THE REPUBLIC OF UGANDA

Luweero District

Hazard, Risk and Vulnerability Profile

2016

Acknowledgement

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

I extend my sincere thanks to the Department of Relief, Disaster Preparedness and Management, under the leadership of the Commissioner, Mr. Martin Owor, for the oversight and management of the entire exercise.

The HRV assessment team was led by Ms. Ahimbisibwe Catherine, Senior Disaster Preparedness Officer supported by Ogwang Jimmy, Disaster Preparedness Officer and the team of consultants (GIS/DRR specialists); Dr. Bernard Barasa, and Mr. Nsiimire Peter, who provided technical support.

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

My appreciation also goes to Luwero 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

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Acronyms

DDMC	District Disaster Management Committee
DEM	Digital Elevation Model
DLG	District Local Government
DRM	Disaster Risk Management
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 Luweero District was a combination of spatial modeling using adaptive, sensitivity and exposure spatial layers 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; preliminary spatial analysis, and hazard prone areas' base maps were generated using Spatial Multi-Criteria Analysis (SMCA) was done in a GIS environment (ArcGIS 10.3).

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.

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.

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 I.

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

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 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 and human induced or technological hazards including bush fires, road accidents land conflicts.

General findings from the participatory assessment indicated that identifying hazards, risks and vulnerable communities is important in the planning process to know which areas require agent attention to address vulnerability. It was also noted that hazard and disaster management should be mainstreamed with a special policy regarding preparedness at all the levels at the district departments to the lower Local Governments in order to effectively respond to these hazards. Finally, with these hazards profiled it is possible to approach Development Partners to assist in intervening or supporting the district in putting up mitigation measures.

1.0 INTRODUCTION

1.1 Background

Uganda has over the past years experienced frequent disasters that ranges 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 shifting the disaster management paradigm from the traditional emergency response focus towards one of prevention and preparedness. Contributing to the evidence base for Disaster and Climate Risk Reduction action, the Government of Uganda is compiling a national risk atlas of hazard, risk and vulnerability conditions in the Country to encourage mainstreaming of disaster and climate risk management in development planning and contingency planning at National and Local levels.

Since 2013 UNDP has been supporting the Office of the Prime Minister to develop district hazard risk and vulnerability profiles in the sub-regions of Rwenzori, Karamoja, Teso, Lango, Acholi and West Nile covering 42 districts. During the 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 subcounty 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.

1.2 Objectives of the study

1.2.1 Main Objective of the study

The main objectives of this study was to develop the District Hazard, Risk and Vulnerability Profiles for Luwero District in mid Central Uganda.

1.2.2 Specific objectives

The study had the following specific objectives

i. Collect and analyse field data generated using GIS in close collaboration and coordination with OPM in the targeted 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 study had the following scope of work and deliverables that have been achieved by the consultant;

i. Collection of field data using GIS in close collaboration and coordination with OPM in the target 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. Perform 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. Complete all the district Hazard, Risk and Vulnerability Profiles in the time frame provided;

iv. Submit for printing soft copies of the complete HRV profiles and maps for all the 10 districts by the end of the duration assigned to this activity;

v. Generate and submit shape files 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 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."

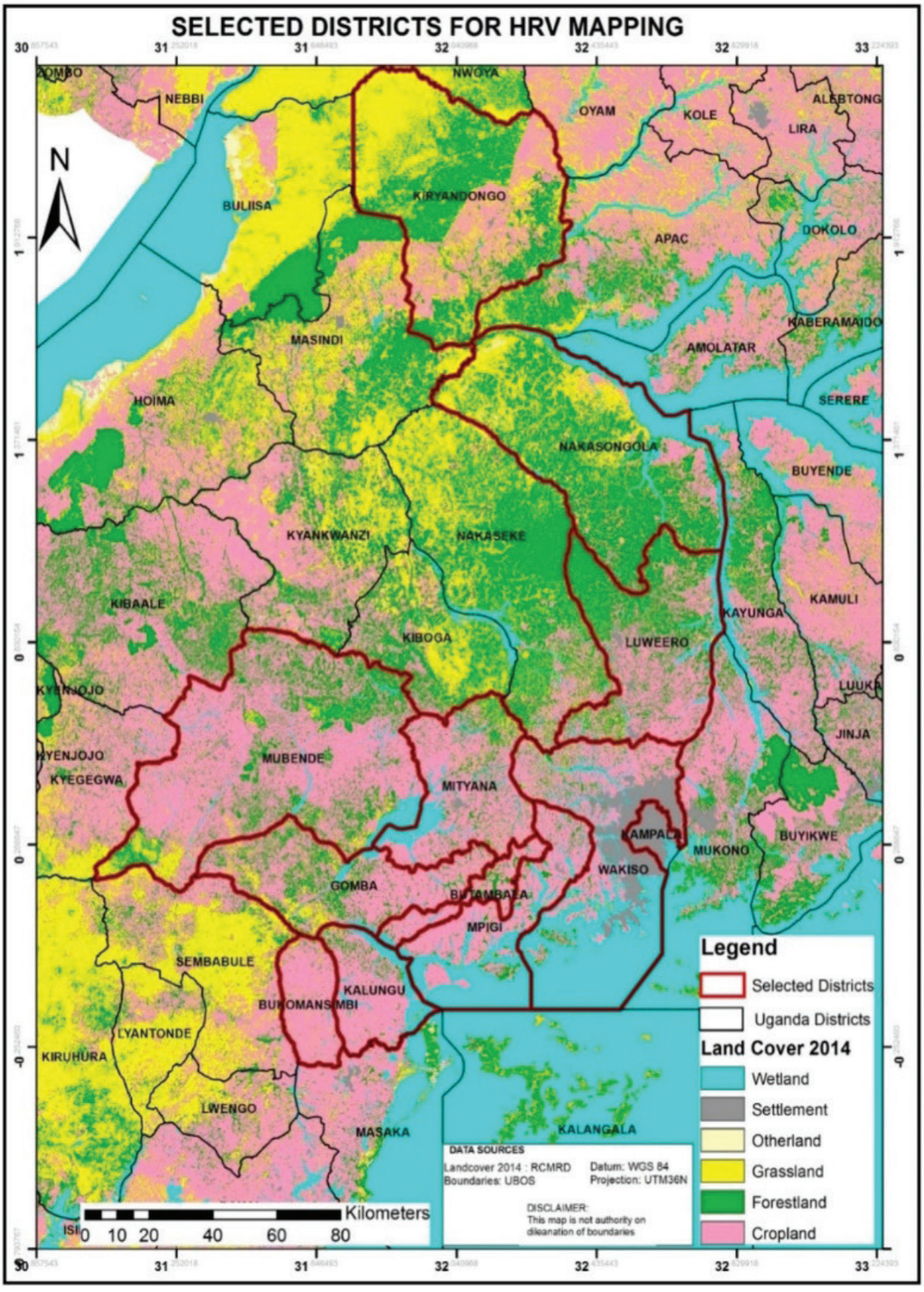

Figure 1 : Location of the study area

2.0 Overview of Luweero District

Luweero District is a district in the Central region of Uganda. Luweero Town is the site of the district headquarters. It is bordered by Nakasongola district to the North, Kayunga District to the East, Mukuno District to the southeast, Wakiso District to the South, and Nakaseke District to the West. The district headquarters at Luweero are approximately 75 kilometres (47 miles), by road, North of Kampala, Uganda's capital and largest city. The coordinates of the District are 00 50N, 32 30E (Latitude: 0.8333; Longitude: 32.500). Luweero District was the site of a fierce insurgency by the rebel group National Resistence Army and a brutal counter-insurgency by the Government of Milton Obote known as the Luweero war or the «Bush War" that left many thousands of civilians dead during the early to mid-1980s. The area affected by the war has come to be known as the Luweero triangle. Luwero District is divided into ten sub counties and three Town Councils namely Luwero, Wobulenzi and Bombo. The district is composed of 90 parishes and 594 villages.

2.1 Geology

The present topography is as a result of a number of ancient denudation processes of the rock systems leaving a series of old erosion level throughout the district. In terms of altitude most of the district ranges between 1,219 and 1,524 meters. The landscape is generally made up of elevated and dissected plateau consisting of a series of flat topped hills and intervening valleys.

The soils are generally red sandy loam, whereas the Southern part is relatively fertile and can support all kinds of crops. In the Northern areas (Kamira and Butuntumula and parts of Kikyusa Sub counties) some parts developed from sandy loam soils and fertility is low. In drier areas, cattle's keeping is the main dominant occupation. A wide range of food crops is grown in the district as well as cash crops. The district is predominantly rural, where farming is found to be the main occupation especially among women.

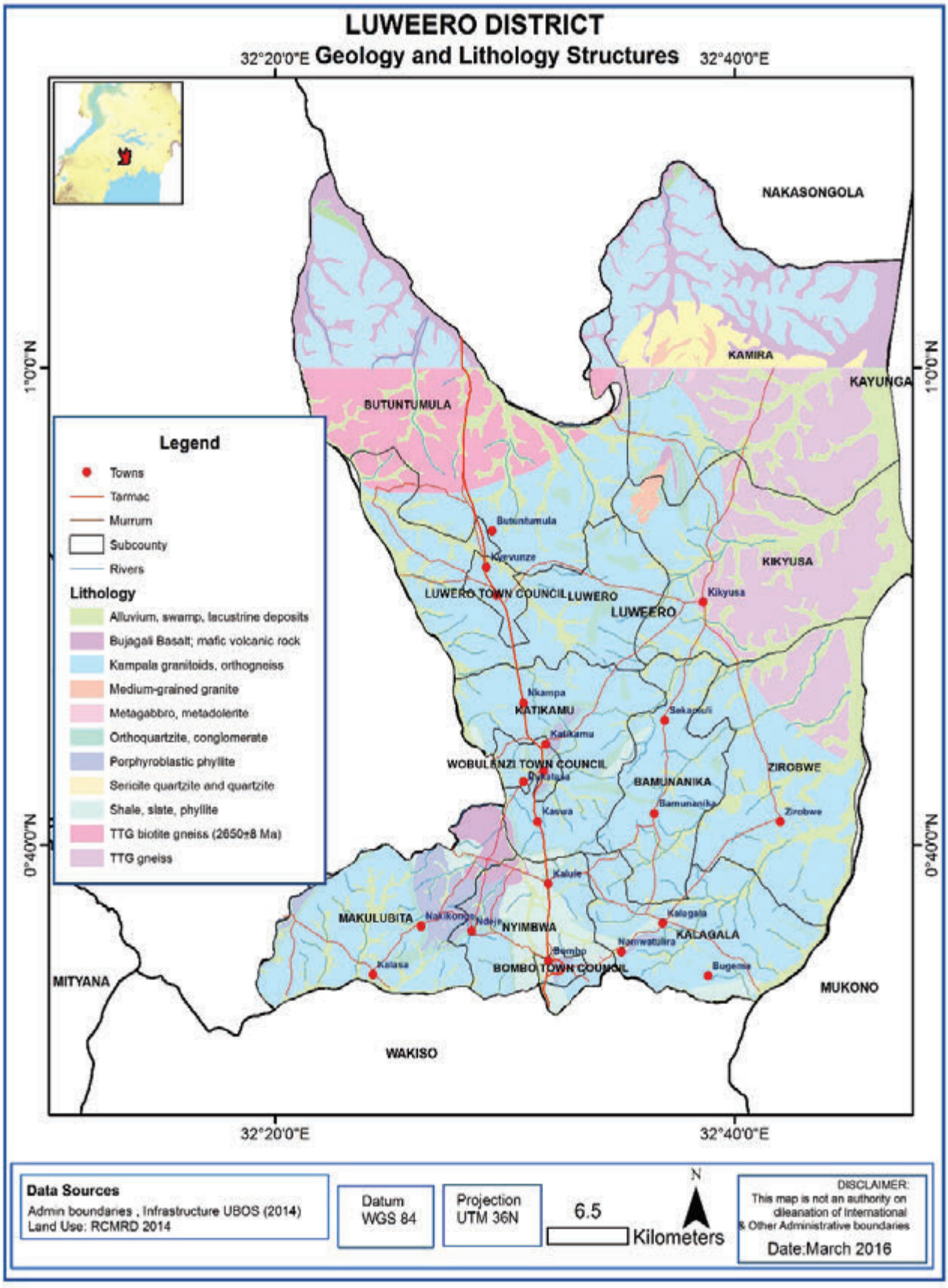

Figure 2 : **Geology and lithology of Luweero District**

2.2 Vegetation and Landuse stratification

Three quarters of the district is covered with savannah. The remaining parts have a tropical kind of environment with a number of wetlands throughout the district including Ssezibwa, Lugogo / Lumansi, Lwajali, Mukote and Danze. The District has 3 gazetted Local forest reserves with a total area of 1330 hectare two of these reserves (Mbale and Wangu in Butuntumula Sub County which are central forest reserves under the management of the National Forest authority and the remaining three (Bombo, Kalagala and Bowa) are Local Forest reserves controlled by the District, figure 3.

