THE REPUBLIC OF UGANDA

Bududa District

Hazard, Risk and Vulnerability Profile

2016

Acknowledgement

On behalf of Office of the Prime Minister, I wish to express my sincere appreciation to all of the key stakeholders who provided their valuable inputs and support to this Multi-Hazard, Risk and Vulnerability mapping exercise that led to the production of comprehensive District Hazard, Risk and Vulnerability (HRV) profiles.

I extend my sincere thanks to the Department of Relief, Disaster Preparedness and Management, under the leadership of the Acting Commissioner, Ms. Rose Nakabugo, for the oversight and management of the entire exercise.

The HRV assessment team was led by Mr. Kumakech Charles, Disaster Management Officer and the team of consultants (GIS/DRR specialists); Mr. Moses Banduga; Mr. Emmanuel M.O. Matua; Mr. Ambrose Buyinza and Mr. Benon Nabaasa Baguma who provided technical support.

Our gratitude goes to UNDP for providing funds to support the Hazard, Risk and Vulnerability Mapping. The team comprised of Mr. Jose Neil A.C Manzano –Disaster Risk Management Advisor; Mr. Gilbert Anguyo - Disaster Risk Reduction Analyst, and Mr. Sidney Tupper – Climate Risk Management Specialist.

My appreciation also goes to Bududa District Team.

The entire body of stakeholders who in one way or another yielded valuable ideas and time to support the completion of this exercise.

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

EXECUTIVE SUMMARY

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

Preliminary spatial analysis
Hazard prone areas base maps were generated using Spatial Multi-Criteria Analysis (SMCA) was done in a GIS environment (ArcGIS 10.1).

Stakeholder engagements
Stakeholder engagements were carried out in close collaboration with OPM's DRM team and the District Disaster Management focal persons with the aim of identifying the various hazards ranging from drought, to floods, landslides, human and animal disease, pests, animal attacks, earthquakes, fires, conflicts etc. Stakeholder engagements were done through Focus Group Discussions (FGDs) and key informant interviews guided by checklist tools (Appendix I). At District level Key Informants included: District Agricultural Officer, District Natural Resources Officer, District Health Inspector and District Planner while at Sub-county level Key informants included: Sub-county and Parish Chiefs, Community Development mobilisers and health workers.

FGDs were carried out in five purposively selected Sub-counties that were ranked with highest vulnerability. FGDs comprising of an average of 12 respondents (crop Farmers, Local Leaders, Nursing Officers, Police Officers and Cattle Keepers) were conducted at Bulucheke, Buwali, Bududa, Nalwanza,Bukigai and Bukibokolo Sub-counties. Each Parish of the selected Sub-counties was represented by at least one participant and the selection of participants was engendered. FGDs were conducted with utmost consideration to the various gender categories (women, men) with respect to age groups since hazards affect both men and women though in different perspectives irrespective of age.
Participatory GIS
Using Participatory GIS (PGIS), local communities were involved in identifying specific hazard prone areas on the Hazard base maps. This was done during the FGDs and participants were requested through a participatory process to develop a community hazard profile map.

Geo-referencing and ground-truthing
The identified hazard hotspots in the community profile maps were ground-truthed and geo-referenced using a handheld Spectra precision Global Positioning System (GPS) unit, model: Mobile Mapper 20 set in WGS 1984 Datum. The entities captured included: hazard location, (Sub-county and parish), extent of the hazard, height above sea level, slope position, topography, neighboring land use among others. Hazard hot spots, potential

and susceptible areas will be classified using a participatory approach on a scale of “not reported/ not prone”, “low”, “medium” and “high”.

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

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

Multi-hazards experienced in Butaleja District were classified as:
- Geomorphological or Geological hazards including landslides, rock falls, soil erosion and earth quakes.
- Climatological or Meteorological hazards including floods, drought, hailstorms, strong winds and lightning
- Ecological or Biological hazards including crop pests and diseases, livestock pests and diseases, human disease outbreaks, vermin and wildlife animal attacks and invasive species.
- Human induced or Technological hazards including bush fires, road accidents land conflicts.

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

The limited adaptive capacity (and or/resilience) and high sensitivity of households and communities in the District increase their vulnerability to hazard exposure necessitating urgent external support. To 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 were recommended policy actions targeting vulnerability reduction:
- The Government should improve enforcement of policies aimed at enhancing sustainable

environmental health.

- The Government through MAAIF should review the animal diseases control act because of low penalties given to defaulters.
- The Government should establish systems to motivate support of political leaders toward Government initiatives and programmes aimed at disaster risk reduction.
- The Government should increase awareness campaigns aimed at sensitizing farmers/ communities on disaster risk reduction initiatives and practices.
- The Government should revive disaster committees at District level and ensure funding of disaster and environmental related activities.
- The Government through UNRA and the District Authority should fund periodic maintenance of feeder roads to reduce on traffic accidents.
- The Government through MAAIF and the District Production should promote drought and disease resistant crop seeds.
- The Government through OPM and Meteorology Authority should increase importation of lightening conductors and also reduce taxes on their importation.
- The GGovernment through OPM and Meteorology Authority should support establishment of disaster early warning systems.
- The Government through MWE increase funding and staff to monitor wetland degradation and non-genuine agro-inputs.
- The Government through OPM should improve communication between the disaster department and local communities.
- The Government through MWE should promote Tree planting along road reserves.
- The Government through MAAIF should fund and recruit extension workers at Sub-county level and also facilitate them.

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ACRONYMS

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

DEFINITION OF KEY TERMS

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

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

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

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

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

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

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

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

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

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

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

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

INTRODUCTION

1.1 Background

Uganda has over the past years experienced frequent disasters that range from drought, to floods, landslides, human and animal diseases, pests, animal attacks, earthquakes, fires, conflicts and other hazards which in many instances resulted in deaths, property damage and losses of livelihood. With the increasing negative effects of hazards that accompany population growth, development and climate change, public awareness and pro-active engagement of the whole spectrum of stakeholders in disaster risk reduction, are becoming critical.

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

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, Eastern and West Nile covering 42 Districts. During the above exercise, Local Government officials and community members have actively participated in data collection and analysis.

The data collected was used to generate hazard risk and vulnerability maps and profiles. Validation workshops were held in close collaboration with Ministries, District Local Government (DLG), Development Partners, Agencies and academic/research institutions.

The developed maps show the geographical distribution of hazards and vulnerabilities up to Sub-county level of each District. The analytical approach to identify risk and vulnerability to hazards in the pilot sub-regions visited of Rwenzori and Teso was improved in subsequent sub-regions.

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

1.2 Objectives of the study

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

1.2.1 Main objective

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

1.2.3 Specific Objectives

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

i. Collect and analyze field data generated using GIS in close collaboration and coordination with OPM.
ii. Develop District specific multi-hazard risk and Vulnerability profile using a standard methodology.
iii. Preserve the spatial data to enable use of the maps for future information.
iv. Produce age and sex disaggregated data in the HRV maps.

1.3 Scope of Work

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

i. Collection of field data using GIS in close collaboration and coordination with OPM in Bududa District and quantify them through a participatory approach on a scale of "not reported/ not prone", "low", "medium" and "high".
ii. Analysis of field data and review the quality of each hazard map which should be accompanied by a narrative that lists relevant events of their occurrence. Implications of hazards in terms of their effects on stakeholders with the vulnerability analysis summarizing the distribution of hazards in the District and exposure to multi-hazards in Sub-counties.
iii. Compilation of the entire District multi-hazard, risk and vulnerability HRV Profiles in the time frame provided.
iv. Generating complete HRV profiles and maps and developing a database for all the GIS data showing disaggregated hazard risk and vulnerability profiles to OPM and UNDP.

1.4 Justification

The Government recognizes climate change as a big problem in Uganda. The draft National Climate Change Policy (NCCP) notes that the average temperature in semi-arid climates is rising and that there has been an average temperature increase of 0.28°C per decade in the country between 1960 and 2010. It also notes that rainfall patterns are changing with floods and landslides on the rise and are increasing in intensity, while droughts are increasing, and now significantly affect water resources, and agriculture (MWE, 2012).

The National Policy for Disaster Preparedness and Management (Section 4.1.1) requires the Office of the Prime Minister to "Carry out vulnerability assessment, hazard and risk mapping of the whole country and update the data annually". UNDP's DRM project 2015 Annual Work Plan; Activity 4.1 is "Conduct national hazard, risk and vulnerability (HRV) assessment including sex and age disaggregated data and preparation of District profiles."

1.5 Structure of the Report

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

OVERVIEW OF BUDUDA District

2.1 Location

Bududa District was carved out of Manafwa District in 2006 in a bid to extend services further to the grassroots. The District is located in the Eastern Region of Uganda, bordering the Republic of Kenya in the East; the Districts of Sironko, Bulambuli and Kween in the North; Mbale in the West and Manafwa in the South. It lies between the longitudes of 34^0 16' 18" and 34^0 32' 6.69" East, and latitudes 00^0 58' 45.63" to 1^0 7' 22.07". The land area is 274 km^2 of which 40% of the land is covered by Mt. Elgon National Park. Bududa District has 15 Sub-counties and 1 Town Council.

These include; Bubiita, Bududa, Bukalasi, Bukibokolo, Bukigai, Bulucheke, Bumasheti, Bumayoka, Bushika, Bushiribo, Bushiyi, Buwali, Nabweya, Nakatsi and Nalwanza Sub-counties and Bududa Town Council. Figure 1 shows the Administrative boundaries and gazetted areas of Bududa District.

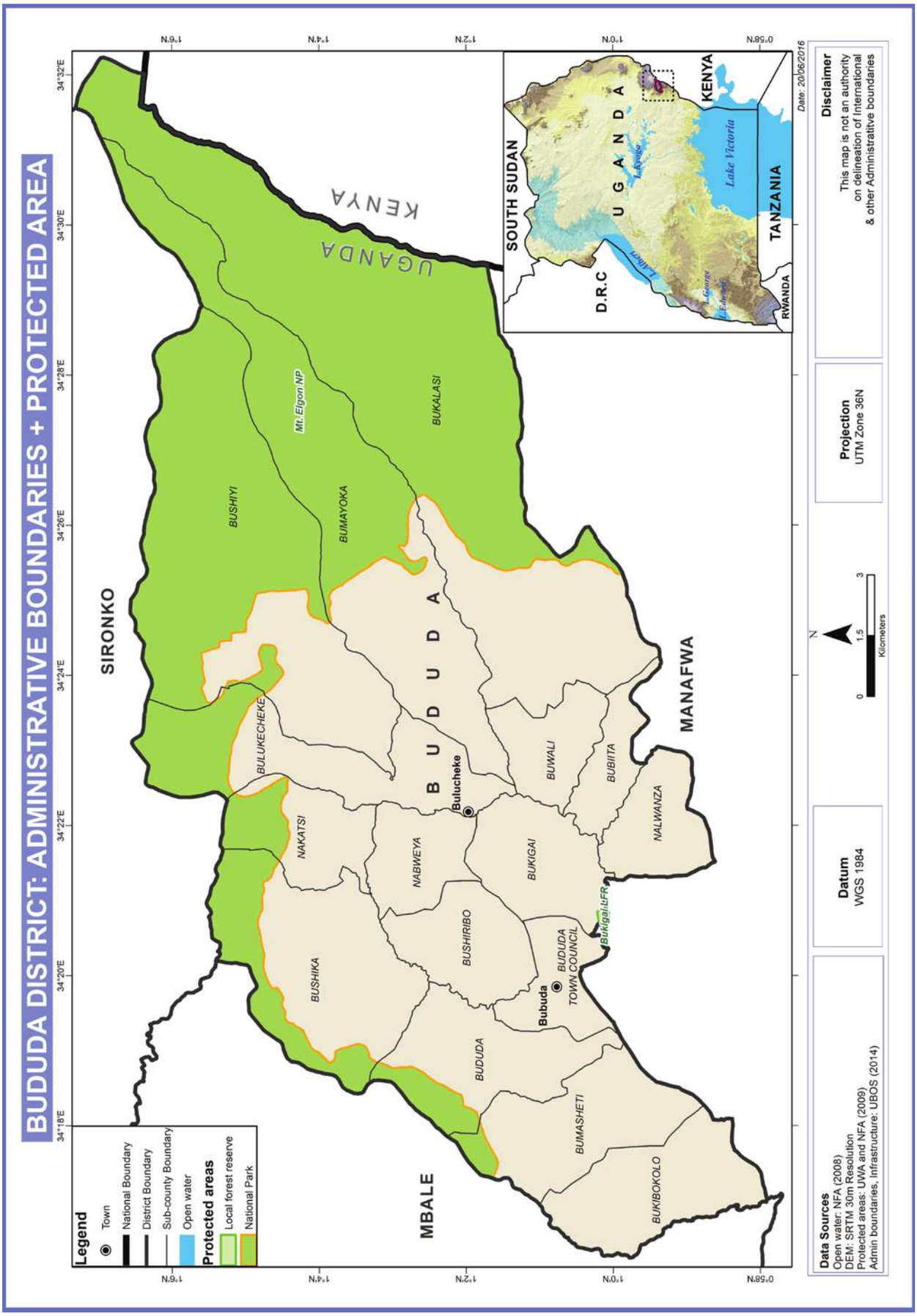


Figure 1: Administrative Boundaries, Bududa District

2.1.1 Geomorphology

Bududa District lies at an average of 1800m above sea level on the slopes of Mt. Elgon in eastern Uganda. The scenery is characterized by stand-alone volcanic cones, interlocking spurs v-shaped valleys and ridges- both gently undulating and rugged.

