THE REPUBLIC OF UGANDA

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

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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

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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

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 Mpigi 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.

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 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 andl ocal 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 andTeso,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 Profile for Mpigi 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.”

1.5 Structure of the Report

This Report is organized into six Sections: Section 1 provides introduction on the assignment. Section 2 elaborates on the overview and the Multi-hazard, Risks and Vulnerability profiles of Mpigi District. Section 3 focuses on the methodology employed. Section 4, elaborates the Multi-harzad, Risk and vulunerability profile. Section 5 coping strategie for Mpigi District. Section 6 discusses the vulunerability analysis of Mpigi District and Section 7 discribes the conclusion and policy related recommendations.

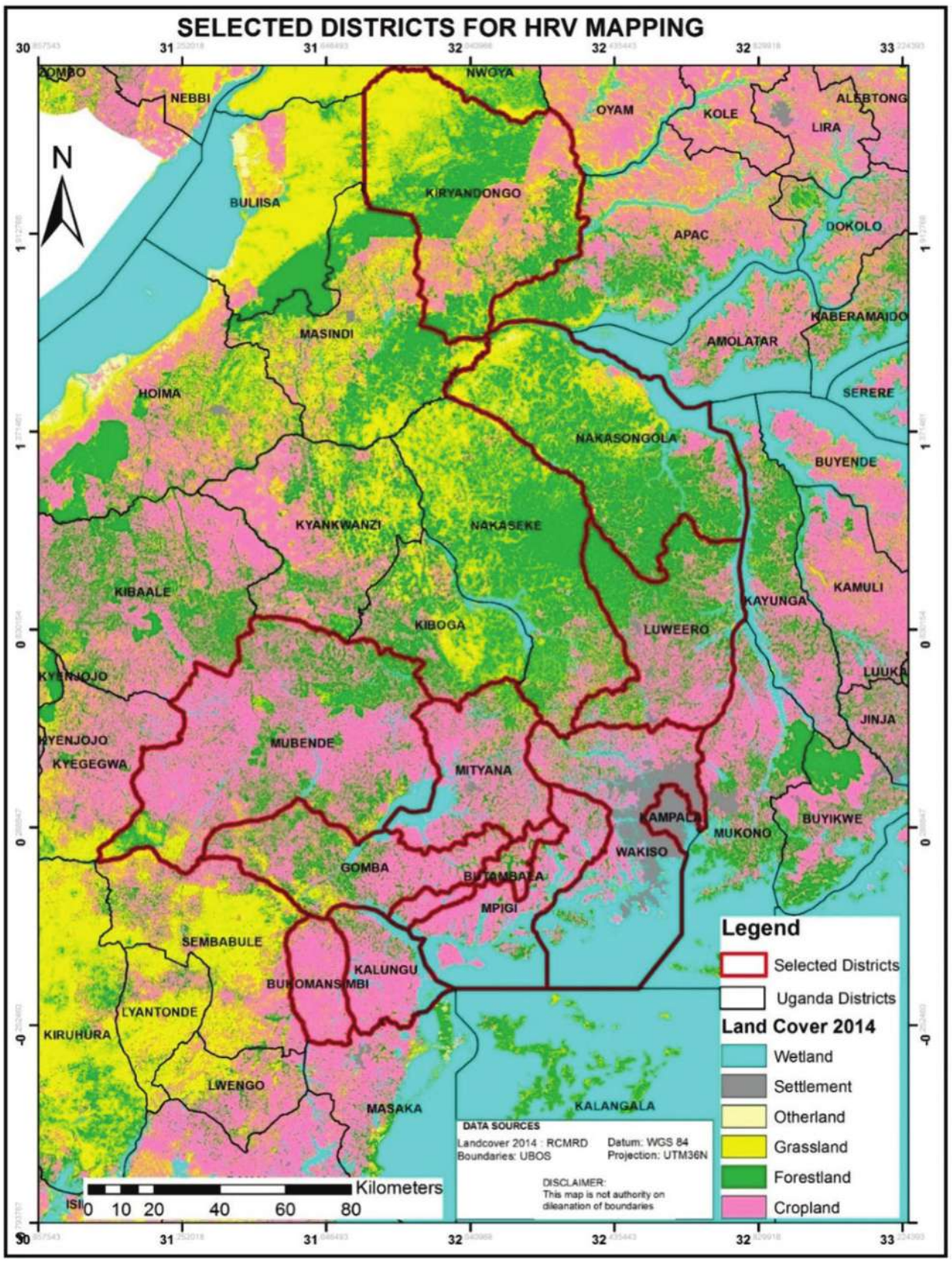

Figure 1: Location of the study area

2.0 Overview of Mpigi District

The current Mpigi District consists of one county which is divided into two constituencies namely Mawokota North and Mawokota South. Mpigi District is made up of seven Administrative Units; there are Six Sub Counties and one Town council. It has a total of 56 Parishes and 339 Villages. The town of Mpigi, where the district headquarters are located, lies approximately 37 kilometres (23 miles), by road, west of Kampala, Uganda's Capital city. The coordinates of the district are: 00 14N, 32 20E.