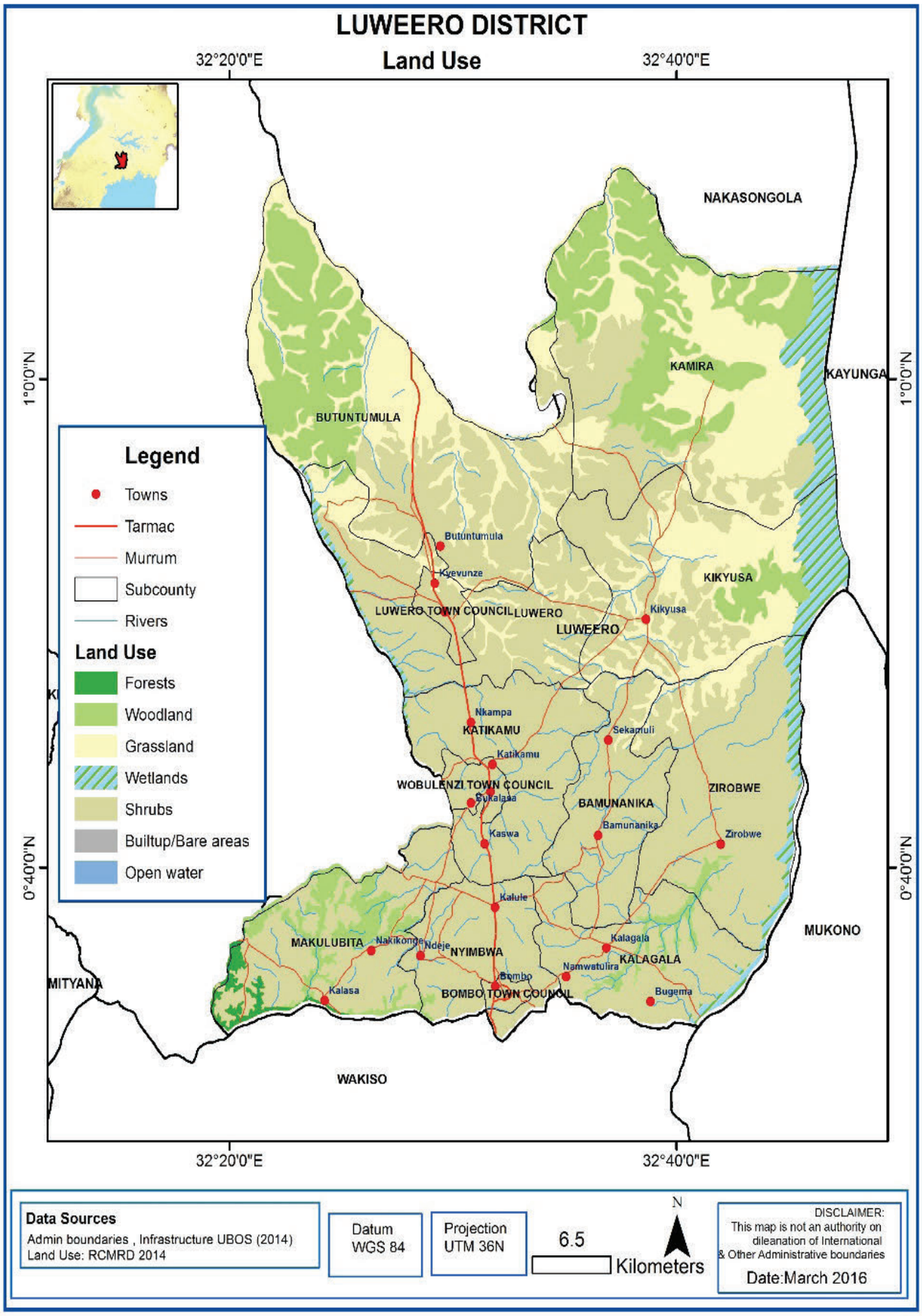

Figure 3 : Land use of Luweero District

2.3 Climatic Conditions

Rainfall is well distributed throughout the year, with an annual average 1,300mm. The mean annual maximum temperature falls between 27.5^{o}C and 30^{o} C, whereas the mean annual temperature is between 15o C and 17.5^{o} C.

2.4 Population and Demographic Characteristics

The 2014 Population and Housing census reveals that Luwero District has 458,158 persons. The population increased by 33,120 persons between 2002 and 2014, while between 1991 and 2002, the population grew to 116,841 people from 85,927 persons of 1980 to 1991. This represents an annual average growth rate of 1.3 percent, 2.5 percent, and 2.5 percent respectively. Majority of the population of Luwero is made up of children (below 18 years) constituting 59 percent, while the elderly contribute only 5 percent of the population.

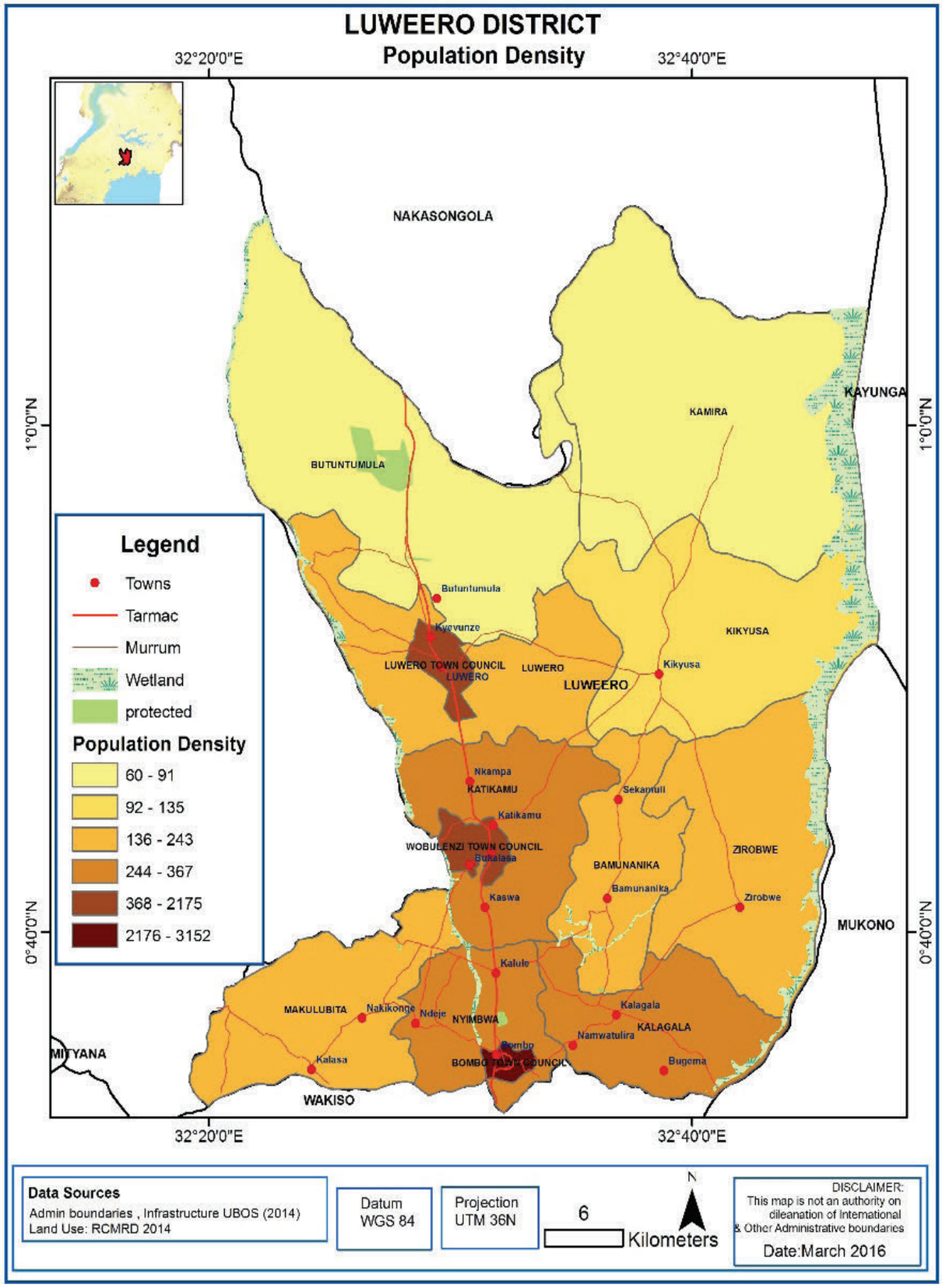

Figure 4 : Population Density of Luweero District

2.5 Economic activity

Agriculture is the main economic activity of the district. It is estimated that 85 percent of the district population are engaged in agriculture (farming and livestock rearing). In the Northern part of the district, they mainly grow cassava, sweet potatoes, maize and bananas. While in the Southern and Central part, they grow bananas, potatoes, cassava, beans, ground nuts, horticulture crops like tomatoes, cabbages and greens, upland rice as food crop. Cash crops for the Southern and Central region are coffee, vanilla, bananas, and the horticultural crops mainly water melons, passion fruits, tomatoes, cabbages and vegetables. Pineapple growing is predominant in most parts of northern parts of the district.

3.0 METHODOLOGY

3.1 Preliminary spatial analysis

Hazard prone areas' base maps were generated using Spatial Multi-Criteria Analysis (SMCA) basing on several 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 etc.) in a GIS environment (ArcGIS 10.2).

3.2 Stakeholder engagements and developing survey instruments

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. 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 (Annex II). 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. Focus Group Discussions were carried out in 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.

Focus Group discussions and Key Informant Interviews were transcribed in the field for data collection. Case stories and photographs were documented and captured. 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 included into the multi hazard, risk and vulnerability profile maps.

3.3 Participatory mapping

The consultant worked in close collaboration and coordination with OPM in the target district to ensure that key DRR committee participate in joint mapping of hazards in the district.

The aim of the participatory mapping was to answer the following objectives:

i. Engage district and sub-district DRR stakeholders in tapping indigenous knowledge and experiences with regards to hazards
ii. Identify natural hazards caused by climatic variables e.g. floods, drought, landslides, wild fires etc and other hazards caused by humans e.g. natural resource conflicts
iii. Jointly map out individual district hazards in a higher resolution preferably at parish administrative level. The mapping looked to answer questions on: Areas affected, types, causes, impacts, interventions and possible policy recommendation. This was done using flip charts, already prepared base maps, tables and thematic discussions, where the consultant will guide the participants in the mapping process
iv. Jointly rank the hazards' risk level in order of impact. The impact/risk as defined by IPCC will focus highly on the economic as well as physical exposure subjected by individual hazards on population/communities in the districts.
v. Risk levels of hazards were also be mapped out jointly based on frequency of occurrence. The consultant will rank and map out the magnitude and impact of the hazard on a scale of: not reported, low, medium, high. This will help inform the hazard hotspots.

In order to achieve the above stated objective, the consultant prepared basemaps for each district showing the sub county boundaries. These basemaps were filled by the communities/ district DRR stakeholders under guidance from the consultant during the participatory mapping forums at district and county level. The following formed part of the discussion questions that helped to thematically direct the participants in hazard risk and vulnerability mapping based on indigenous knowledge/ experience:

i. Which climatic hazard is most manifested in the district and what other hazards exist?
ii. While providing reasons, rank all the hazards in the district in the order of their occurrence and priority
iii. What trends on historical occurrences can be attributed to the aforementioned hazards?
iv. List down/ elaborate on the main contributors to these perceived hazards in the region
v. Which gender (Male / Female) and Age group (children <5, youth (10 - 25), middle aged (30 - 40), old (>60 years) in the societal set-up is the most affected and by what hazard.
vi. Mapping Occurrence :
vii. Which areas within the district experience these hazards (Note : each hazard was mapped separately)
viii. Mapping Risk (Risk is defined by the economic losses or physical exposure e.g death caused or directly attributed to a hazard):

For each hazard occurring in the district please rank each parish within the district on a scale of 1 – 4 in terms of the risk level the parish is exposed to the specific hazard. In this case, risk level : 1 = Not reported, 2= Low, 3= Medium and 4 = High

3.4 Field work and ground truthing verification:

The consultant carried out field work in order to inform 3 key objectives: Source for evidence based on hazards and as informed by the outcome of participatory mapping. An example will be to visit a flooded prone area and get further data from the community including taking real photos of the river beds, dykes, flood plains. Source higher resolution spatial datasets from already existing DRR programs e.g. hazard forecasts and trend datasets, Gather socio-economic setup/ information on communities in this districts e.g. the major land uses and land cover types.

3.5 GIS modeling analysis

At this stage of the project, hazard delineation and risk mapping was already accomplished and the consultant carried out vulnerability mapping. The consultant used this opportunity to check the quality of each hazard and risk maps and enhance the same through map layering with socio-economic datasets acquired from field work.

The vulnerability mapping was based on the IPCC definition of vulnerability: IPPCC defines vulnerability as “the extent to which climate change may damage or harm a system’’. It recognizes that the propensity for harm is not solely a function of the magnitude of the stressor (e.g. exposure to climatic extremes) but also depends on a system’s sensitivity and its ability to adapt to new climatic conditions. In essence, Vulnerability = Exposure + Sensitivity + Adaptive Capacity. The consultant hence developed composites of vulnerability hotspots profiles/ maps at district level by categorizing different GIS layers of the districts separately into the following key classes:

a)-Exposure Layer: This layer will comprise of climatic variables specifically:

i. Long term average precipitation (1984 - 2014)
ii. Long term temperature average (1984 - 2014)
iii. Long term Coefficients of variability for precipitation (1984 - 2014)
iv. Flood Risk (obtained from participatory mapping)
v. SPI based Drought Risk data (Source: GeoClim) as well as drought risk data obtained from participatory mapping)

The consultant used datasets obtained from local meteorological stations (source: Uganda Meteorological Authority) to develop the climatic composite for exposure layer, however in the event where data was lacking , the consultant accessed proxy datasets from satellite observations like the Climate Hazard Group Infra-Red Precipitation and Station rainfall estimates (CHIRPs) datasets which is multi temporal covering over 30 years and at 5kilometer spatial resolution, as well as Temperature data from moderate Imaging Spectro- Radiometer Satellite observations MODIS which has a consistent monthly average temperature estimates from the year 2000 at 250meters resolution.

b) - Sensitivity Layer: Sensitivity explains the magnitude or extent to which the stressors mainly climatic variables (Exposure layer) have on the ecosystem. The GIS layers were used to form the Sensitivity composite that were determined largely by the varying ecosystems, societal and ecological disparities from district to district and this came up from the participatory mapping. Despite this, the consultant envisaged that the following layers will cut across different districts for this layer: land conflicts, environmental degradation, road accidents, lightning, bush fires, landslides, vermins, crop diseases, humn diseases, soil erosion, earth quakes, strong winds and landslides.

c) - Adaptive Capacity Layer: This layer informs on the ability of an ecosystem or community to bounce back from an extreme climatic event (hazard). Again, the GIS layers used to form this layer composite were determined largely by the varying ecosystems, societal and economic disparities from district to district and this was identified during participatory mapping. Despite this, the consultant envisaged that the following layers will cut across different districts for this composite; market access and poverty index.