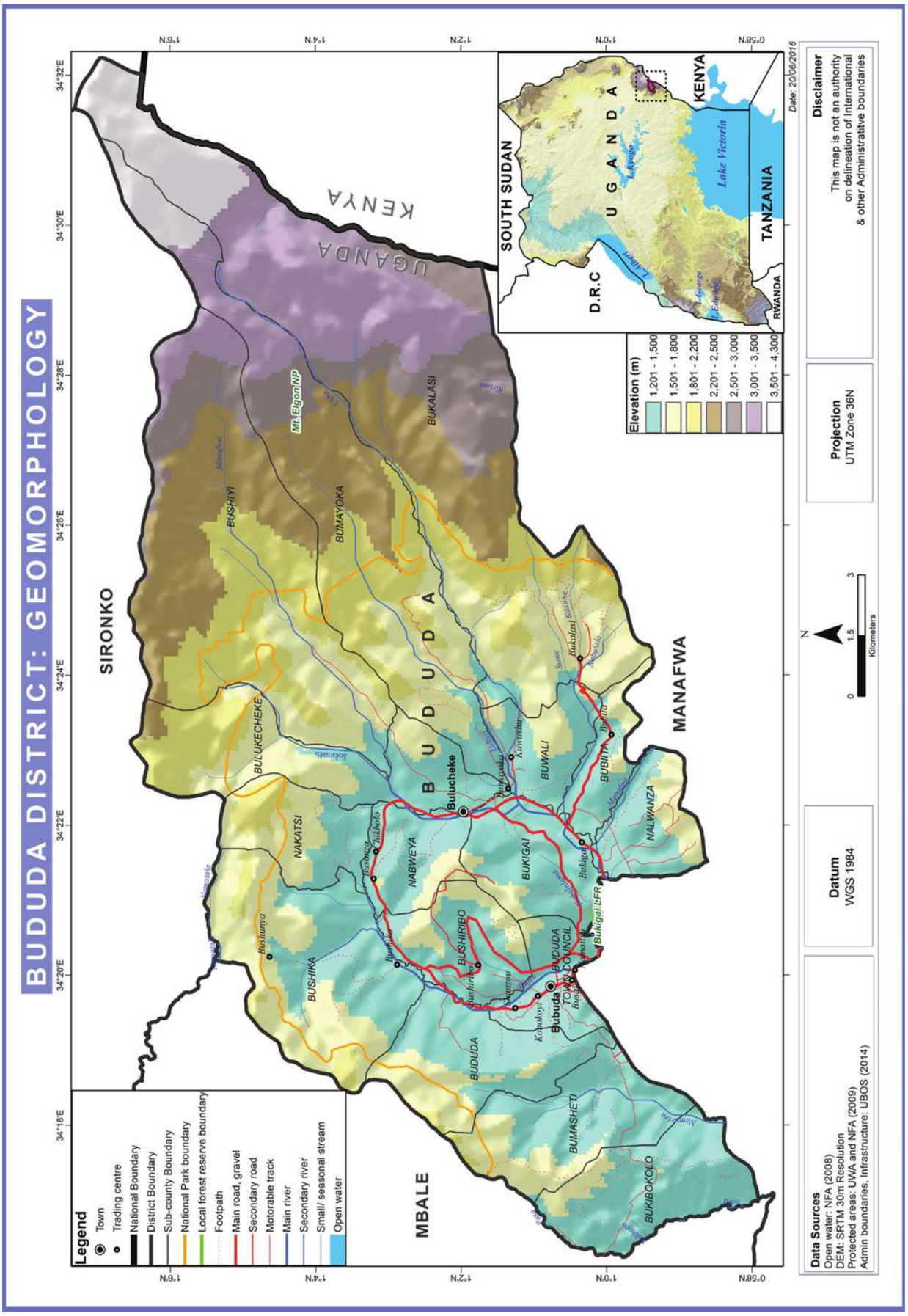


Figure 2: Geomorphology, Bududa District

2.1.2 Geology and soils

In Bududa District three main lithologies can be distinguished and these are the Butiriku carbonatite covering the central part which corresponds with the Sub-county of Bukigai, a zone of fenitised basement rocks of Precambrian age surrounding this central carbonatite outcrop and the third zone with Mount Elgon agglomerates and tuffs situated in the north east of Bududa District and falling within the borders of Mount Elgon National Park. These highly weathered rocks are composed of extremely fine pyroclasts of potash feldspar and are referred to as potash ultra-fenites.

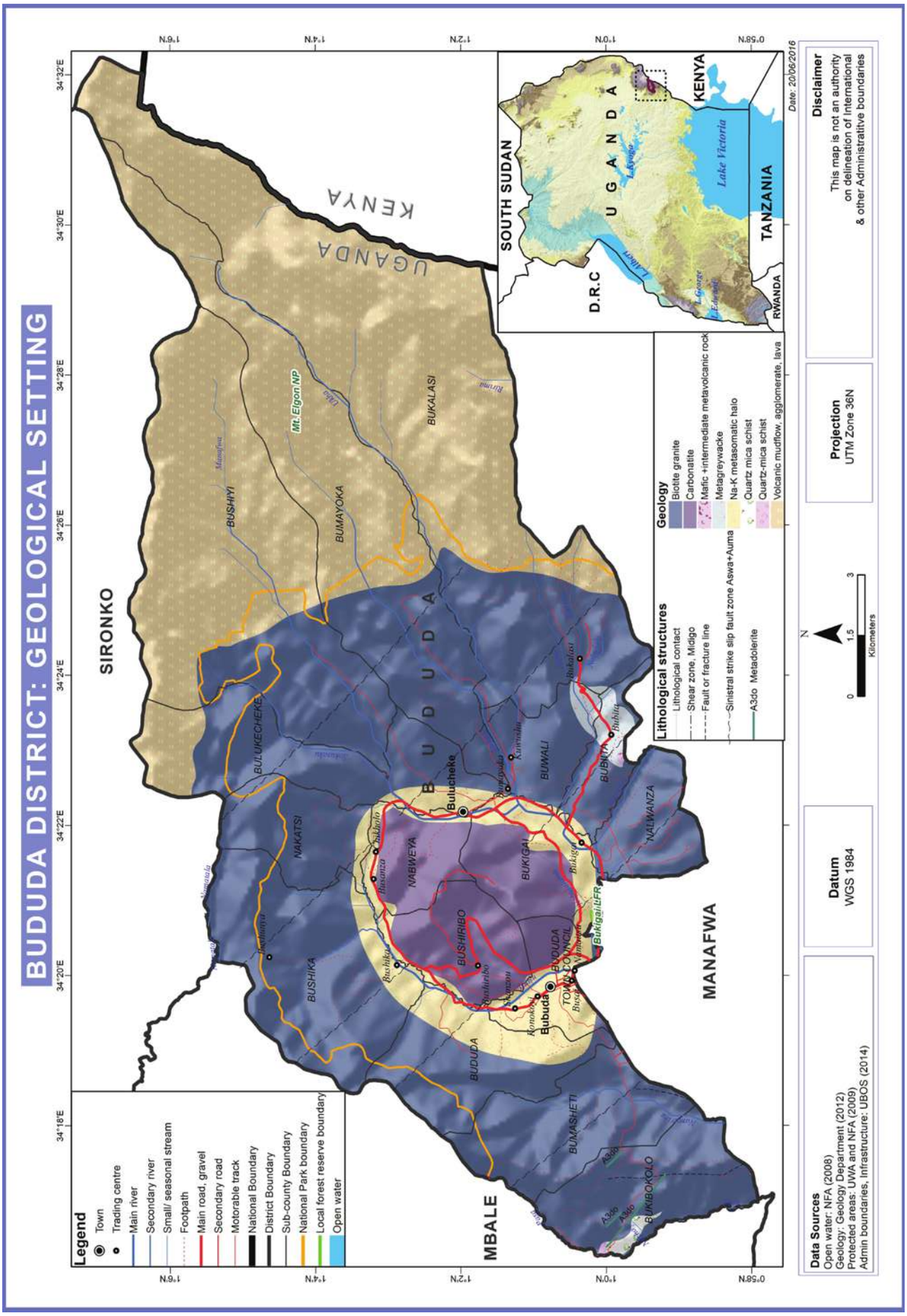


Figure 3: Geology and Lithological structure, Bududa District

2.1.3 Vegetation and Land use Stratification

Given the mountainous nature of the District and the high population density, there is hardly any dominant natural vegetation in the District. Most of the vegetation (40%) is tropical forest followed by alpine vegetation towards the mountain summit. There are also bamboo forests, some moors and fern on the mountain summit. Other vegetation zones include grasses and swampy vegetation.

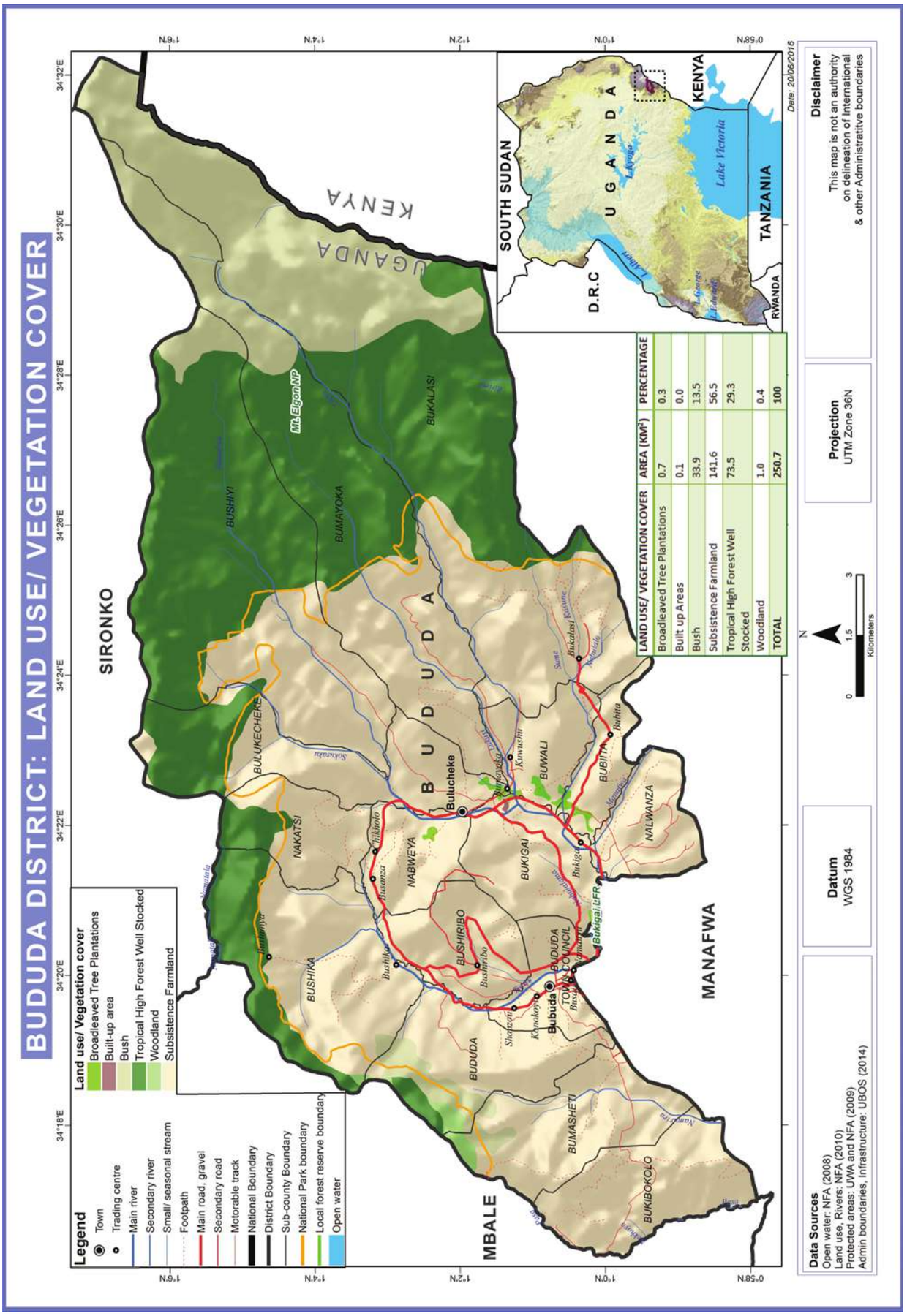


Figure 4: Land Use Stratification, Bududa District

2.1.4 Temperature and Humidity

The District generally records mean monthly maximum temperatures between 25°C and 29°C. This leads to prolonged perennial dry spell mainly from December to March. Relative humidity ranges between 80% - 90% in the morning and decreases to between 61% and 66% in the afternoons during the months of January and May.

2.1.5 Wind

The District is swept by the South East and North East monsoon winds since it lies near the equator and experiences mean annual vapour pressure between 18-20 m b and the highest potential evaporation is in March.

2.1.6 Rainfall

The District experiences bi-modal type of rainfall with the highest coming in the first season of March to June and the second, which is normally light, in September to November. A short dry spell is between June and July while the December to March spell is longer. The average rainfall is 1800mm per annum. This very high rainfall is very supportive to intensive agriculture, which forms the backbone of the District economy.