Mpigi District is one of the districts of Uganda situated in the Central Region of the country, often referred to as Buganda Region. The district boarders with the Districts of Wakiso in the North East and East, Mityana in the North, Butambala in West and North West, Kalangala and Lake Victoria in the South and Kalungu is to the Southwest. The District lies on the shores of Lake Victoria, the largest fresh water lake on the Continent of Africa. The Equator, a natural spectacular phenomena traverse the district at Nabusanke in Nkozi sub-county and River Katonga One of Uganda's longest rivers that Joins Lake Victoria to Lake George traverses the district in Nkozi Sub County. Mpigi district covers an area of 1,541.13 square Kms which is about 0.07% of the country size. The district lies in the central plateau of Uganda comprising of flat topped –undulating hills with deeply incised valleys. Hills summits range between 1100m-1400 meters above sea level. These hills form part of the catchment for both seasonal and permanent wetlands that drain most low lying areas.

2.1 Geology

The underlying geology comprises mainly rock of Precambrian age that are highly weathered. The most dominant rocks being of the Buganda-Tooro system. The topography and geology provides abundant gravel and rock resources used in construction. The district has a variety of iron deports, stone debris, Murrum and clay soils. Soils are mainly of the Buganda Catena and are combinations of clay and sandy loams resulting in sandy clay loams. The soils are relatively fertile and favorable for crop production. Most soils however require soil engineering and vegetative soil conservation. Soils on hills tend to be thin and unsuitable for cultivation and are therefore mainly used for grazing under natural vegetation. Due to the various soil types, different crops seem to have obtained niches, for instance in Nkozi Sub County, the sandy soils have traditionally supported the cultivation of water melon while in Budde and parts of Kibibi, soils have facilitated large scale cultivation of ginger.Poor farming practices continue to resulted in loss of fertility in most parts of the district thus reducing productivity.