The final vulnerability hotspots map for each district was developed by summing up the 3 composite layers (exposure, sensitivity and lack of adaptive capacity layers) then dividing by 3. This was then normalized to a scale of 0 – 100 after which the vulnerability hotspot layer were indexed into 4 scores as follows not reported, low, medium, high.

Further GIS data processing and statistical analysis were carried out using statistical package R Statistics.The consultant assembled and organized all datasets derived from the project into an organized spatial database that is compatible with ArcGIS 10.2.

The normalized rasters for each vulnerability component were summed up using the equal weighted sum and then normalized to generate the exposure, sensitivity and lack of adaptive capacity rasters. The overall vulnerability raster was developed by adding the exposure, sensitivity and adaptive capacity layers and normalizing the output. The maps are represented in vulnerability classes of 1 (not reported), 2 (low), 3 (medium) and 4 (High). The use of equal interval maps with set categories means that areas included in each class vary depending on the underlying statistical distribution of the components. The maps can be used to understand the components of vulnerability in a given location (how each component contributes to the overall score); and to identify areas of relatively higher exposure, sensitivity, lack of adaptive capacity, and overall vulnerability that may require interventions.

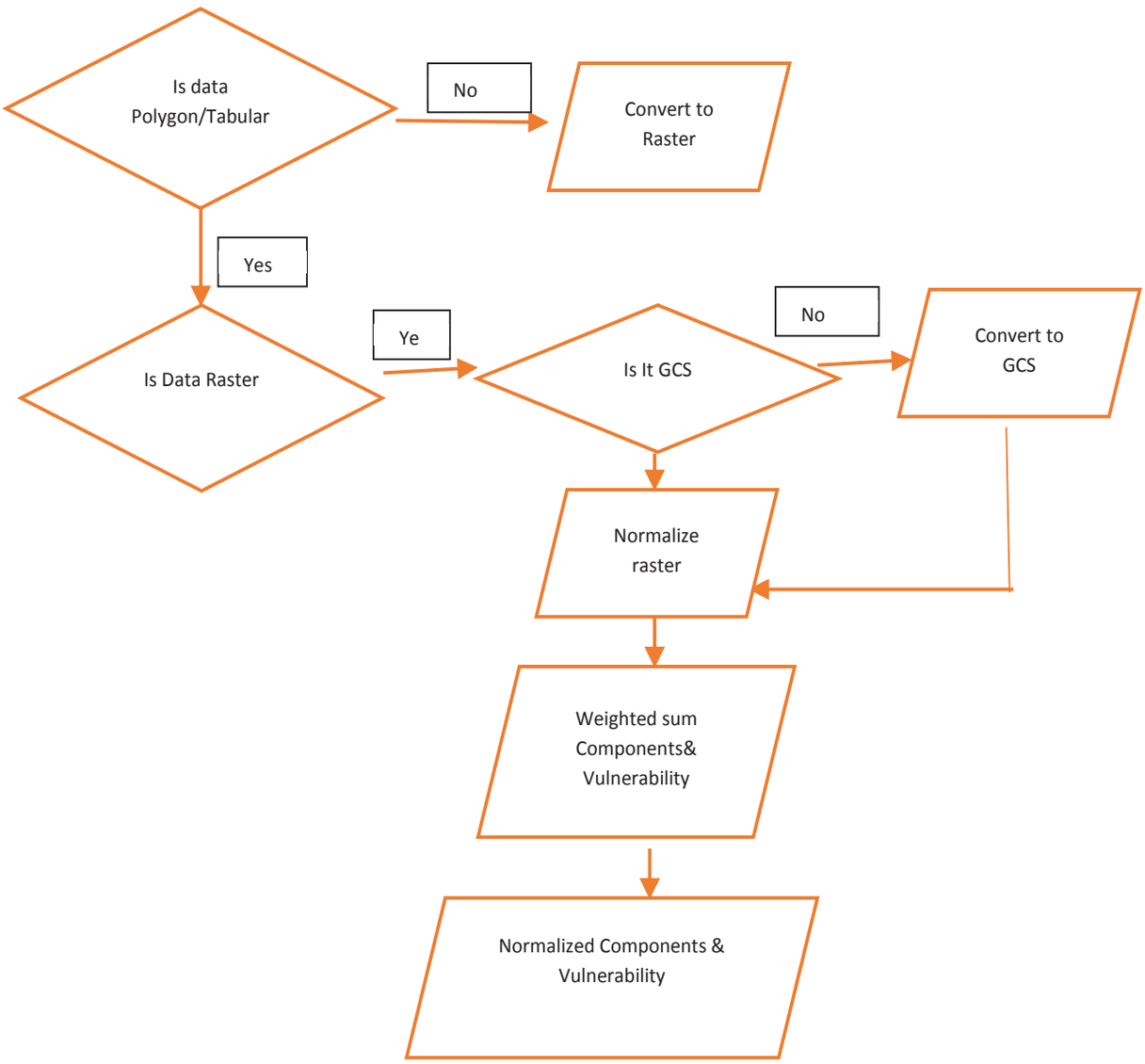

Figure 5 : Data conversion work flow

3.6 Regional Stakeholder Workshop for Data verification and validation

In collaboration with OPM, a five-day regional data verification and validation workshop was organized by UNDP in Masaka 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.

4.0 RESULTS FROM MULTI-HAZARD RISK, VULNERABILITY MAPPING

The following hazards were identified in their order of priority and importance.

4.1 Droughts

It was noted that the luweero is prone to droughts. Notable adaption measures were reducing on meals, eating 'kayanja' a variety of green banana used in making alcohol, getting assistance from relatives, mangoes and jack fruit. Zirombwe, bututumula, kihyusa and kamira were some of the sub counties that are heavily hit. Hotspots were noted in Kamira subcounty in Kabunyata, Katagwe, Mazzi, Kaswa, Kitenderi parishes ; Zirobwe sub county in Nakigoza, Wabitungulu, Bububi, Kyetume parishes ; Butuntumula Kalwanga, Kyawangabi, Kakabala parishes and Kikyusa in Wankanya, Kibengo, Wabusana, Kireku parishes. These hotspots were chosen because they experience prolonged dry spells, famine, water scarcity, food insecurity and deforestation.

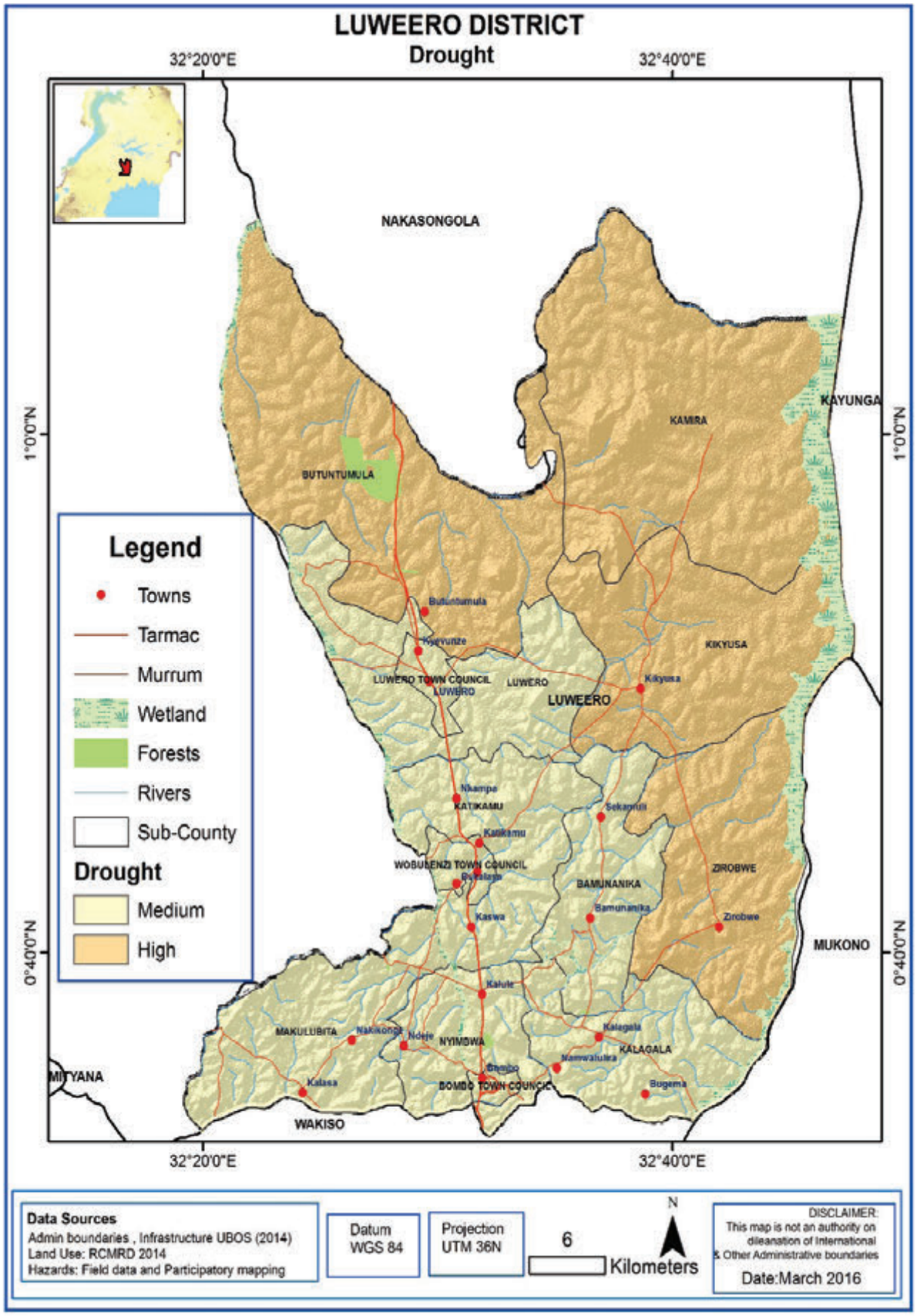

Figure 6 : **Drought in Luweero District**

4.2 Crop pests and diseases

Major crop pests and diseases identified are; coffee twig bora, banana weavels, diamond black moths for vegetable growing areas(Katikamu and Bamunika); nematodes especially among banana growers which affect the plant in that it no longer absorbs any nutrients although this can be treated; coffee wilt, banana bacterial wilt; bacterial wilt in vegetables(tomatoes and egg plants); heart rot in pineapples and cabbages; and mango fruit flies. Coffee wilt is in all sub counties. Hotspots were noted in Luwero Subcounty, Katikamu, Wobulenzi town, Council, Bombo Town Council, Kikyusa, Luwero Town Council, Zirobwe, Kalagala, Nyimbwa, Butuntumula, Kamira, Bamunanika, and in Makulubita. Poor pesticide use, Poor crop husbandry, inadequate extension services, high costs of improved varieties, inadequate enforcement, use of fake agro-chemicals are responsible for the persistence of these diseases.

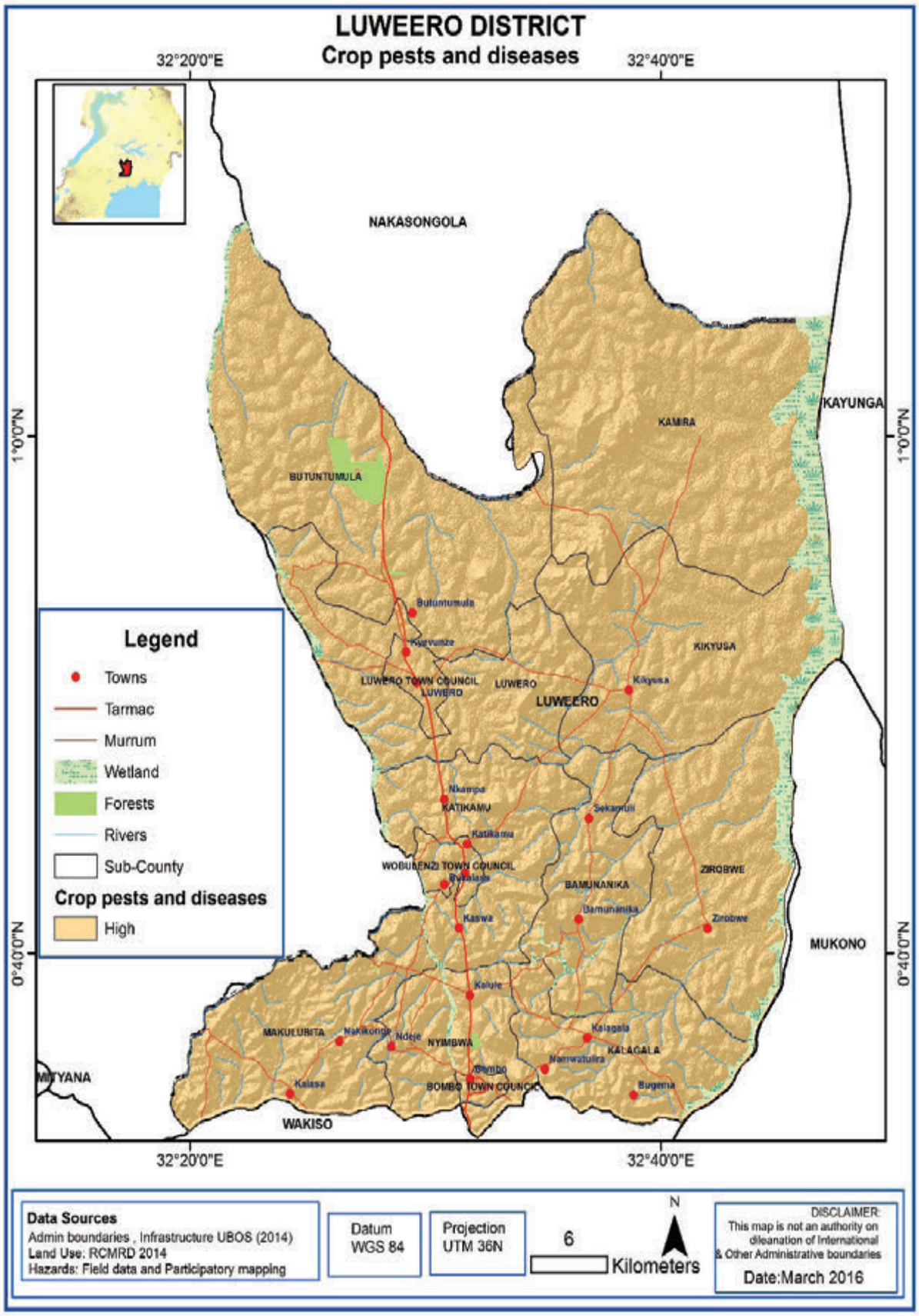

Figure 7 : **Crop pests and diseases in Luweero District**

4.3 Environmental degradation

Deforestation for firewood and charcoal was noted to be high in cattle corridor subcounties. These areas were also being converted for farms although timber logging was also highlighted to be contributing to deforestation.Wetland reclamation being converted for agriculture, settlement, industrial development and garbage dumping was noted as a major challenge. These areas were being targeted by investors because they are cheap. Poor waste management especially in urban councils.

