977).

Results from the participatory assessments indicated that Mbarara District has been experiencing soil erosion, rock falls and minor landslides. Participants in the discussions indicated that these hazards mainly occur during the rainy seasons and destroy crops, houses and roads. It was observed that Mwizi, Bugamba, Rugando, Ndeija sub-counties were prone to soil erosion, rock falls and to a small extent landslides because of their hilly topography. Minor cases of incidences of these hazards were reported in Biharwe Division and Rubaya sub-county. This information was integrated with the spatial modelling using socio-ecological spatial data i.e. generated from Soil texture (data for National Agricultural Research Laboratories – Kawanda (NARL) 2014, Rainfall (Meteorology Department 2014), Digital Elevation Model (DEM), SLOPE, ASPECT (30m resolution data from SRTM Shuttle Radar Topography Mission (SRTM). Figure 7 shows areas vulnerable to landslides, rock falls and soil erosion. The map also shows hot spot areas where landslides, rock falls and soil erosion have occurred in the past 20 years.

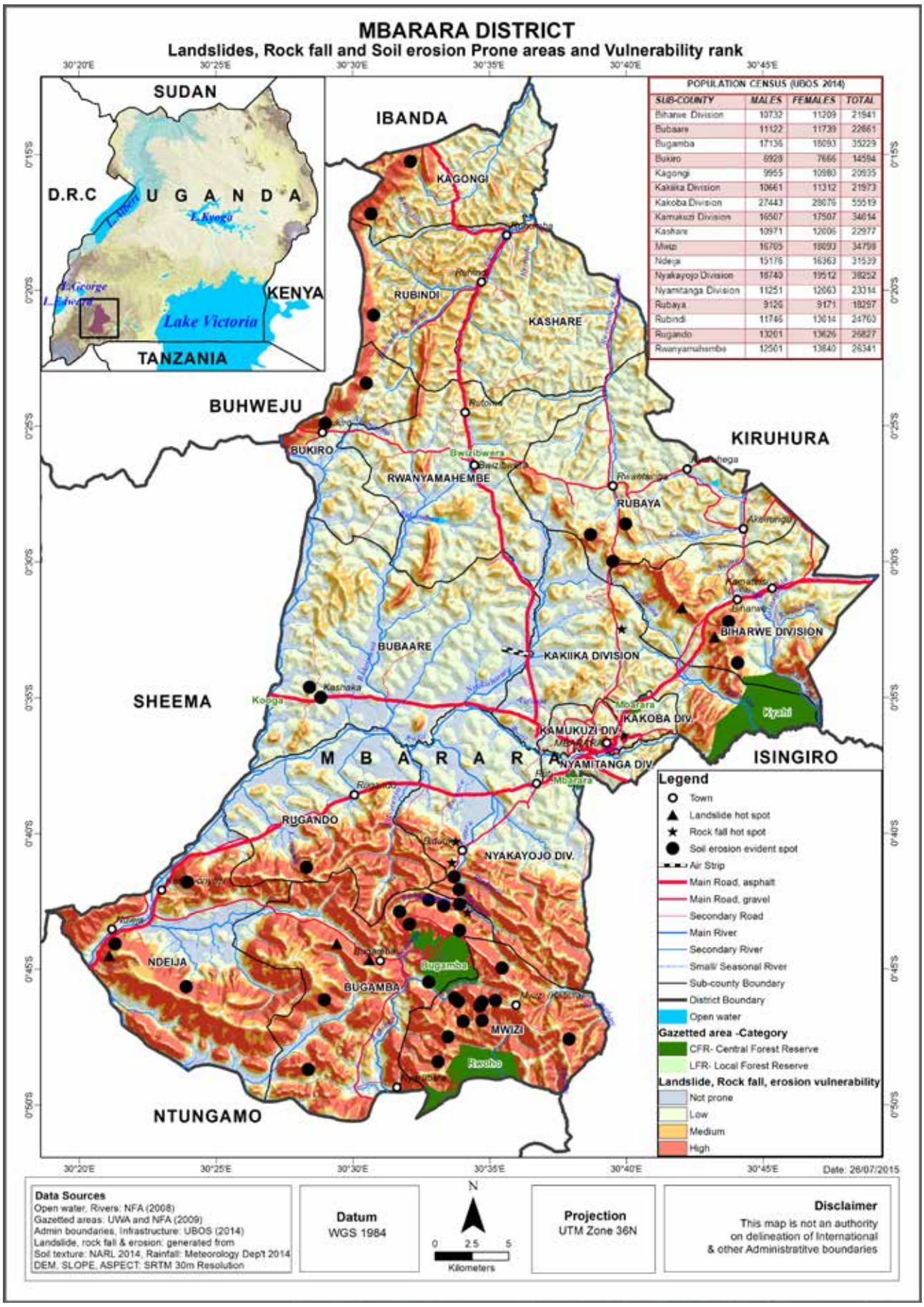


Figure 7: Landslides, Rock falls, Soil erosion prone areas, Mbarara District

2.4.2.2 Earthquakes and faults

Results from the participatory assessments revealed that earthquakes weren't a serious problem in Mbarara District. However, it was observed that the entire district only experiences light tremors. Participants reported that faults were present in rocks and soil masses in the Rwampara highlands. It was further reported that these faults are a potential threat as they are susceptible to rock falls and landslides. The other faults have been caused by stone quarries on hill slopes exposing foot slopes to potential rock falls and landslides in Ndeija sub-county and Nyakayojo Division. The other sub-counties affected by faults include: Bugamba and Mwizi. Figure 8 indicates areas where faults exist as vulnerable areas where earthquakes have more impact and the ranking is dependent on the distance from the faults and lithological veins.

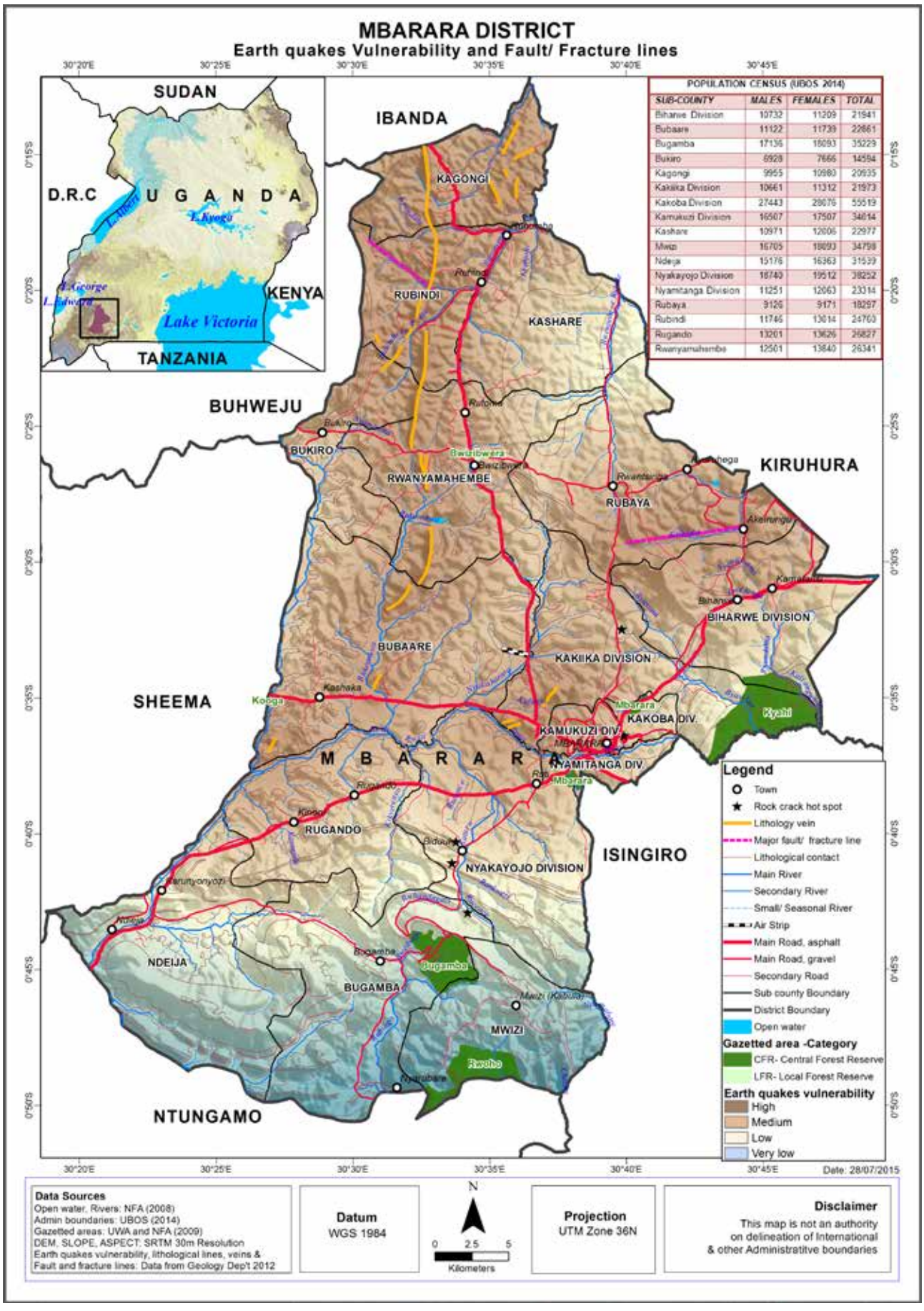


Figure 8: Earth quakes Vulnerability, Fault lines, Mbarara District

2.4.3 CLIMATOLOGICAL OR METEOROLOGICAL HAZARDS

2.4.3.1 Floods

Results from the focus group discussions revealed that floods usually occur in the low-lands of Bugamba, Rugando and Ndeija sub-counties and along River Rwizi. Participants indicated that flooding causes loss of crops and grazing pasture in the flood plains of the affected sub-counties. The other affected sub-counties include: Bubaare, Rubaya and Rwanyamahembe. Nyakayojo was the most affected Division. This information was integrated with the spatial modelling using socio-ecological spatial data i.e. generated from Soil texture (data for National Agricultural Research Laboratories – Kawanda (NARL) 2014, Rainfall (Meteorology Department 2014), Digital Elevation Model (DEM), SLOPE, ASPECT (30m resolution data from SRTM Shuttle Radar Topography Mission (SRTM). Figure 9 shows areas vulnerable to floods. The map also shows hot spot areas where floods have occurred in the past 20 years.

