THE REPUBLIC OF UGANDA

Mityana District

Hazard, Risk and Vulnerability Profile

2016

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Acknowledgement

On behalf of Office of the Prime Minister, I wish to my express 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.

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

Multi-hazards experienced in the districts were classified as geomorphological or Geological hazards including landslides, rock falls, soil erosion and earth quakes, climatological or Meteorological hazards including floods, drought, hailstorms, strong winds and 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.

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).

LIST OF 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

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

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 Nakasongola, Bukomansimbi, Gomba, Mityana, Mubende, Luwero, Mpigi, Kalungu, Kiryandongo and Wakiso Districts 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."

1.5 Structure of the Report

This Report is organized into six chapters: Chapter 1 provides introduction on the assignment. Chapter 2 elaborates on the overview and the Multi-hazard, Risks and Vulnerability profiles of Nakasongola district. Chapter 3 focuses on the overview and the Multi-hazard, Risks and Vulnerability profiles of Bukomansimbi district. Chapter 4 elaborates the Multi-hazard, Risks and Vulnerability profiles of Gomba district detailing their extent and policy implications. Chapter 5 describes the Multi-hazard, Risks and Vulnerability profiles of Mityana district. Chapter 6 discusses the overview and the Multi-hazard, Risks and Vulnerability profiles of Mubende district. Chapter 7 discusses the overview and the Multi-hazard, Risks and Vulnerability profiles of Luwero district. Chapter 8 discusses the overview and the Multi-hazard, Risks and Vulnerability profiles of Mpigi district. Chapter 9 discusses the overview and the Multi-hazard, Risks and Vulnerability profiles of Kalungu district. Chapter 10 discusses the overview and the Multi-hazard, Risks and Vulnerability profiles of Kalungu district. Chapter 11 discusses the overview and the Multi-hazard, Risks and Vulnerability profiles of Kiryandongo district. Chapter 12 discusses the overview and the Multi-hazard, Risks and Vulnerability profiles of Wakiso district.

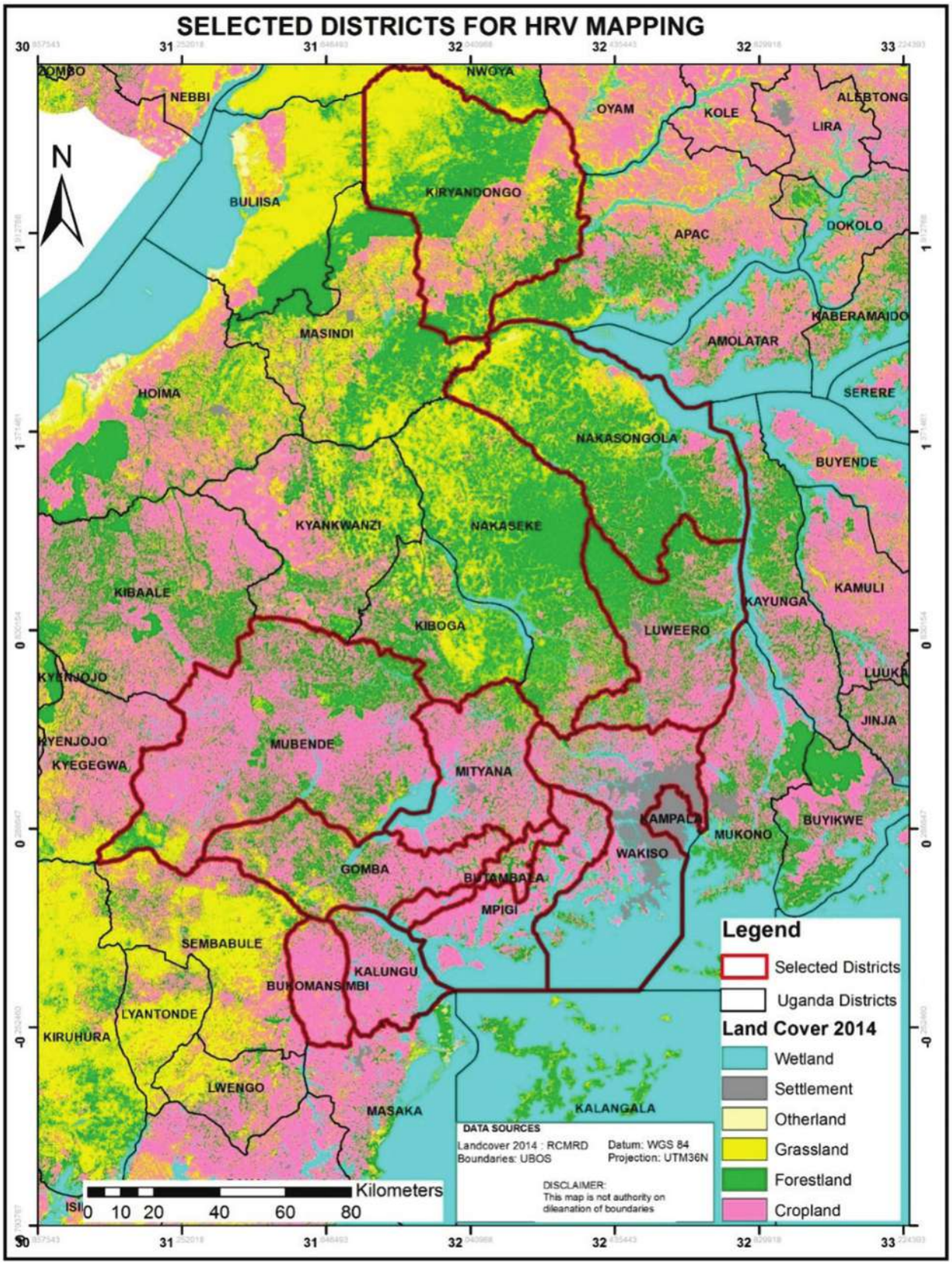

Figure 1: Location of the study area

2.0 Overview of Mityana District

Mityana is a district in the central region of Uganda. The district was created in 2005, by taking the Mityana and Busujju counties from Mubende District. Mityana District is bordered by Kiboga District to the North, Nakaseke District to the Northeast, Wakiso District to the East, Mubende District to the West, Mpigi District to the Southeast, Butambala and Gomba Districts to the South. Mityana is the site of the district headquarters and is approximately 77 kilometers by road, West of Kampala, Uganda's capital. The town is about half-way between Kampala and Mubende on an all-weather tarmac highway that links Uganda's capital with the town of Fort Portal in the Western region. The coordinates of the district are 00 27N, 32 03E. The 1991 national population census estimated the district's population at 223,530. In 2002, the national census estimated the district population at 266,110. In 2012, the district population was estimated at 311,600 (UBOS, 2014).

2.1 Geology

Mityana district is underlies both old and recent rock systems, which include Precambrian, Cenozoic and Laterites. All the three major divisions of rocks, - sedimentary, Igneous and Metamorphic are represented. The Cenozoic rock extend towards Lake Wamala.

The soils are generally highly productive and are mainly sandy clay soils. The dominant soils types are red gravely loamy with occasional marram, reddish brown sandy loam, red clay loam and yellowish sands with quartz gravel. The soils in wetlands include gray sands whose parent material is alluvium and hill wash, gray coarse sand from lake deposits, black and grey clays from swamps streams and clay formed from papyrus residue and river alluvium.The district is characterized by isolated flat-topped hills with steep slopes, often merging sharply into long and gentle pediments which are usually dissected by relatively broad valley. Mityana District is divided into two main topographic zones, the Lake Wamala zone and high land zone, with an average elevation of Mityana town at about 1,209 metres (3,967 ft) above sea level.

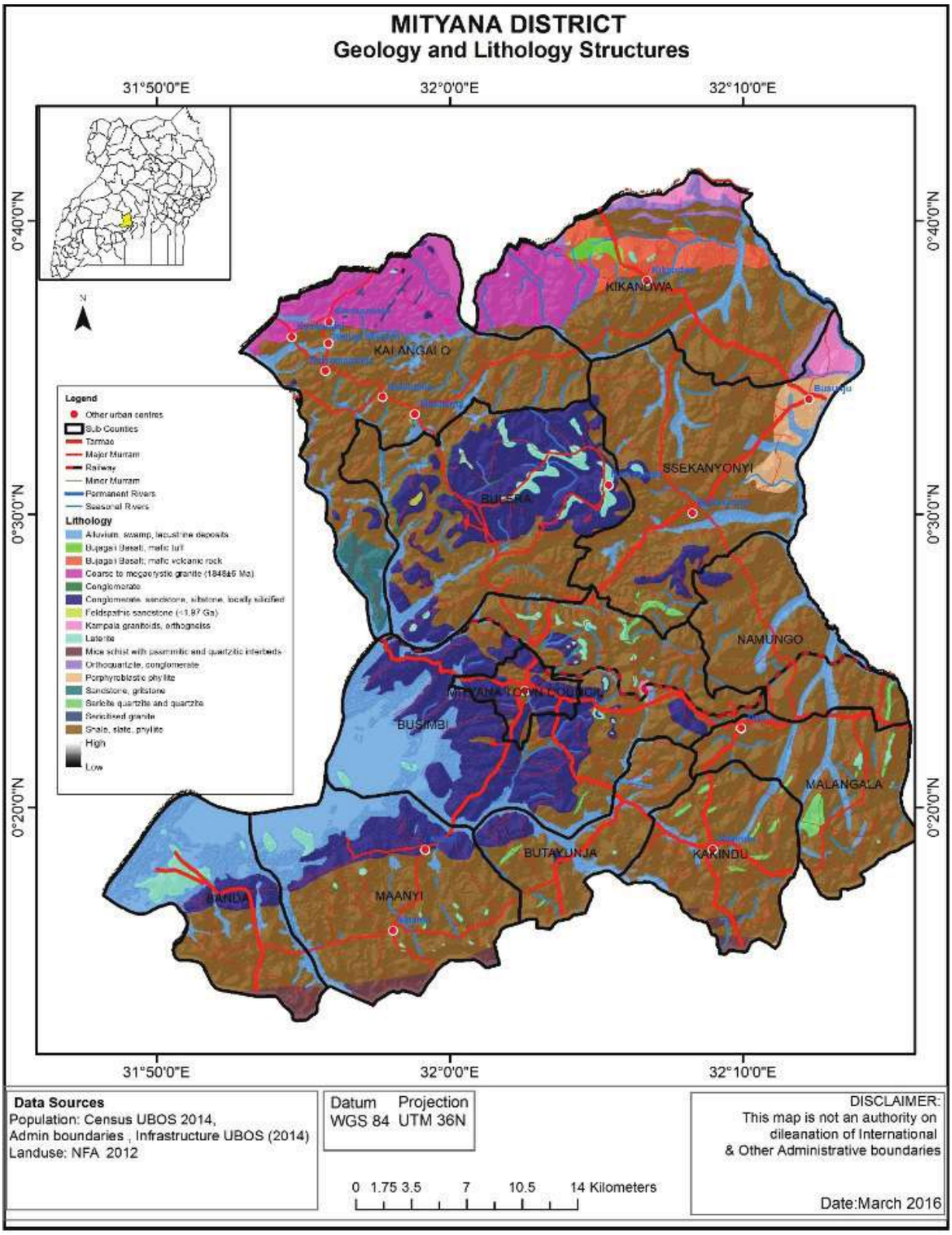

Figure 2: Geology and Lithology of Mityana District

2.2 Vegetation and Landuse stratification

Much of Mityana District land is occupied by wetlands that are 3.58% coverage of the districts land surface area. Permanent wetlands cover 273.6 hectares while seasonal wet lands cover 250.11 ha. In addition, a total of 117.04 of wetlands, mainly seasonal have been reclaimed for agriculture representing 0.8% of the districts land area.They are divided into the following categories, lake areas and riverine swamps. Cyperus papyrus dominates most wetland herbaceous vegetation flooded either permanently or for most parts of the year. They occur on the edges of Lake Wamala.