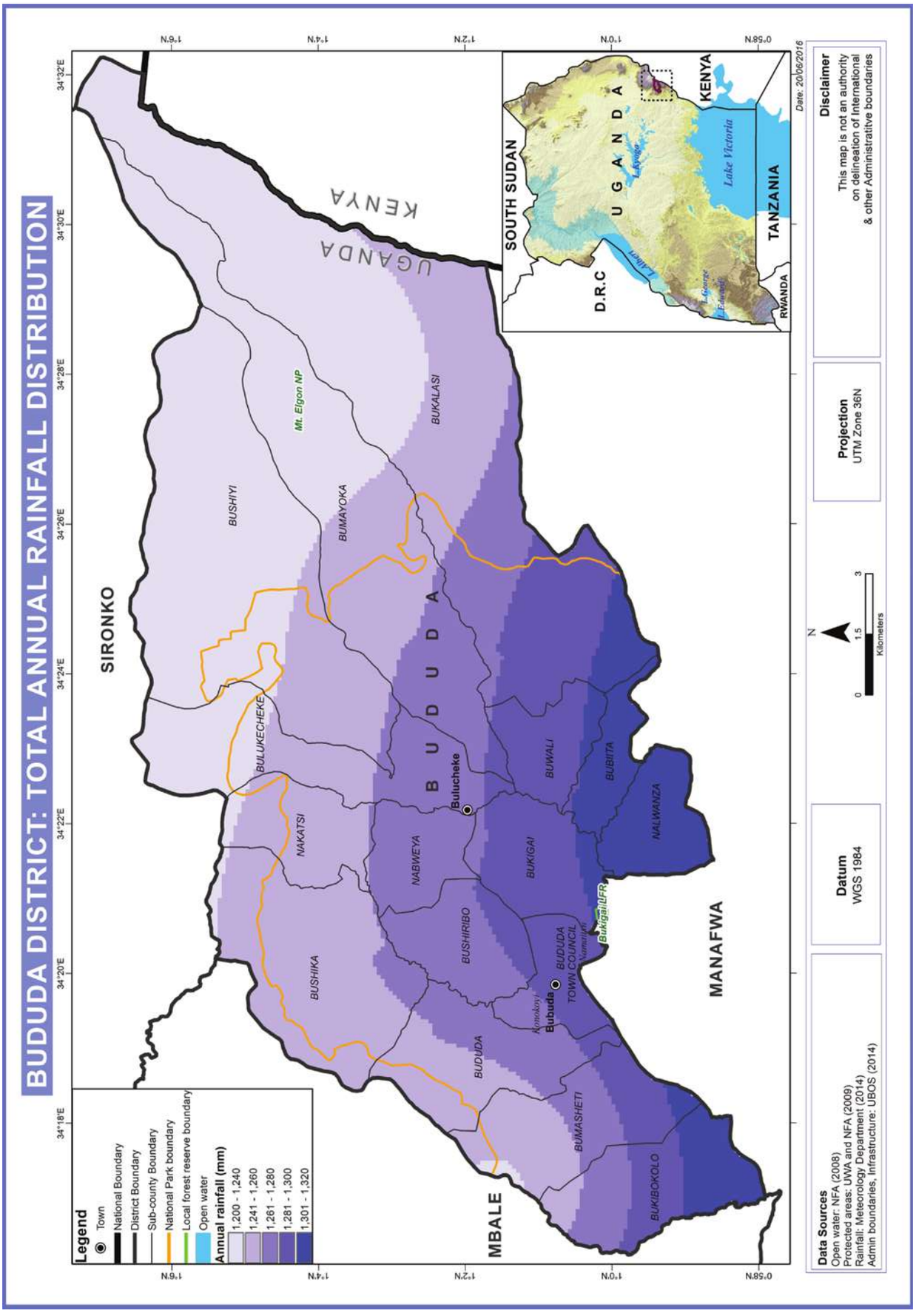


Figure 5: Total Annual Rainfall Distribution, Bududa District

2.1.7 Hydrology

Whereas the District is endowed with many streams and rivers, the total area under water is not very significant in relation to total land area. This is because of the absence of large water masses like lakes. The terrain of the District is such that water will immediately flow off thus the wetlands are promptly drained by rivers and streams. This leaves the District with only 12 km^2 of land under water/wetlands 4.3%. Comparisons can be made with the rest of Uganda which has 25% covered with water. The main rivers include Manafwa, Uukha, Tsutsu, Liisi, Malabasi, Kasuuni, Suume and Khokhobi.

2.1.8 Population

According to the National Population and Housing Census (2014) results, Bududa District had a total population 211,683 with the population density of above 1200 people per sq. Km. Results also showed that most of the people in Bududa District reside in rural areas (204,953 (96.8%) compared to (6,730 (3.2%) who reside in urban centers. The gender distribution was reported to be males: 105,938 (50.1%) and females: 105,745 (49.9%). About 99.4% (210,351) of the population form the household population and only 0.6% (1332) is Non-household. Bushika Sub-county had the highest population of 31,530 people while Buwali Sub-county had the least population of 6,375 people (Figure 6). Table 1 shows the population distribution per Sub-county for the different gender.

Table 1: Population Distribution in Bududa District

	HOUSEHOLDS		POPULATION		
Sub-county	***Number***	***Average Size***	***Males***	***Females***	***Total***
Bubiita	1605	4.5	3521	3624	7145
Bududa Town Council	1234	5.3	3398	3332	6730
Bududa	2257	4.8	5405	5455	10860
Bukalasi	2686	4.9	6622	6561	13183
Bukibokolo	1775	5.7	5053	5047	10100
Bukigai	2779	6.4	8656	9083	17739
Bulucheke	2378	6.2	7677	7184	14861
Bumasheti	2433	6.5	8174	7743	15917
Bumayoka	2966	6.6	9689	9742	19431
Bushika	5215	6	15613	15917	31530
Bushiribo	1868	5.8	5765	5734	11499
Bushiyi	2961	5.3	7870	8053	15923
Buwali	1271	5	3240	3135	6375
Nabweya	2062	5.1	5271	5187	10458
Nakatsi	1937	5.7	5467	5511	10978
Nalwanza	1601	5.6	4517	4437	8954

Source: UBOS Census 2014

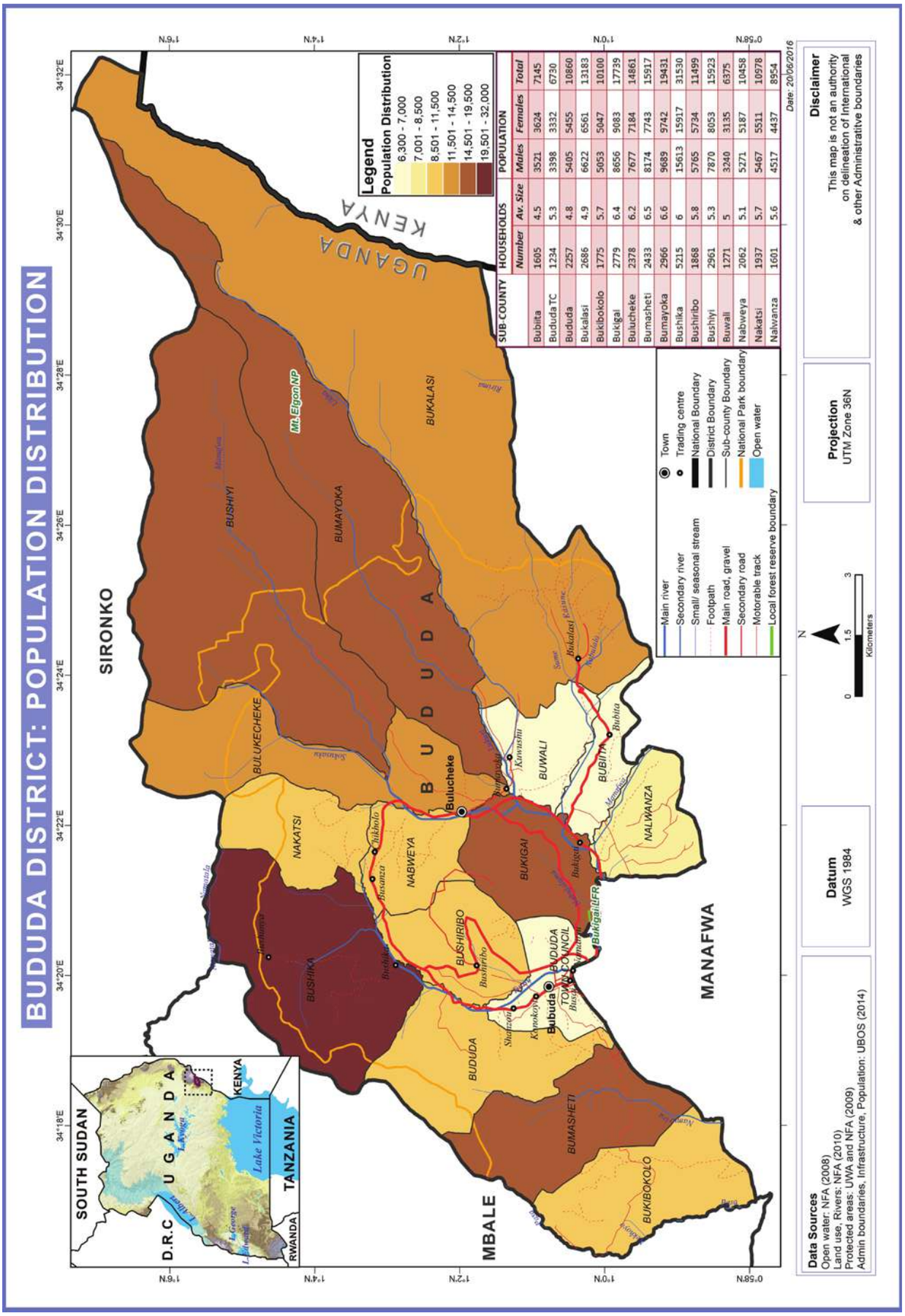


Figure 6: Population Distribution, Bududa District

2.1.9 Economic activities

Most households are engaged mainly in agriculture with emphasis on food crops such as bananas, cassava, sweet potatoes, yams beans, maize, ground nuts with lots of horticultural and cash crops consist of coffee and sugar canes. A considerable number of people have also established woodlots on the slopes of Mt. Elgon.

METHODOLOGY

3.1 Collection and analysis of field data using GIS

3.1.1 *Preliminary spatial analysis*

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

3.1.2 Stakeholder engagements

Stakeholder engagements were carried out in close collaboration with OPM's DRM team and the District Disaster Management focal persons with the aim of identifying the various hazards ranging from drought, floods, landslides, human, animal and crop diseases, pests, wildlife animal attacks, earthquakes, fires and conflicts among others. Stakeholder engagements were done through Focus Group Discussions (FGDs) and Key Informant Interviews guided by checklist tools (Appendix I). At District level, one Key Informant Interview comprising of four respondents (Deputy Chief Administrative Officer, District Production Officer, District Natural Resources Officer and Vice-Chairperson LC V) was held at Bududa District Headquarters. At Sub-county level key informants included: Sub-county and Parish Chiefs and Community Development Officers. FGDs were carried out in four purposively selected Sub-counties that were ranked with the highest vulnerability. FGDs comprising of an average of 12 respondents (crop farmers, local leaders and cattle keepers) were conducted at Nalwanza Sub-county, Bukigai Sub-county, Bumasheti Sub-county and Bukibokolo Sub-county.

Each Parish of the selected Sub-counties was represented by at least one participant and the selection of participants was engendered. FGDs were conducted with utmost consideration to the various gender categories (women, men) with respect to age groups since hazards affect both men and women though in different perspectives irrespective of age. This allowed for comprehensive representation as well as provision of detailed and verifiable information. Focus Group discussions and Key Informant Interviews were transcribed in the field for purposes of input into the NVIVO software for qualitative data analysis. Case stories and photographs were documented and captured respectively. In order to produce age and sex disaggregated data, results from FGDs and KIIs were integrated with the District population census data. This was also input in the multi-hazard, risk and vulnerability profile maps.

3.1.3 Participatory GIS

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

3.1.4 Geo-referencing and ground-truthing

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

3.2 Develop District specific Multi-hazard risk and vulnerability profiles

3.2.1 Data analysis and integration

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

3.2.2 Data verification and validation

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

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

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

RESULTS FROM MULTI-HAZARD RISK, VULNERABILITY MAPPING

4. Multi-hazards

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

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

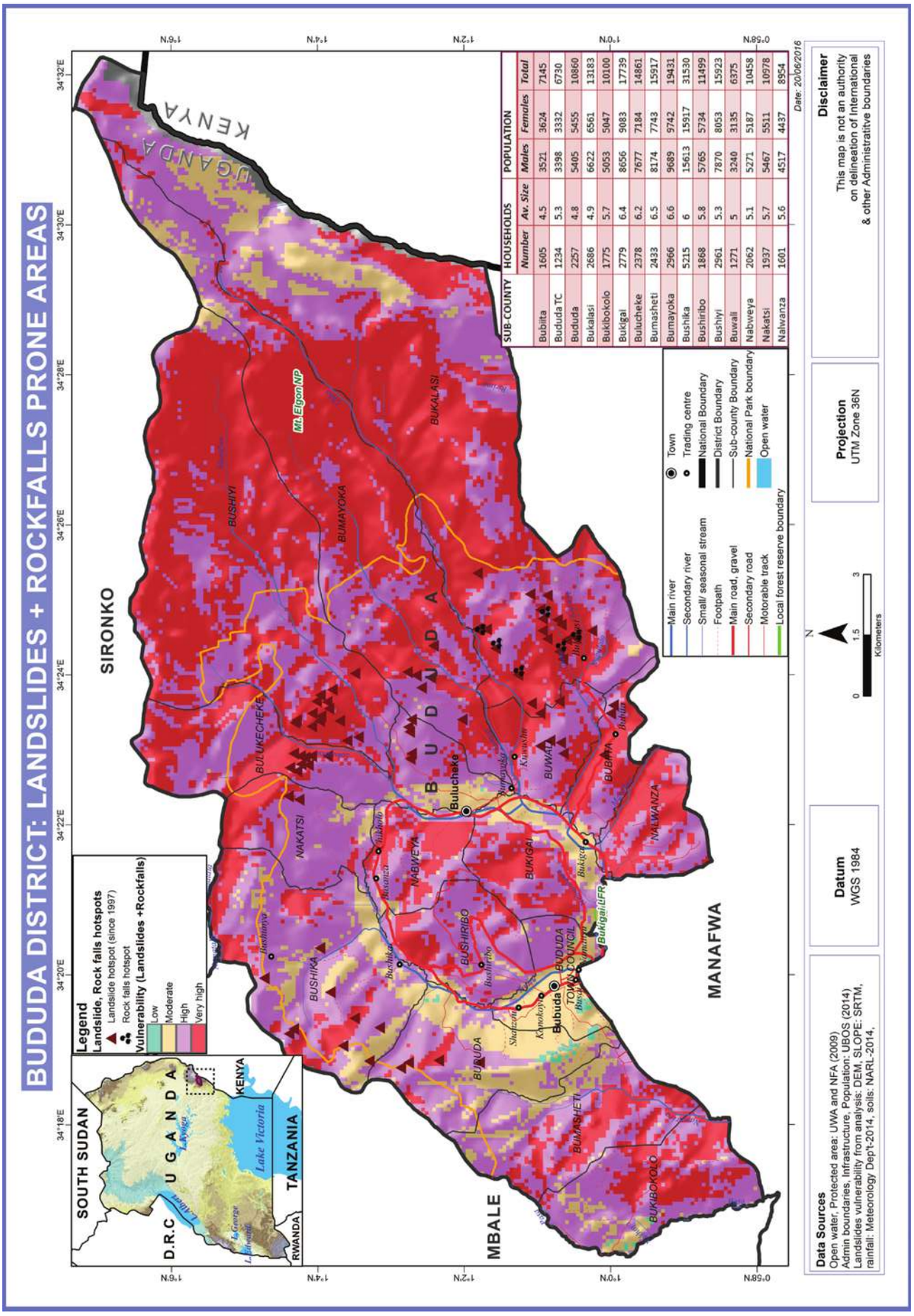
i. Geomorphological or Geological hazards including; landslides, rock falls and soil erosion
ii. Climatological or Meteorological hazards including; floods, drought, hailstorms, strong winds and lightning
iii. Ecological or Biological hazards including; crop pests and diseases, livestock pests and diseases,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

4.1 Geomorphological and Geological Hazards

4.1.1 Landslides, rock falls and soil erosion

Results from the participatory assessments indicated that Bududa District was so vulnerable to landslides, mudslides, flash floods, rock falls and soil erosion due to the steep slopes, vegetation loss as a result of increased degradation on hill slopes. Several incidences of landslides were reported and the worst being the one that occurred on 1st March 2010 at Namesti and Matuwa villages in Bukalasi and Bumayoka Sub-counties which killed over 365 people. This disaster caused extensive destruction of crops, property, and infrastructure thus affecting the livelihood of the people. Another incident happened in Busayi village in 1997 where a huge landslide destroyed 97 houses but no life was lost.