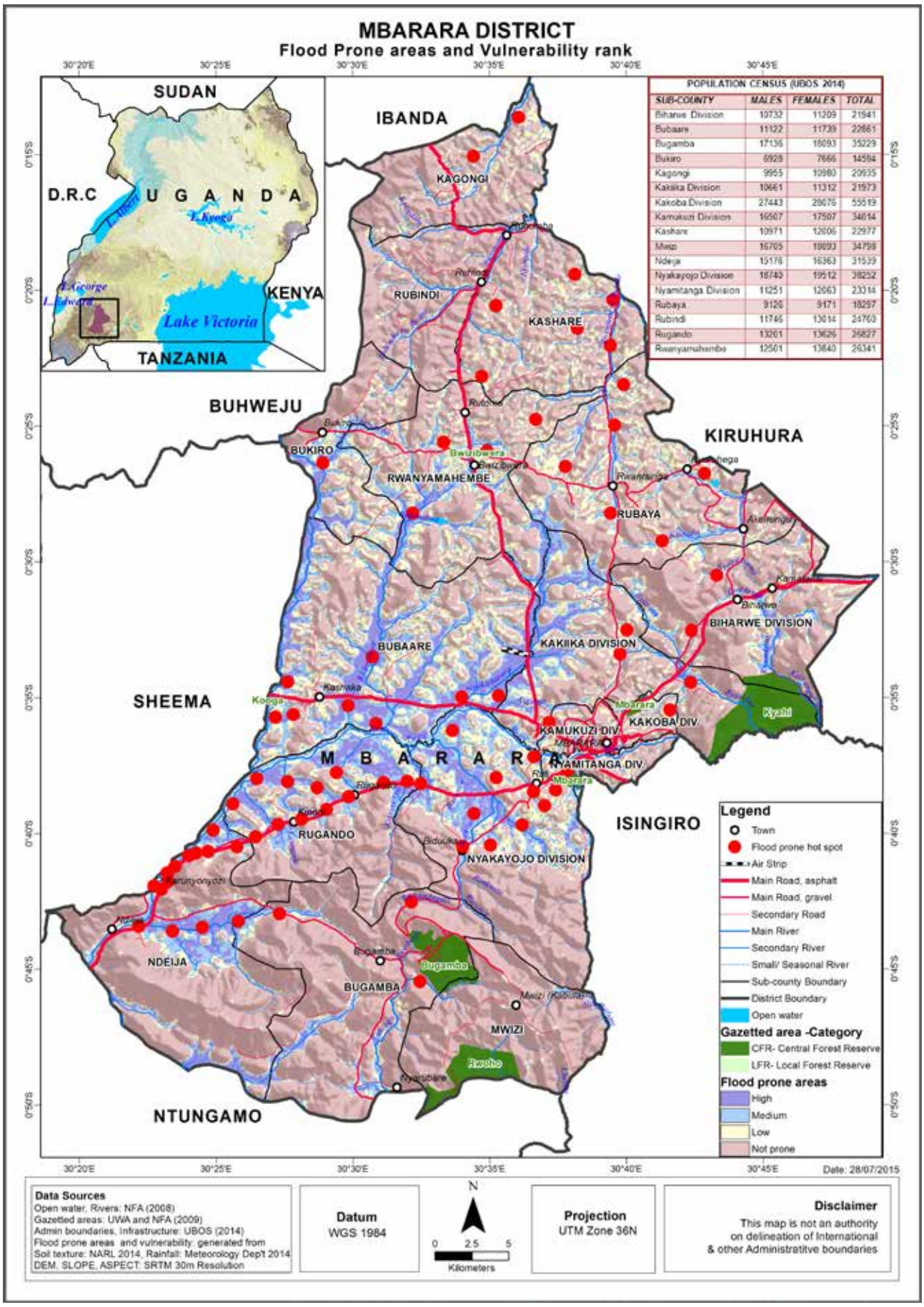


Figure 9: Flood prone areas and Ranking, Mbarara District

2.4.3.2 Drought

Participatory assessments through the focus group discussions indicated that droughts in Mbarara District are experienced in the form of long dry spells without rainfall. Participants reported that droughts were a serious threat leading to food insecurity at household levels within the district. The worst drought in Mbarara district which caused significant crop failures was recorded in 2000. The most affected areas in order of severity are; Kashare, Biharwe, Rubaya, Kakiika, Bubaare and Bukiiro. This information was integrated with the spatial modelling using socio-ecological spatial data i.e. generated from Rainfall and Temperature (Uganda National Meteorological Authority, 2014) using the WASP index. Figure 10 shows areas that are affected by drought and their ranking.

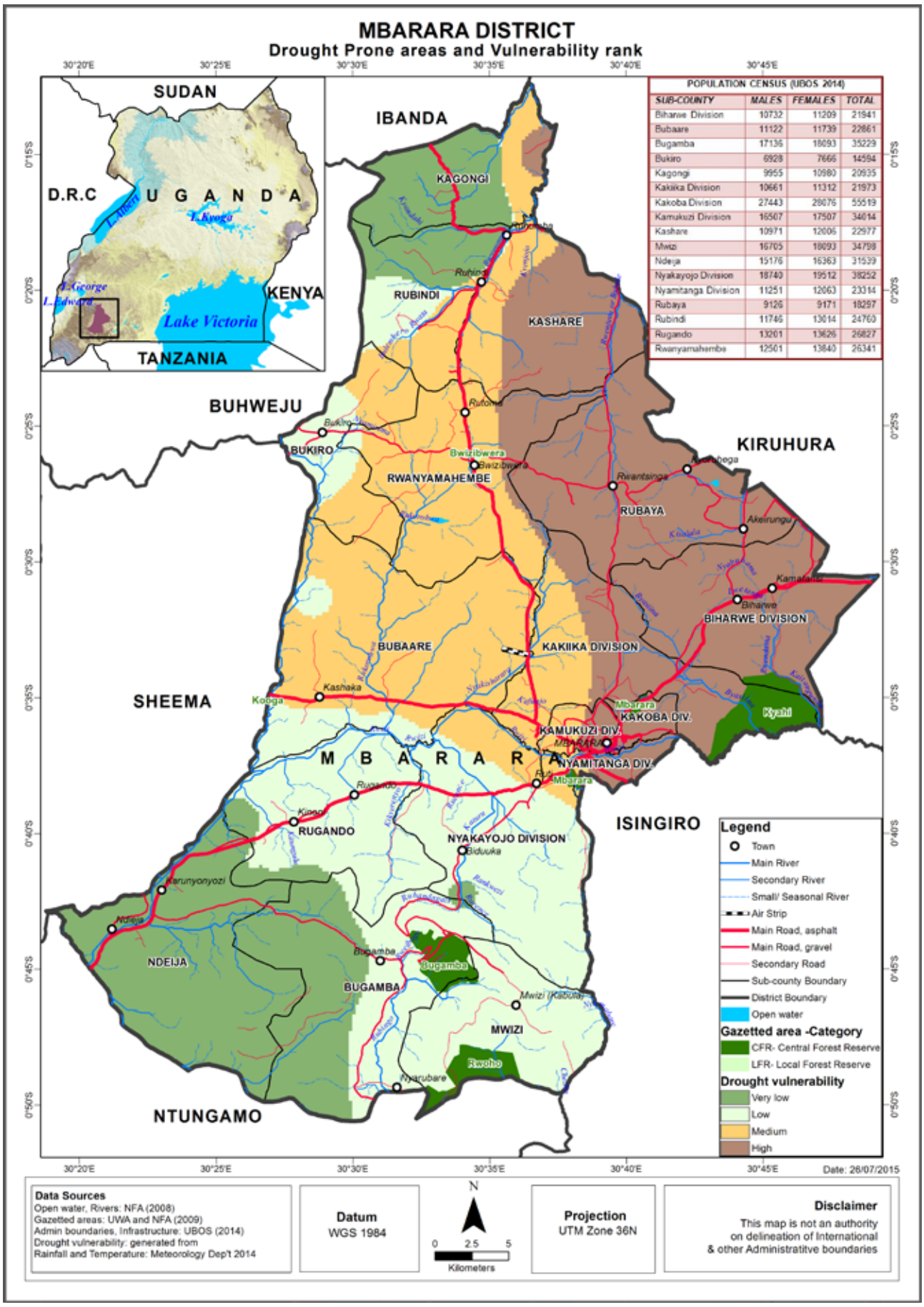


Figure 10: Drought prone areas and Ranking, Mbarara District

2.4.3.3 Hailstorms

Results from the participatory assessments showed that Bubaare, Bugamba and Mwizi, Ndeija sub-counties and Nyamitanga and Nyakayojo divisions are the most affected by hailstorms in Mbarara District. The effects of hailstorms included: loss of crops especially bananas, maize, millet, beans, sorghum, cassava and sweet potatoes.