Lake Wamala is one of the freshwater bodies located in Mubende, Mpigi, Mityana and Mawokota districts of Central Uganda, it covers a total area of 250 sq. km. It is dotted by many islands including Lwanja, Mabo and Bagwe. It is associated with several rivers and wetlands. The rivers Nyanzi-kitenga, Kabasuma, Mpamujugu and Bimbye flow into the lake, whereas river Kibimba drains westwards into Lake Victoria. River Katonga coming from Lake Victoria flows into Lake Wamala. The vegetation surrounding Lake Wamala is dominated by papyrus.

There are also trees such as Raphia and other palms. There exist remnants of a variety of species such as sitatunga, wild pigs, hippopotamus, bush bucks, waterbuck's velvet monkeys, baboons and a variety of birds such as guinea fowls, turraco. Francolins in the forests, while a diversity of water based birds are visible in the remaining wetlands. Existing fish species include among others tilapia, catfish lung fish and mud fish.

Water sheds are important sources of water for house hold use, animal consumption and irrigation. Rivers and lakes, play an important role in the hydrological cycle. Currently many water shed forests in the district especially on private land have been degraded and deforested. This has resulted into soil erosion, lowering of water tables, decrease in stream and river flows silting of water bodies, floods and reducing water quality (district state of the environment report Mityana 2007-2008

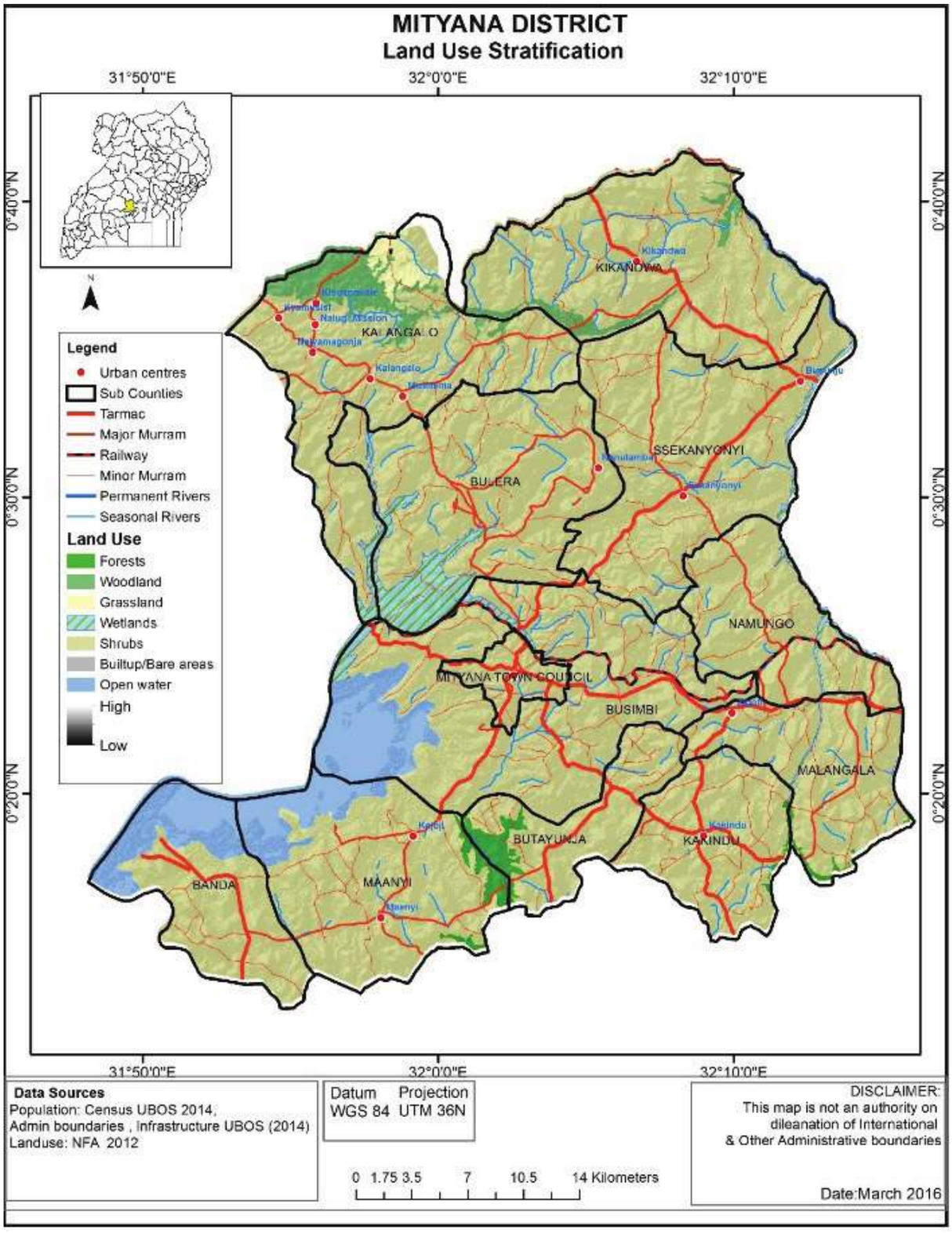

Figure 3: Land use stratification of Mityana District

2.3 Climatic Conditions

There is minimal variation of temperature, humidity, winds. The district experiences rain throughout the year, with heavy rains in march-April and September- November. The annual average rain fall is 930mm. The high altitude ensures favorable climate with medium annual temperature ranging from 17.2 degrees to 29 degrees centigrade.

2.4 Demographic Characteristics

Basing on the 2014 population and housing census the district currently has a total population of 331,266 people. The population of Busimbi Sub County and Mityana town council were above other sub counties in population numbers with Butayunja Sub County having the least population. Basing on the 1991 National population and housing census, the fertility rate was 7.5 which is higher than the national figure of 6.9. Currently the Population density is at 217 people per square kilometre compared to 144 persons per square kilometre in 1991. Mityana district 13% of its population lives in Mityana town council i.e., 34,116 out of 266,108 people stay in urban areas.

In Mityana, 17.3% of the total population is children of less than 4 years of age. This is followed by age groups of 5-9 years (16.9%) and 10-14 years (16.8%) Only 11.8 % of the population is above age group 45 years. This means that about 51 % of the district population is young (aged below 15) This is slightly higher than the national proportion of about 50 percent. Approximately 4 percent of the district population is elderly (65 years and above).

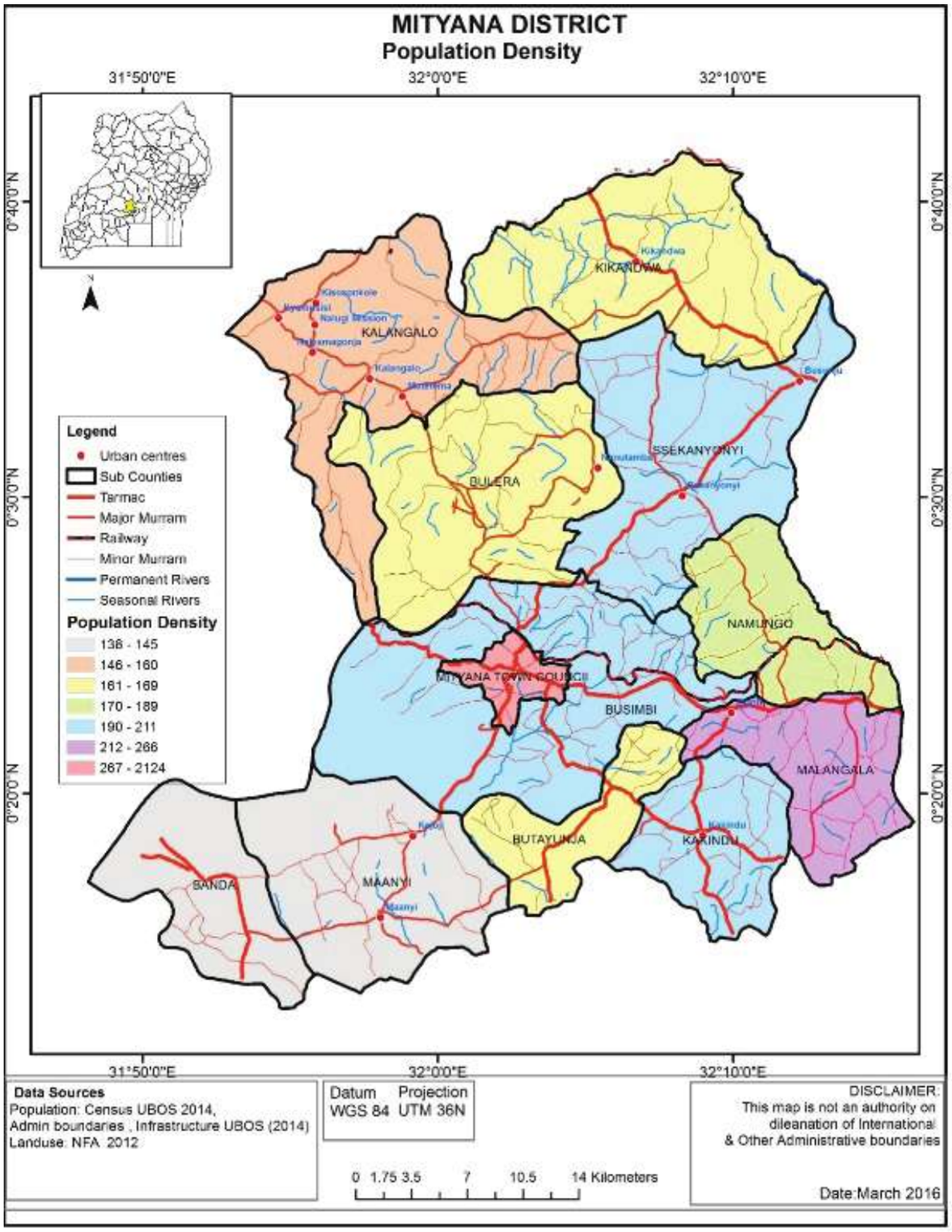

Figure 4: Population density 2014 of Mityana District

2.5 Main economic activities

Over 89% of Mityana District is agricultural based characterized as subsistence production. Partial commercial agriculture exists with farmers like TAMTECO, Madhivan and Namutamba Tea plantations. Commercial farming is characterized by use of migrant labour from West Nile, Kabale, Rwanda and Burundi living in labour camps characterized by poor housing, sanitation and with little pay. Coffee is another cash crop grown and fetching reasonable incomes to those with sizeable acreage. However, coffee has always been adversely affected by diseases and as such affecting incomes. There is an emerging realisation that non perennial crops such as maize, tomatoes, Irish potatoes, sweet potatoes and beans once grown on a commercial scale can as well bring in lots of income. Subsistence agriculture is characterized by low acreage due to increasing family sizes and slicing of land, low productivity per unit acre arising from deteriorating soil fertility over cultivation and soil erosion. The females provide most labour and yet the men take most of the biggest share of farm proceeds.

Fishing on Lake Wamala is also another economic activity in the District. Fishing on this Lake offers a means of livelihood ranging from fishermen, fishmongers to transporters. However, production of fish from the Lake is getting affected by poor fishing methods which requires surveillance.

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 modelling 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.