This information was integrated with the spatial modelling using socio-ecological spatial data i.e. Soil texture (data for National Agricultural Research Laboratories – Kawanda (NARL) 2014, Rainfall (Meteorology Department 2014), Digital Elevation Model (DEM), SLOPE, ASPECT (30m resolution data from SRTM Shuttle Radar Topography Mission (SRTM) to generate Land slide, rock falls and soil erosion vulnerability map (Figure 7).



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Nakatsi	1937	5.7	5467	5511	10978
Nalwanza	1601	5.6	4517	4437	8954

Figure 7: Landslides, rock falls and soil erosion prone areas and vulnerability, Bududa District

4.1.2 Earthquakes and faults

Participants of the focus group discussion indicated that earthquakes weren't a problem in Bududa District. However, it was observed that the entire District only experiences minor tremors. The participants also reported that there was a crack that had developed across the entire District (Figure 8).

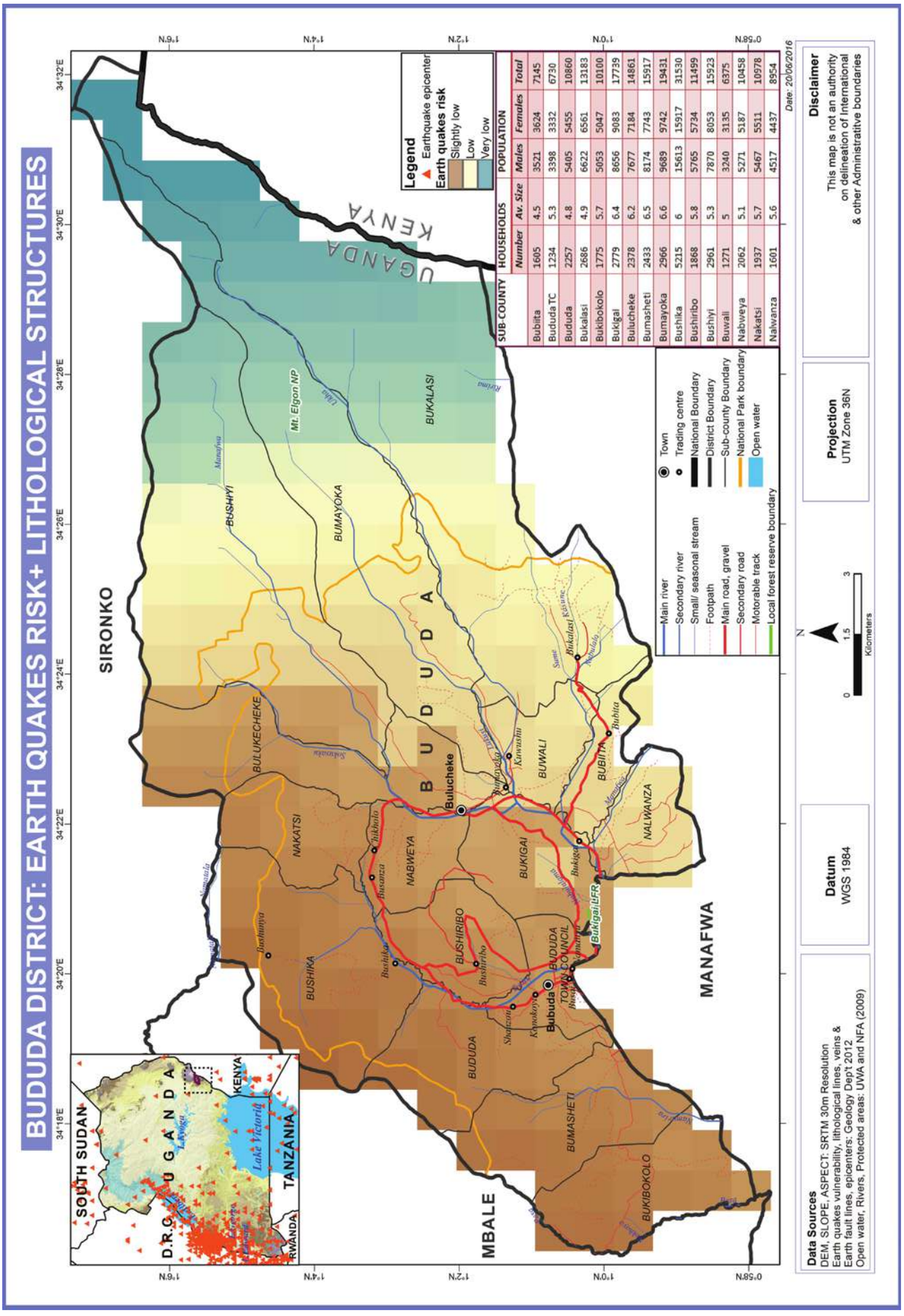


Figure 8: Earthquakes Vulnerability and Fault lines, Bududa District

4.2 Climatological and Meteorological Hazards

4.2.1 Floods

Results from the focus group discussions revealed that floods usually occur along rivers, low lying areas and valleys during the rainy seasons. Participants reported that floods submerge crops such as beans, sweet potatoes and maize thus causing food insecurity and considerable economic losses. Incidences of flooding were reported along most rivers originating from Mt. Elgon such as Ukha, Manafwa, Sakusaku, Suume, Liisi. In 2013, Tsutsu River flooded and killed 1 person.

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 susceptible to floods.

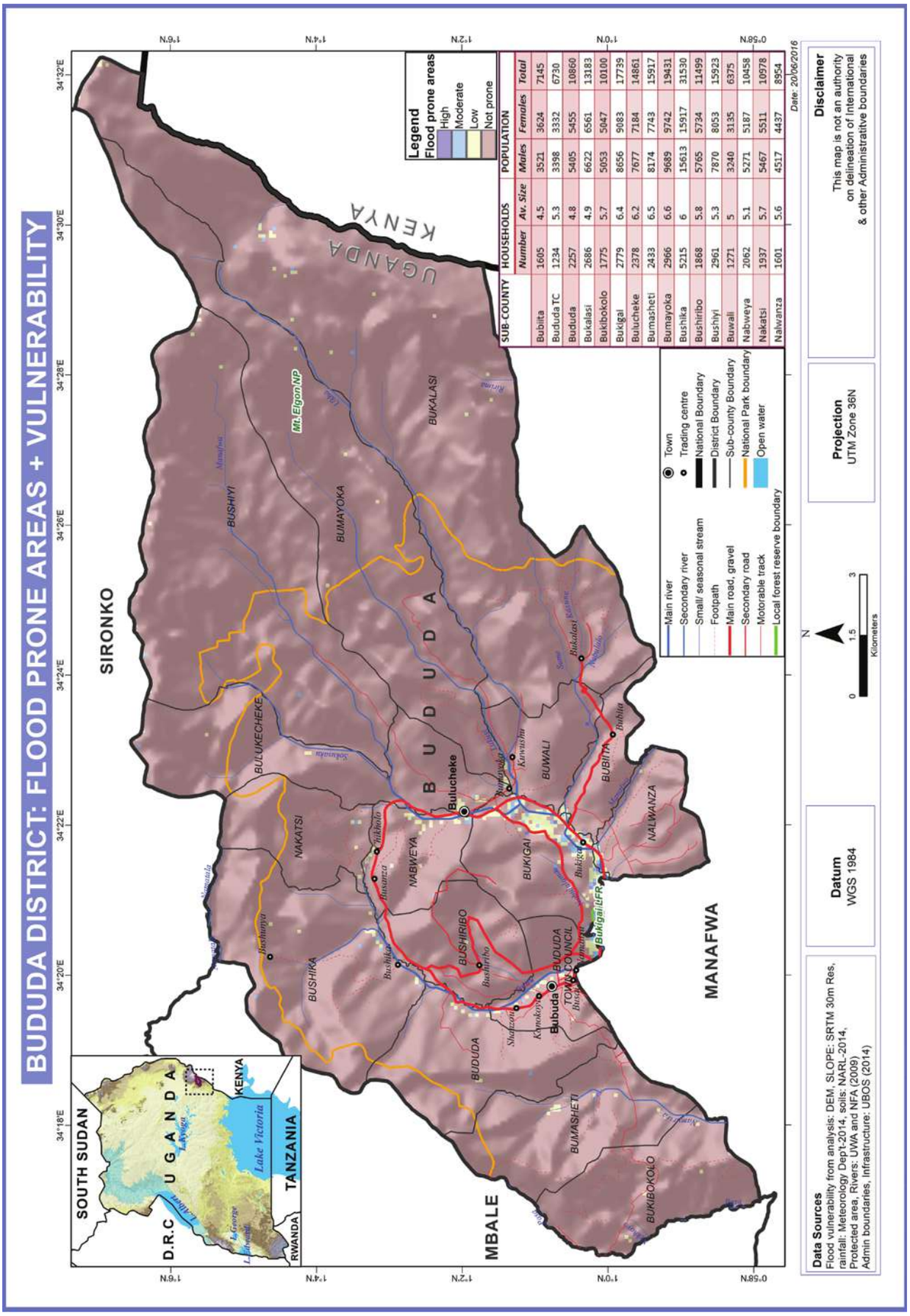


Figure 9: Earthquakes Vulnerability and Fault lines, Bududa District

4.2.2 Dry spells

Participatory assessments through focus group discussions indicated that Bududa District experiences drought in form of long dry spells. Participants indicated that these long dry spells had detrimental impacts on their livelihoods and wellbeing. Some of these impacts include; drying up of water sources, lack of pastures for livestock, food insecurity and rampant outbreaks of crop and livestock diseases. This information was integrated with the spatial modeling using socio-ecological spatial data i.e. generated from Rainfall and Temperature (Uganda National Meteorological Authority, 2014) using the Standardized Precipitation Index. Figure 10 shows areas that are affected by drought and their ranking.

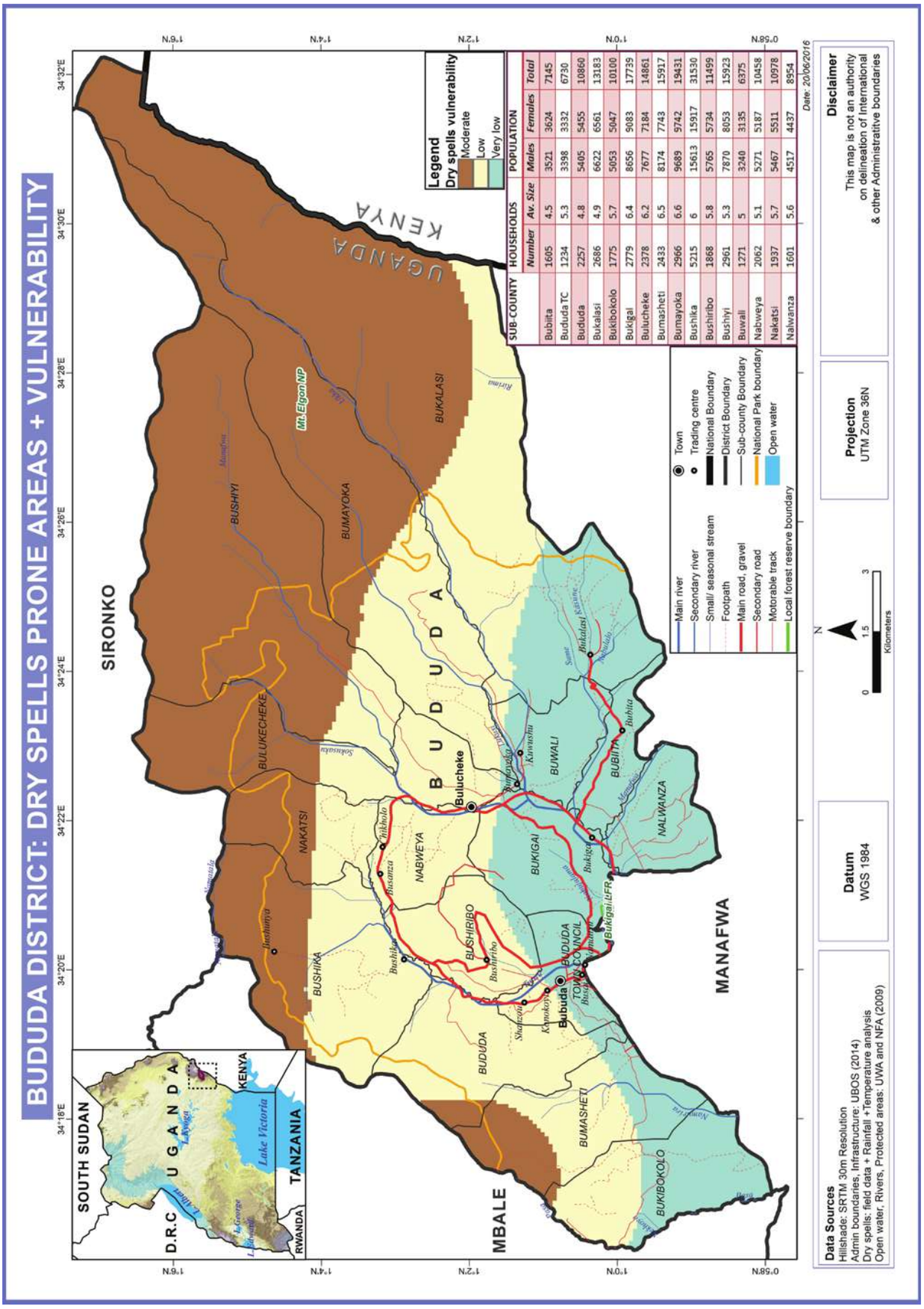


Figure 10: Prolonged dry spells Prone Areas and Vulnerability Ranking, Bududa District

4.2.3 Hailstorms

Results from the participatory assessments showed that Bududa District experiences hailstorms at the beginning of the rainy seasons. Participants reported that hailstorms cause serious damage to crops such as beans, coffee, maize and banana plantations leading to food insecurity and considerable economic losses to farmers. The most affected Sub-counties are Nabweya, Bushika and Bushiyi notably but however, this cut across the whole District (Figure 11).