2.4.3.4 Strong winds

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 Mbarara district. The general conclusion from these climatic figures is that for most of the year, Mbarara District experiences moderate to strong and gusty winds. Results from the Participatory assessments indicated that strong winds are also experienced during the rainy season. Participants reported that strong winds blow off roof tops of households and schools, uproot banana plantations and trees. Mwizi, Ndeija, Bugamba, Bubaare sub-counties and Nyakayojo Division are the most affected by strong winds.

2.4.3.5 Lightening

Lightning is a sudden high-voltage discharge of electricity that occurs within a cloud, between clouds, or between a cloud and the ground. The distribution of lightning on Earth is far from uniform. The ideal conditions for producing lightning and associated thunderstorms occur where warm, moist air rises and mixes with cold air above. Results from the participatory assessments showed that there have been increased incidences of lightning in Mbarara District during rainy seasons. It was reported that in 2015, lightning killed 2 people in Ruburara parish, 3 cows and 9 goats in Bunenero parish all in Rubaya sub-county. In Bugamba sub-county, 1 person and 5 cows were killed by lightning in 2014. Most schools in the affected sub-counties are at risk of being struck by lightning because they lack lightening conductors. Figure 11 indicates areas where hailstorms, strong winds and lightening are prominent and their ranking. The map also indicates crop gardens where hailstorms were evident and village spots where lightening was reported.

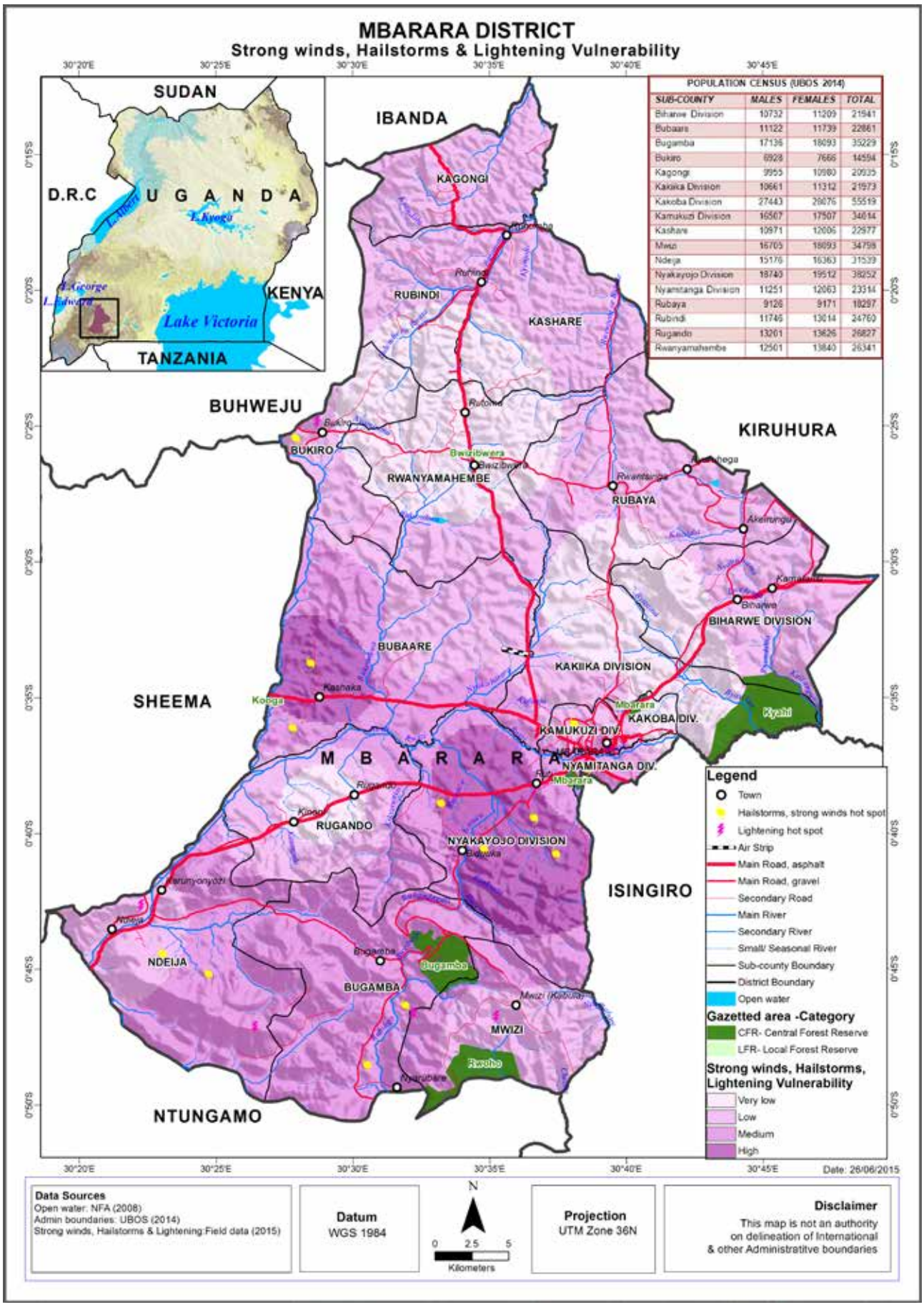


Figure 11: Hailstorms, strong winds, lightening and Ranking, Mbarara District

2.4.4 ECOLOGICAL OR BIOLOGICAL HAZARDS

2.4.4.1 Crop Pests and Diseases

Results from participatory assessments revealed that crop farmers in Mbarara District as a whole are vulnerable to crop pests and diseases. The most affected crops include bananas and coffee because the district lies in the banana-coffee agro-ecological zone. The most reported diseases were banana bacterial wilt, fusarium wilt, panama wilt and coffee wilt disease while the most reported crop pests were coffee twig borer, caterpillars and snails. Bukiiro, Bubaare and Rubaya sub-counties and Biharwe and Nyakayojo Divisions were the most affected by diseases. It was reported that caterpillars have in the past severely damaged crops in the rangelands of Biharwe Division and Bubaare sub-county. Figure 12 indicates areas where crop pests and diseases are prominent, hot spots especially for BBW and ranking. The map also indicates the Agricultural Advisory Services Headquarters at the Mbarara District Headquarters.

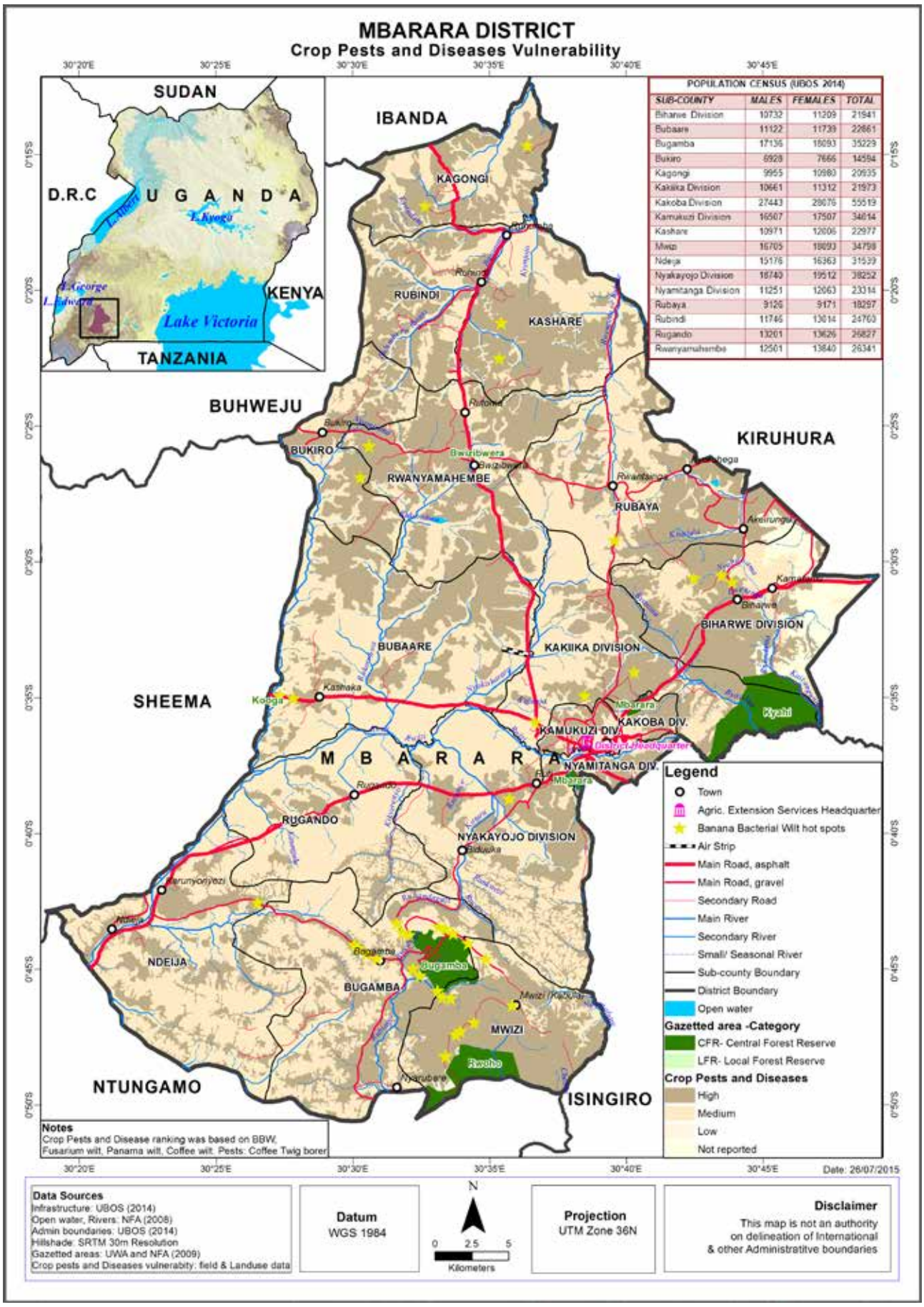


Figure 12: Crop Pests and Diseases Vulnerability, Mbarara District

2.4.4.2 Livestock Pests and Diseases

Livestock pests and diseases are a serious problem because Mbarara District is located in the cattle corridor. Mbarara district is prone to livestock pests such as ticks and diseases including foot and mouth disease, anthrax and rabies. It was reported that Biharwe Division and Rubaya, Rwanyamahembe and Kashare sub-counties are prone to foot and mouth disease. In 2000, Biharwe Division, Kashare and Rwanyamahembe sub-counties were hit by anthrax which killed very many animals until strict measures from government such as quarantine and burning animal carcasses helped control the disease. Almost all the sub-counties in the district are affected by ticks. Figure 13 indicates areas where livestock pests and diseases are prominent and their ranking. The map also indicates the veterinary services Headquarters at the Mbarara District Headquarters.