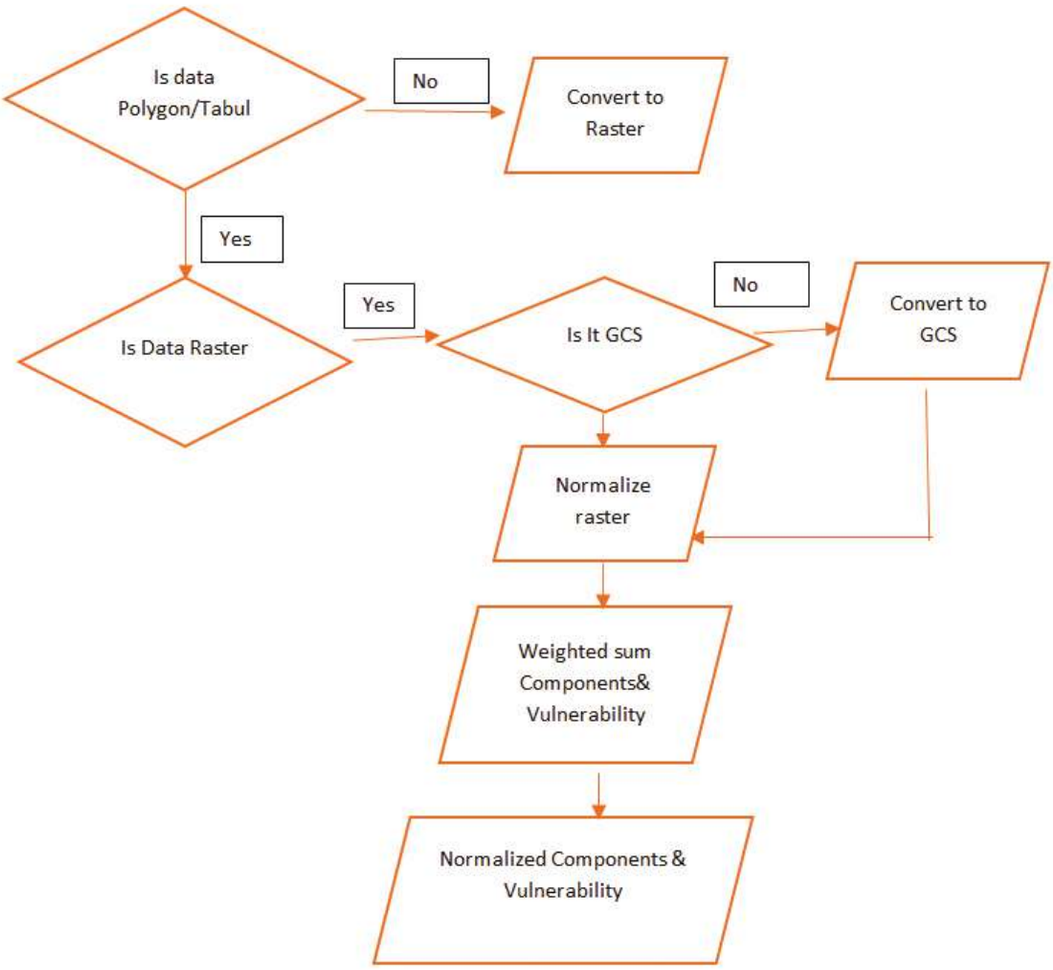

Figure 5: Data conversion work flow

3.6 Regional Stakeholder Workshop for Data verification and validation

In collaboration with OPM, a five days 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 as the major threats within the district in order of their priority.

4.2 Environmental degradation

The major environmental challenge identified is deforestation were Mityana has lost most of its forest cover. High cases of deforestation in Butayunja, Busimbi, Maanyi, Bulera and Kalangaalo) were noted and hotspots in Bulera sub county, Kibaale Parish; Ssekanyonyi Sub County, sekanyonyi parish and Busunju town Board; Bbanda Sub county, Mpongo parish; Busimbi Sub county, Naama, Nakaseeta, Nakibanga, Busuubizi and Kabuwambo parishes; Butayunja Sub County, Buluma parish; Kalangaalo Sub County: Kalangaalo and Kikuuta Parishes were highlighted.

Conversion of wetlands to farms and eucalyptus plantations was noted as a major threat to the environment in Mityana. Brick lying in wetlands was observed to be a threat too. This was attributed to poor land tenure systems were people are being issued titles in wetlands to develop them. Overfishing in Maanyi, Bbanda and Busimbi Sub County was also noted as another serious environmental challenge which has led to endrastic drop in fish catches (5000-1000tones). Because of degradation the lake size has been reducing over the years.

Sand mining in unsustainable organised manner without protective gears was also noted in Butembi were people lost lives due to weak soils burying them in the pits. Because of weak soils, there have been incidences of pit latrines falling and this is prominent especially in Kalangalo and Bulera were two people died in 2015. It was noted that if promotion of alternative income generating activities is done for people destroying wetlands and forests it could significantly reduce this degradation.

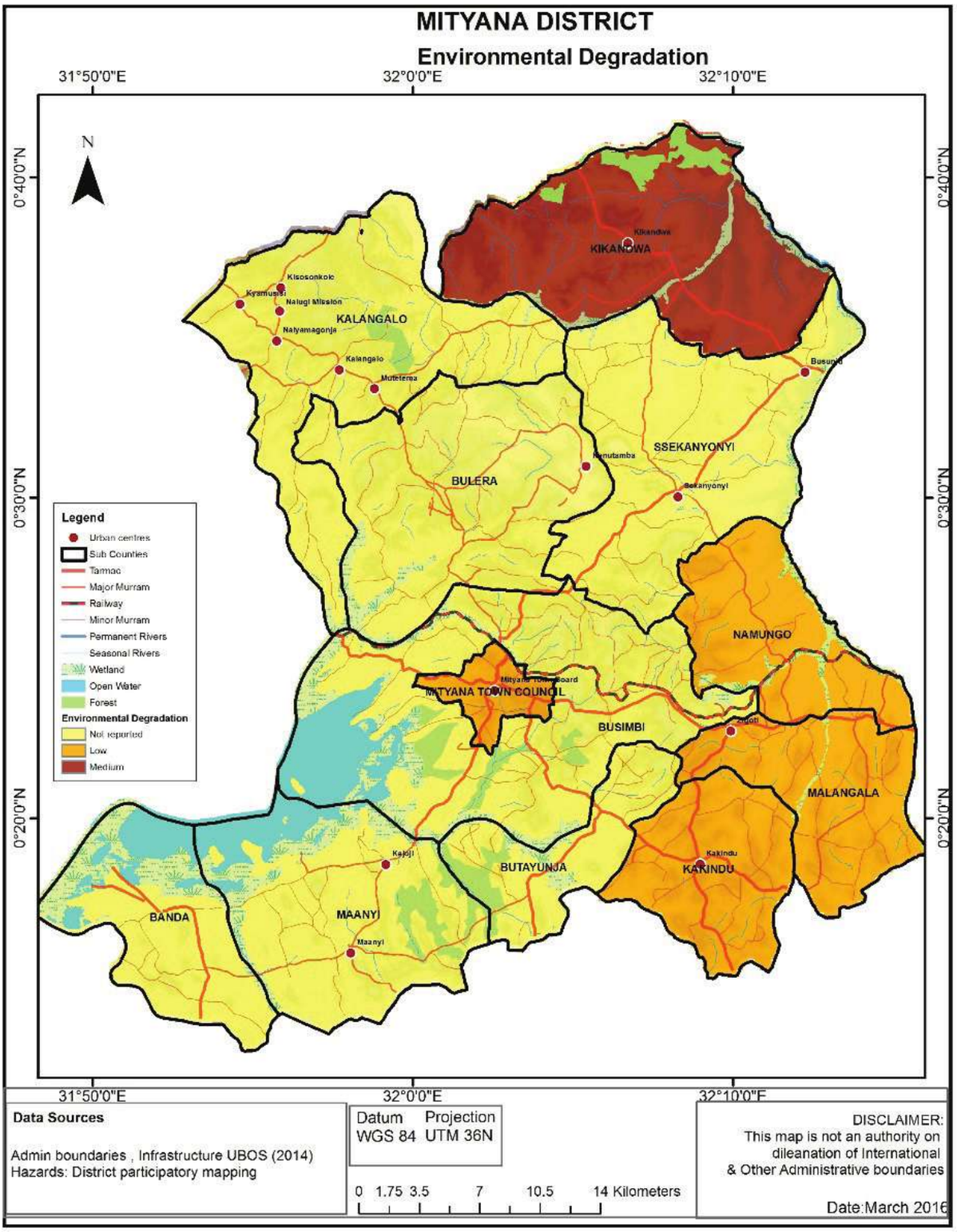

Figure 6: Environmental degradation in Mityana District

4.5 Land conflicts

It was noted that land conflicts are high in the entire district and mostly attributed to land tenure systems which are not clear; Urbanization of most of the areas ; Increase in population ; Proximity for big market in kampala ; Ignorance about the land laws ; Many of the rich and educated opting for Agricultural activities. Avoiding private land brokers, conmen and sensitizing the general public about the right channels to follow when handling land issues was considered to be one of ways in mitigating these conflicts.

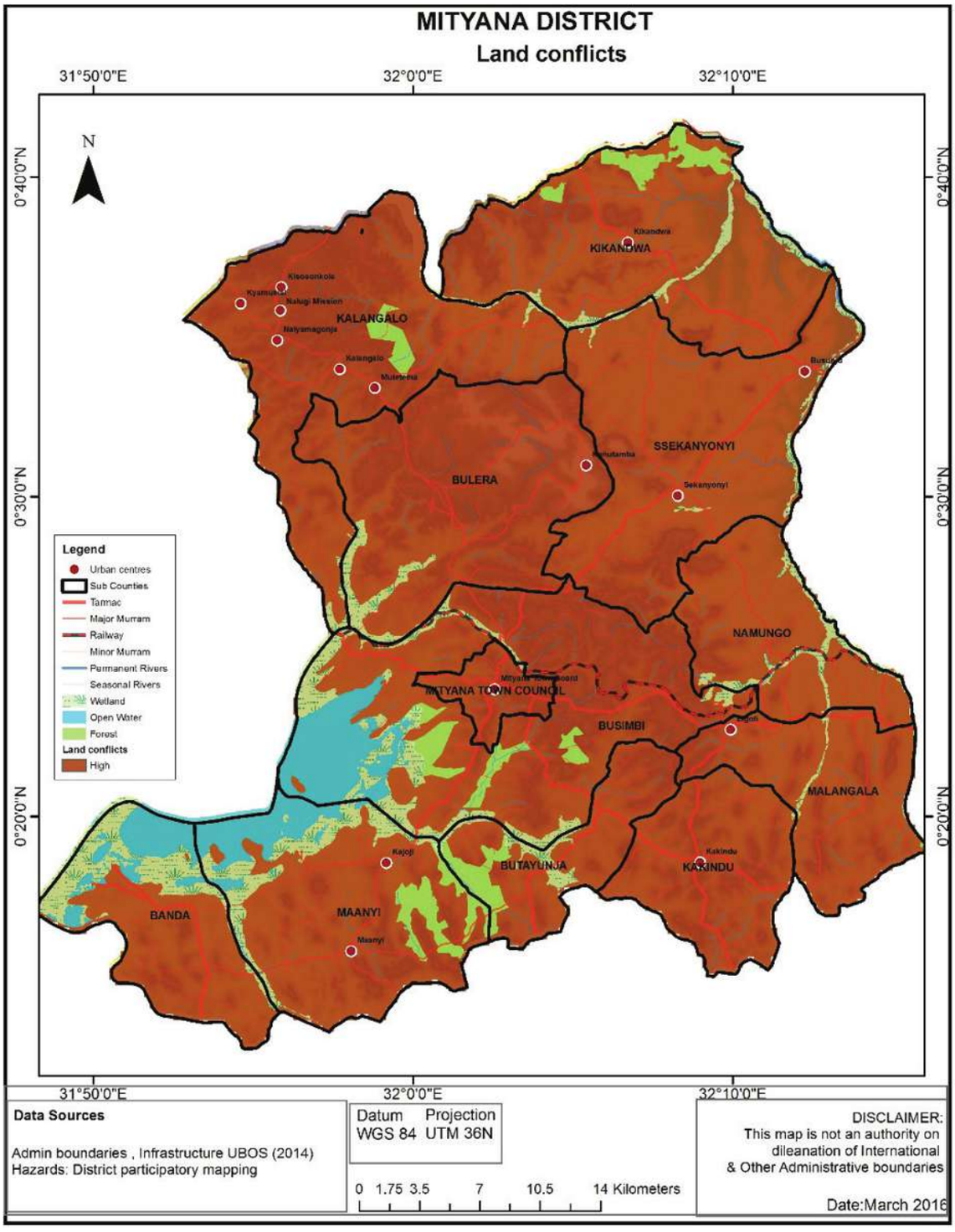

Figure 7: Land conflicts in Mityana District

4.6 Crop pests and diseases

Major crop pests and disease identified were Coffee wilt, coffee twig bora, Bananana bacterial wilt, Blights for fruits and vegetables especially in tomatoes in Busimbi the main vegetable growing Sub County which can lead to 100% loss in the case of early blights. Fruit flies and cassava mosaic were also noted. Although with new varieties, cassava mosaic has been seen to be reducing. All that is needed is sensitization of the general public to adopt use of these new varieties. Bacterial wilt disease a soil borne infection in tomatoes, passion fruits, cabbages and pineapples is increasingly becoming prominent. This is possibly because of poor soil management. However, it was observed that there is need for sensitization of local communities on seed selection and control measures to curb most of these disease and pests. Sub counties of Kikandwa; Bbanda and Busimbi were noted as the key hotspots as there are always high incidences of pests and diseases occurring season after season affecting both annuals and perennials. There are also significant reduced crop yields in these sub counties.