4.2.4 Strong winds

The participants of the focus group discussions reported that strong winds are experienced during the rainy seasons. It was observed that strong winds blow off roof tops of houses, churches and schools, destroy banana plantations and cause tree falls. This affects all Sub-counties but notably Bushika, Bushiyi, Bukigai, Bumashieti and Bukibokolo (Figure 11).

4.2.5 Lightning

Lightning is a sudden high-voltage discharge of electricity that occurs within a cloud, between clouds, or between a cloud and the ground. The distribution of lightning on Earth is far from uniform. The ideal conditions for producing Lightning and associated thunderstorms occur where warm, moist air rises and mixes with cold air above. Results from participatory assessments indicated that Bududa District experiences lightning usually at the onset of the rainy season. It was reported that Lightning killed children and cattle in Bukibokolo, and Bushika Sub counties (Figure 11).

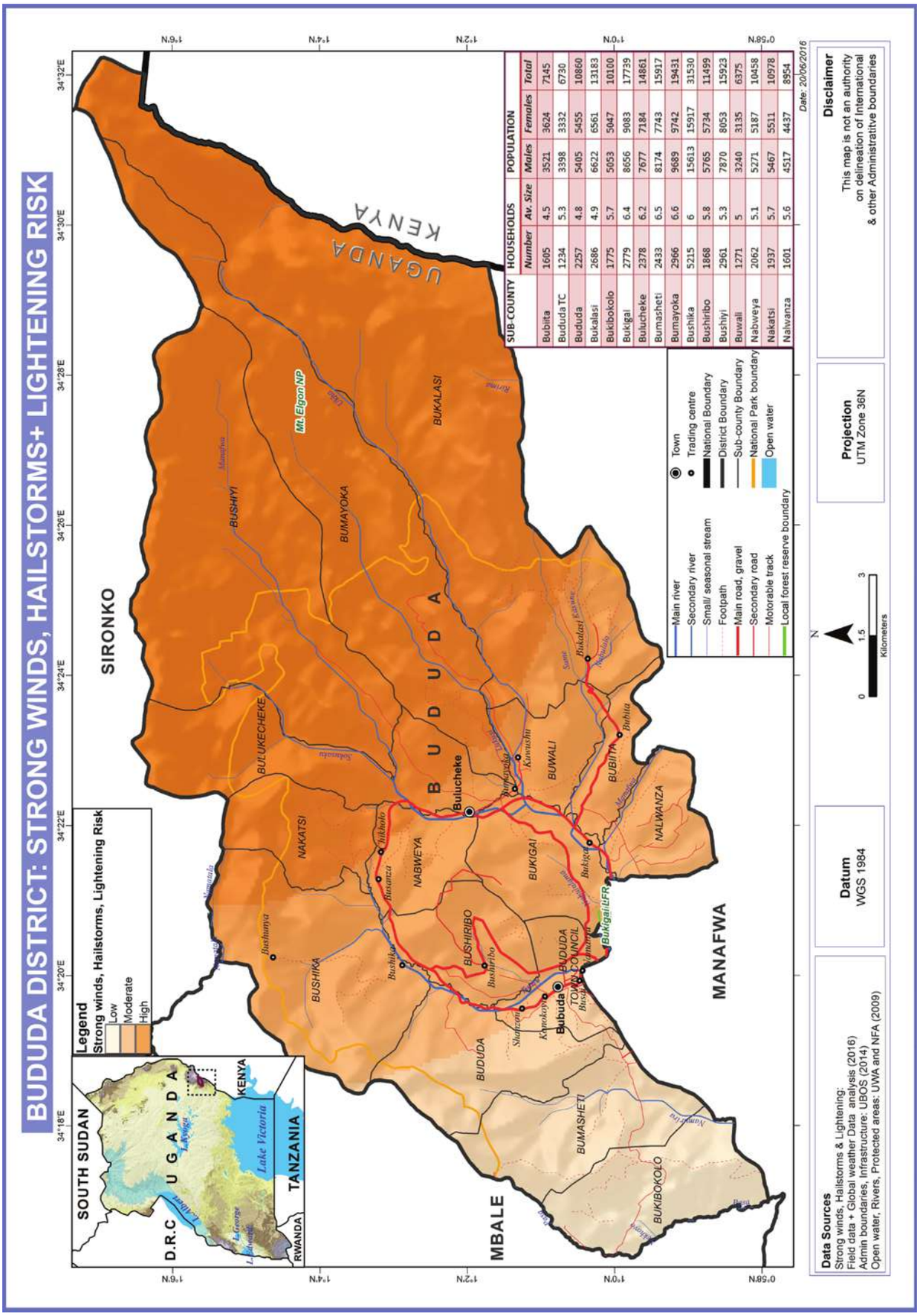
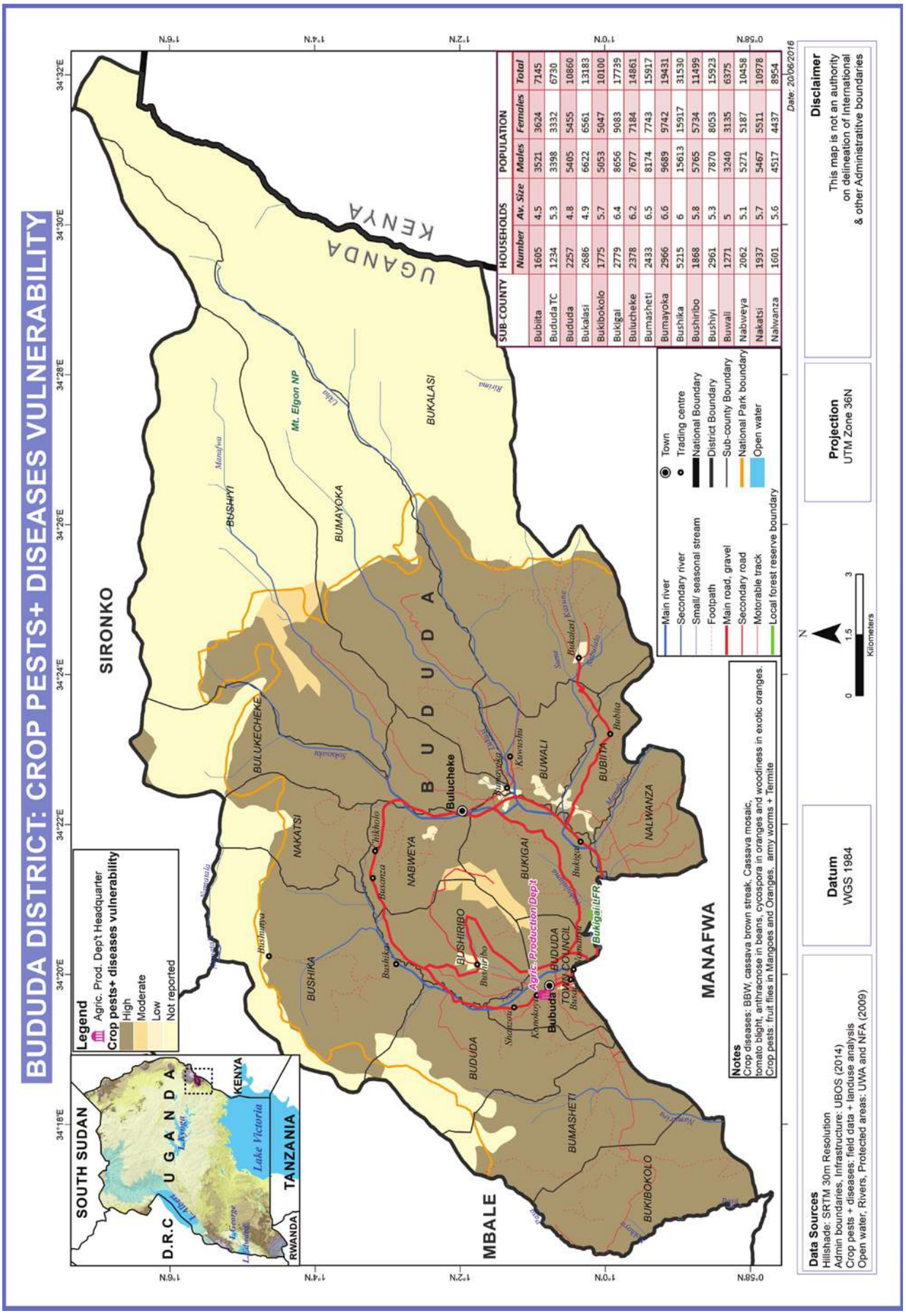


Figure 11: Strong winds, Hailstorms and Lightning Hotspots and Vulnerability, Bududa District

4.3 Ecological and Biological Hazards

4.3.1 Crop Pests and Diseases

Participatory assessments through focus group discussions indicated that Bududa District was vulnerable to crop pests and diseases. The main crop disease causing agents include; plant viruses, bacteria, fungi and damage by arthropod pests. All crops grown in the District are affected leading to reduction of yield and quality of produce. The most common crop pests in the District are; coffee twig borer, coffee leaf rust. While the most common crop diseases include; Coffee wilt disease, banana bacterial wilt, cassava and potatoes mosaic. Most affected Sub-counties include Bududa, Bushika, Bumasheti, Bukibokolo, Bukigai, Nabweya and Bulucheke (Figure 12).



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Nakatsi	1937	5.7	5467	5511	10978
Nalwanza	1601	5.6	4517	4437	8954

Figure 12: Crop Pests and Diseases Vulnerability, Bududa District

4.3.2 Livestock vectors and Diseases

Results from the focus group discussions indicated that livestock vectors and diseases were not a serious problem in Bududa District. However, the most common livestock diseases in the District are; foot and mouth disease, East Coast Fever, Lumpy skin disease and Nagana while ticks are most common pests. Participants of the focus group discussions reported that all Sub-counties were affected by livestock vectors and diseases (Figure 13).

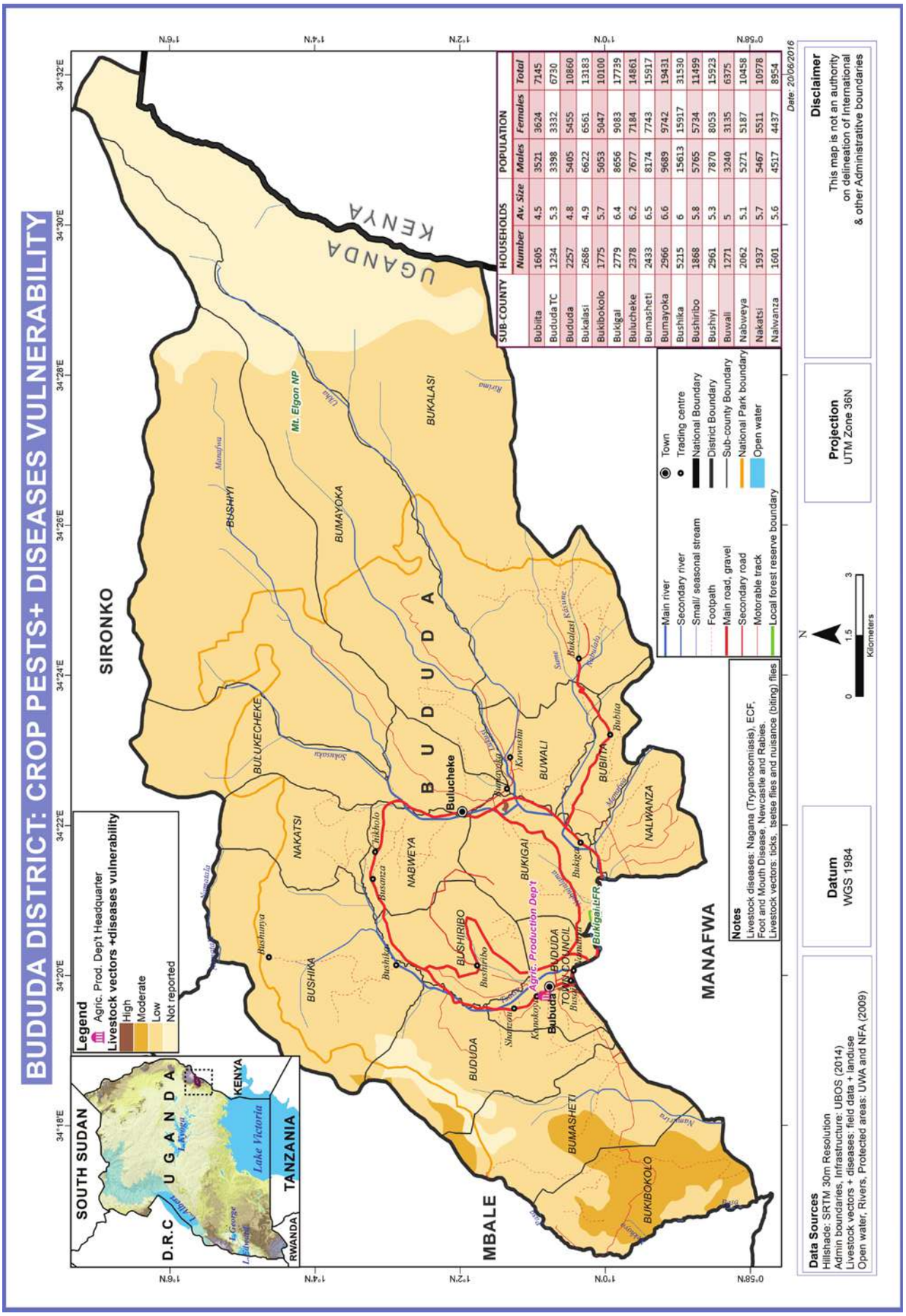

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Figure 13: Livestock Pests and Diseases Vulnerability, Bududa District

4.3.3 Human Diseases

Participants in the series of focus group discussions held indicated that the most common human diseases in Bududa District were malaria, cholera, dysentery, HIV/AIDS, typhoid and diarrhea. It was observed that incidences of malaria had gone down a little compared to the previous years probably due to the mosquito nets that Government provided. Reports showed that there was a cholera outbreak in 2013 and early 2016 especially along River Manafwa in Bushiyi, Bulucheke and Bukigai Sub-counties.