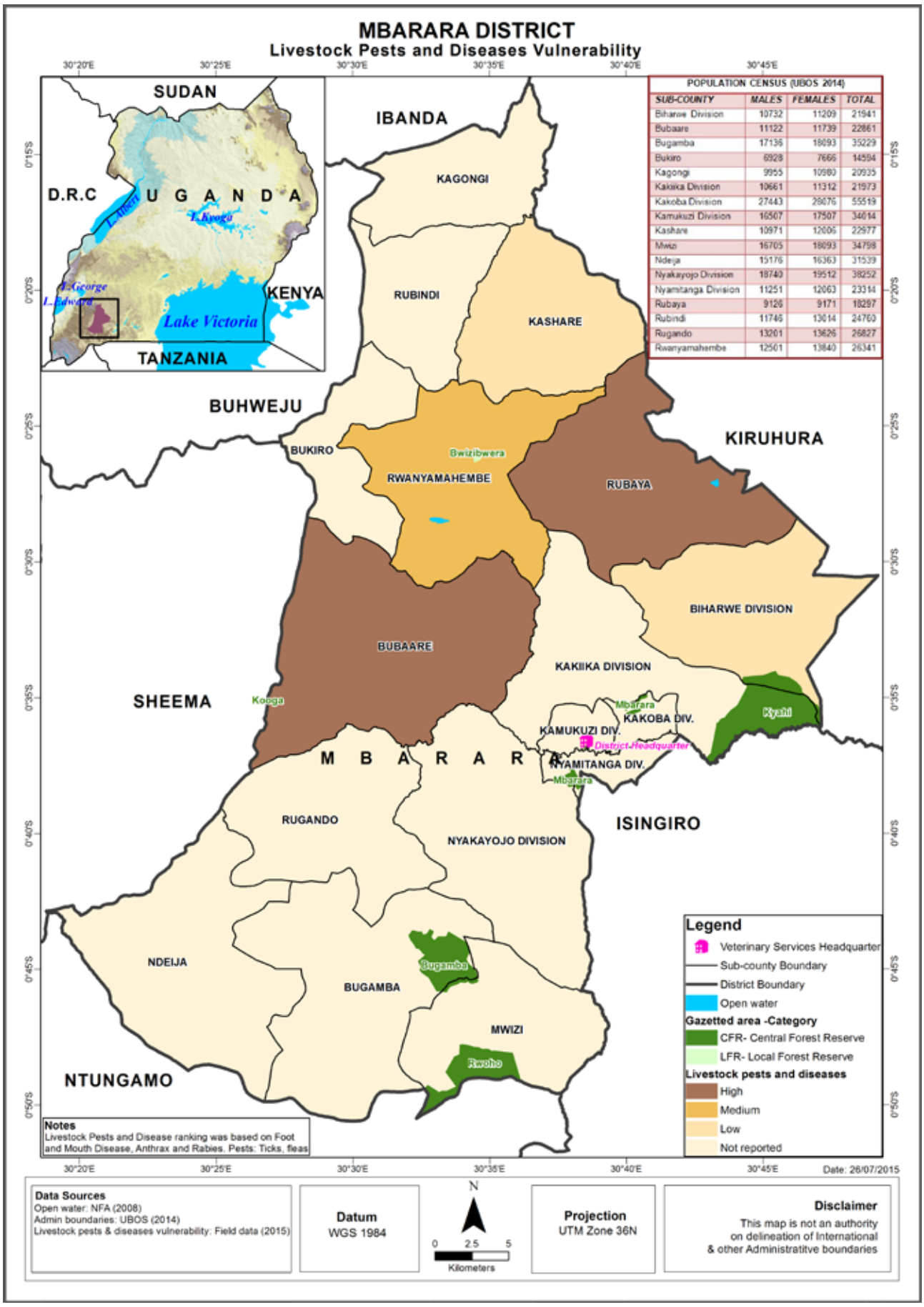


Figure 13: Livestock Pests and Diseases Vulnerability, Mbarara District

2.4.4.3 Human Diseases outbreaks

In the series of focus group discussions held, participants revealed that HIV/AIDS, malaria, brucellosis and sexually transmitted infections are common diseases in Mbarara District. It was reported that malaria is most prevalent in the entire district during dry seasons. HIV/AIDS prevalence rates were reported to be at 6% in the whole district with Bugamba sub-county having the highest prevalence rate of 17%. Households in Biharwe Division and the sub-counties of Kashare and Rwanyamahembe were the most affected by Brucellosis. It was also reported that all the sub-counties are equally affected by malaria. However, the recent provision of treated mosquito nets by government has reduced malaria prevalence rates in the district. Figure 14 indicates areas where human disease outbreaks are prominent and their ranking. The map also shows the location of the different health centres and hospitals.

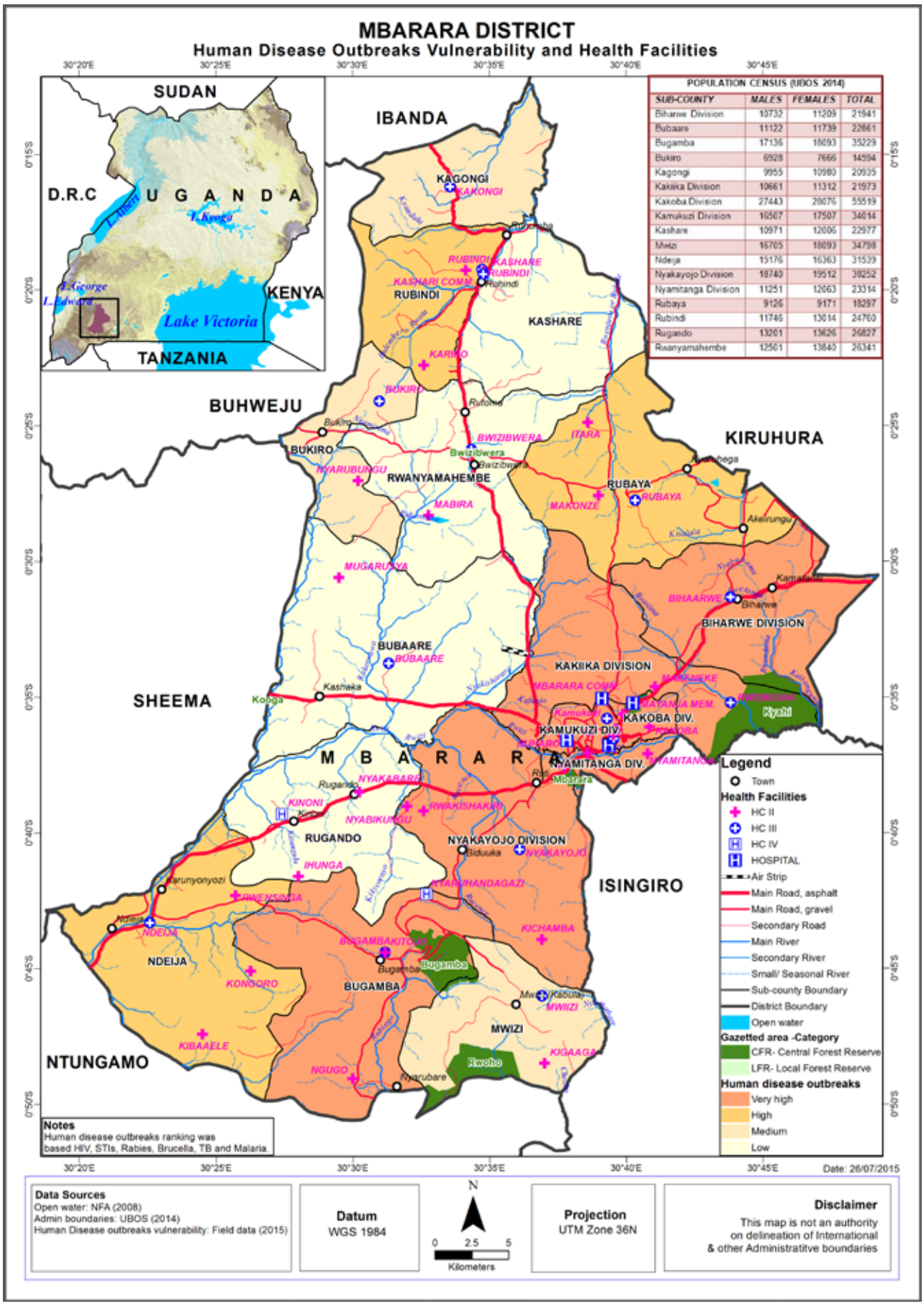


Figure 14: Human Disease Outbreaks Vulnerability, Mbarara District

2.4.4.4 Vermin and Wild-life Animal Attacks

Participatory assessments through focus group discussions revealed that there are incidences of vermin and wild life attacks in the areas adjacent to Lake Mburo national park in Biharwe Division. Vermin and wild life attacks were also reported in parts of Mwizi sub-county neighboring Rwoho central forest reserve. Vermin such as monkeys, birds, rats and squirrels are fond of destroy maize, beans, millet, cassava and sweet potato gardens. Figure 15 indicates areas where vermin and wildlife animal attacks have occurred and their vulnerability ranking.