Interventions such as global climate change alliance help to farmers to adapt to climate change through tree planting and sustainable coffee farming were higlighted ; Income generating activities such as mushroom growing, energy saving technologies and USAID capacity building for climate change adaptation ; Other notable organisations working in the area include save the children promoting disaster risk reduction in schools ; pride-promotion of upland rice for better protection of wetlands ; feed the future-encourages farmers to use quality agro-chemical; Environmental livelihood management project promoting energy efficiency stoves and tree planting and luweero Rwezori, which gives inputs to support household income.

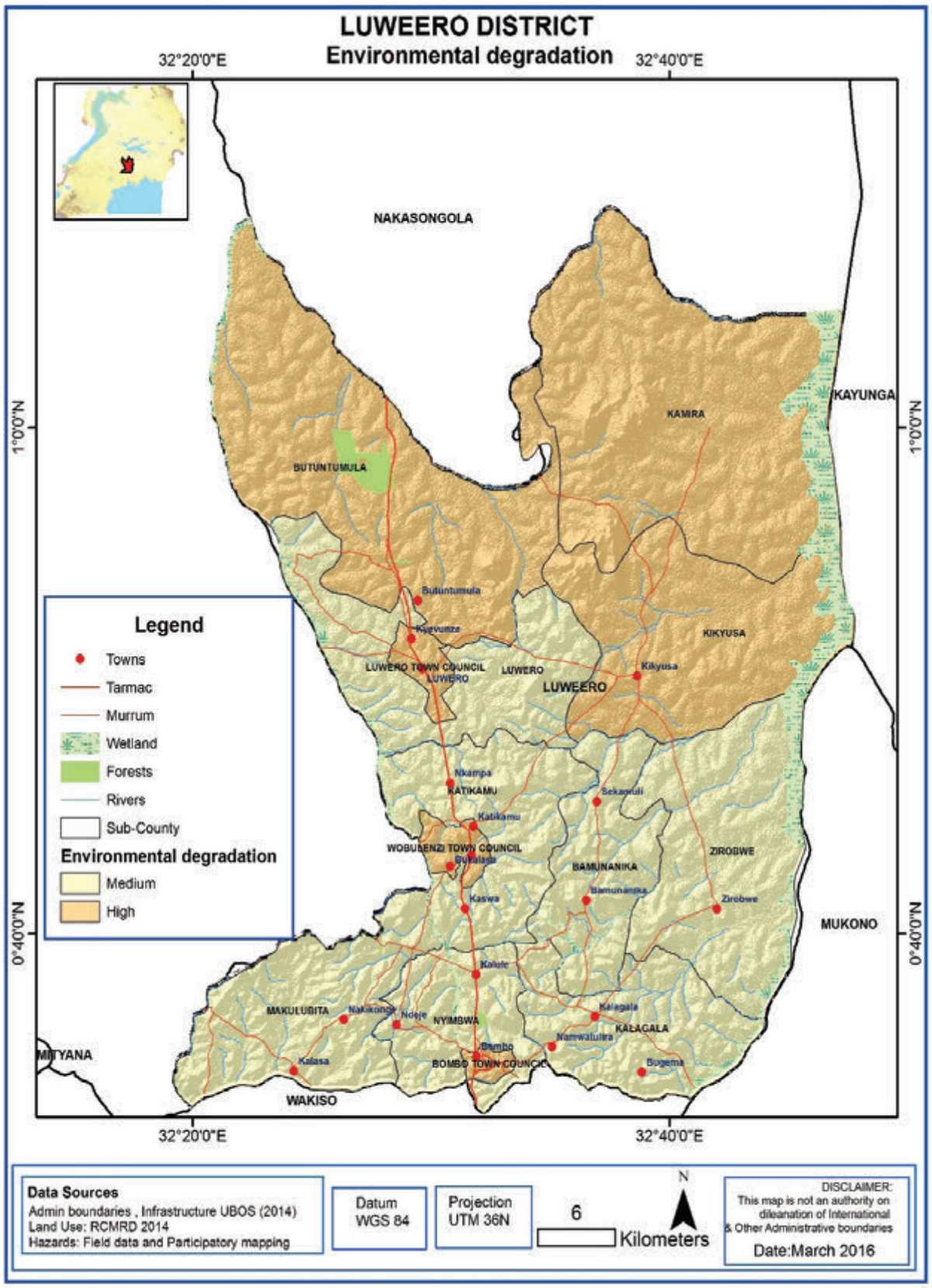

Figure 8 : **Environmental degradation in Luweero District**

4.4 Human disease out breaks

Malaria prevance is about 50% and still remains the major disease challenge in the district. The high malaria prevalence could be attributed to favorable environment for mosquitoes and also people not sleeping in mosquito nets. Respiratory infections such as pneumonia especially in under-fives and diarrhea in under-fives are a common phenomenon. Other major diseases are HIV at 7.2%, skin diseases in children, typhoid, T.B and cancers. In 2013 one case of Ebola was registered attributed to a refuge from congo who could have contracted it from the monkeys. All sub counties are equally affected due to poor hygiene & sanitation, Low levels of use mosquito nets, Inadequate treatment, Inadequate preventive measures, Use of expired drugs, Unregulated medical practioners within the District.

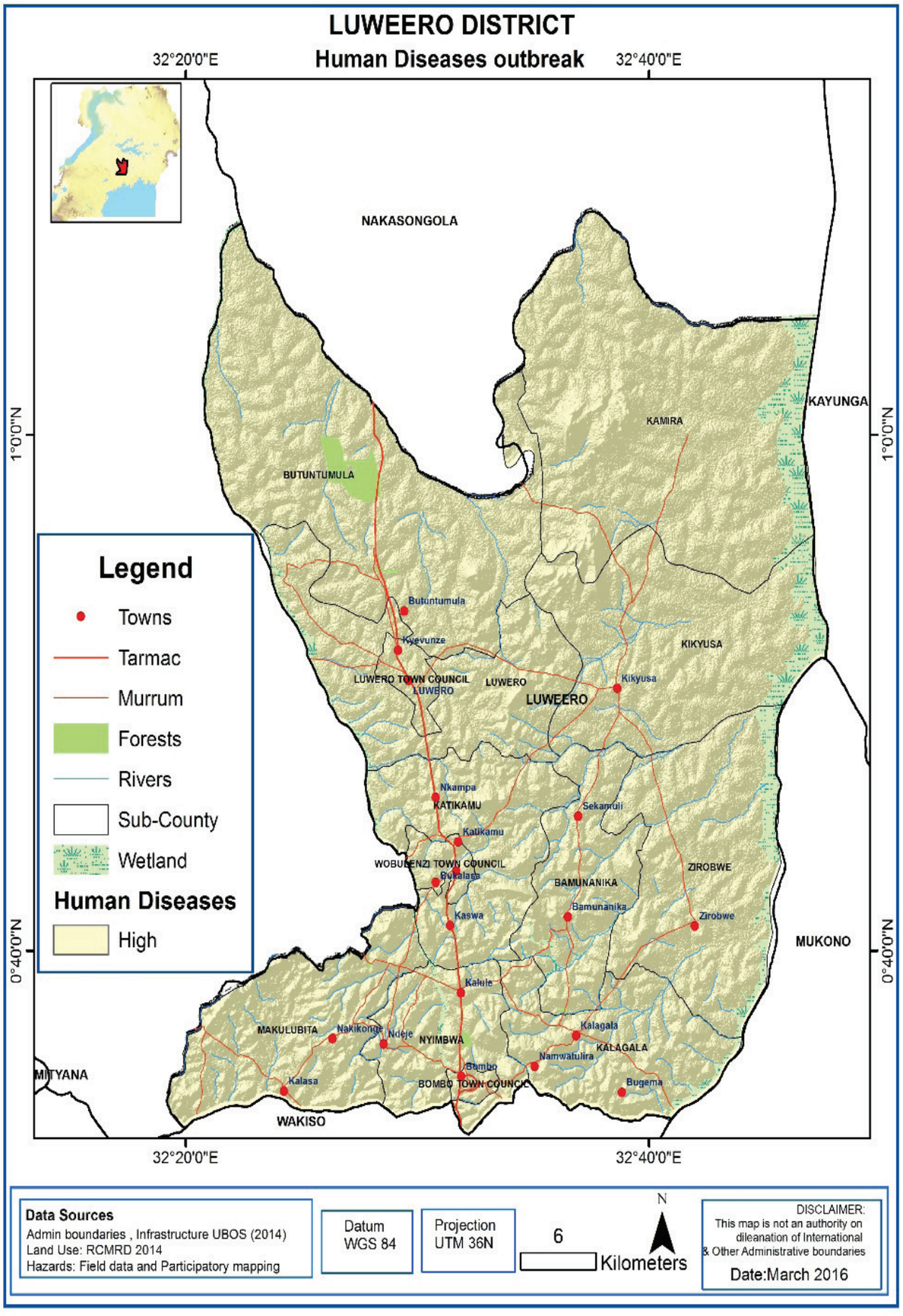

Figure 9 : **Human diseases in Luweero District**

4.5 Livestock pests and diseases

Major livestock pests and diseases identified are; foot and mouth disease (FMD); East coast fever, trypanomiasis, rabies, tsetse flies, African swine fever, Newcastle in poultry. All sub counties are equally affected due to Irregular vaccination programs, Low awareness, Inadequate enforcement, Inadequate spraying regimes, Poor use of veterinary drugs and Use of fake drugs within the district.

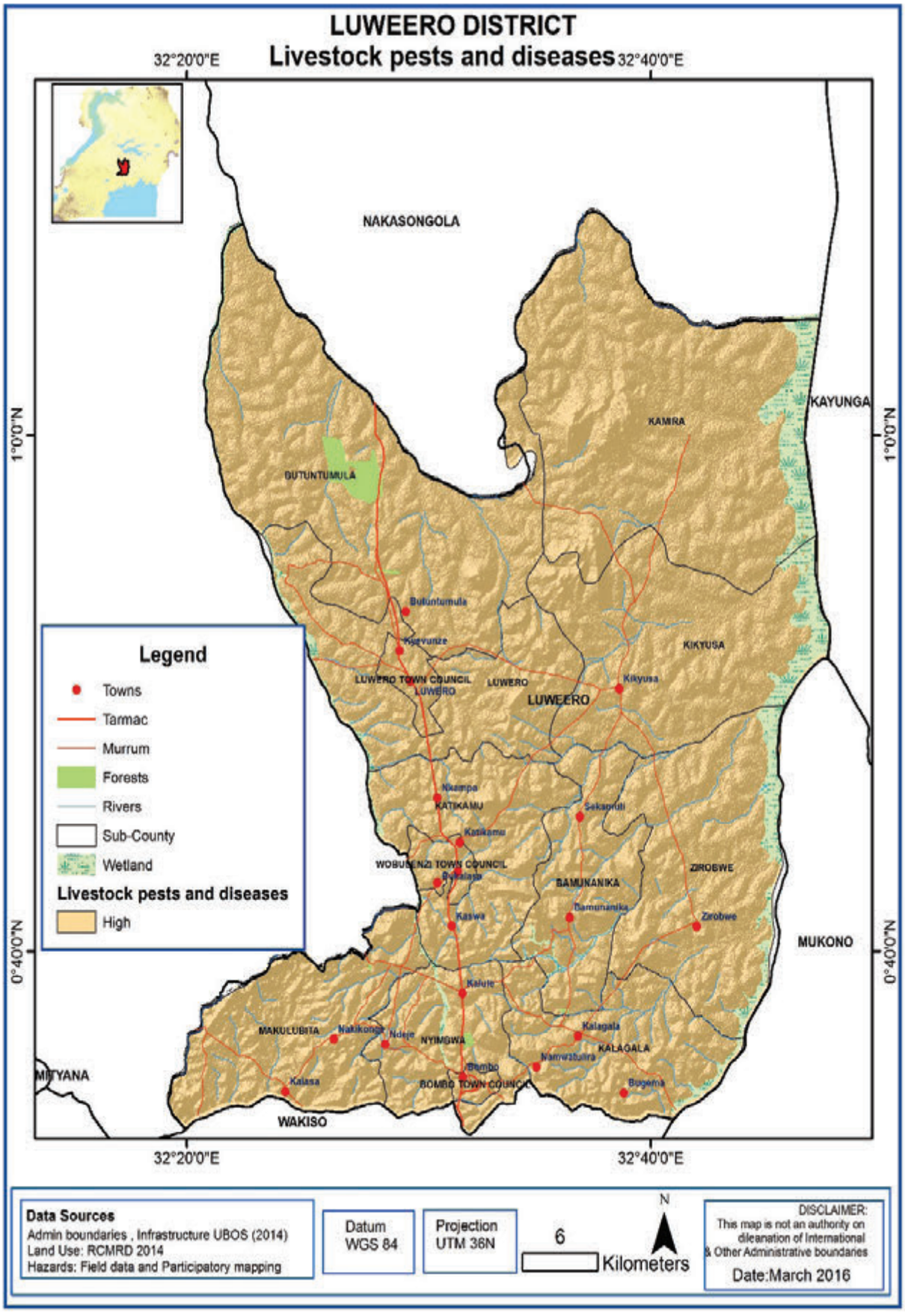

Figure 10 : Livestock pests and diseases in Luweero District

4.6 Strong winds, hailsorms, and lightning

Strongs winds were noted to be prominent and Luweero town council in all parishes, Luwero sub county, Katikamu, Wobulenzi town council and Makulubita are hotspots. This is normally at the begining of rainy seasons towards the end of the dry season. These were attributed to tree cutting, infrastructural development and poor agricultural practices. For hailstorms all sub counties are affected although Luwero sub county, Katikamu, Wobulenzi town council, Bombo Town Council, Kikyusa, Luwero TC, Zirobwe, Kalagala, Nyimbwa, Butuntumula, Kamira, Bamunanika and Makulubita were noted as hotspots.