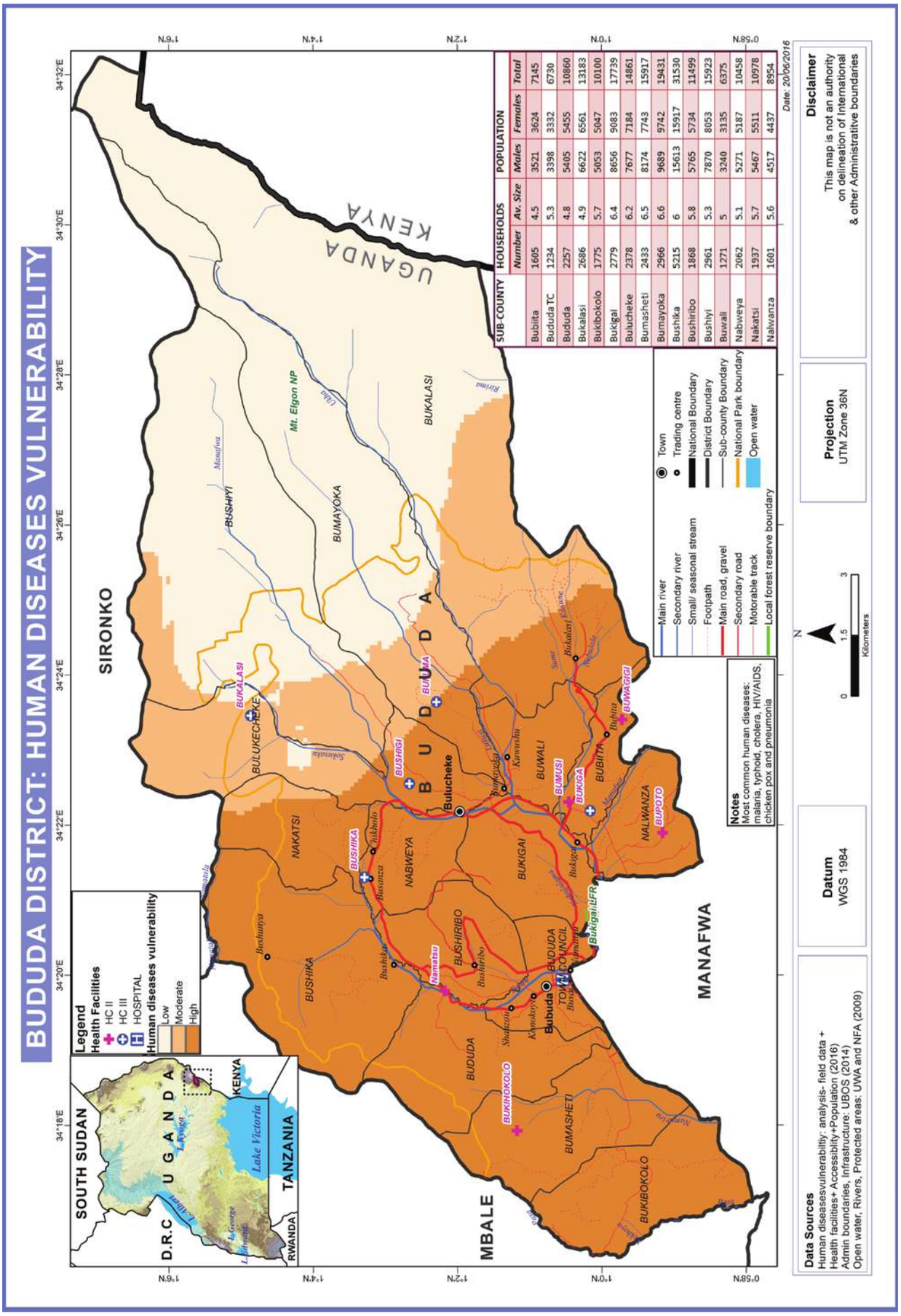

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Figure 14: Human Disease Prevalence and Health Facilities, Bududa District

4.3.4 Vermin and Wildlife Animal Attacks

Participatory assessments through focus group discussions revealed that there are incidences of vermin and wildlife animal attacks in the areas adjacent to Mt. Elgon National Park. The most reported vermin and wild animals include: squirrels, birds, mole rats, monkeys, hedge hogs and rats. Vermin and wildlife animal attacks were also reported in parts of Bulucheke, Bumayoka, Bukalasi, Bubiita and Bushiyi Sub-counties. These include monkeys that destroy gardens thus causing significant economic losses and food insecurity.

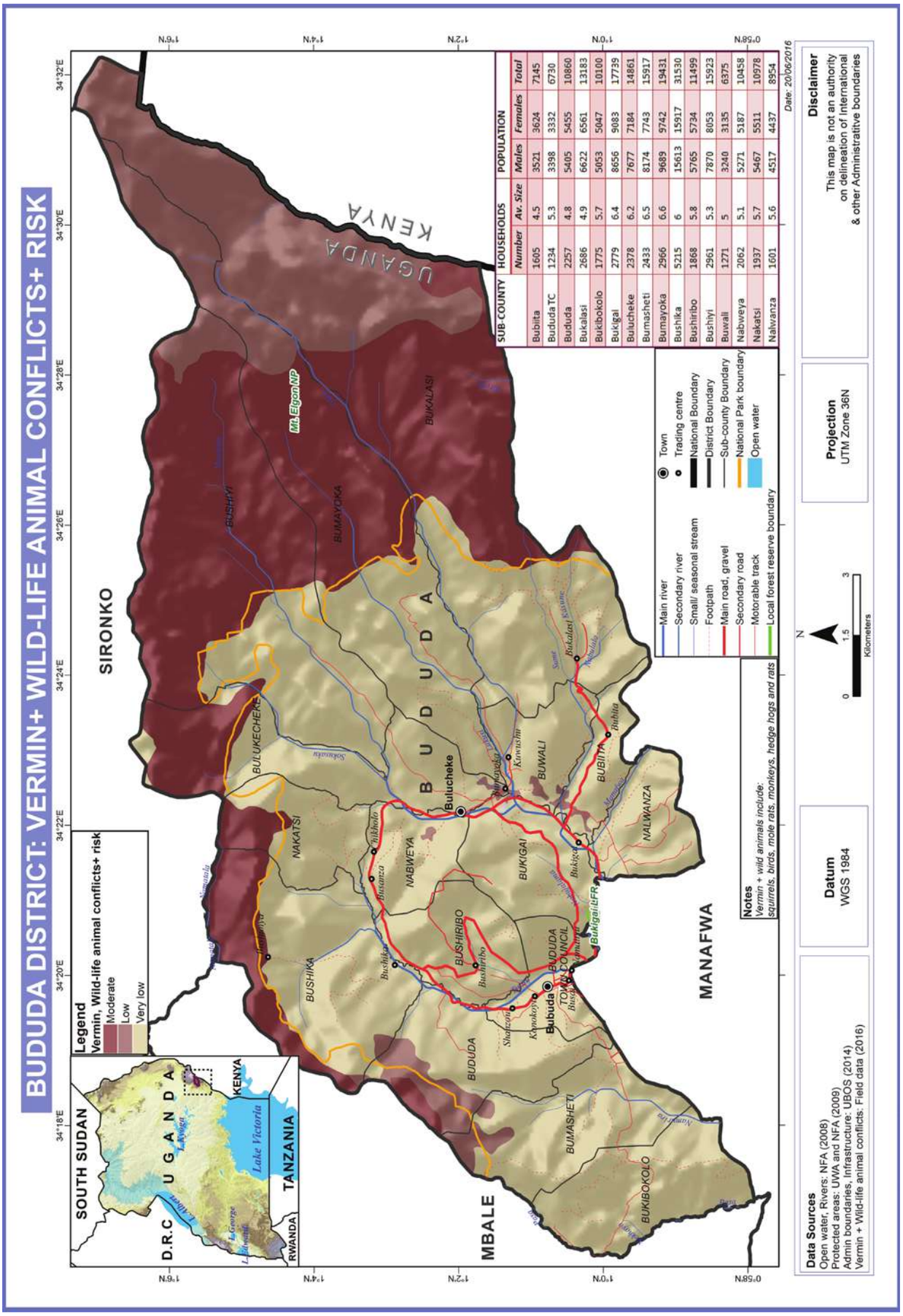

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Figure 15: Vermin and Wildlife Animal Conflicts and Vulnerability, Bududa District

4.3.5 Invasive species

The most common invasive species in Bududa District were; *Lantana camara* and *oxalis spp.* Participants reported that *Lantana camara* suppresses the growth of other crops. The entire District was said to be affected by *Lantana camara*. Figure 16 indicates areas where invasive species exist and their ranking.

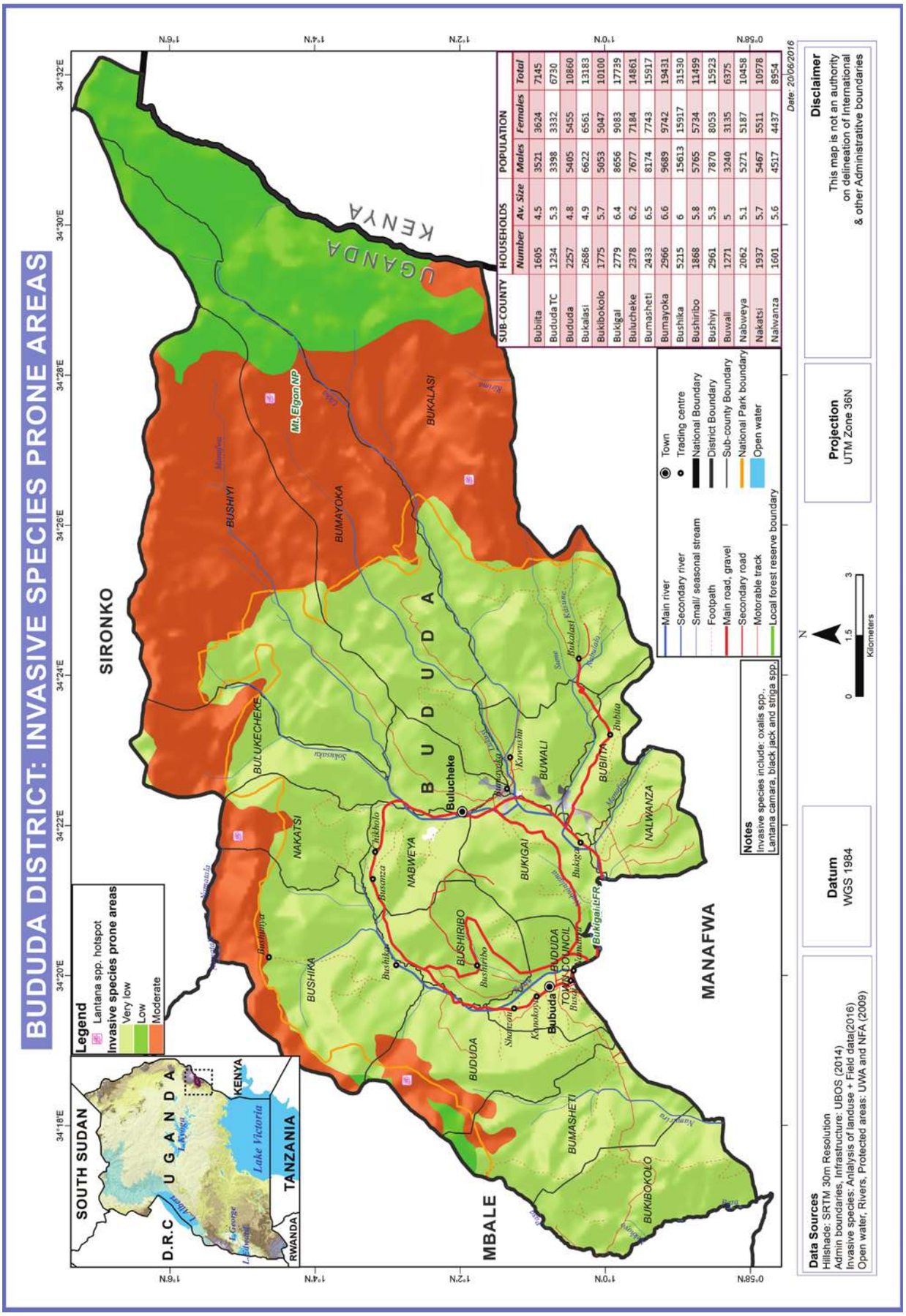

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Figure 16: Invasive Species Vulnerability, Bududa District

4.4 Human Induced and Technological Hazards

4.4.1 Bush fires

Results from the participatory assessments indicated that bush burning was not a serious problem in Bududa District. However, incidences of arson were reported to have occurred at Bunamubi rural trading center where 2 people died. Participants also reported incidences of intentional bush fires in the Sub-counties adjacent to Mt. Elgon National park. These fires which are always stopped by the game rangers.