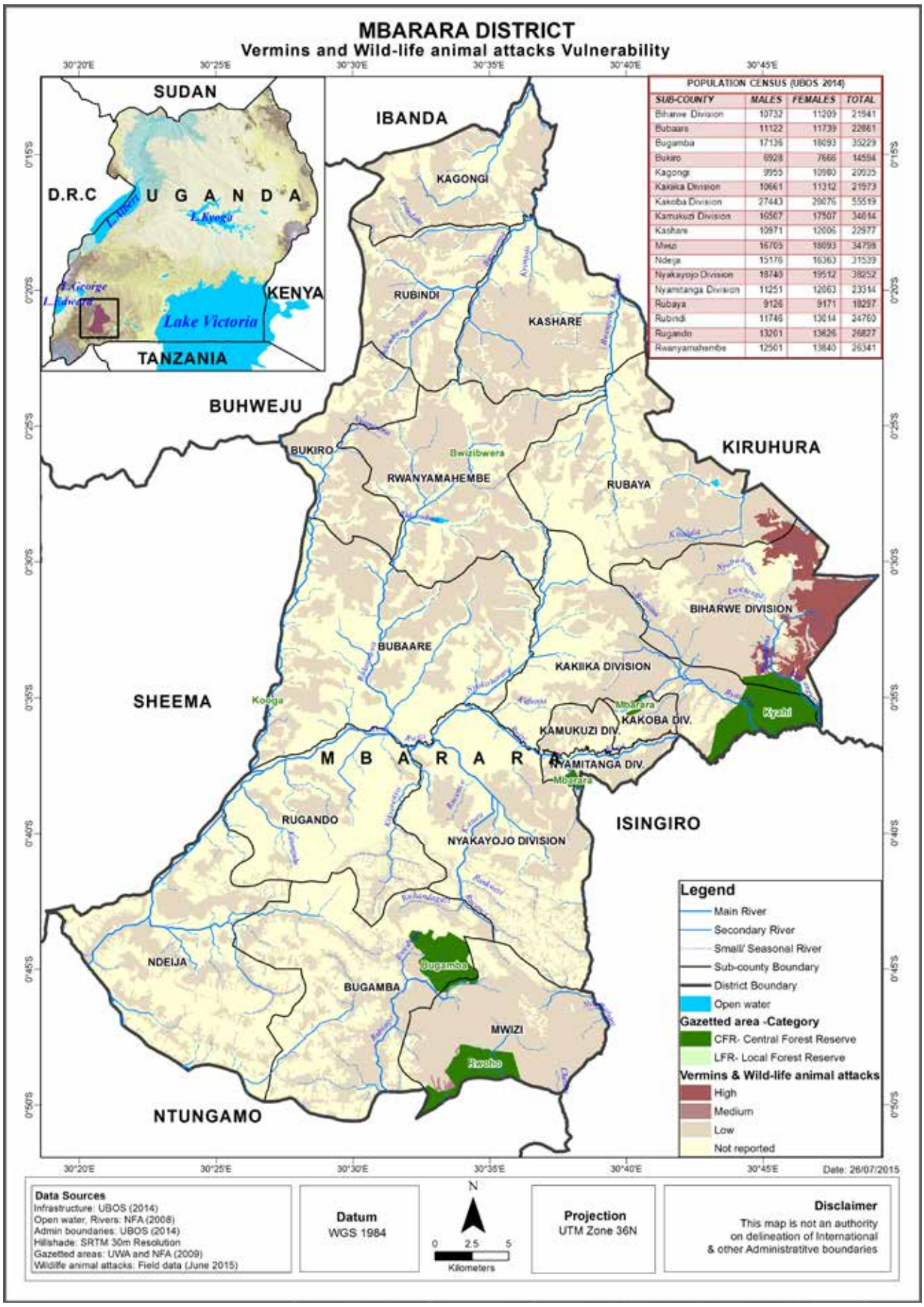


Figure 15: Vermin, Wild-life animal attacks vulnerability, Mbarara District

2.4.4.5 Invasive species

Results from the discussions indicated that *Lantana camara, acacia hockii and Pasperum spp*. were the most reported invasive species in Mbarara District. Farm lands in Biharwe Division and Rubaya and Kashare sub-counties are dominated by *Lantana camara, Acacia hockii and Pasperum spp*. despite efforts of clearing them by livestock keepers. These invasive species have destroyed pastures that would have been palatable to cattle in the farm lands. Figure 16 indicates areas where invasive species exist and their ranking.

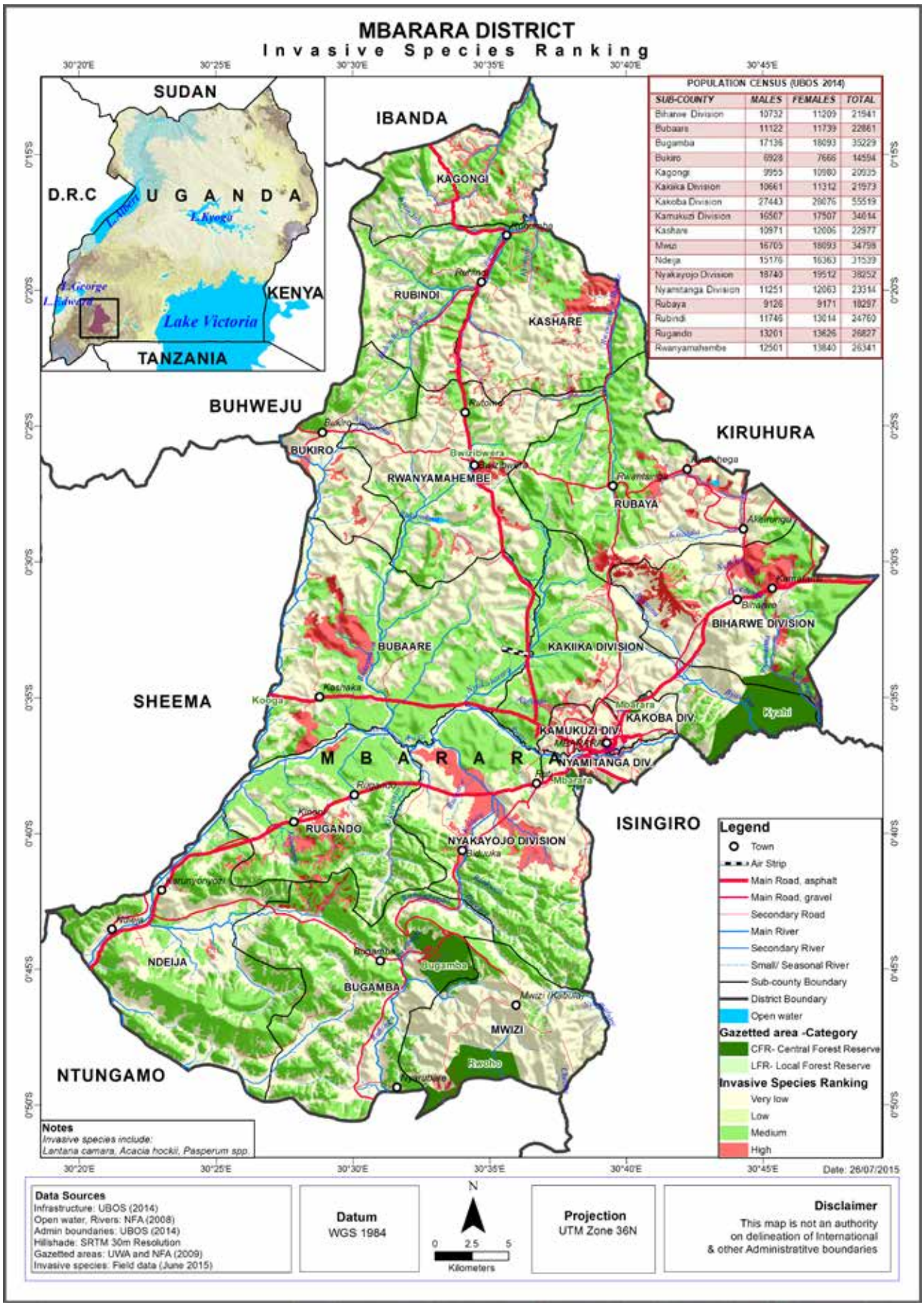


Figure 16: Invasive Species Ranking, Mbarara District

2.4.5 HUMAN INDUCED AND TECHNOLOGICAL HAZARDS

2.4.5.1 Bush fires

Participants in the discussions indicated that cattle grazing communities burn old grass lands to allow regeneration of fresh pastures for their cattle. However, when this burning is uncontrolled, it will burn crop gardens and tree plantations. A case in example, in 2011 a very large commercial tree plantation belonging to one of the district officials was burnt in Bugamba sub-county. The other sub-counties affected by such fires include: Rugando, Ndeija, Kashare and Biharwe Division. Figure 17 indicates areas where bush fires have occurred and their vulnerability ranking.