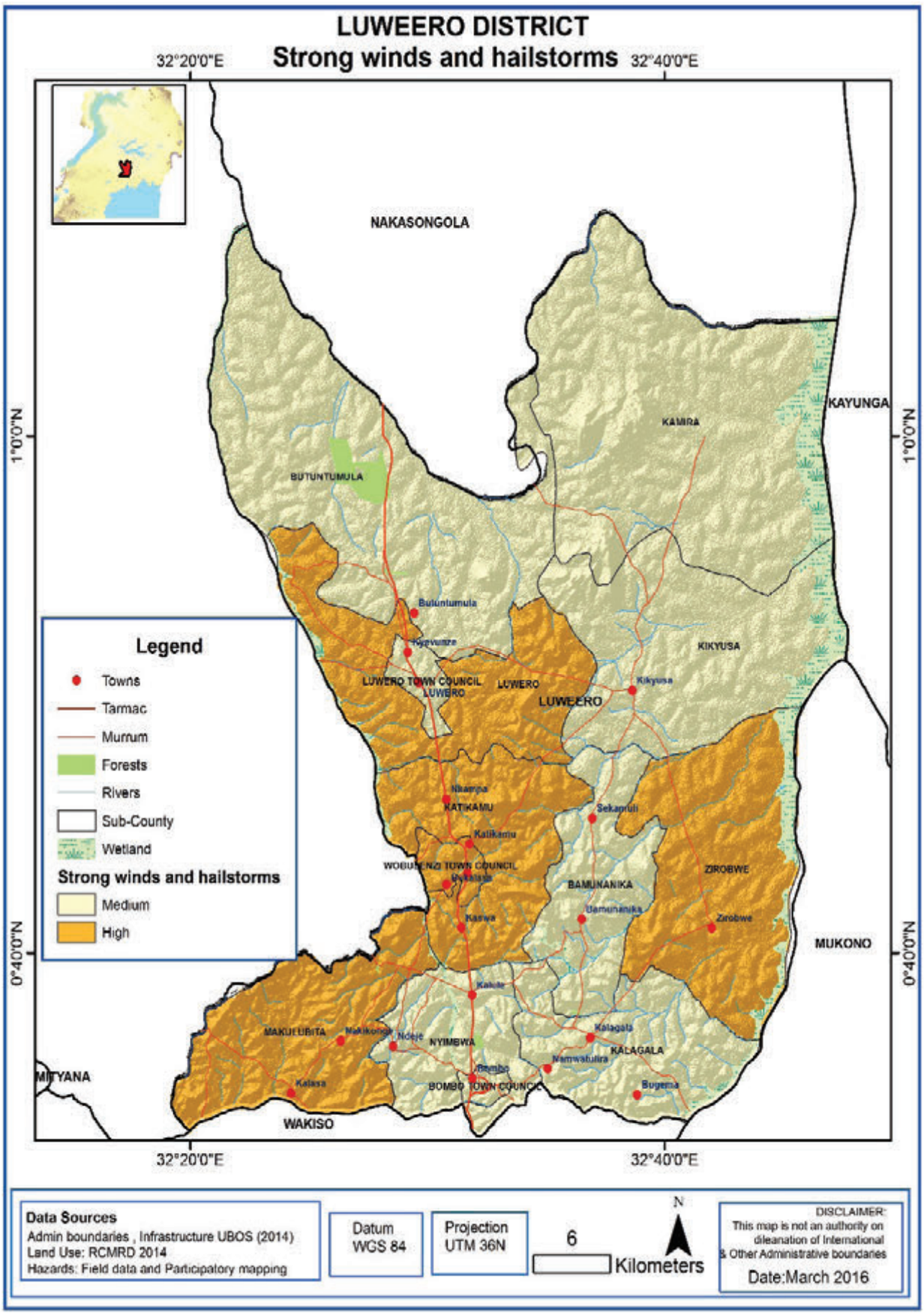

Figure 11: Strong winds and hailsorms in Luweero District

Lightning incidences are of rare occurrence with exception of Kikyusa were there was an incidence that ended in the death of pupils, figure 12 below.

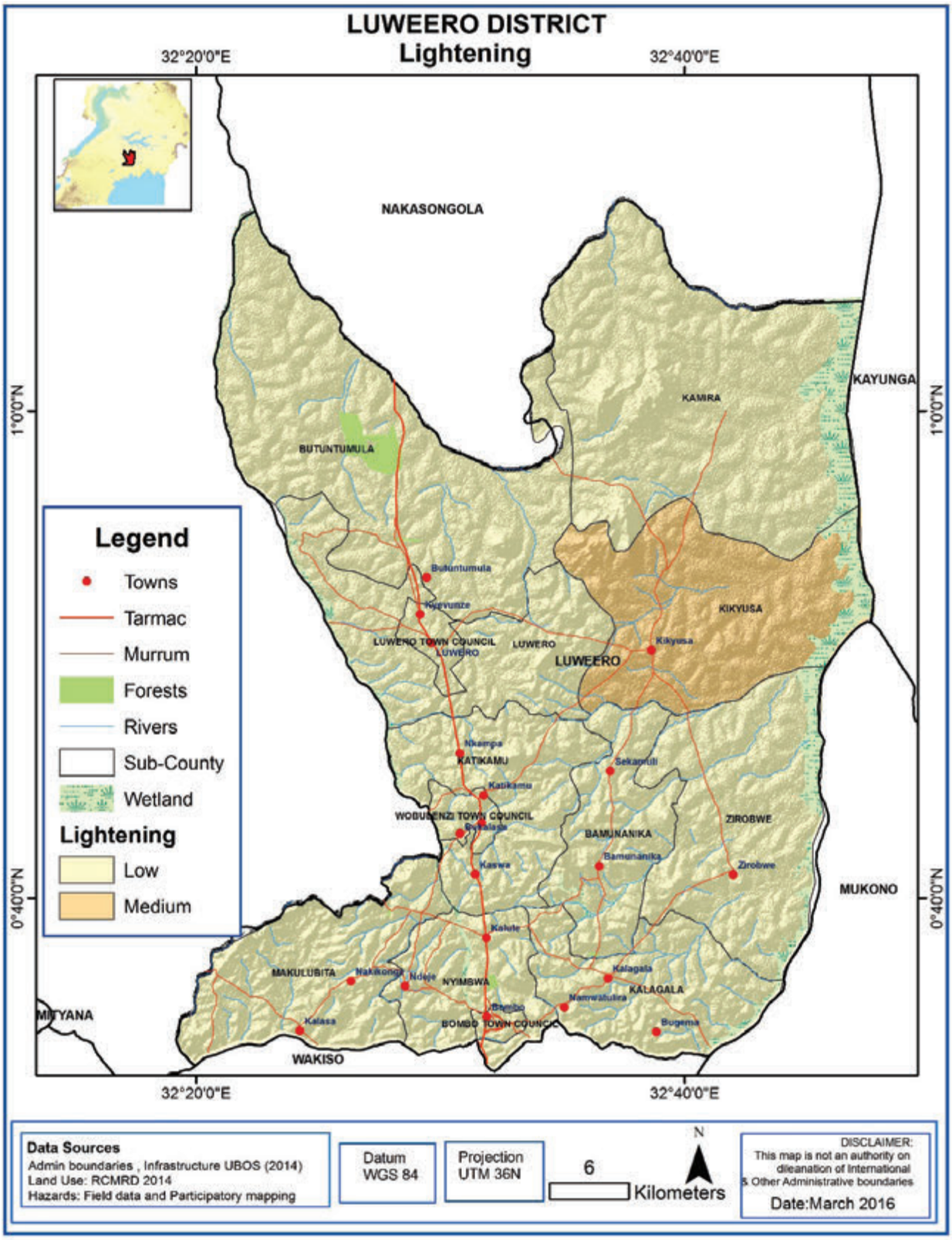

Figure 12: Lightning in Luweero District

4.7 Soil erosion

Luweero is relatively flat and therefore Soil erosion is very minimal. Kikyusa sub county in Kibengo, Wankanya, Wabusana, Kireku parishes ; Kamira sub county in Kabunyata, Mazzi, Kaswa, Katagwe, Kitenderi parishes and Makulubita sub-county in Mawale, Kangave, Kanyanda, Kasozi parishes. This was mainly because of Poor agricultural practices, deforestation, overgrazing and bush burning.

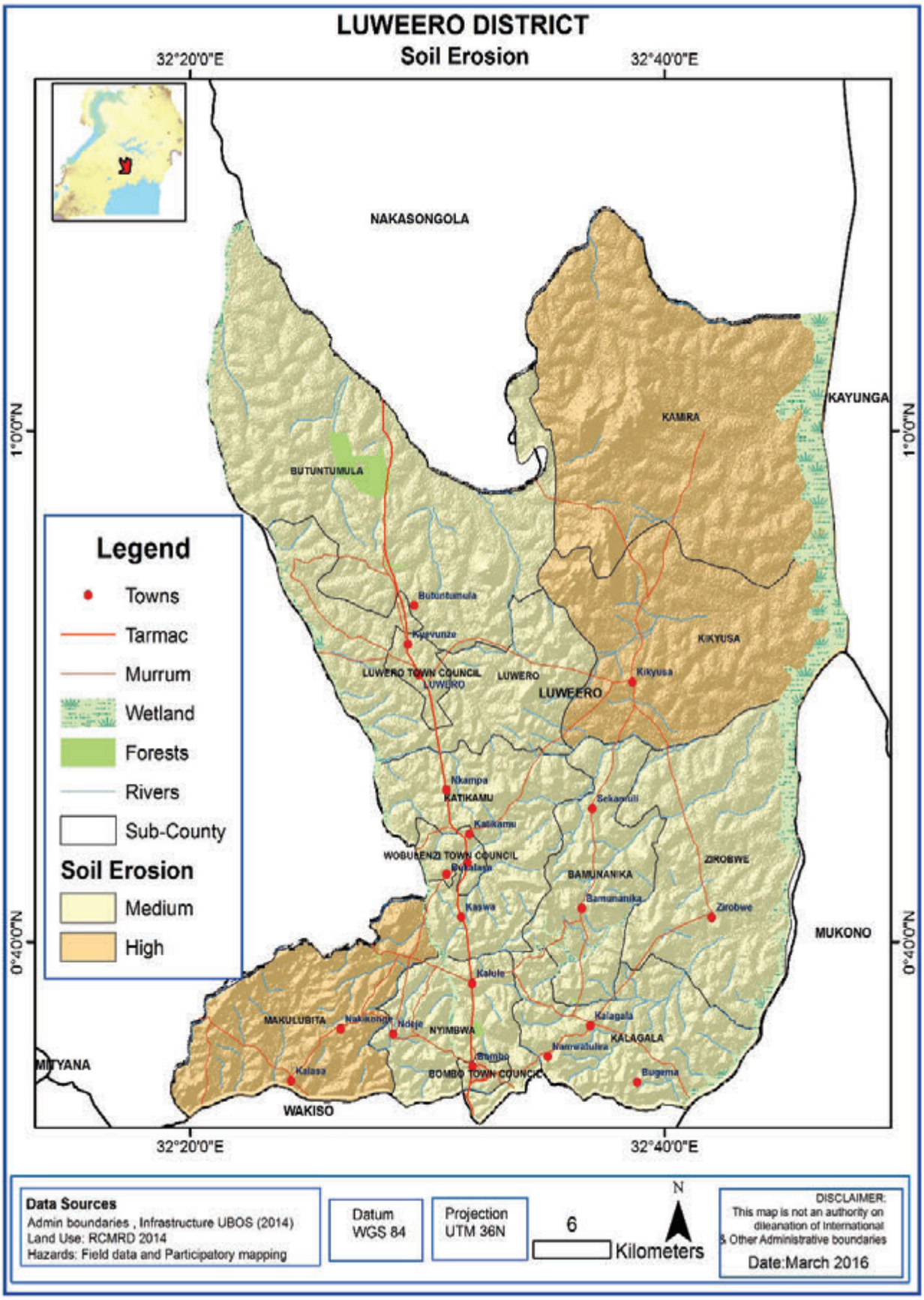

Figure 13 : Soil erosion in Luweero District

4.8 Land conflicts

Land conflicts were noted to be common. Zirobwe, Kalagala, Butuntumula, Luwero Town Council, Bombo town council and Kamira were noted as hotspots for land conflicts. This is mainly because of high demand for land; Inadequate awareness on land laws, Unharmonized provisions in the land law (land lords & Bibanja holders), poor enforcement of land laws.