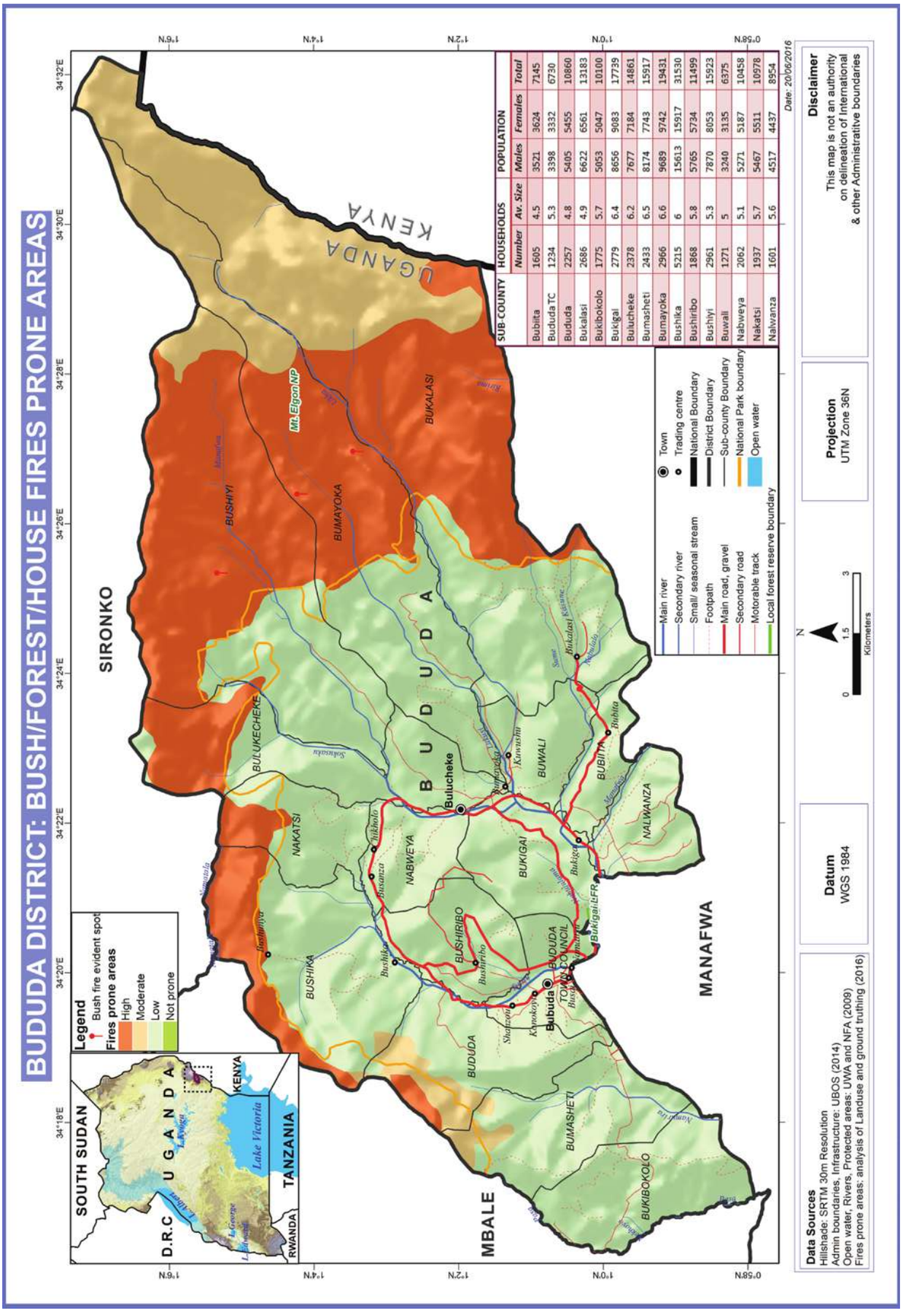

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Figure 17: Bush/Forest fires Hotspot Areas and Vulnerability, Bududa District

4.4.2 Land conflicts

Participants indicated that land conflicts were very common in Bududa District. Reports indicated that most of the registered conflicts are family land wrangles. It was also reported that Bududa District was in conflict with Manafwa District over a boundary around the Town Council. Matters of land disputes in the District are mostly settled by the RDCs office and Magistrate's Court.

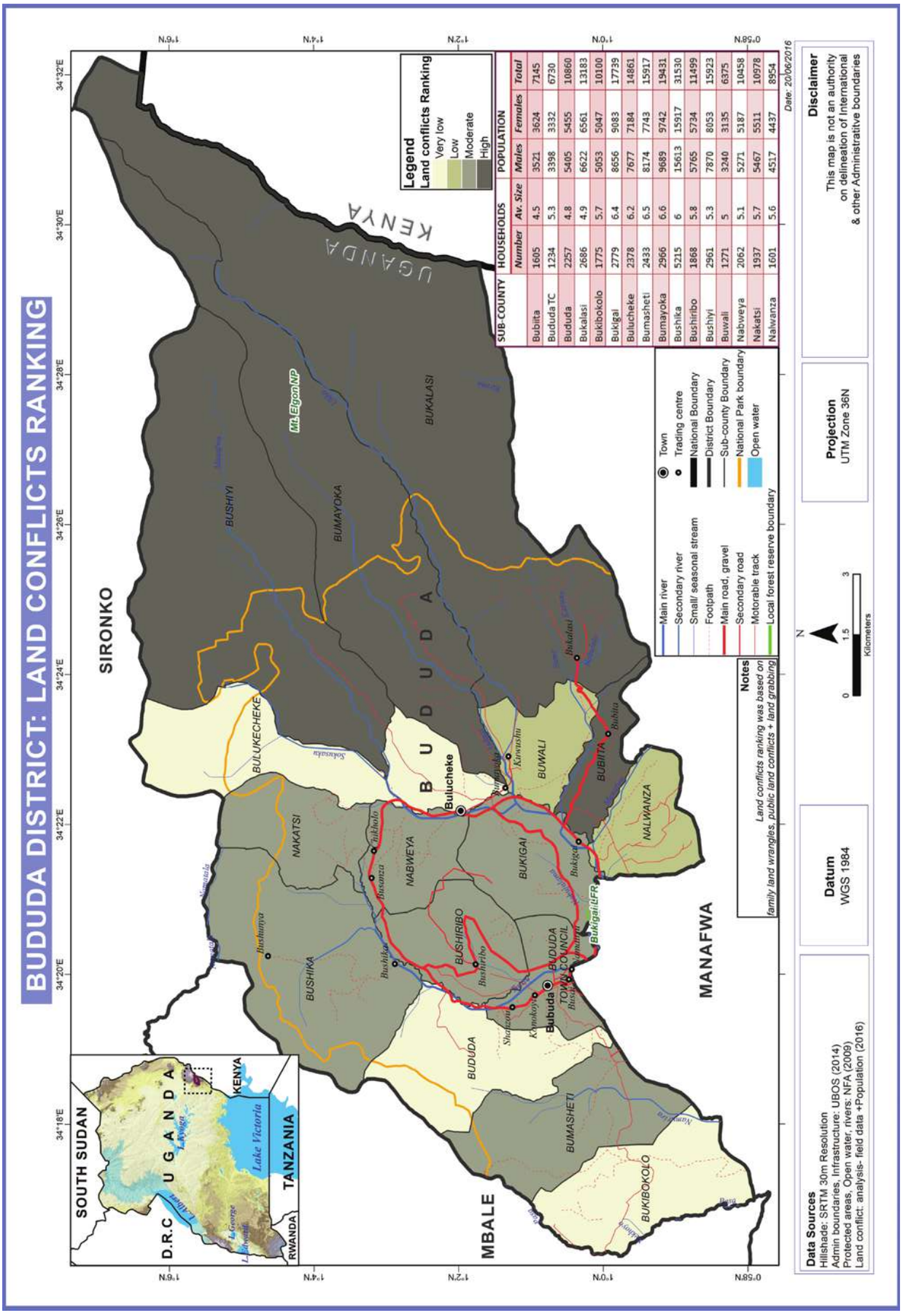

Figure 18: Land Conflicts Ranking, Bududa District

4.4.3 Environmental Degradation

The most reported forms of environmental degradation in Bududa District include; murram excavation, quarrying, sand mining, brick laying, river bank encroachment, over cultivation on steep slopes and encroachment on Mt. Elgon National Park. Participants reported that the opening up of Nalufufu – Bududa road involved a lot of murram excavation. It was also observed that the Nashinde, Namasho, Lukhonje Shishendu, and Malabasi wetlands are slowly being converted into cropland. Figure 19 indicates areas where environmental degradation has occurred and ranking.

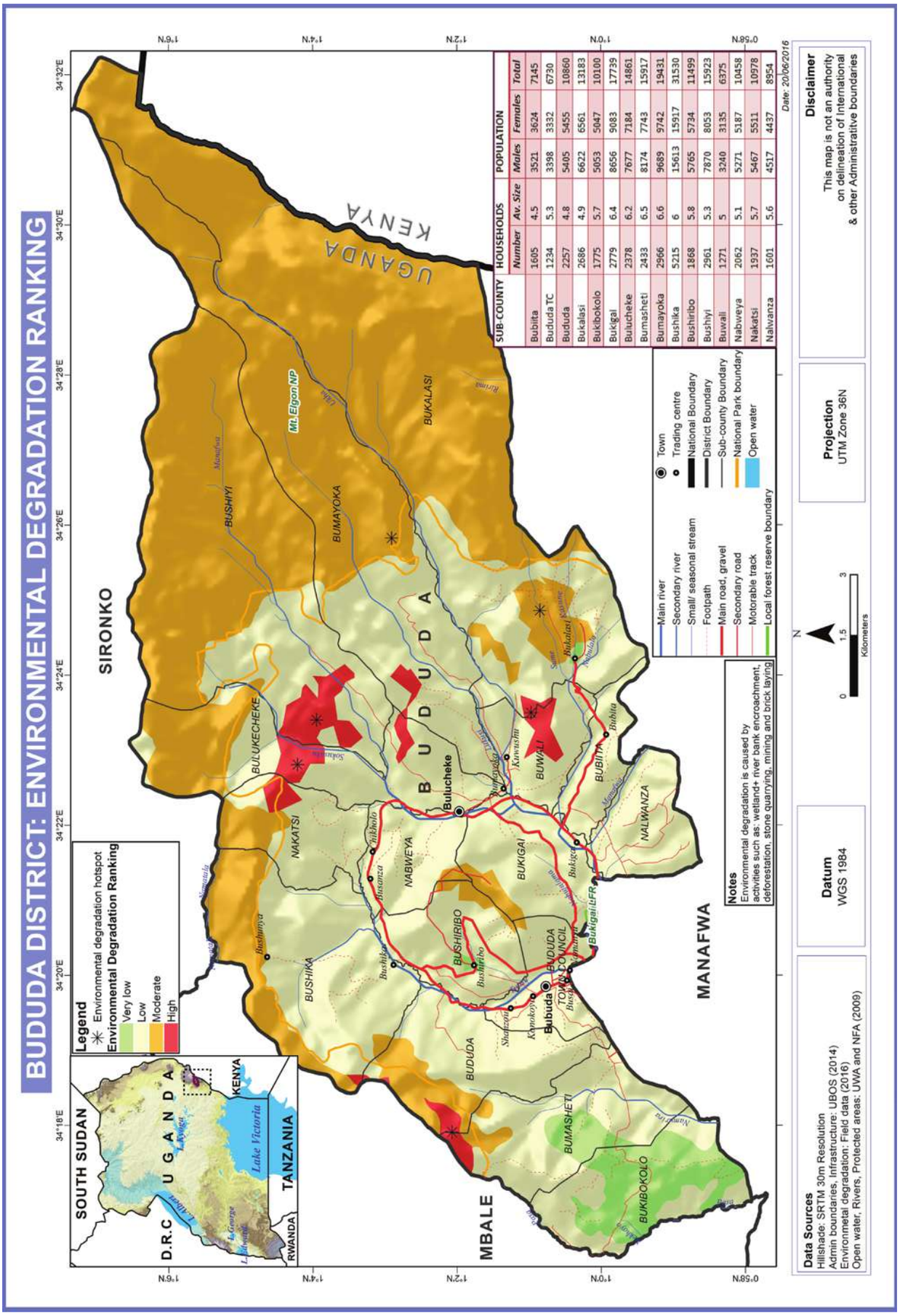

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Figure 19: Environmental Degradation Ranking, Bududa District

4.4.4 Road Accidents

Participants in the focus group discussions reported that there were not many registered cases of road accidents in Bududa District. It was reported that boda boda accidents are the most common especially along ring road with an average of 2 to 3 persons getting involved in accidents daily. In May 2016, a boda boda accident claimed 2 people at Bunamubi trading center.

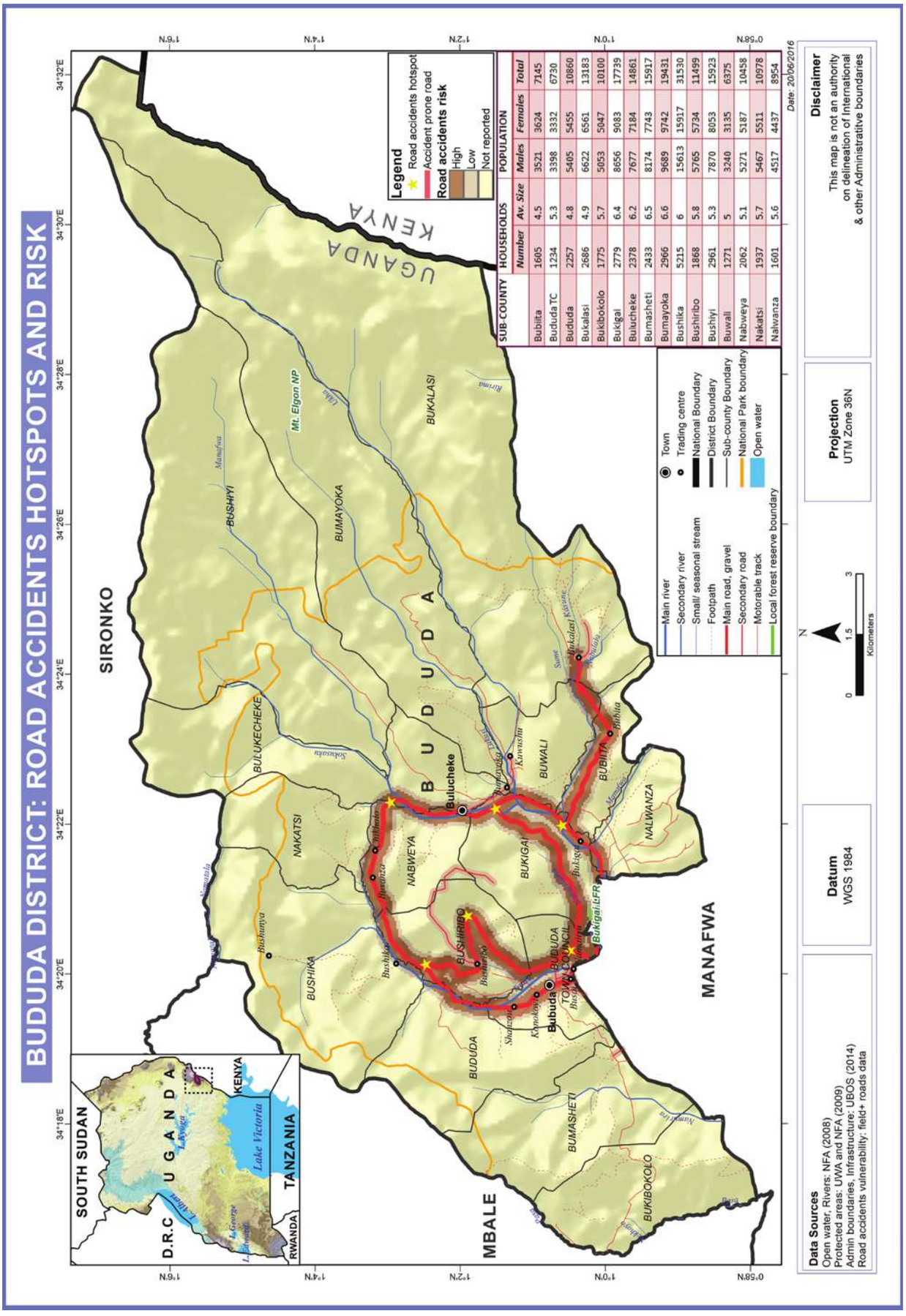

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Figure 20: Road Accidents Hotspots and Vulnerability, Bududa District