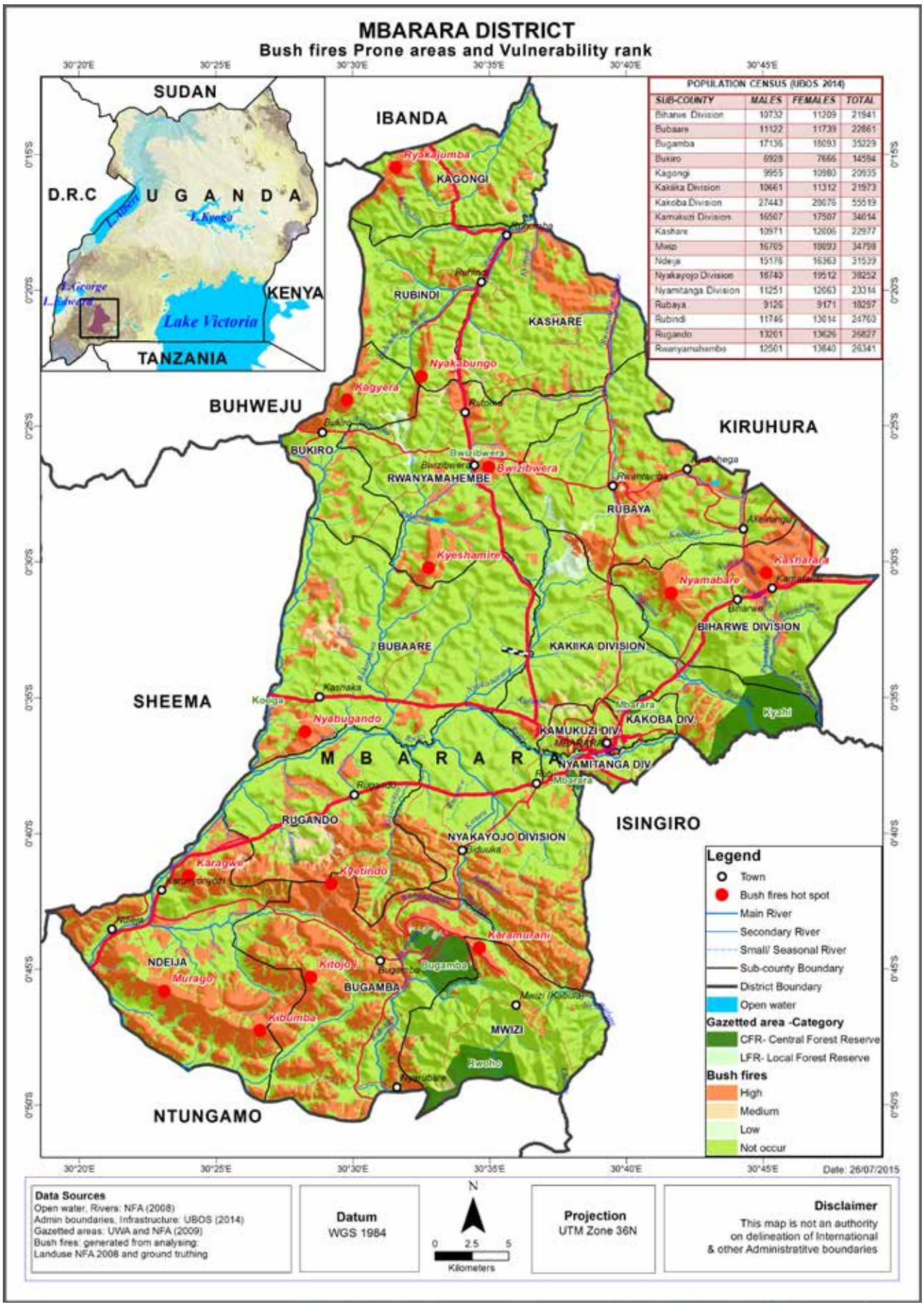


Figure 17: Bush fires prone areas Ranking, Mbarara District

2.4.5.2 Land conflicts

Land wrangles were reported in all sub-counties of Mbarara District. Such conflicts range from ownership and boundary user rights. Family land wrangles are the most reported cases at the district court.

2.4.5.3 Environmental Degradation

Results from the participatory assessments indicated that the conversion of wetlands to grazing land, sand mining and brick laying in the Rwizi wetland system were the most reported forms of environmental degradation in Mbarara district. These activities were reported to be reducing the coverage of wetlands which would have been important in controlling floods along River Rwizi and its tributaries in Kakoba and Nyakayojo divisions, Bubaare, Rugando and Ndeija sub-counties. Figure 18 indicates areas where degradation has occurred ranking from High to very Low.

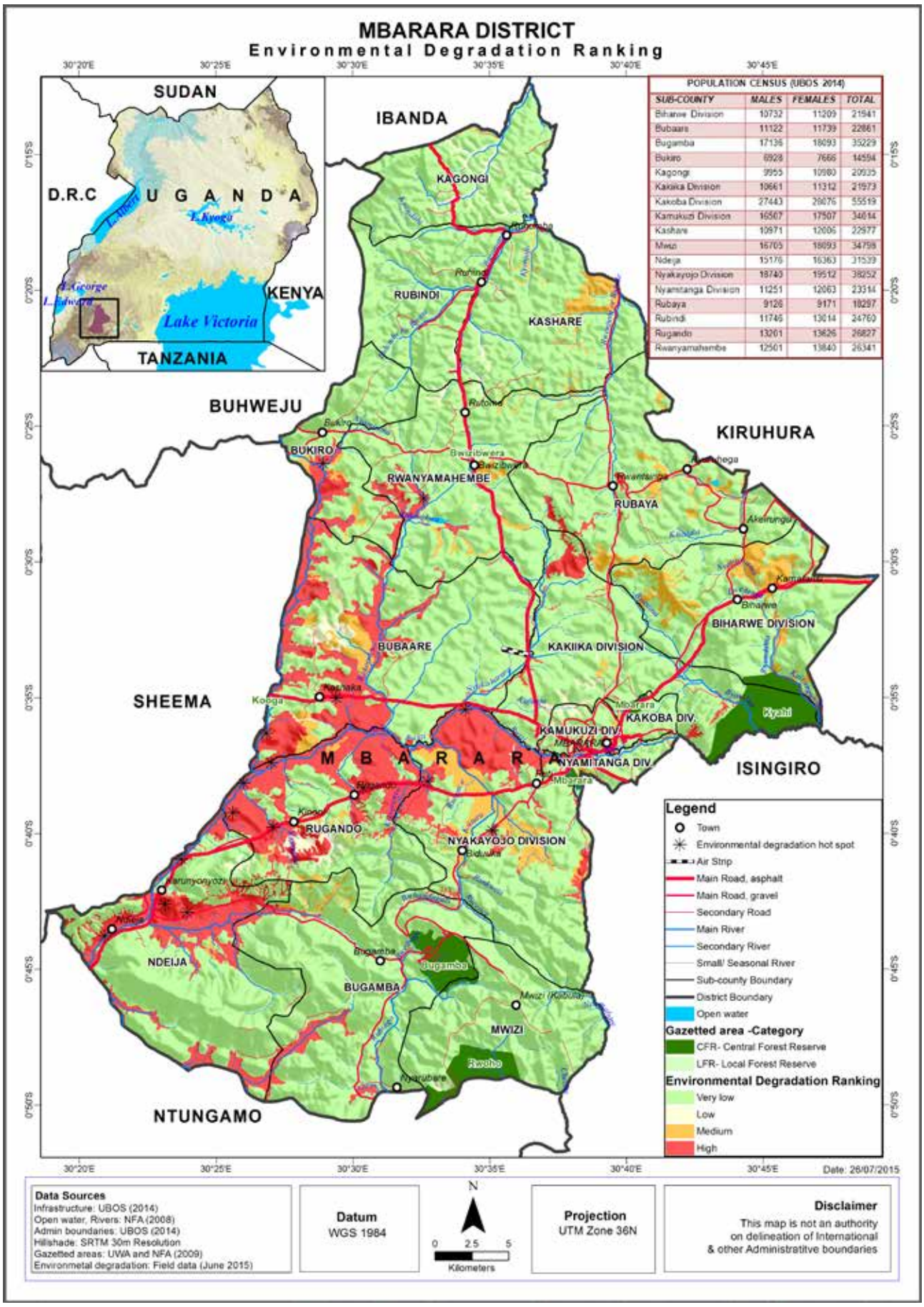


Figure 18: Environmental Degradation Ranking, Mbarara District

2.4.5.4 Road Accidents

Road accidents including head on collisions, overturning of heavy trucks and fuel trucks usually occur along Mbarara-Masaka, Mbarara-Kabale, Mbarara-Kasese and Mbarara-Ibanda highways leading to human and livestock injuries and death. Figure 19 indicates accident prone roads and hot spots/ black spots where most accidents have been registered.