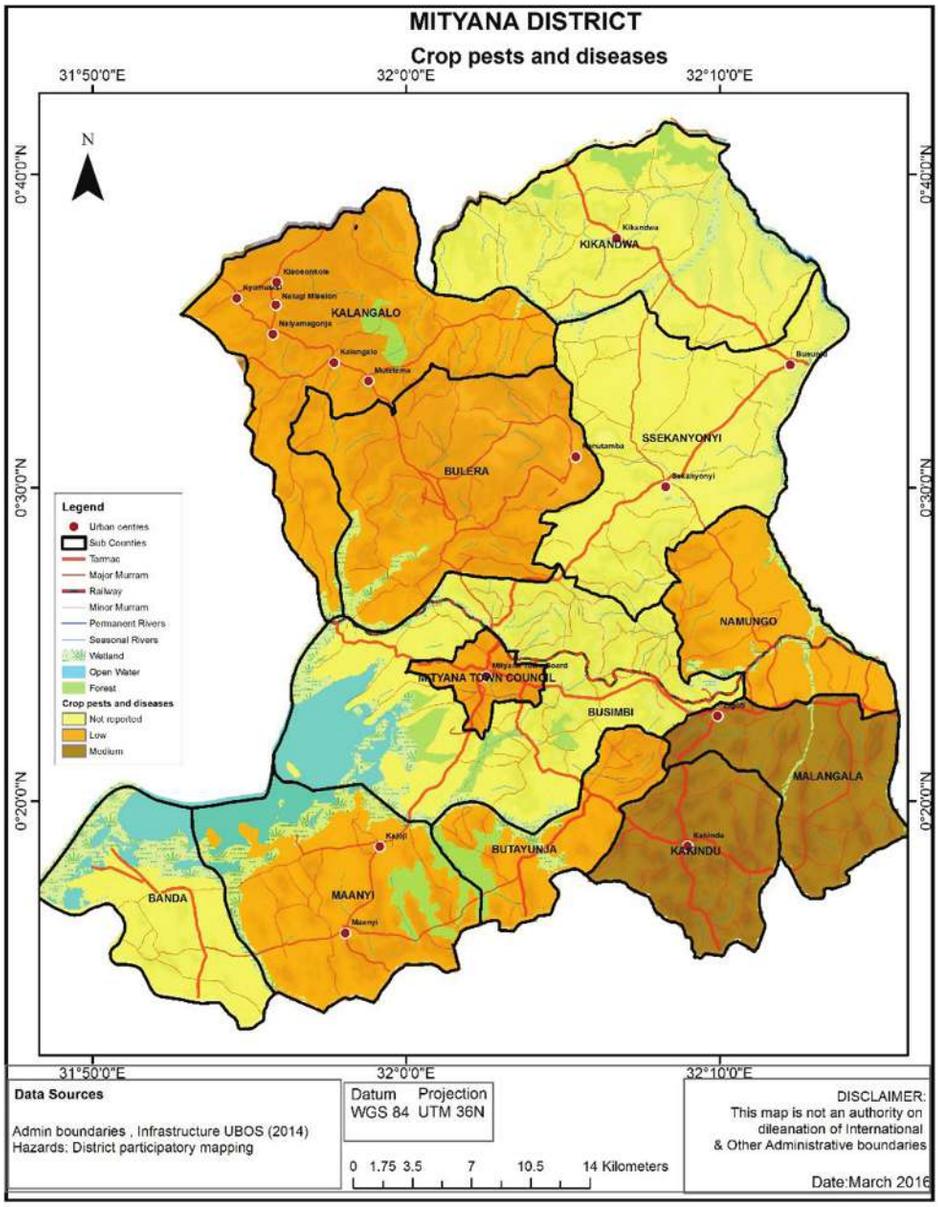

Figure 8: Crop pests and diseases in Mityana District

4.7 Livestock pests and diseases

Tick borne diseases like East coast fever, anaplasmosis, African swine fever were seen as the major threat and hindrance to livestock keeping in Mityana district. Other diseases such as Lumpy skin disease which is a bacterial infection in cattle and Newcastle in poultry are also of common occurrence. Tsetse flies especially around river Mayaja is a major threat causing Nagana in cattle. Few cases of foot and mouth disease have been reported although because of the nature of cattle keeping in Mityana (Zero grazing and in paddocked farms systems) it has been easy to contain the disease.The biggest challenge to control of these diseases was noted to be absence of vaccines to some of these diseases like African swine or vaccines are too expensive that they are not affordable by some of the farmers which have resulted in resistance to use some of these available drugs or vaccines. The issue of Accaricide resistance was also noted and this was attributed to use of counter fake drugs on the market. The other issues were absence of strict bio-security measures. The presence of rabies was attributed to stray dogs and jackals hiding in tea plantations in Busimbi, Kakindo and Bulera. Sub Counties of Kikandwa, Bulera, Ssekanyonyi, Busimbi, Butayunja, Kakindu, Namungo were noted as hotspots because of high incidences of pests and diseases that attack and cause death in liestock. Pigs and poultry are mostly hit causing 100% loss.

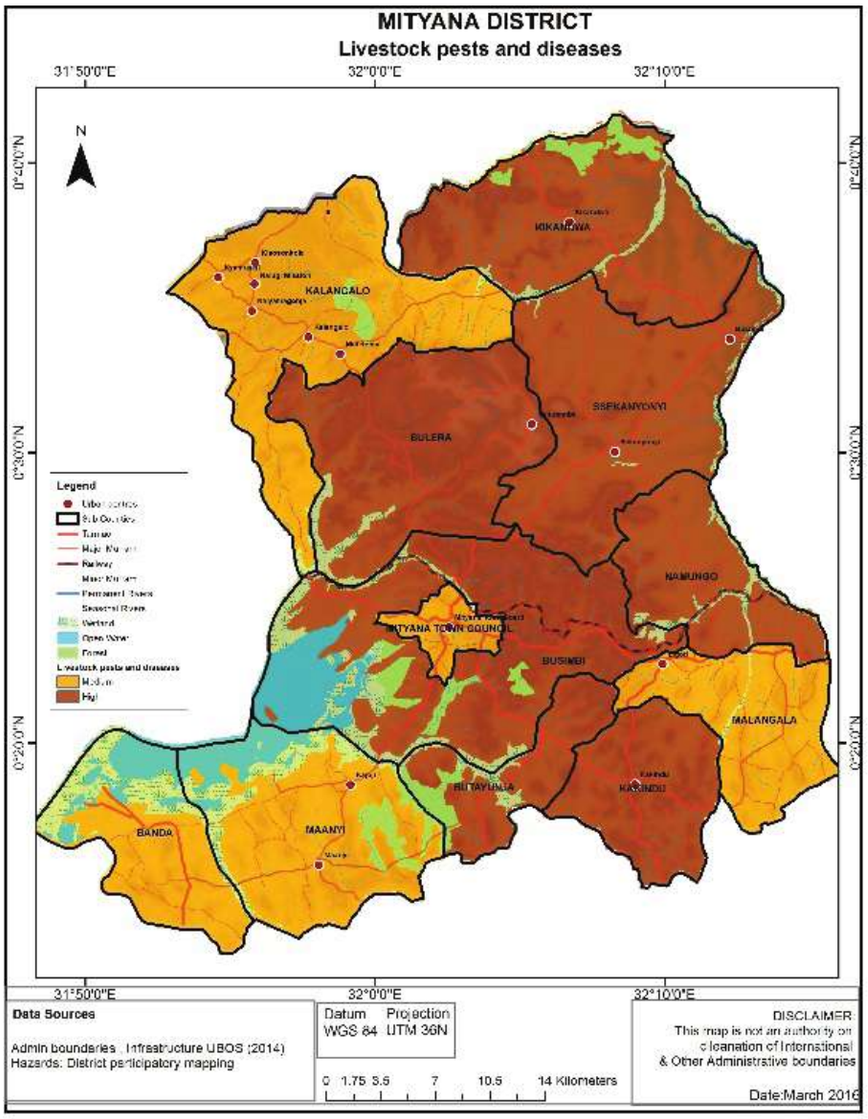

Figure 9: Livestock pests and diseases in Mityana District

4.8 Human diseases outbreaks

Malaria still remains the major killer disease in this district although there were several interventions being done including distribution of ant-malarial drugs and mosquito nets by the Village Health Team (VHT). It was noted that HIV& AIDS is still a threat with prevalence of 13% way above the national average near the areas close to landing sites and trading centers. Although spread has been controlled and most people are living on antivirals, it could be a major threat culminating into a disaster in case of any environmental stresses of the general public given their immunity has been compromised. It was noted that there is Bilharzia around Lake Wamala and rabies in towns that is beingspread by stray dogs. Other diseases such as respiratory infections (coughs, flus etc) were also noted.

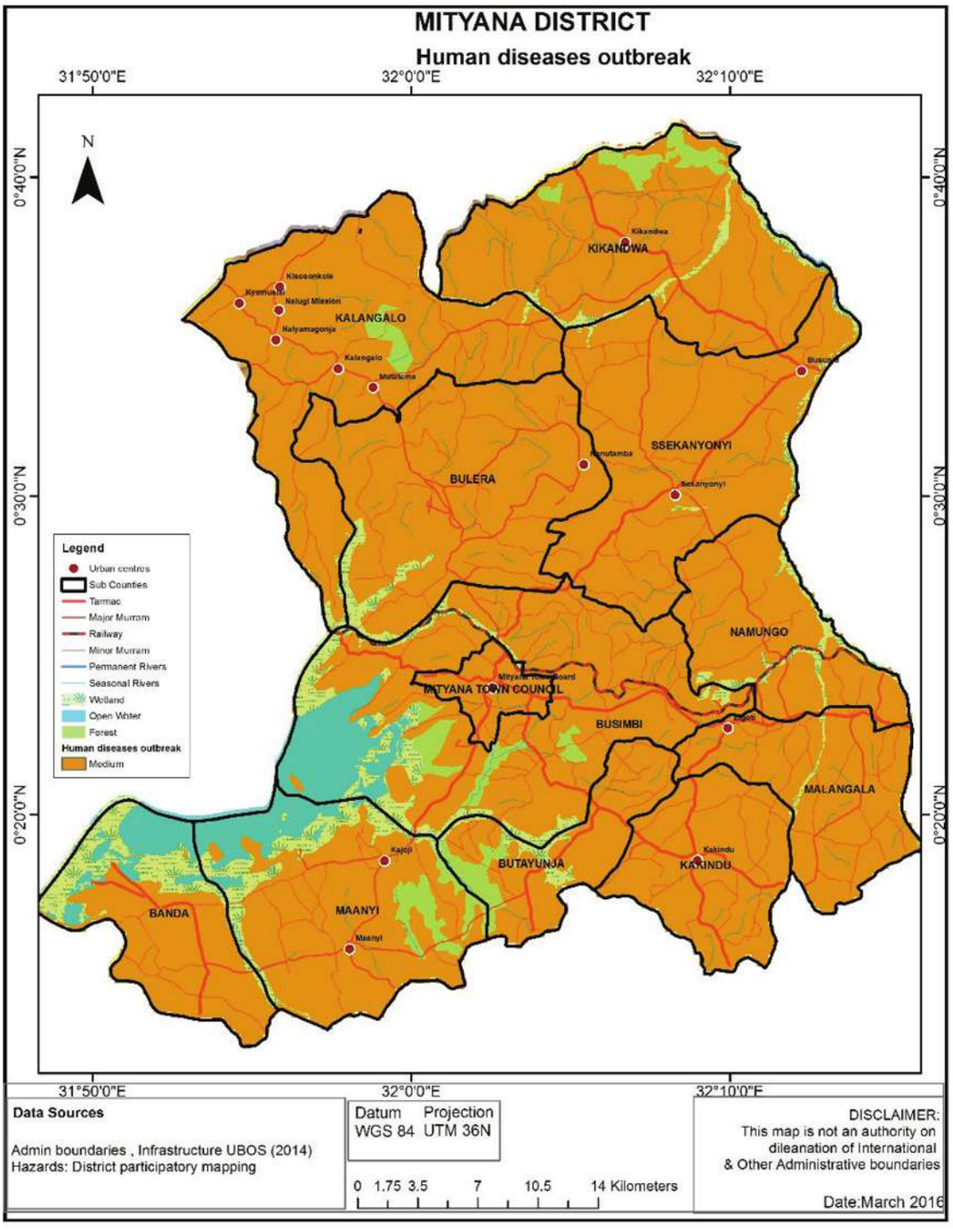

Figure 10: Human diseases in Mityana District

4.9 Rock falls and soil erosion

Sekanyonyi Sub County in Busunju Town Board where there is a stone quarry, it was noted that this place is prone to rock falls which has buried many people. Sub counties of Kikandwa, Sekanyonyi, Manyi and Banda are prone to soil erosion.