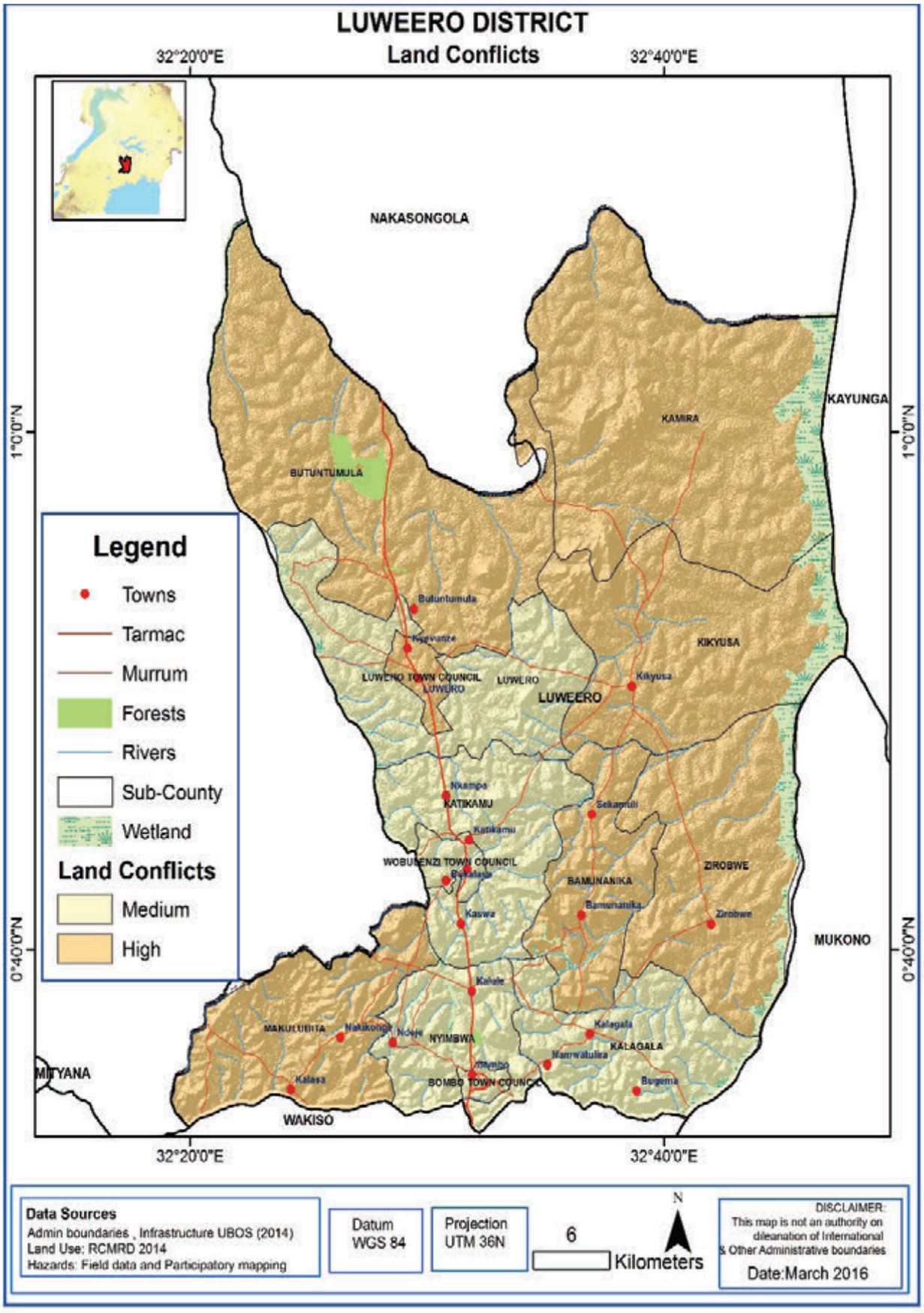

Figure 14 : Land conflicts in Luweero District

4.9 Bush fires

Bush fires are common in the cattle keeping corridor. Sub counties of Zirobwe, Butuntumula, Kikiyusa, and Kamira were noted as hotspots. This is mainly due to the practice of pasture manangement were they use fire as a tool, prolonged dry spell, hunting and malicous fire.

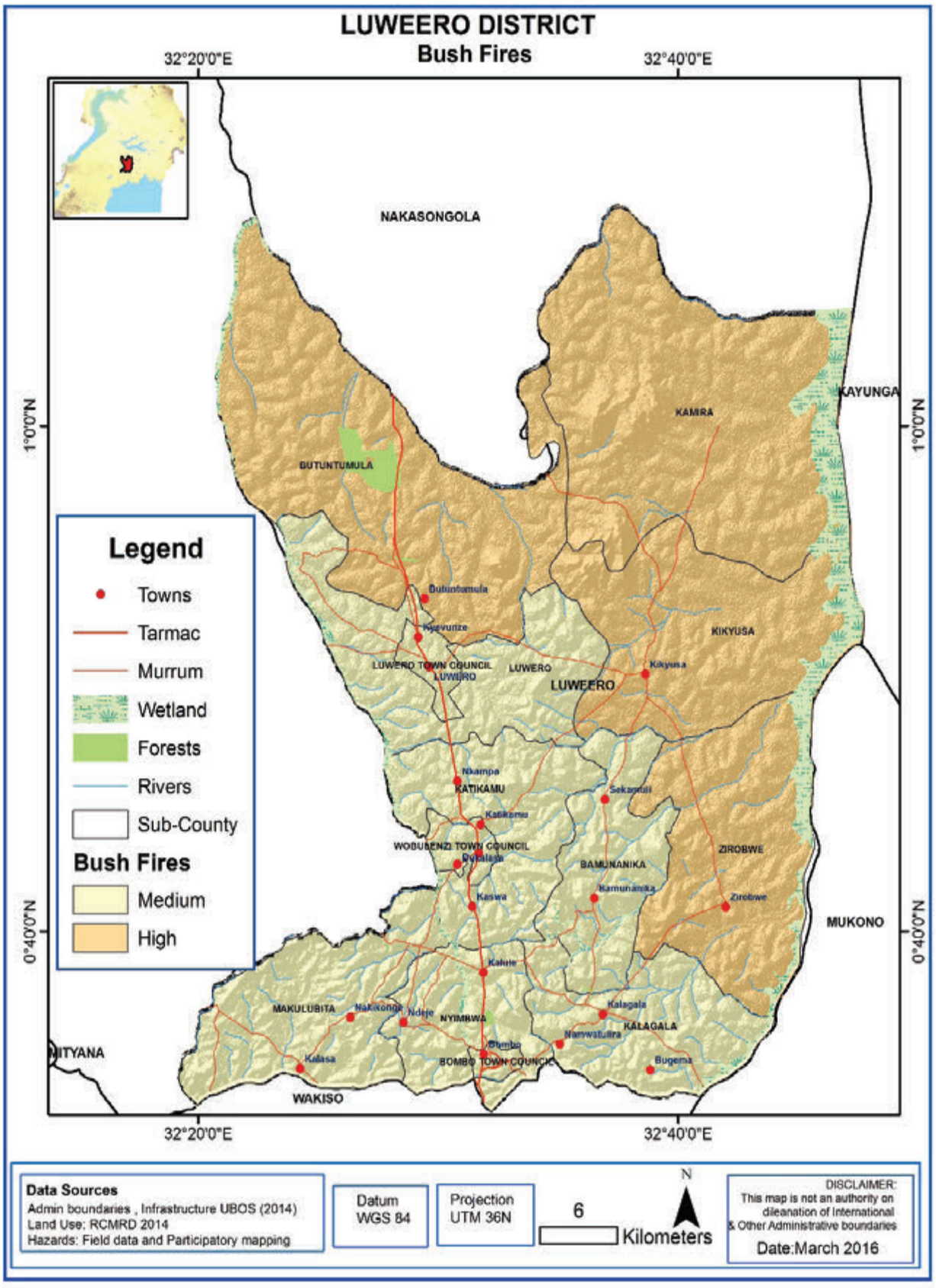

Figure 15 : Bush fires in Luweero District

4.10 Vermin & wildlife attacks

Zirobwe, Butuntumula, Kikiyusa, Kamira were noted as hotspots. This is becasue of rich in biodiversity, Inadequate vermin control services, Inadequate control of problem animals.

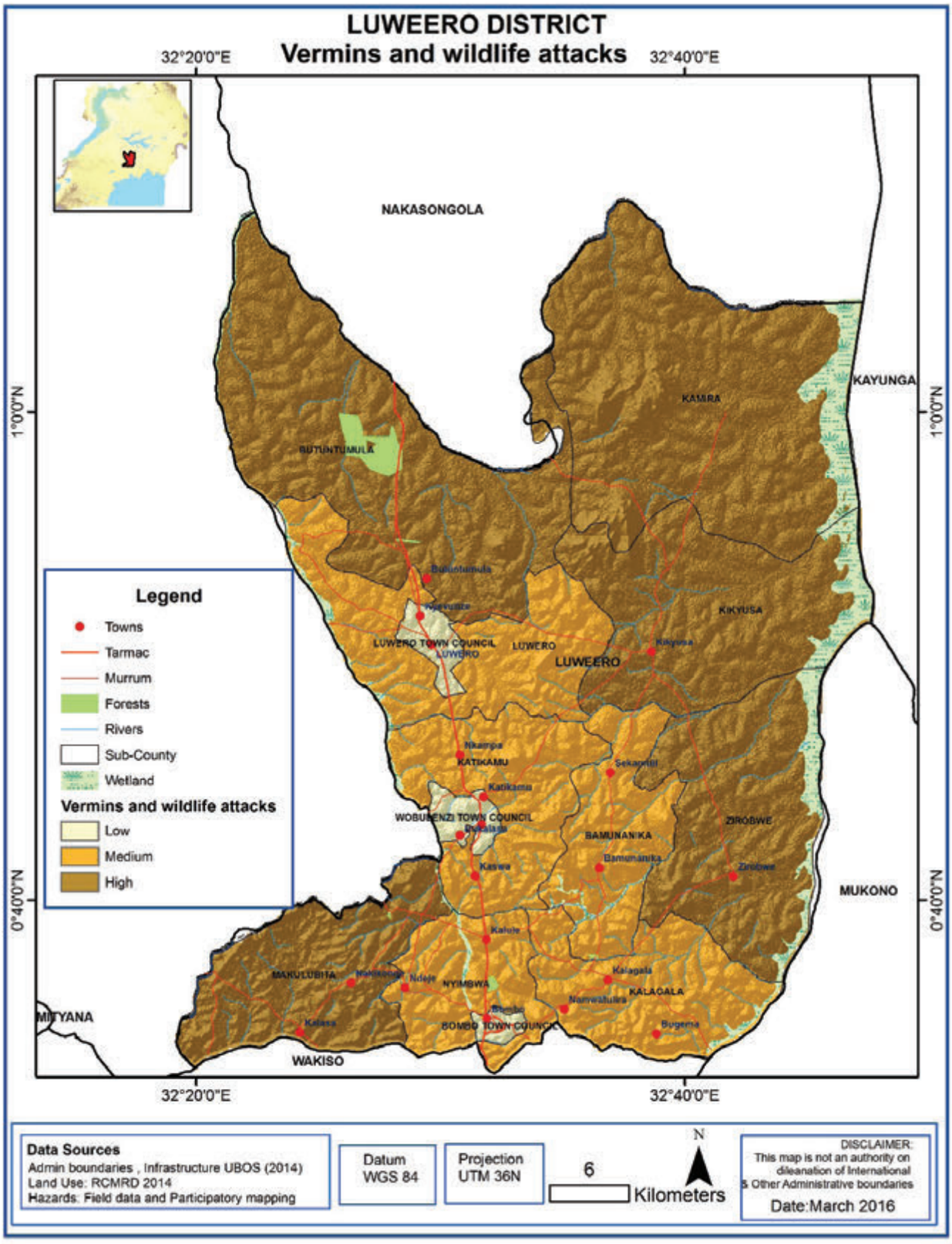

Figure 16 : Vermins and wildlife attacks in Luweero District

4.11 Road Accidents

Luweero being on the main road its prone to accindents. Butuntumula, Luwero Town Council, Luwero Sub-county, Katikamu, Wobulenzi Town Council and Nyimbwa were noted as hotspots. This is mainly because of Non-compliance to traffic regulations and Narrow roads.

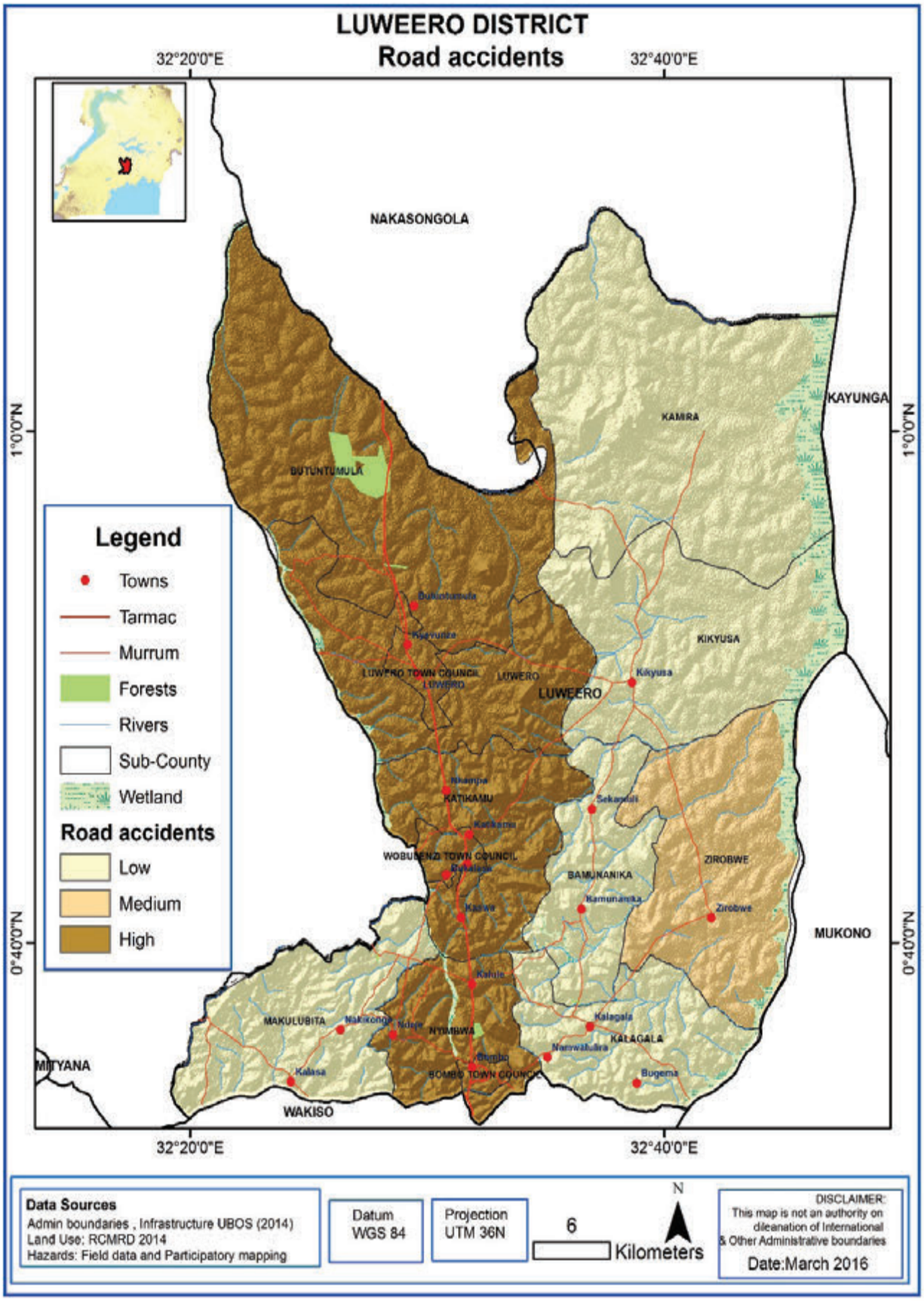

Figure 17 : Road accidents in Luweero District

4.12 Gender and age group mostly affected

Hazard	Gender and age group mostly affected
Drought	Women, PWD and children (search for water for domestic use)
Erosion	Women, Children affected more due to low crop production
Strong winds	Men, women, men play a big role in housing and women affected when food crops are trampled down.
Hail storms	Men, women and children
Crop pests & diseases	Men, women and children due to poor crop production
Livestock pests & diseases	Men spend more on treatment of livestock Women and children lack livestock products for home consumption
Human diseases outbreaks	Men women and children
Vermin & wildlife attacks	Men and women (vermins destroy crops especially food crops)
Land conflicts	Men (spend more in settling land conficts)
Bush fires	Women (Firewood wood source destroyed by bush fire)
Environmental degradation	Men and women due to reduced productivity
Road Accidents	Children (improper use the roads)