4.5 VULNERABILITY PROFILE

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

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

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

Table 2: Components of Vulnerability in Bududa District

Vulnerability	Exposure			Susceptibility			Resilience
Socio-economic component	**Hazards**	**Elements at Risk**	**Geographical Scale**	**Susceptibility**	**Geographical Scale**	**Coping strategies**	**Geographical Scale**
	Landslides, Rock falls and Soil erosion	- Human and livestock ad jacent 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
	Flash Floods	- Livestock ad jacent 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 infra structure e.g. houses, schools, roads adja cent to flood plain	Parish	- Migration - Sensitization on wet land conservation - Dig trenches	Parish

	Dry prolonged spell	- Livestock - Crops - Human population	Village	- Hunger & poverty - Livestock loss - Crop failure - Shortage of pas ture - Shortage of water	Village	- Migration - Sensitization on tree planting - Buy food from else where	Village
	Hailstorms, strong winds and Lightning	- Human and livestock populations - Crops - Infrastructure e.g. houses, schools, health centres	Parish	- Loss of lives - Destruction of crops - Destruction of in frastructure e.g. houses, schools, roads ad jacent 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
	Human Disease outbreaks	- Human Population	District	- Loss of lives - Reduced labour productivity	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 - bye laws - enforcements -	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
Environmental component	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	
	Earth quakes	- Infrastructure e.g. houses, schools	District	- Loss of lives - Destruction of Infrastructure e.g. houses, schools	District	-No much measure so far	

	Floods	- Livestock adjacent to flood plain - Crops on flood plain - Infrastructure e.g. houses, schools, roads adjacent to flood plain	Parish	- Livestock loss - Destruction of crops - Destruction of infrastructure e.g. houses, schools, roads adjacent to flood plain	Parish	-Migration -Sensitization on wetland conservation -Dig trenches	
	Drought	- Livestock - Crops - Human population	Village	- Hunger & poverty - Livestock loss - Crop failure - Shortage of pasture - Shortage of water	Village	-Migration -Sensitization on tree planting -Buy food from elsewhere	
	Hailstorms, strong winds and Lightning	- Human and livestock populations - Crops - Infrastructure e.g. houses, schools, health centres	Parish	- Loss of lives - Destruction of crops - Destruction of infrastructure e.g. houses, schools, roads adjacent to flood plain	Parish		
	Crop Pests and Diseases	-Crops	District	- Complete crop failure	District	- Spraying - Cut and burry affected crops -Sensitization on crop disease management	

	Livestock Pests and Diseases	-Livestock (cattle, goats etc.)	District	- Loss of livestock - Reduced livestock productivity	District	- Vaccination - Burry and burn animals that have died from infection - Quarantine	
	Human Disease outbreaks	- Human Population	District	- Loss of lives	District	- Mass Immunization - Use of mosquito nets	
	Invasive species	-indigenous species -Animals	District	- Outcompete the indigenous spp., suppress growth of indigenous spp - Loss of indigenous spp. - Complete crop Failure - suppress growth of pasture	District	- Cut and burn -Sensitization on Invasive species management	
	Bush fires	- Livestock - Crops - Infrastructure e.g. houses, schools	Sub-county	- Loss of livestock - Shortage of pasture - Destruction of crops - Destruction of infrastructure e.g. houses, schools	Sub-county	-Sensitization	
	Road accidents	- Human population - Infrastructure adjacent to accident black spots e.g. houses, schools etc.	Sub-county	- Loss of lives - Destruction of vehicles - Destruction of Infrastructure adjacent to accident black spots e.g. houses, schools etc.	Sub-county	-Humps on roads -Signage on speed limits -Sensitization on traffic rules	

	Land conflicts	- Human population	Village	-Loss of lives -Family violence and break outs	Village	- Community dialogue - District court in charge of land issues	
	Vermin and Wildlife animal attacks	- Human population - Livestock - Crops	Parish	-Loss of lives -Livestock loss -Crop destruction	Parish	- Report to UWA - Guard gardens -Poison -Hunt and kill -Fence water collection points with Wildlife animals	
	Environmental degradation	- Human and livestock populations - Crops - Natural vegetation	Sub-county	-Crop failure -Shortage of pasture -Shortage of water -Decline of water quality	Sub-county	-Sensitization on wetland conservation -Sensitization on tree plating -Setting bi-laws	

Table 3: Vulnerability Profile for Bududa 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*	
Flash floods	5	4	20	Bukigai, Nalwanza, Buwali, Bukalasi, Bubiita, Bulucheke, Bushiyi, Bushiribo, Bushika and Bududa Town Council.
Dry spells	3	3	9	Bukibokolo, Bukigai,and Bumasheti
Soil erosion, rock falls and landslides	5	4	20	All Sub-counties
Hail storms, Lightning and strong winds	4	3	12	All Sub-counties
Bush fires	3	2	6	Bushika, Nakatsi, Bududa, Bulucheke, Bubiita, Bukalasi and Bushiyi.
Crop pests and diseases	3	3	9	All Sub-counties
Livestock pests and diseases	4	3	12	All Sub-counties
Human Diseases outbreaks	2	3	6	Bushiyi, Bulucheke, Bukigai, Nalwanza, Buwali and Bududa Town Council
Land conflicts	4	3	12	All Sub-counties

Vermin and Wild-life animal attacks	2	2	4	All Sub-counties adjacent to Mt. Elgon National Park.
Earthquakes and faults	2	2	4	All Sub-counties
Road accidents	4	2	8	All Sub-counties
Environmental degradation	5	4	20	All Sub-counties
Invasive species	2	2	4	All Sub-counties.

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

Key for Relative Risk

	High
	Medium
	Low
	Not reported/ Not prone

Table 4: Hazard Risk Assessment

Hazard	Bulucheke	Bumayoka	Bushiyi	Bukalasi	Bubiita	Nalwanza	Buwali	Bushiribo	Bukigai	Nabweya	Bushika	Nakatsi	Bumasheti	Bukibokolo	Bududa	Bududa T.C
Floods	H	H	H	H	H	H	H	M	H	L	H	M	L	L	L	H
Prolonged Dry Spells	L	L	L	L	L	L	L	L	LL	L	L	L	M	M	L	L
Landslides, Rock falls and Erosion	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L
Strong winds, Hailstorms and Lightning	M	H	H	M	M	M	M	H	H	M	H	H	M	H	M	L
Crop pests and Diseases	M	M	M	M	M	M	M	M	H	M	H	M	H	H	M	M
Livestock pests and Diseases	M	M	M	M	M	M	M	M	H	M	H	M	M	H	M	M
Human disease outbreaks	H	M	H	H	M	H	H	LL	H		H	M				H
Vermin and Wildlife animal attacks	L	L	L	L	L	L										
Land conflicts	M	M	H	H	H	M	L	L	L	L	H	H	H	L	H	H
Bush fire	L	L	L	L	L	L	L				L	L	L	L	L	
Environmental degradation	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Earthquakes and faults	L	L	L	L	L	L	L	L	L	L	L	L				
Road accidents	L	L	L	L	L	L	L	L	H		H	M	L	L	L	L
Invasive species	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

Key

H	High
M	Medium
L	Low
	Not reported/ Not prone

4.5.1 Gender and Age groups mostly affected by Hazards

Table 5: Gender and age groups mostly affected by hazards

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

4.5.2 Coping Strategies

In response to the various hazards, participants identified a range of coping strategies that the community employs to adjust to, and build resilience towards the challenges. The range of coping strategies are broad and interactive often tackling more than one hazard at a time and the focus of the communities leans towards adaptation actions and processes including social and economic frameworks within which livelihood and mitigation strategies take place; ensuring extremes are buffered irrespective of the direction of climate change and better positioning themselves to better face the adverse impacts and associated effects of climate induced and technological hazards (Table 6).

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

No	Multi-Hazards		Coping strategies
1	Geomorphological or Geological	Landslides, Rock falls and Erosion	• Migration/Relocation 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 • Designs of houses (pillars) • Early warning system • Vigilance • Sensitization • Emergency response mechanisms
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		Prolonged dry spells	• 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 Lightning	• Plant trees as wind breakers • Use of stakes against wind in banana plantations • Use of ropes to tire banana against wind • Installation of Lightning conductors • Stay indoors during rains • Changing building designs and roof types • Removal of destroyed crops • Request for aid from the Office of the Prime Minister • Installation of Lightning conductors on newly constructed schools
6	Ecological or Biological	Crop pests and Diseases	• Spraying pests • Cutting and burying BBW affected crops • Burning of affected crops • Vigilance
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 • Mauritius thorns • Dig trenches • Chain link • Plant red pepper as buffer • Recommend vermin guards
10		Invasive species	• Uproot • Spray with herbicides (e.g 2-4-D) • Biological control (e.g beetles) • Cut and burn • Sensitization on Invasive species management • Blacklisting exotic species
11	Human induced or technological	Land conflicts	• Community dialogues • Report to court • Migration • Resettlement • Surveying and titling • Strengthen Land management structures • Sensitization on land ownership • Proper demarcation (live fencing)
12		Bush fires	• Stop the fires in case of fire outbreak • Fire lines (may be constructed, cleared grass) • Fire breaks planted along gardens e.g. euphorbia spp. • Vigilance especially in dry seasons where most burning is done • Bye-laws • Sensitization on dangers of fires
13		Road accidents	• Construction of humps • Road Signage including speed limits • Separate lanes on sharp corners • Sensitisation • Widen narrow roads • Plant trees on road reserve, as road guards • Deployment of Traffic officers
14		Environmental degradation	• Leave wetlands as water catchments • Plant appropriate tree species as climate modifiers • Sensitization • Bye-laws • Enforcement • Gazette and demarcate wetlands • Restore wetlands and other fragile ecosystems • EIA for new developments • No land titles for wetland areas • Cancellation of existing wetland land titles • Developing land use plans and enforce them

GENERAL CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

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

Results from the participatory assessment indicated that Bududa District has over the past two decades increasingly experienced hazards including; Landslides, rock falls, soil erosion, floods, dry spells, hailstorms, strong winds, Lightning, crop pests and diseases, livestock pests and diseases, human disease outbreaks, vermin, wildlife animal attacks, invasive species, bush fires and land conflicts putting livelihoods at increased risk.

Generally landslides and mudslides, flash floods, hail and wind storms and soil erosion were identified as most serious hazards in Bududa District with almost all Sub-counties being vulnerable to these hazards. The limited adaptive capacity (and or/resilience) and high sensitivity of households and communities in Bududa District has increased their vulnerability to hazard exposure necessitating urgent external support.

Hazards experienced in Bududa 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, prolonged dry spells, hailstorms, strong winds and Lightning.
iii. Ecological or Biological hazards including crop pests and diseases, livestock pests and diseases, human disease outbreaks, vermin and wildlife animal attacks and invasive species.
iv. Human induced or Technological hazards including bush fires, road accidents land conflicts.

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

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

5.2 Policy-related Recommendations

The following recommended policy actions targeting vulnerability reduction include:

i. The Government should improve enforcement of policies aimed at enhancing sustainable environmental health.
ii. The Government through MAAIF should review the animal diseases control act because of low penalties given to defaulters.
iii. The Government should establish systems to motivate support of political leaders toward Government initiatives and programmes aimed at Disaster risk Reduction.
iv. The Government should increase awareness campaigns aimed at sensitizing farmers/ communities on disaster risk reduction initiatives and practices.
v. The Government should revive disaster Committees at District level and ensure funding of disaster and environmental related activities.
vi. The Government through UNRA and the District Authority should fund periodic maintenance of feeder roads to reduce on traffic accidents.
vii. The Government through MAAIF and the District Production Office should promote drought and disease resistant crop seeds.
viii. The Government through OPM and Meteorology Authority should increase importation of Lightning conductors and also reduce taxes on their importation.
ix. The Government through OPM and Meteorology Authority should support establishment of disaster early warning systems.
x. The Government through MWE increase funding and staff to monitor wetland degradation and non-genuine agro-inputs.
xi. The Government through OPM should improve communication between the disaster department and local communities.
xii. The Government through MWE should promote Tree planting along road reserves.
xiii. The Government through MAAIF should fund and recruit extension works at Sub-county level.
xiv. There is need to formulate ordinances and bye-laws for sustainable management of environment and its natural resources.
xv. The Government through Ministry of Lands, Housing and Urban Development should survey and acquire titles deeds for Government land.
xvi. Formulation of a bye-law on distribution and usage of electric power.

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APPENDIX I: DATA COLLECTION TOOLS

FOCUS GROUP DISCUSSION GUIDE FOR District DISASTER RISK MANAGEMENT FOCAL PERSONS

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

No.	Name of Participants	Designation	Contact	Signature

Introduction

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

17. What impacts have been caused by earth quakes?

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

34. In which way are crops affected by drought?

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

71. What impacts have been caused by wildlife attacks?

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

87. What impacts have been caused by environmental degradation?

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

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

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

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

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

93. What impacts have been caused by land conflicts?

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

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

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

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

98. Which roads have experienced Road accidents?

99. What impacts have been caused by Road accidents?

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

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

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

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

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

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

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

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

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

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

FOCUS GROUP ATTENDANCE LIST FOR District DISASTER RISK MANAGEMENT FOCAL PERSONS

Name of Participant **Designation** **Contact**

FOCUS GROUP DISCUSSION ATTENDANCE LIST FOR LOCAL COMMUNITIES

Name of Participant **Village/Parish** **Contact**

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><td rowspan="5">Land use type (tick)
Bush
Grassland
Wetland
Tree plantation
Natural forest
Cropland
Built-up area
Grazing land
Others</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></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, Lightning, cattle disease outbreaks, human disease outbreaks, land conflicts, wildlife conflicts, bush fires, earthquakes, faults/ cracks, pictures, any other sensitive features)</td></tr>
</table>

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