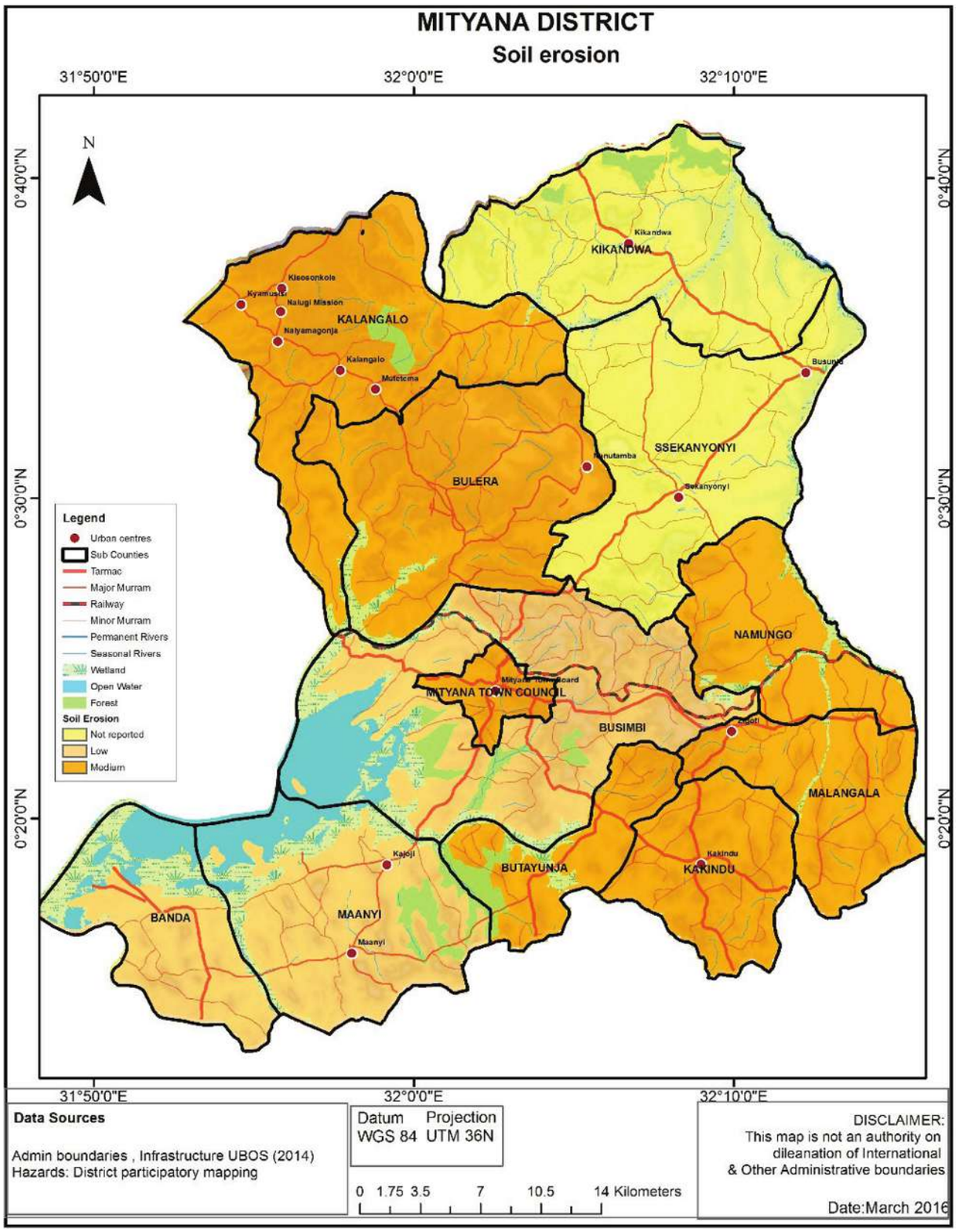

Figure 11: Soil erosion in Mityana District

4.10 Droughts

Mityana is less prone to droughts, only Kikandwa and Kalangaalo Sub Counties which are close to the cattle corridor that experience severe prolonged dry spells were water sources dry up and a jerry can of water increase to 1000UGX. Many animals also die during prolonged dry spells and farmers are forced to sell off some of their animals to reduce on the number and remain with what is manageable. Crop yields also reduce significantly. Water harvesting as seen in Bukuya and Busimbi were they have been provided underground water tank for irrigation in orange growing could be replicated in other areas sub counties that are prone to water stresses.

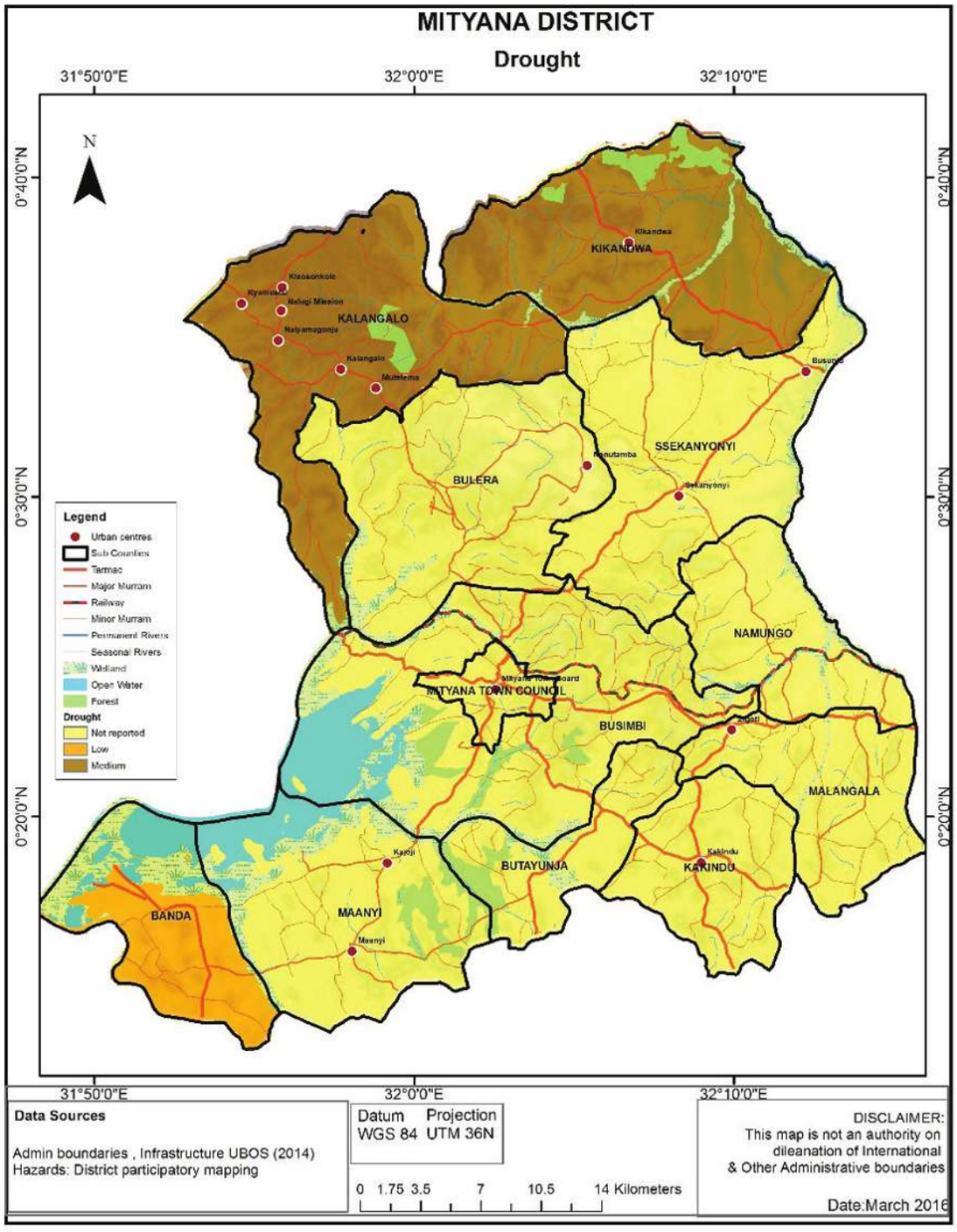

Figure 12: Drought in Mityana District

4.11 Road accidents

Road accidents were also noted to be high especially along the high way.Roads need to have clear road signs and road users especially drivers and riders trained how to use the roads being mindful of other users. Mityana town council, in East ward were identified as the major hotspots of accidents because of high incidences of accidents that result into Loss of life, property and destruction of vehicles.