5.0 District Vulnerability Analysis

For vulnerability assessment, this study utilised the second conceptualization which as outcome *vulnerability,* which "represents an integrated vulnerability concept that combines information on potential climate impacts and on the socio-economic capacity to cope and adapt." The IPCC framework builds on this, in that vulnerability is considered to be a function of *exposure* to climate impacts, including variability and extremes, and the *sensitivity* and *adaptive capacity* of the system being exposed. The three components can further be expanded on as follows:

- **Exposure (E**) - the size of the area and/or system, sector or group affected and the magnitude of the stressor.
- **Sensitivity (S)** - the characteristics of a system or population and the governance/market structures that influence the degree to which it is affected by stressors.
- **Adaptive capacity (A)** - capacities of the system, sector or group to resist impacts, cope with losses and/or regain functions.

Table 3 : **Indicators utilised by vulnerability component**

COMPONENT	DATA	SOURCE
Exposure	Precipitation Coefficient of Variation	CHIRPS blended satellite- station precipitation
	Average Precipitation	CHIRPS blended satellite- station precipitation
	Average Temperature	MODIS Land surface Temperature
	Flood frequency	Participatory mapping at District Level
	Droughts	Participatory mapping at District Level
Sensitivity	Landslides	Participatory mapping at District Level
	Winds and hailstorms	Participatory mapping at District Level
	Crop pests	Participatory mapping at District Level
	Livestock Diseases	Participatory mapping at District Level
	Human Diseases	Participatory mapping at District Level
	Land Conflicts	Participatory mapping at District Level
	Bush fires	Participatory mapping at District Level
	Environmental hazards	Participatory mapping at District Level
	Vermin pests	Participatory mapping at District Level
	Road Accidents	Participatory mapping at District Level
	Soil Erosion	Participatory mapping at District Level
	Strong winds	Participatory mapping at District Level
	Earthquake	Participatory mapping at District Level
	Lightning	Participatory mapping at District Level
Lack of Adaptive Capacity	Market Access	Joint Research Centre
	Poverty Index	Multi Criteria Poverty Index from DHS

5.1 Exposure Analysis

The exposure analysis involved the combination of the precipitation coeficient of variation (PPTCV), average precipitation (AVGPPT), average temperature (AVGTEMP), flood and drought layers.

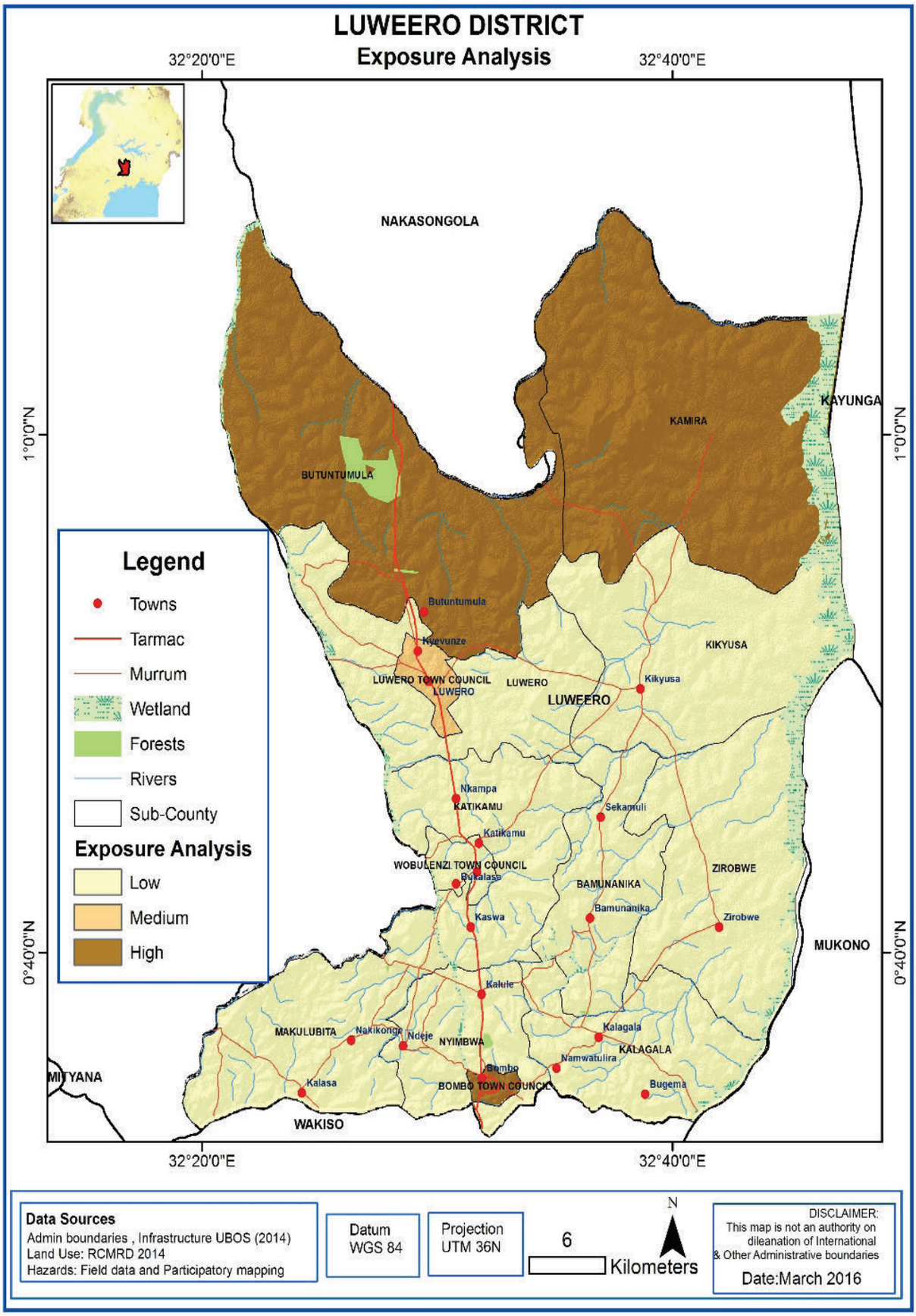

Figure 18 : Exposure of climatic conditions in Luweero District

Butuntumula, Kamira and Bombo Town Council sub counties experienced the highest exposure to climate stressors. The Exposure layer was influenced by flooding and a reduction in annual mean precipitation.

5.2 Sensitivity Analysis

The exposure analysis involved the combination of the follwing layers ; land conflicts, environmental degradation, road accidents, lightning, bush fires, landslides, vermins, crop diseases, humn diseases, soil erosion, earth quakes, strong winds and landslides.

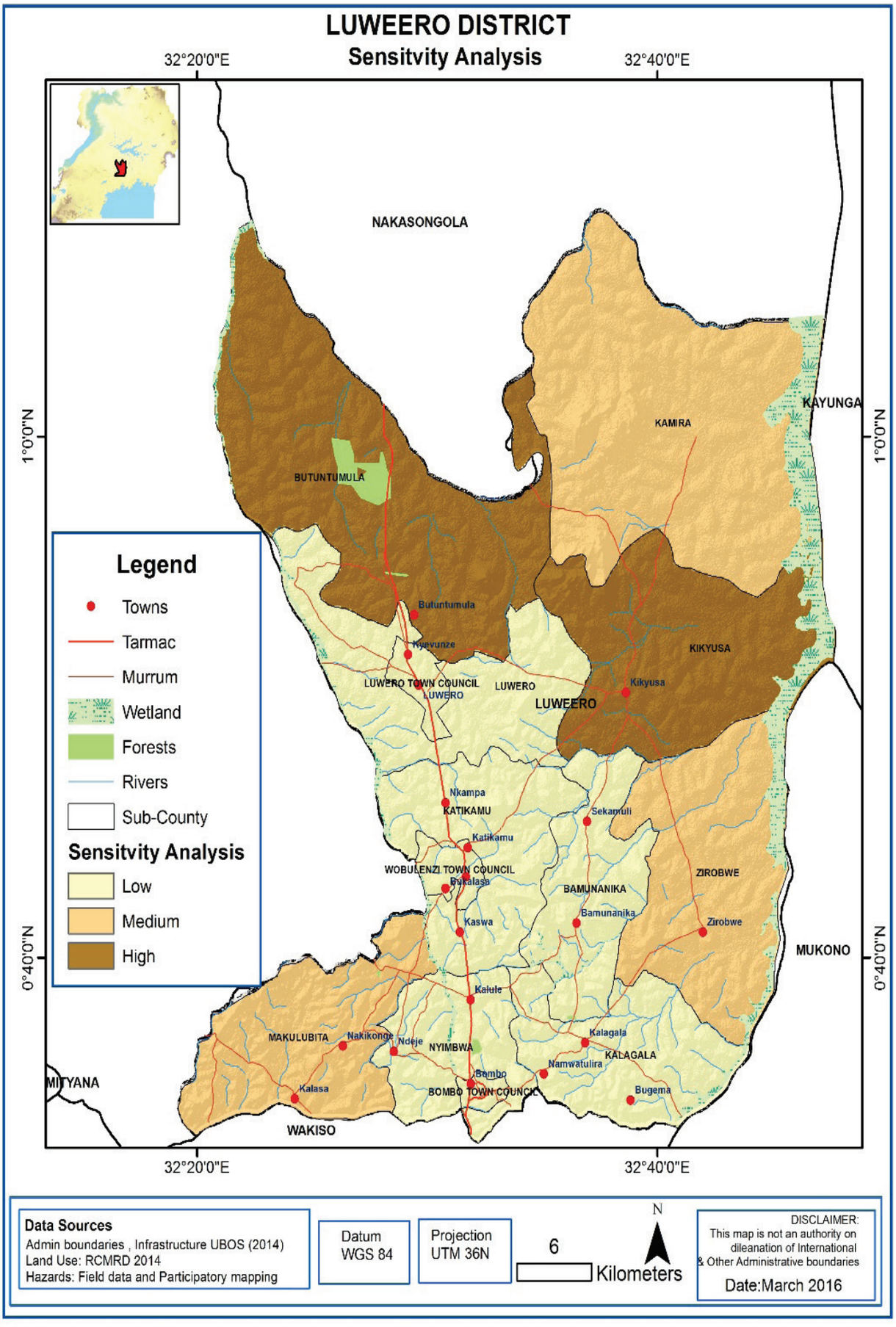

Figure 19 : Sensitivty of stressors in Luweero District

Prevalence of human and livestock diseases, vermin pests, winds and hailstorms and other hazards rendered Butuntumula and Kikyusa sub counties highly sensitive in the Luwero area.

5.3 Lack of Adaptive Capacity

The lack of adaptive capacity was analyzed using the market access and poverty index.