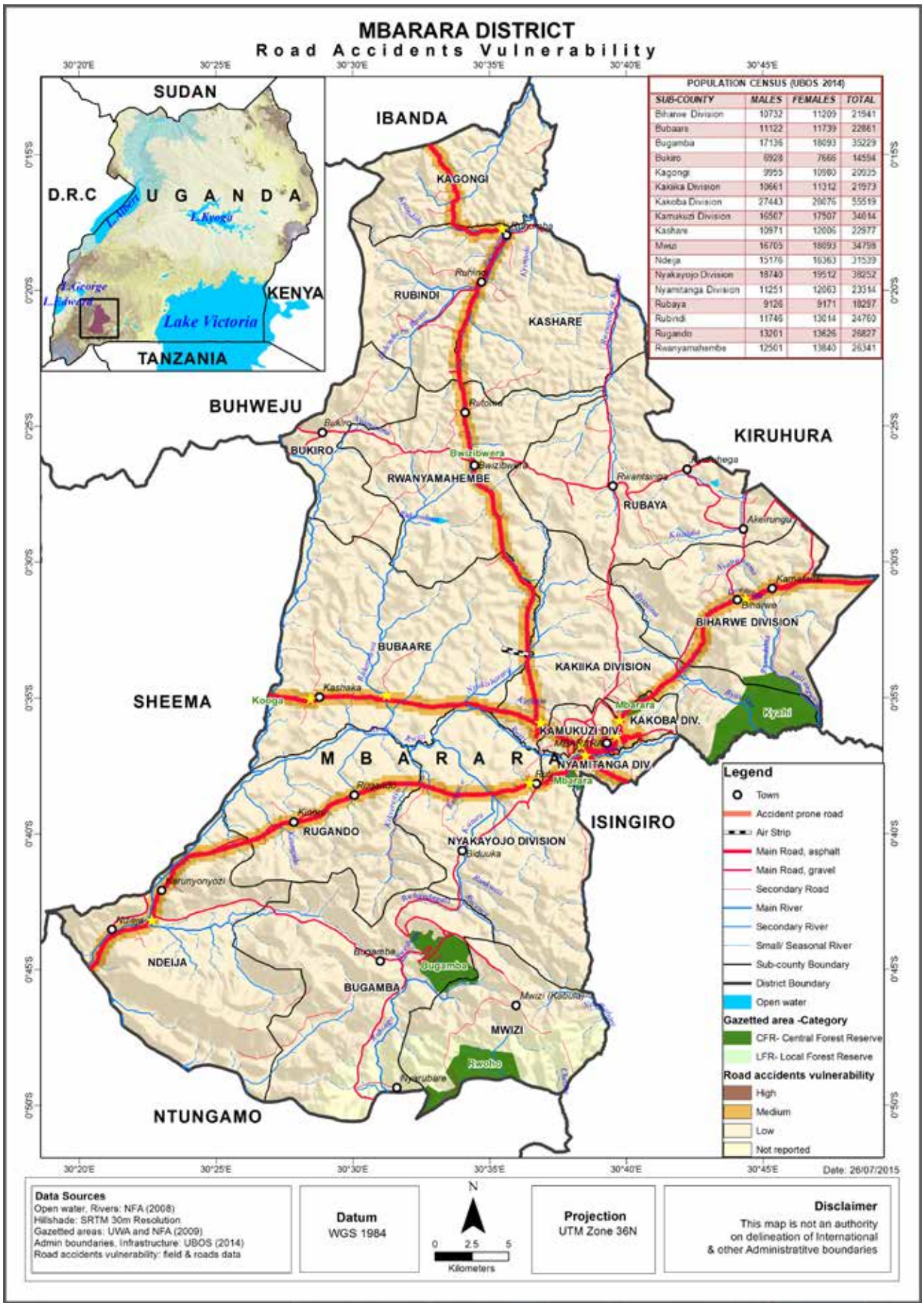


Figure 19: Road Accidents Vulnerability, Mbarara District

2.5 COPING STRATEGIES

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

Table 2: Coping strategies to the Multi-hazards in Mbarara District

No	Multi-Hazards		Coping strategies
1	Geomorphological or Geological	Landslides, Rock falls and Erosion	• Migration to safe areas • Terracing/ contour farming • Plant trees to control water movement on hill slopes • Mulching in banana plantations • Plant grass in banana plantations on hill slopes • Removal of stones from banana farmlands
2		Earthquakes and faults	No action, communities think the tremors are minor
3	Climatological or Meteorological	Floods	• Digging up of trenches in the flood plains • Planting trees to control water movement to flood plains • Migration to other areas • Seek for government food aid
4		Drought	• Leave wetlands as water catchments • Plant trees as climate modifiers • Buy food elsewhere in case of shortage • Buy water from the nearby areas • Food Storage especially dry grains
5		Strong winds, Hailstorms and Lightening	• Plant trees as wind breakers • Use of stakes against wind in banana plantations • Use of ropes to tire banana against wind • Installation of lightening 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 lightening conductors on newly constructed schools
6	Ecological or Biological	Crop pests and Diseases	• Spraying pests • Cutting and burying BBW affected crops • Burning of affected crops • Vigilance
7		Livestock pests and Diseases	• Spraying pests • Vaccinations • Burying animals that have died from infection • Quarantine
8		Human epidemic Diseases	• Mass immunisation • Visiting health centres • Use of mosquito nets
9		Vermin and Wild-life animal attacks	• Guarding the gardens • Poisoning • Hunt and kill • Report to UWA
10		Invasive species	• Uproot • Cut and burn • Sensitization on Invasive species management
11	Human induced or technological	Land conflicts	• Community dialogues • Report to court • Migration
12		Bush fires	• Stop the fires in case of fire outbreak • Fire lines (may be constructed, cleared grass) • Fire breaks planted along gardens e.g. euphorbia spp. • Vigilance especially in dry seasons where most burning is done
13		Road accidents	• Construction of humps • New road has Signage including speed limits • Sensitisation
14		Environmental degradation	• Leave wetlands as water catchments • Plant trees as climate modifiers • Sensitization

2.6 VULNERABILITY PROFILES

Vulnerability depends on low capacity to anticipate, cope with and/or recover from a disaster and is unequally distributed in a society. The vulnerability profiles of Mbarara 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 3).

Table 4 (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 4). Table 5 shows Hazard assessment for Mbarara District.

Table 3: Components of vulnerability in Mbarara District

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

Table 4: Vulnerability Profile for Mbarara 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	4	3	12	Nyakayojo Division, Bubaare, Ndeija and Rugando sub-counties are the most affected.
Droughts	4	3	12	Biharwe and Kakiika Divisions, Kashare and Rubaya sub-counties are the most affected by drought.
Soil erosion, rock falls and landslides	5	3	15	Bugamba, Mwizi, Ndeija and Rugando sub-counties are the most affected.
Hail storms, lightening and strong winds	5	3	15	Bubaare, Rubaya, Nyakayojo, Nyamitanga, Bygamba, Mwizi and Ndeija are the most affected.
Bush fires	3	2	6	Kagongi, Kashare, Rubaya, Bugamba sub-counties and Biharwe Division are the most affected.
Crop pests and diseases	4	3	12	Kashare, Rubindi, Rwanyamahembe, Biharwe, Nyakayojo and Mwizi are the most affected.
Livestock pests and diseases	4	4	16	Kashare, Rubaya, Rwanyamahembe and Biharwe are the most vulnerable.
Human Diseases outbreaks	5	3	15	The whole district is affected by human diseases especially malaria. Bugamba sub-county had the highest HIV prevalence rate.
Land conflicts	5	3	15	Biharwe, Kakiika, Kakoba, Kamukuzi, Nyakayojo and Nyamitanga Divisions were the most affected by land conflicts.
Vermin and Wild-life animal attacks	5	2	15	Biharwe and Mwizi are the most affected.
Earthquakes and faults	3	2	6	Minor tremors occur in all sub-counties of the district.
Road accidents	3	3	9	Biharwe, Nyakayojo and Nyamitanga Divisions are the most affected.
Environmental degradation	5	2	10	Bubaare, Nyakayojo, Ndeija and Rugando are the most affected.

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

Key for Relative Risk

H	High
M	Medium
L	Low
N	Not reported/ Not prone

Table 5: Hazard Risk Assessment

Hazard	Bubaare	Bukiiro	Kagongi	Kashare	Rubaya	Rubindi	Rwanyamahembe	Biharwe Division	Kakiika Division	Kakoba Division	Kamukuzi Division	Nyakayojo Division	Nyamitanga Division	Bugamba	Mwizi	Ndeija	Rugando
Floods	H	M	L	L	L	M	M	L	M	L	L	H	L	M	L	H	H
Drought	M	M	L	H	H	L	M	H	H	M	M	L	M	L	L	L	L
Landslides, Rock falls and Erosion	L	L	L	L	M	L	L	M	L	L	L	M	L	H	H	H	H
Strong winds, Hailstorms and Lightening	H	M	M	M	H	M	M	M	L	L	L	H	H	H	H	H	M
Crop pests and Diseases	M	M	M	H	M	H	H	H	M	M	M	H	M	M	H	M	M
Livestock pests and Diseases	M	M	M	H	H	M	H	H	L	L	L	L	L	M	M	M	M
Human disease outbreaks	M	M	M	M	M	M	M	M	M	M	M	M	M	H	M	M	M
Vermin and Wildlife animal attacks	M	M	M	M	M	M	M	H	L	L	L	M	L	M	H	M	M
Land conflicts	M	M	M	M	M	M	M	H	H	H	H	H	H	M	M	M	M
Bush fires	M	M	H	H	H	M	M	H	L	L	L	L	L	H	M	M	M
Environmental degradation	H	M	M	M	M	M	M	M	M	M	M	H	M	M	M	H	H
Earthquakes and faults	M	L	H	L	H	H	H	M	M	M	M	M	M	L	L	L	L
Road accidents	M	L	L	L	M	M	M	H	M	M	M	H	H	M	M	M	M

Key

H	High
M	Medium
L	Low
N	Not reported/ Not prone

2.7.0 GENERAL CONCLUSIONS AND RECOMMENDATIONS

2.7.1 Conclusions

The multi-hazard vulnerability profile output from this assessment was a combination of spatial modeling using socio-ecological spatial layers (i.e. DEM, Slope, Aspect, Flow Accumulation, Land use, vegetation cover, hydrology, soil types and soil moisture content, population, socio-economic, health facilities, accessibility, and meteorological data etc.) 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 Mbarara 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. Generally drought and flooding were identified as most serious problem in Mbarara 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 Mbarara district increase their vulnerability to hazard exposure necessitating urgent external support.