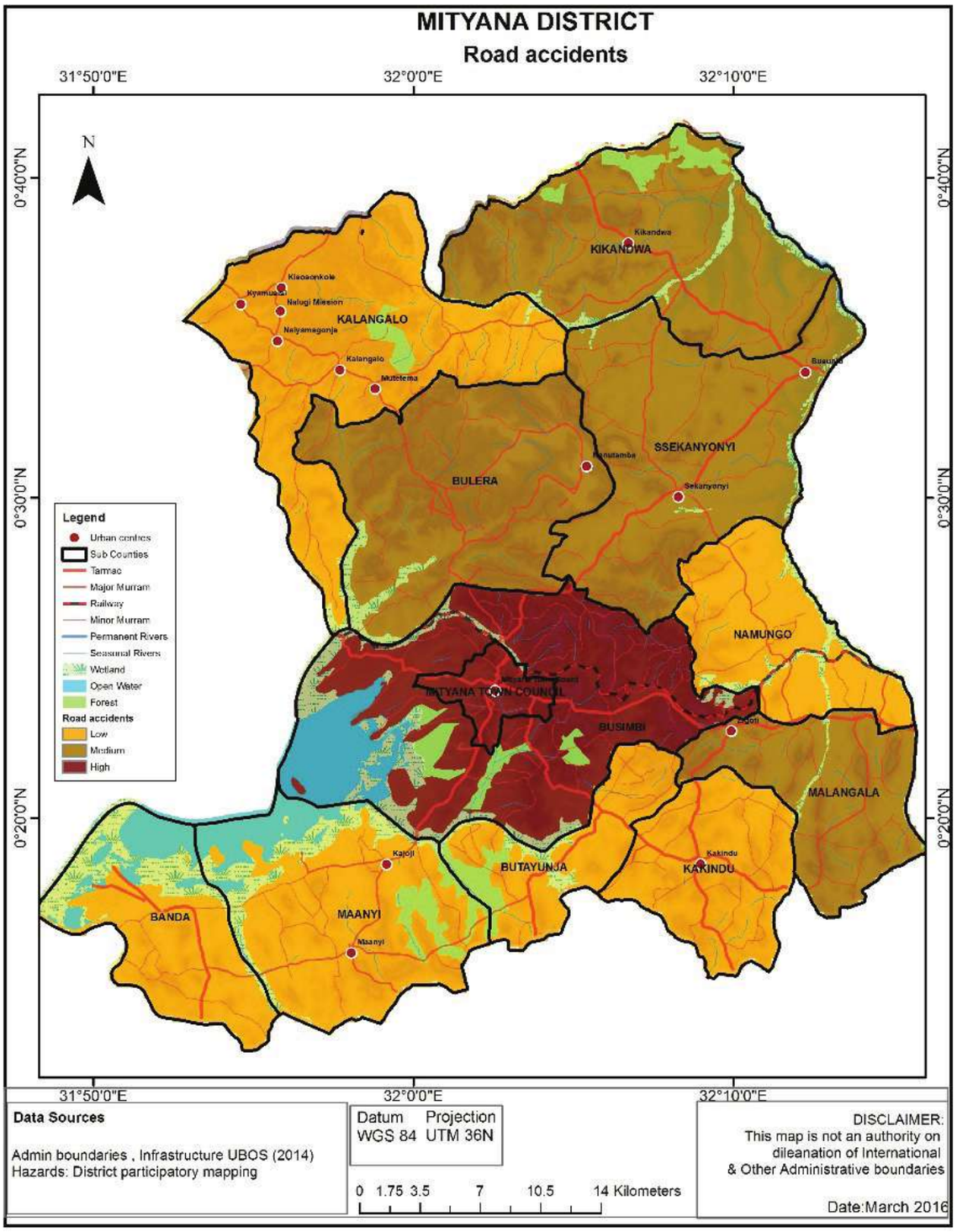

Figure 13: Road accidents in Mityana District

4.12 Strong winds, hailstorms and Lightning

It was noted that incidences of strong winds are relatively medium in the entire district normally occurring at the end of a dry season.

It was also highligted that incidences of hailstorms are high in Malagala (Kanyanya and Magonga Parishes), Busimbi (Ttanda parish and Kabule parishes) and Kakindu (Nsambya Parish) as they are more frequent especially prior and towards the end of rains and farmer crops and property are lost. In other parts hailstorms occurrences are medium.

For Lightning, occurrences in Kikandwa, Bulera and Busimbi have been high. Naama and Nakaseeta Parishes in Busimbi Sub County being identified as the hotspot because people including school children died and property was lost in these areas

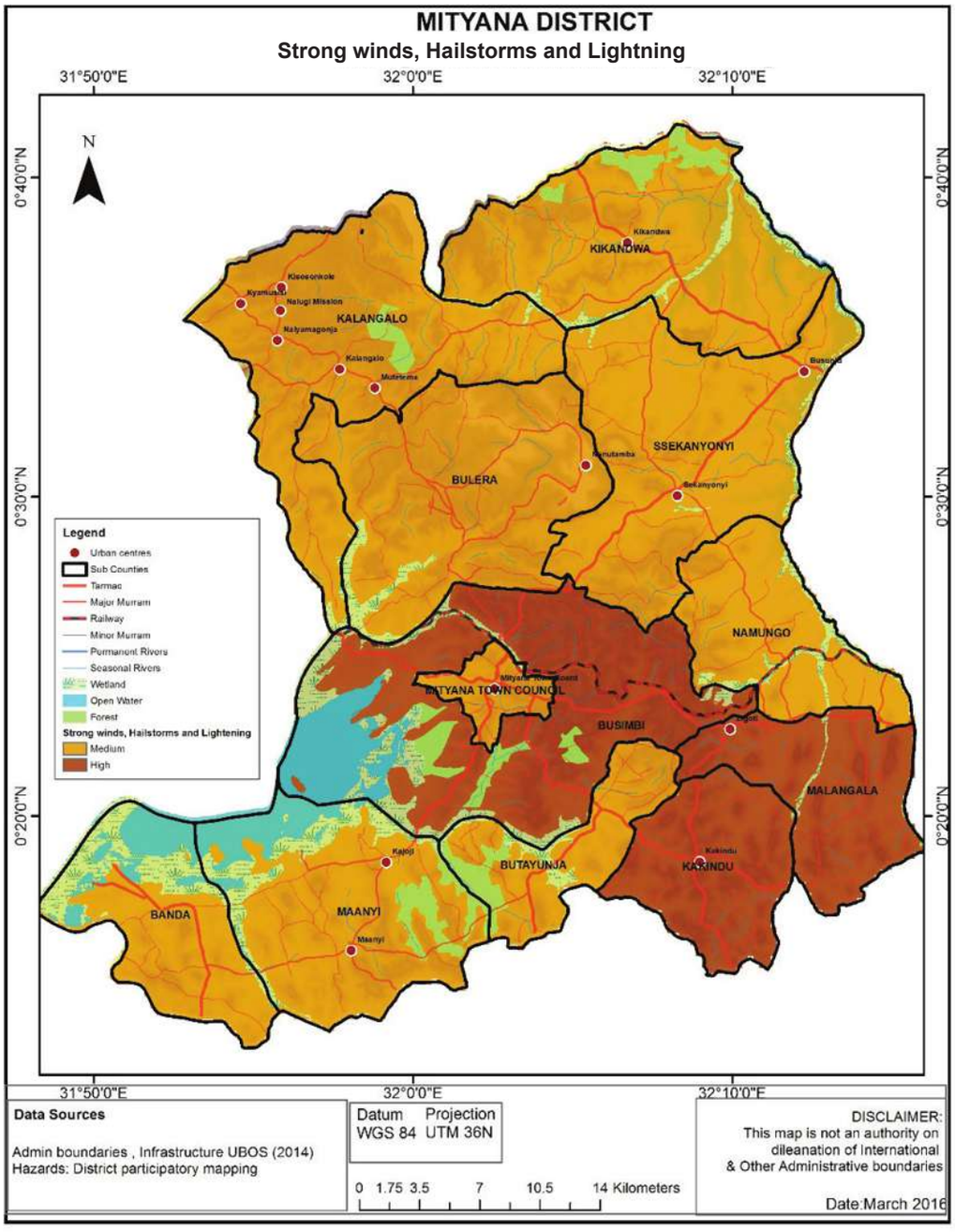

Figure 14: Strong winds, hailstorms and Lightning in Mityana District

4.13 Vermin's and wild animals

It was noted that vermins are persistent in butanyunja, malangala and kalagalo and Busimbi. Most of the vermin's are monkeys from degraded forest fragments. Kakindu sub County in Mwera and Nsambya parishes were noted as the hotspot as many cases of monkey invasions have been reported.

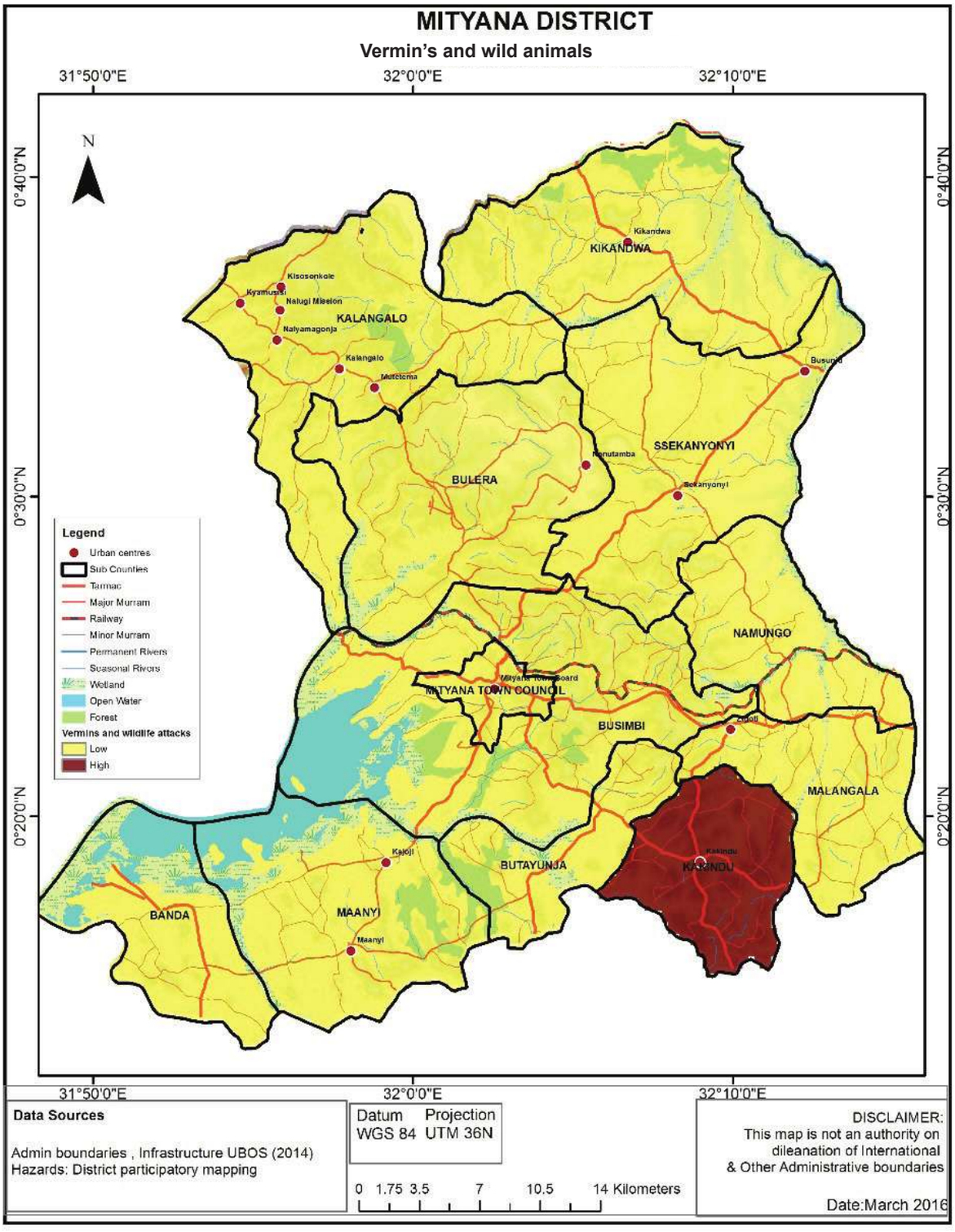

Figure 15: Vermins and Wildlife attacks in Mityana District

4.14 Bush fires

It was noted that bush fires are only used during preparation of land for agriculture and in Kikandwa were cattle keepers' burn bushes to get new grass for their cattle, bush fires occurrences are high. Crops and pastures affected including loss of property.