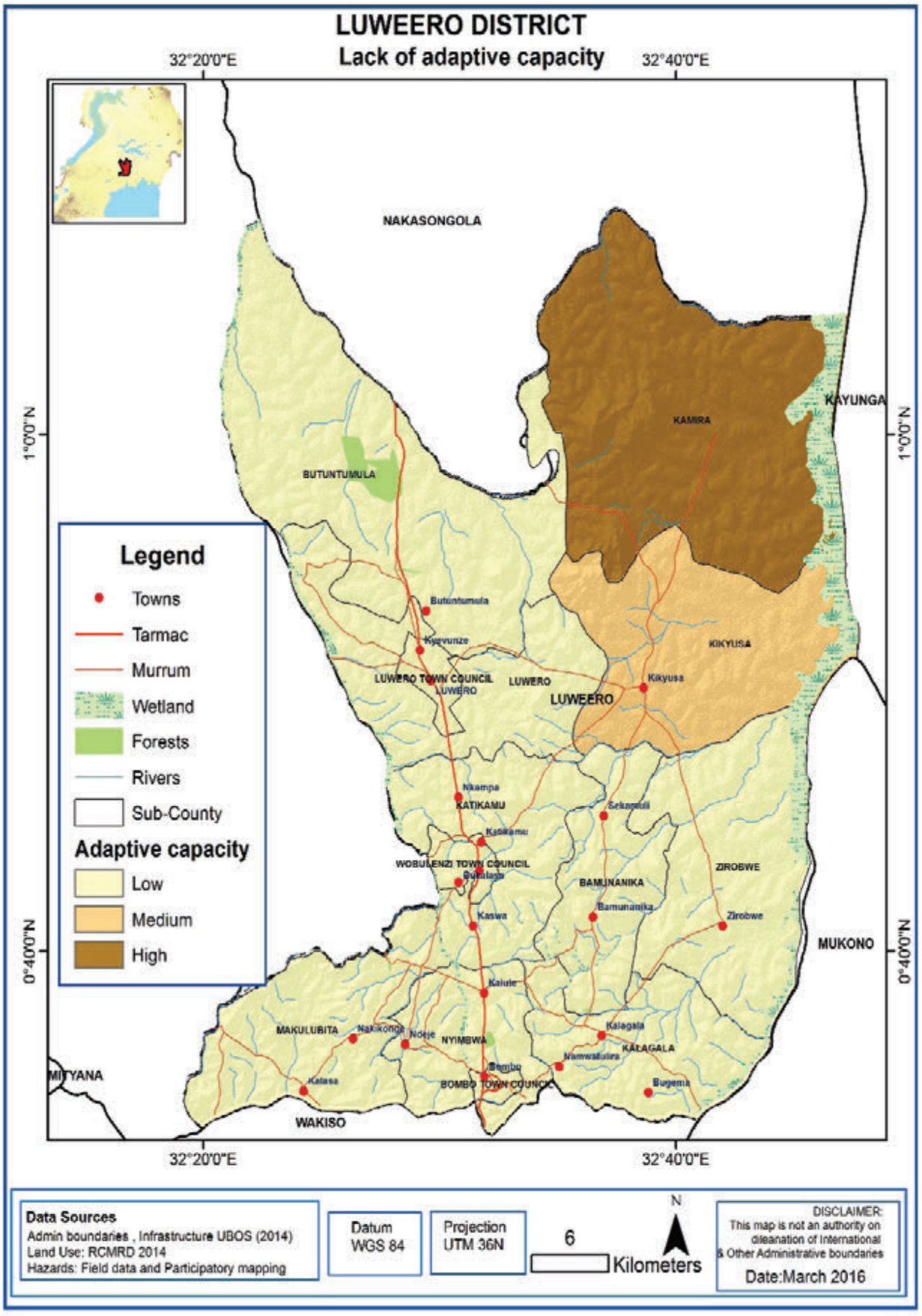

Figure 20 : Lack of adaptive capacity in Luweero District

Both layers influenced the vulnerability of the area with Kamira and Kikyusa being the most vulnerable sub counties due to their high poverty levels and lack of access to markets leading to low capacity to adapt to climate stressors and other hazards.

5.4 Vulnerability assessment

The vulnerability assessment is a result of combination of the exposure, sensitivity and lack of adaptive capacity layers.

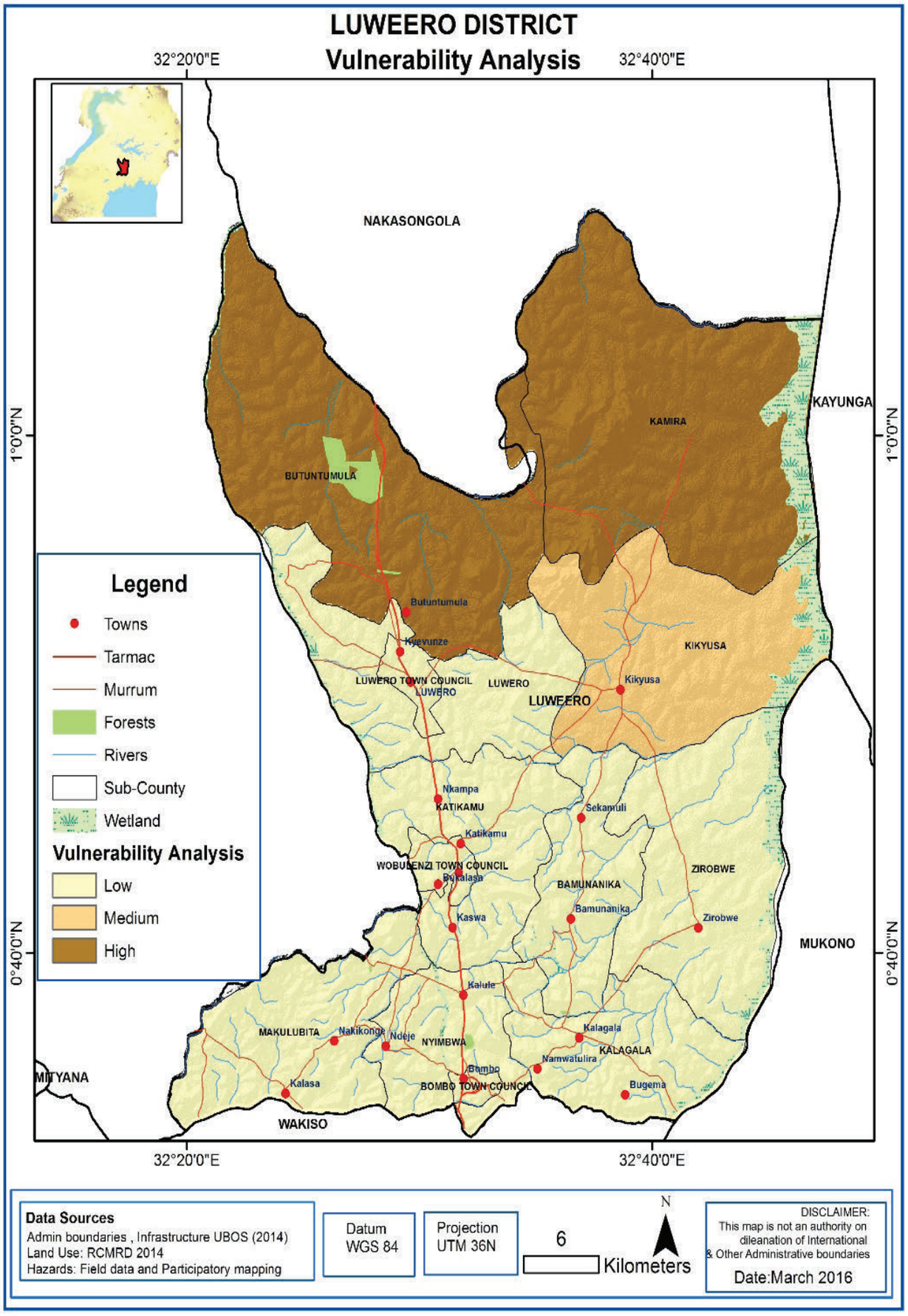

Figure 21: Vulnerability assessment of Luweero District

Exposure and adaptive capacity influenced the overall vulnerability of the area with Butuntumula and Kamira emerging as the most vulnerable sub county due to being highly exposed to climate stressors and highly sensitive to different hazards while lacking the capacity to adapt.

6.0 Coping Strategies

Table 2 : Coping strategies of Luweero District

Hazard	Coping Strategies in Luweero
Drought	-Conduct training and awareness workshop -Promote tree planting -Promote use of improved drought resistant varieties -Information gathering & dissemination -Construct shallow wells, boreholes and valley tanks. -Support & strengthen the functions of the disaster committees
Crop pests & diseases	-Conduct training and awareness workshops -Promote plant clinic operations -Support use of improved varieties -Observance of agronomical principles -Compliance visits
Environmental degradation	-Conduct training and awareness workshops -Tree planting -Develop and implement natural resource management plans -Conduct compliance visits -Support tree planting, fish farming, energy efficient technologies
Human diseases outbreaks	-Awareness and training workshops -Proper case management -Support disease surveillance system -Conduct immunization and vaccination activities -Enforce rules and regulations
Livestock pests & diseases	-Awareness raising -Promote vaccination and spraying operations -Provide technical support
Hail storm	-Awareness and training workshops -Conduct compliance lists -Information dissemination
Strong winds	- Tree planting campaign -Awareness and training workshops -Conduct compliance lists -Information dissemination

Erosion	-Training and awareness workshops -Promote tree planting -Compliance and farmer advisory visits
Land conflicts	-Awareness and training workshops -Conflict arbitration -Information dissemination
Bush fires	-Training and awareness rising -Enactment of byelaws and ordinance. -Enforce the laws
Vermin & wild life attacks	-Provide Vermin control services -Information dissemination -Technical support by UWA
Road accidents	- Enforcement of traffic laws & regulations -Proper road maintenance. -Training & awareness workshops
Floods	-Awareness & training workshops -Information dissemination -Use of early warning system
Lightning	-Awareness & training workshops -Use of lightning arresters -Use of early warning system -Mainstreaming in plans & projects
Earthquake	-Awareness & training workshops -Use of early warning system

7.0 General Conclusion and Recommendations

7.1 Conclusion

Over all it was acknowledged that identifying hazards, risks and vulnerable communities is important in the planning process to know which areas require agent attention to address vulnerability. It was also noted that hazard and disaster management should be mainstreamed with a special policy regarding preparedness at all the levels at the district departments to the lower local governments in order to effectively respond to these hazards. Finally, with these hazards profiled it is possible to approach Development partners to assist in intervening or supporting the district in putting up mitigation measures.

7.2 Recommendations

Drought

- Promote climate smart agriculture
- Ensure information gathering and dissemination
- Promote early warning system
- Mainstream environment and drought concerns into district plans, projects and budgets
- Promote proper land use and management
- Awareness raising & capacity building
- Improve access to safe water & water for production
- Promote climate smart agriculture
- Form and support the disaster committees functions at all levels

Crop pests & diseases

- Capacity building and awareness
- Promote Early warning system
- Promote use of improved varieties
- Promote pesticide and fungicide use.
- Enforce laws and regulations

Environmental degradation

- Capacity building and awareness
- Enforce laws and regulations
- Promote restoration measures
- Information gathering and dissemination
- Promote natural resource management planning

Human diseases outbreaks

- Support immunization and vaccination programmes
- Ensure supply of mosquito nets and their use with mosquito nets
- Capacity building and awareness
- Promote proper hygiene and sanitation
- Ensure proper treatment

Livestock pests & diseases

- Promote improved breeds
- Support regular vaccination and treatment
- encourage proper livestock management

Hail storm

- Awareness capacity building
- Promotion of tree planting
- Enforcing appropriate building standards & codes
- disseminate weather information

Strong winds

- Good Agricultural Practices
- awareness capacity building
- Promotion of tree planting
- Enforcing appropriate building standards
- disseminate weather information

Erosion

- Good Agricultural practices
- Capacity building and awareness
- Enforce laws and regulations
- Promote soil and water conservation measures
- Support adoptive research
- Information gathering and dissemination

Land conflicts

- Awareness raising and capacity building
- Develop ordinances and byelaws
- Support arbitration on land matters

Bush fires

- Develop ordinances and byelaws
- Awareness and capacity building
- Support institutions at various levels to control bush fires
- Monitoring and evaluation

Vermin & wild life attacks

- Promote vermin control services
- Awareness and capacity building
- Collaboration with ministry of Tourism and wild lif

Road accidents

- Enforce road traffic laws, rules and regulations
- Awareness and capacity building
- Support equip health centers to handle road accident cases

Floods

- Awareness and capacity building
- Identification of major flood areas
- Gathering information and dissemination on flood occurrence

Lightning

- Awareness and capacity building
- Enforce building standards
- Promote use of lightning arresters.

Earthquake

- Capacity building
- Enforce building standards

Annex I : Hazard risk assessment in sub-counties within the District

	Sub-county												
Hazard	Zirobwe	Bamunanika	Kalagala	Butuntumula	Luwero TC	Luwero	Katikamu	Wobulenzi	Bombo TC	Nyimbwa	kikyusa	kamira	Makulubita
Floods	L	N	L	N	L	N	N	L	N	N	N	N	N
Drought	H	M	M	H	M	M	M	M	M	M	H	H	M
Erosion	M	M	M	M	M	M	M	M	M	M	H	H	H
Strong winds	M	M	M	M	H	H	H	H	M	M	M	M	H
Hailstorms	H	H	H	H	H	H	H	H	H	H	H	H	H
Lightning	L	L	L	L	L	L	L	L	L	L	M	L	L
Crop pests and Diseases	H	H	H	H	H	H	H	H	H	H	H	H	H
Livestock pests and Diseases	H	H	H	H	H	H	H	H	H	H	H	H	H
Human disease outbreaks	H	H	H	H	H	H	H	H	H	H	H	H	H
Vermin and Wildlife animal attacks	H	M	M	H	L	M	M	L	L	M	H	H	H
Land conflicts	H	H	M	H	H	M	M	M	M	M	H	H	H
Bush fires	H	M	M	H	M	M	M	M	M	M	H	H	M
Environmental degradation	M	M	M	H	H	M	M	H	H	M	H	H	M
Earthquakes	L	L	L	L	L	L	L	L	L	L	L	L	L
Road accidents	M	L	L	H	H	H	H	H	H	H	L	L	L

N= Not reported, L = Low, M= Medium, H= High

Annex II : Field Data collection questionnaire

DATA COLLECTION

FOCUS GROUP DISCUSSION GUIDE FOR DISTRICT DISASTER RISK MANAGEMENT FOCAL PERSONS

Interviewer Team Name(s)	District: Sub- county:	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.

Hazard risk assessment

1. Which crops are majorly grown in your area of jurisdiction?
2. Which domestic animals are dominant in your area of jurisdiction?
3. List down/ elaborate on the major contributor’s hazards in the region.
4. Which gender (Male and female) and age group (children≤5, youth10-25, middle aged 30-40, old (>60years) in the societal set-up is the most affected and by what hazard.
5. What challenges are faced by farmers in your area of jurisdiction?
6. Have you experienced any of the following (risks and disasters) in the last 10 years?
    - Floods, Droughts, Landslides, rock falls and erosion
    - Strong winds, hailstorms and lightning
    - Crop pests and diseases
    - Animal pests and diseases
    - Human diseases and out breaks
    - Vermin and wildlife animal attacks
    - Land conflicts
    - Bush fires
    - Environmental degradation
    - Earthquakes and faults road accidents

7. How often do you experience such?
8. Which sub-counties have been most affected?
9. As a way of ranking from (1-5) for not reported, Low, Medium, High and Very high, rank sub-counties that have been most affected?
10. What impacts have been caused by the above hazards?
11. List the above hazards in their order of importance on how they are affecting you?
12. What strategies are being adopted by communities to cope with the above hazards?
13. Is there any relevant government’s interventions focusing on mitigating the above challenges?

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