Hazards experienced in Mbarara 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.

2.7.2 Recommendations

The following recommended policy actions targeting vulnerability reduction include:

i. Improved enforcement of policies aimed at enhancing sustainable environmental health.
ii. Quickly review the animal diseases control act because of low penalties given to defaulters.

iii. Establishment of systems to motivate support of political leaders toward government initiatives and programmes aimed at disaster risk reduction.
iv. Increased awareness campaigns aimed at sensitizing farmers/communities on disaster risk reduction initiatives and practices.
v. Revival of disaster committees at the district levels
vi. Periodic maintenance of feeder roads to reduce on traffic accidents.
vii. Relocation of communities in the affected areas in the district by government.
viii. Promotion of drought and disease resistant crop seeds.
ix. Increase funding in the disaster and environmental departments
x. Removal taxes on the importation of lightening conductors
xi. Support establishment of disaster early warning systems
xii. Increase funding and staff to monitor wetland degradation and non-genuine agro-inputs
xiii. Improve the communication channel between the disaster department and local Communities
xiv. Office of the prime minister should decentralize their activities at the district level
xv. Tree planting along road reserves
xvi. Fund and equip recruited extension works
xvii. Government should allocate funds aimed at disaster preparedness and management at district levels
xviii. Removal of taxes on the importation of lightening conductors
xix. Support establishment of a disaster risk early warning systems
xx. Uplifting the ban on the construction of health centre IIs

References

Jorn Birkmann (2006). Measuring Vulnerability to promote Disaster-Resilient Societies: Conceptual Frameworks and Definitions

MWE (2013). *Water and Environment Sector Performance Report*: Ministry of Water and Environment, Kampala

MWE (2012). *Uganda National Climate Change Policy*, Ministry of Water and Environment, Kamapla, Final version for approval, 18 July 2012, p.2

UNDP-UNDRO (1991). Mitigation Strategies in Disaster Mitigation UN Disaster Management Training Program

UNISDR (2009). UNISDR Terminology on Disaster Risk Reduction.

APPENDIX I: DATA COLLECTION TOOLS

Plate 1: Focus Group Discussion in Rubaya Sub-county

FOCUS GROUP DISCUSSION GUIDE FOR DISTRICT DISASTER RISK MANAGEMENT FOCAL PERSONS

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

No.	Name of Participants	Designation	Contact	Signature

Introduction

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

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

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

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

Section A: Floods, Droughts, Landslides, Crop and Animal Production

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 floods in the past 10 years in your area of jurisdiction?

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

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 floods in your area of jurisdiction?

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

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

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

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

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

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

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

17. In which way are crops affected by drought?

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

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

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

21. What are the relevant government's interventions focusing at helping farmers mitigate

the challenges mentioned?

22. Have you experienced landslides in the past 10 years in your area of jurisdiction?

23. Which villages, parishes or sub-counties have been most affected by landslide?

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

25. Which crops are majorly affected by landslides in your area of jurisdiction?

26. In which way are the crops affected by landslides?

27. Which domestic animals are majorly affected by landslides in your area of jurisdiction?

28. In which way are the domestic animals affected by landslides?

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

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

Section B: Animal, crop and human disease outbreaks

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Section C: Land, wild-life conflicts and Road accidents

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

53. Which villages, parishes or sub-counties have been most affected by land conflicts?

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

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

56. What impacts have been caused by land conflicts?

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

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

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

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

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

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

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

64. What impacts have been caused by wildlife attacks?

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

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

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

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

69. Which roads have experienced Road accidents?

70. What impacts have been caused by Road accidents?

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

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

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

Section D: Hailstorms, lightening, bush fires, earthquakes, faults/ cracks

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

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

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

77. What impacts have been caused by hailstorms or lightening?

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

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

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

81. Have you experienced any serious bush fires in the past 10 years in your area of jurisdiction?

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

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

84. What impacts have been caused by serious bush fires?

85. To what extent have the serious bush fires affected livelihoods of the local communities in your area of jurisdiction?

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

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

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

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

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

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

92. What impacts have been caused by earth quakes?

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

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

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

FOCUS GROUP DISCUSSION GUIDE FOR LOCAL COMMUNITIES

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

No.	Name of Participants	Village/ Parish	Contact	Signature

Introduction

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

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

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

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

Section A: Floods, Droughts, Landslides, Crop and Animal Production

1. Which crops are majorly grown in this community?

2. Which domestic animals are dominant in your community?

3. Have you experienced floods in the past 10 years?

4. Since when did you last experience floods?

5. In a period of 10 years, how often do you experienced floods?

i. Monthly…
ii. 2 months…
iii. 3 months…
iv. Quarterly …
v. 6 months…
vi. Annually…
vii. Others specify…

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

7. In which way are the crops affected by floods in your community?

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

9. In which way are the domestic animals affected by floods in your community?

10. What measures have been taken by the Government to mitigate the effects of floods?

11. Have you experienced drought in the past 10 years?

12. Since when did you last experience drought?

13. In a period of 10 years, how often do you experience drought?

i. Monthly…
ii. 2 months…
iii. 3 months…
iv. Quarterly …
v. 6 months…
viii. Annually…
ix. Others specify…

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

15. In which way are crops affected by drought in your community?

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

17. In which way are the domestic animals affected by drought in your community?

18. What measures have been taken by the Government to mitigate the effects of drought?

19. Have you experienced landslide in the past 10 years?

20. Since when did you last experience landslide?

21. In a period of 10 years, how often do you experience landslide?

vi. Monthly…
vii. 2 months…
viii. 3 months…
ix. Quarterly …
x. 6 months…
x. Annually…
xi. Others specify…

22. Which crops are majorly affected by landslide in your community?

23. In which way are crops affected by landslide in your community?

24. Which domestic animals are majorly affected by landslide in your community?

25. In which way are the domestic animals affected by landslide in your community?

26. What measures have been taken by the Government to mitigate the effects of landslide?

Section B: Animal, crop and human disease outbreaks

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

28. Specify the epidemic animal disease outbreaks that have majorly affected animals in your community?

29. Which domestic animals are majorly affected by epidemic animal disease outbreaks in your community?

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

31. Which measures have you adopted to mitigate the above epidemic animal disease

outbreaks in your community?

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

33. Have you experienced any crop pests and disease outbreaks in the past 10 years in your community?

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

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

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

37. Which measures have you adopted to mitigate the above crop pests and disease outbreaks in your community?

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

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

40. Specify the epidemic human disease outbreaks that have majorly affected animals in your community?

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

42. Which measures have you adopted to mitigate the above epidemic human disease outbreaks?

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

Section C: Land, wild-life conflicts and Road accidents

44. Have you experienced land conflicts in the past 10 years in your community?

45. Which particular villages, parishes or sub-counties have been majorly affected by land conflicts in your community?

46. What impacts have been caused as result of land conflicts?

47. To what extent have the land conflicts affected livelihoods in your community?

48. Which conflict resolution measures have you adopted to mitigate the above challenges?

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

50. Do you have any national park or wildlife reserve in your community?

51. What is the distance of your community from the national park or wildlife reserve?

52. Have you experienced wildlife attacks in the past 10 years in your community?

53. Which particular villages, parishes or sub-counties have been majorly affected by wildlife attacks in your community?

54. What impacts have been caused by wildlife attacks?

55. To what extent have the wildlife attacks affected livelihoods in your community?

56. Which measures have you adopted to mitigate the above challenges?

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

58. Have you experienced Road accidents in the past 20 years in your community?

59. Which roads have experienced Road accidents?

60. What impacts have been caused by Road accidents?

61. To what extent have the Road accidents affected livelihoods in your community?

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

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

Section D: Hailstorms, lightening, bush fires, earthquakes, faults

64. Have you experienced hailstorms or lightening in the past 10 years in your community?

65. Which particular villages, parishes or sub-counties have been majorly affected by hailstorms or lightening in your community?

66. What impacts have been caused by hailstorms or lightening?

67. To what extent have the hailstorms or lightening affected livelihoods in your community?

68. Which measures have you adopted to mitigate the above challenges?

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

70. Have you experienced serious bush fires in the past 10 years in your community?

71. Which particular villages, parishes or sub-counties have been majorly affected by or lightening in your community?

72. What impacts have been caused by serious bush fires?

73. To what extent have the serious bush fires affected livelihoods in your community?

74. Which measures have you adopted to mitigate the above challenges?

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

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

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

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

79. What impacts have been caused by earth quakes?

80. To what extent have the earth quakes affected livelihoods in your community?

81. Which measures have you adopted to mitigate the above challenges?

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

SPATIAL DATA COLLECTION SHEET FOR HAZARD VULNERABILITY AND RISK MAPPING

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

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

With support from:
United Nations Development Programme
Plot 11, Yusuf Lule Road
P.O. Box 7184
Kampala, Uganda
Site: www.undp.org

Empowered lives.
Resilient nations.