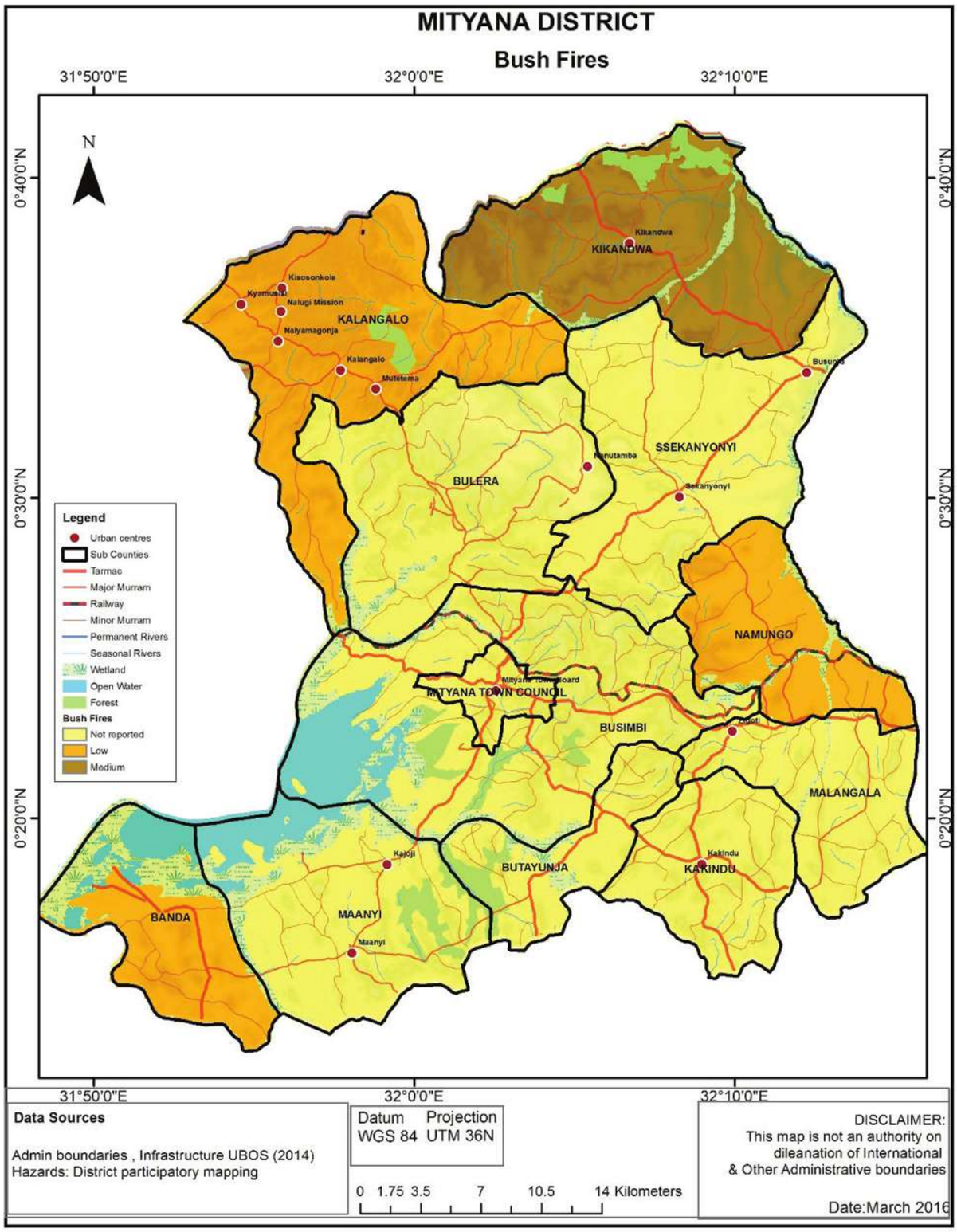

Figure 16: Bush Fires in Mityana District

5.0 Gender and age groups of most affected by the hazards

Malaria, HIV& AIDS and rabies affects mostly children, drought affects all age groups although women and children are mostly affected since they are the ones who fetch water and are always engaged in agriculture, crop pests and diseases affect men because they are the ones engaged in digging in wetlands and near forests, land conflicts mostly affected although all age groups and gender are affected as well, bush fires mostly affect men, environmental degradation affects all gender and age groups and road accidents affect children and men as they are riders and drivers of most motor cycles and cars.

6.0 Coping Strategies

Hazard	Coping strategies in Mityana
Drought	Sensitization of local communities on timely planting and water for production; Dissemination of weather forecast in time (got from metrological center) for better planning; Training farmers in pasture conservation and preservation; construction of valley tank for water harvesting for example in Kiryokya Parish (Kalangaalo Sub county) using District funds and one valley dam in Luwunga Parish (Kikandwa S/C) by MAAIF.
Landslides,Rock falls and Erosion	Sensitization on proper and defensive mining and good farming practices
Hailstorms	Sensitization of communities to engage in planting trees and other agro forestry plants; District officials communicating to OPM for food relief and building materials.
Lightning	Sensitization; Lightning arresters are now included in the Bills of quantities for Government buildings like schools and health Centres.
Crop pests and Diseases	Sensitization on multidisciplinary control measures; MAAIF and UCDA have supported the district with chemicals.
Livestock pests and Diseases	Sensitization; Vaccination
Human disease out breaks	Sensitization; Vaccination, use of condoms and mosquito nets
Vermin and Wildlife animal attacks	Sensitization; Restoration of central forest reserves which are natural habitats for these vermin's and wildlife.
Land conflicts	Avoiding private land brokers, conmen and sensitizing the general public about the right channels to follow when handling land issues
Bush fires	Sensitization
Environmental degradation	Creating alternative sources of livelihood ; Agroforestry and Restoration of Central forest reserves.
Road accidents	Roads need to have clear road signs and road users especially drivers and riders trained and sensitized how to use the roads being mindful of other users

Table 1: Coping strategies for hazards in Mpigi district

7.0 District Vulnerability Analysis at District level

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 2: 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 and diseases	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, Hailstorms and Lightning	Participatory mapping at District Level
	Earthquake	Participatory mapping at District Level
Lack of Adaptive Capacity	Market Access	Joint Research Centre
	Poverty Index	Multi Criteria Poverty Index from DHS

7.1 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.

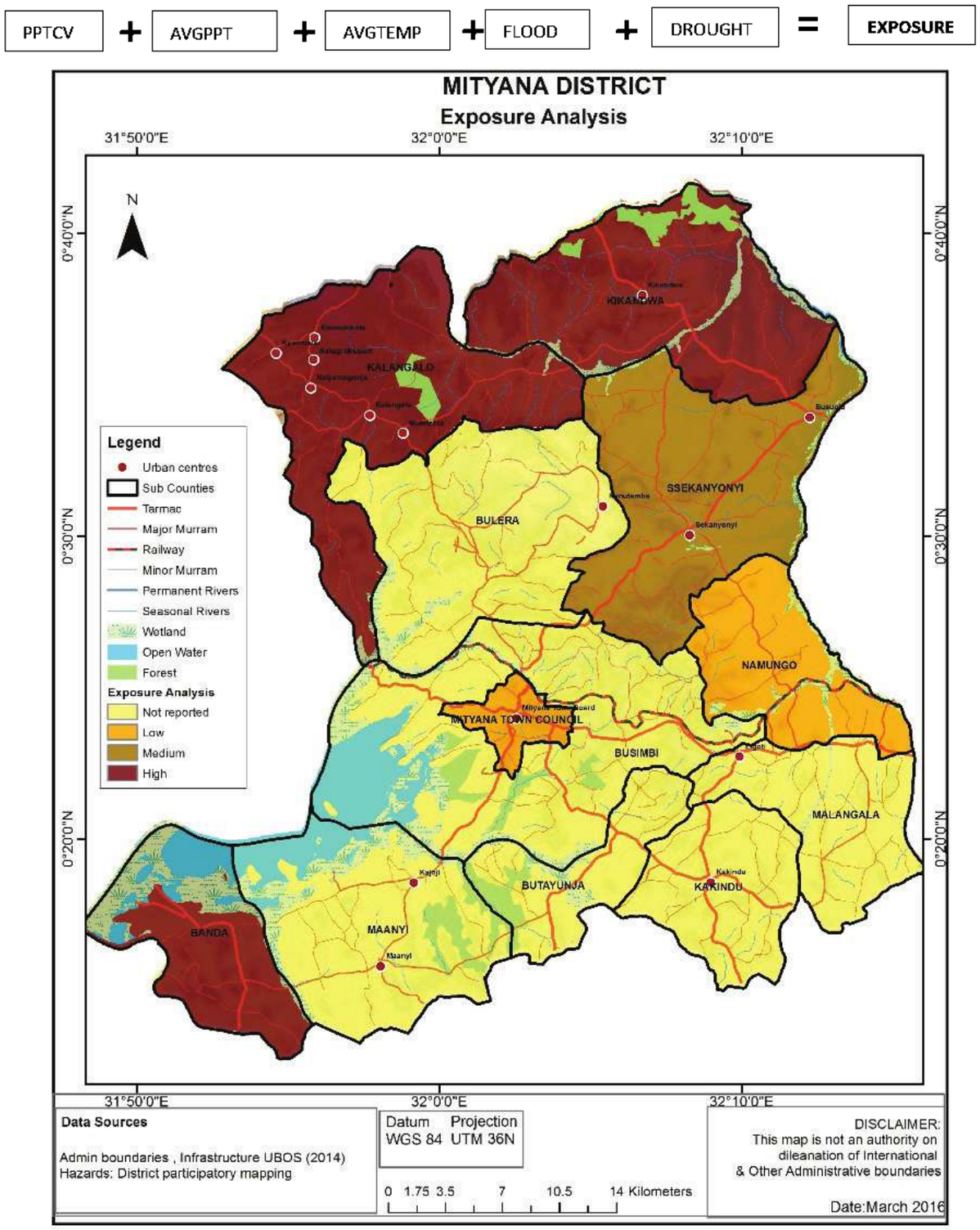

Figure 17: Exposure of climatic conditions in Mityana District

Mityana's exposure to climate stressors was influenced by variation in precipitation and a reduction in annual average rainfall. Kalangalo and Kikandwa areas having the highest levels of exposure to climate stressors.

7.2 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.

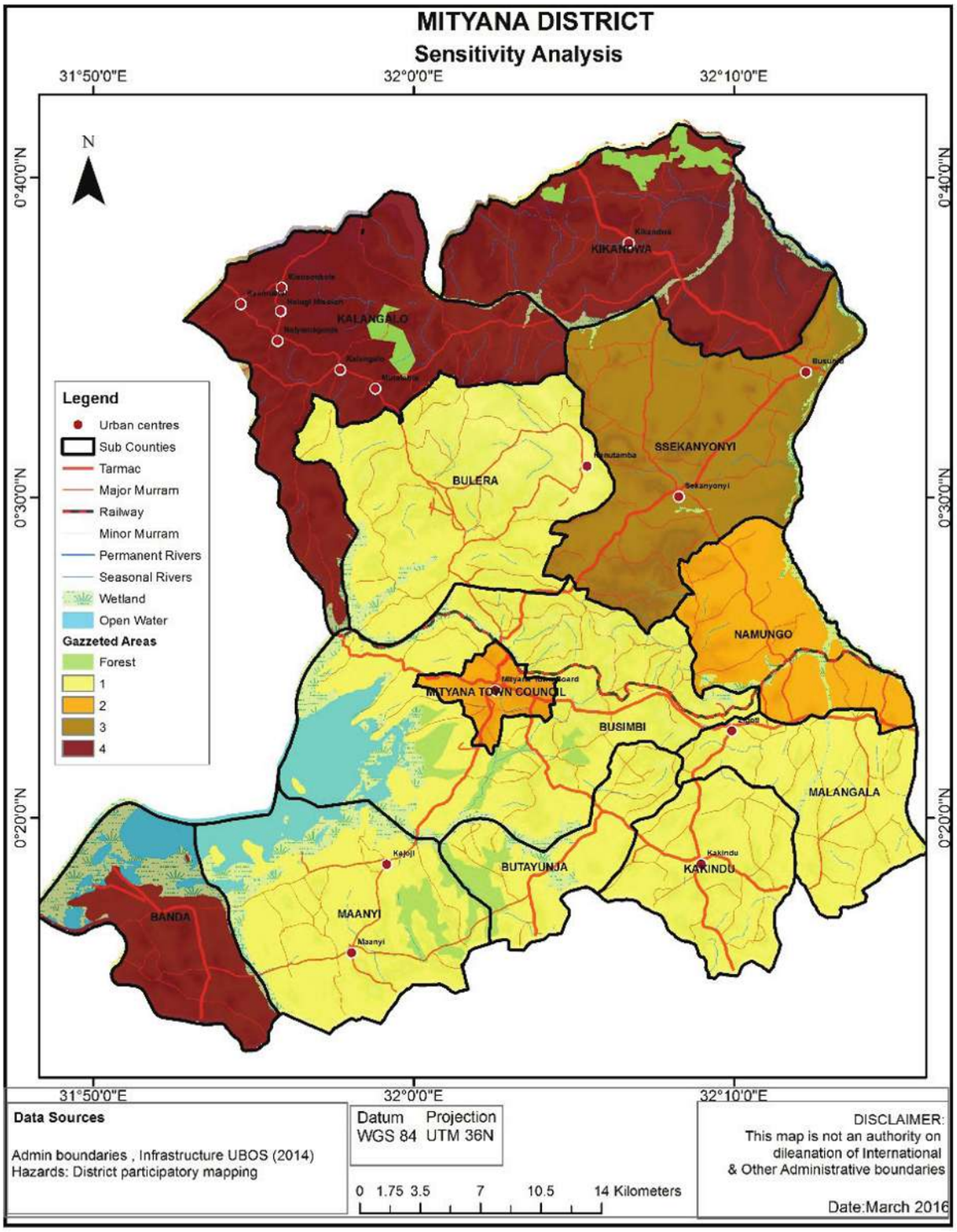

Figure 18: Sensitivty of stressors in Mityana District

Accidents and environmental hazards informed the sensitivity of Mityana to hazards. Kikandwa, SSekanyonyi and Busimbi displayed the highest level of exposure to the hazards

7.3 Lack of Adaptive Capacity

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

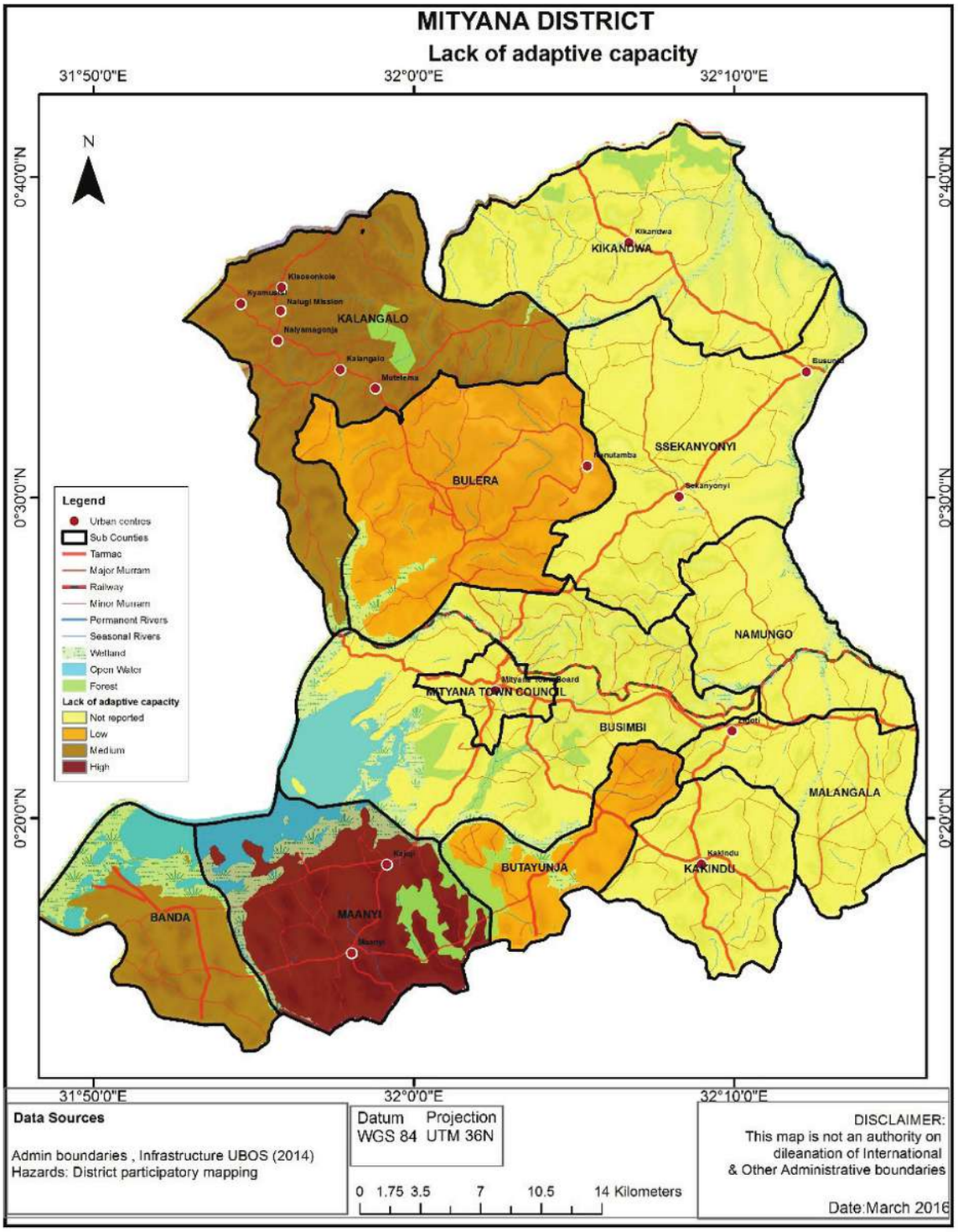

Figure 19: Lack of adaptive capacity in Mityana District

Both market access and poverty index influenced the capacity of Mityana to adapt to the shocks from climate stressors and other hazards. Due to low access to markets and moderately high poverty levels, Maanyi has the lowest capacity to recover from climate stressors and hazards.

7.4 Vulnerability assessment

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

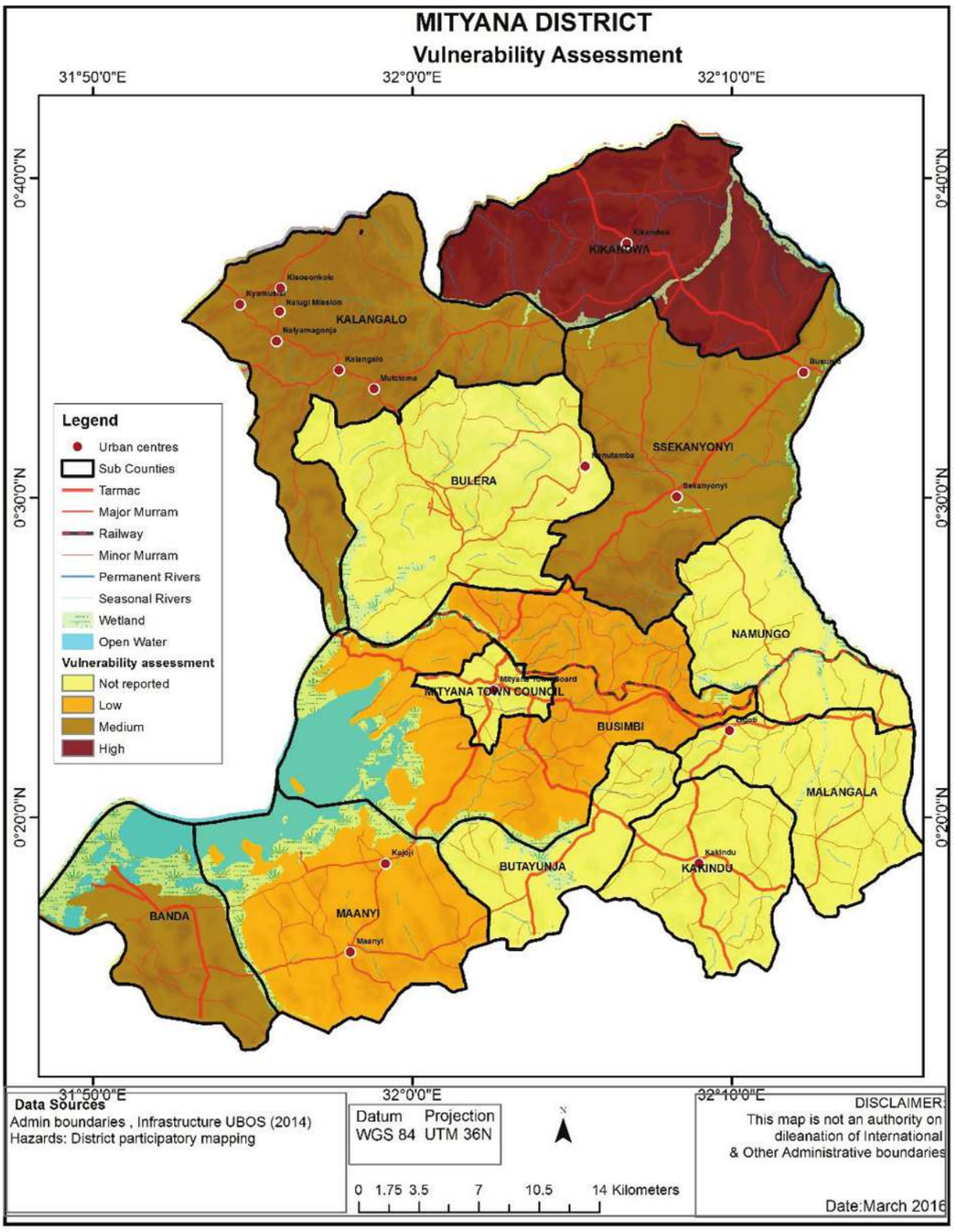

Figure 20: Vulnerability assessment of Mityana District

Kikandwa was the most vulnerable sub county in Mityana due to being highly exposed to climate stressors and having the lowest capacity to adapt.

8.0 General Conclusion and Recommendations

8.1 Conclusions

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.

8.2 Recommendations

Floods

- Swamp raising during road construction
- River training and bridge construction
- Construction of trenches and bunds near wet lands

Drought

- Promoting water and soil conservation technologies
- Pasture conservation and preservation
- Digging dip wells
- Promoting irrigation
- Promoting Agro forestry
- Tree planting along the roads in the reserves.

Land Slides

- Restore pits excavated during stone mining
- Continuous sensitization
- Construction of lined pit latrines
- Reforestation of hilly areas

Erosion:

- Promoting soil and water conservation measures
- Promoting water harvesting
- Agro forestry

Strong Winds:

- Promoting tree planting and Agro forestry

Hail Stoms:

- Agro forestry

Lightning:

- Including Lightning arresters in all public, institutional and private buildings

Crop Pests And Diseases:

- Promoting best agronomic practices
- Quarantine

Livestock Pests And Diseases

- Promoting best husbandry practices
- Quarantine

Human Disease Out Breaks:

- Sensitization
- Immunization

Vermin And Wild Life attacks

- Restoration of degraded central forest reserves to provide a habitat for wild life
- Land Conflicts:
- Land reforms
- Sensitization of communities about land laws
- Operationalization / revitalization of Local council courts
- Encourage people to make wills.

Bush Fires

- Sensitization and Enforcement
- Environmental Degradation:
- Demarcation of wet land boundaries and forest reserves
- Restoration of degraded central forest reserves and wet lands
- Providing alternative livelihood for wet land and forest encroachers
- Sorting waste by providing enough garbage banks
- Buying landfills for every urban centre.

Road Accidents

- Sign posts
- Promote defensive driving

Annex I: Hazard risk assessment in sub-counties within Mityana district

Hazard	Sub-county											
	Banda	Kikandwa	Bulera	Sekanyonyi	Busimbi	Mityana TC	Maanyi	Butayunja	Kakindu	Malangala	Namugo	kalangalo
Floods	L	N	N	N	N	N	L	N	N	N	L	L
Drought	M	H	L	L	L	L	L	L	L	L	L	H
Rock falls	N	M	N	H	M	N	N	N	N	N	N	M
Erosion	M	H	L	H	M	L	M	L	L	L	L	L
Strong winds	M	M	M	M	M	M	M	M	M	M	M	M
Hailstorms	M	M	M	M	H	M	M	M	H	H	M	M
Lightning	M	H	H	M	H	M	M	M	M	M	M	M
Crop pests and Diseases	H	H	L	H	H	L	L	L	M	M	L	L
Livestock pests and Diseases	M	H	H	H	H	M	M	H	H	M	H	M
Human disease outbreaks	M	M	M	M	M	M	M	M	M	M	M	M
Vermin and Wildlife animal attacks	L	L	L	L	L	L	L	L	H	L	L	L
Land conflicts	H	H	H	H	H	H	H	H	H	H	H	H
Bush fires	M	H	L	L	L	L	L	L	L	L	M	M
Environmental degradation	H	M	H	H	H	M	H	H	M	M	M	H
Earthquakes and faults	L	L	L	L	L	L	L	L	L	L	L	L
Road accidents	L	M	M	M	H	H	L	L	L	M	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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