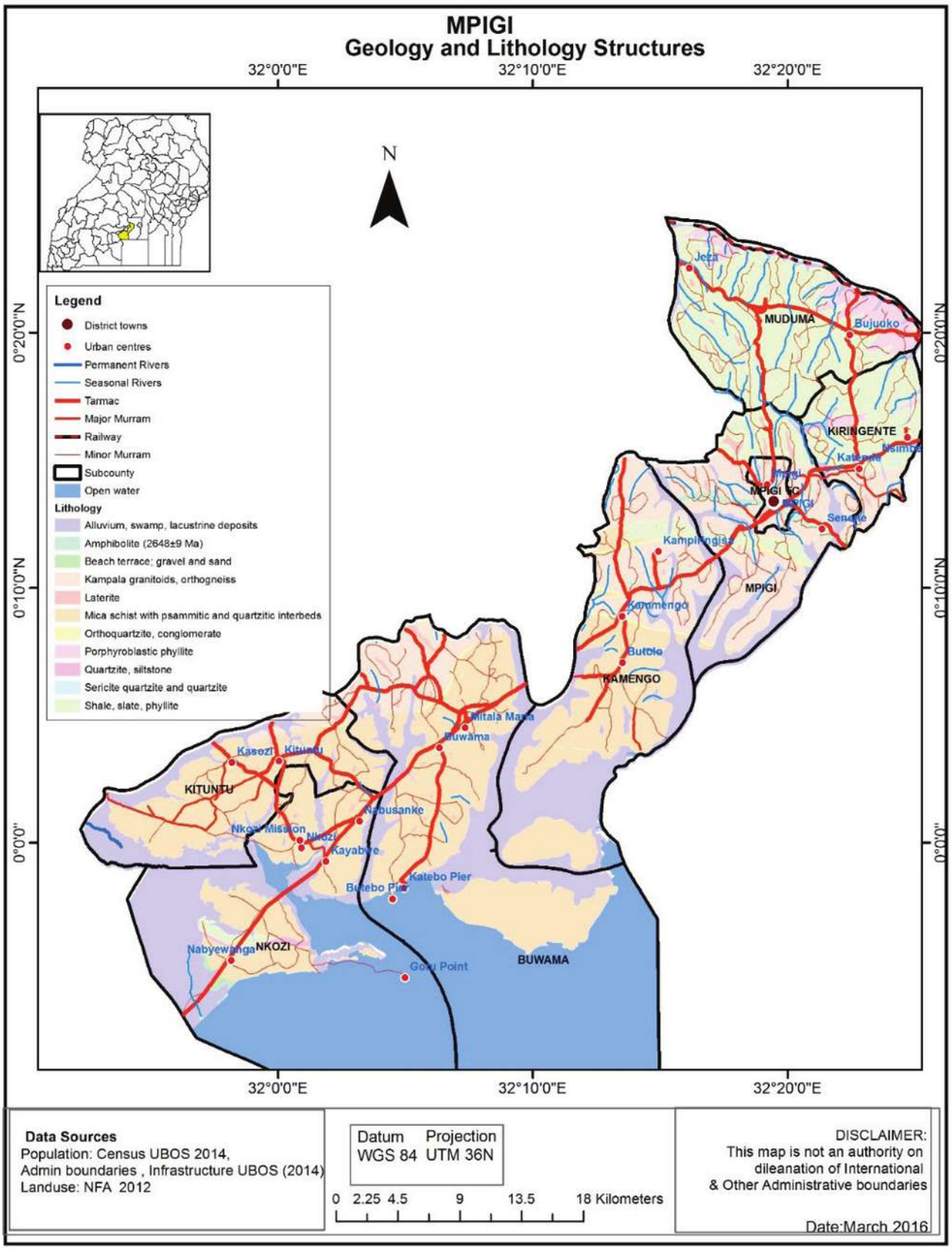

Figure 2: Geology and Lithology structures of Mpigi District

2.2 Vegetation and Landuse stratification

About 90% of the people in the district live in rural areas and depend on agriculture (subsistence). The District has a total land area of 3075.7 km^2 of which 1025 km^2 is arable land. With an average rainfall of 1320 mm p.a. and temperatures ranging between 20-30^{o}c, the district has favorable climate for agriculture and the area under crop cover is approx. 37.5%. Land cover is a combination of tropical high forests, wetlands and arable land. Wetlands range from forested wetlands to grassland wetlands, while forests are mainly tropical high forests. Wetlands (715 km^2) and forests (~1099.6 km^2) cover a large part of the district. These have traditionally been source of fuel wood, timber, medicines, craft materials, water and food. Common species in the tropical high forests include Antianstoxicaria, *Maesopsis eminii*, Celtis sp., Canarium sp., Bosqueia sp., Pyaranthus sp., Albizzia, Prunus sp, Fantumia sp. Piptadeniastrum sp., Pseudospondias sp., Sapium.

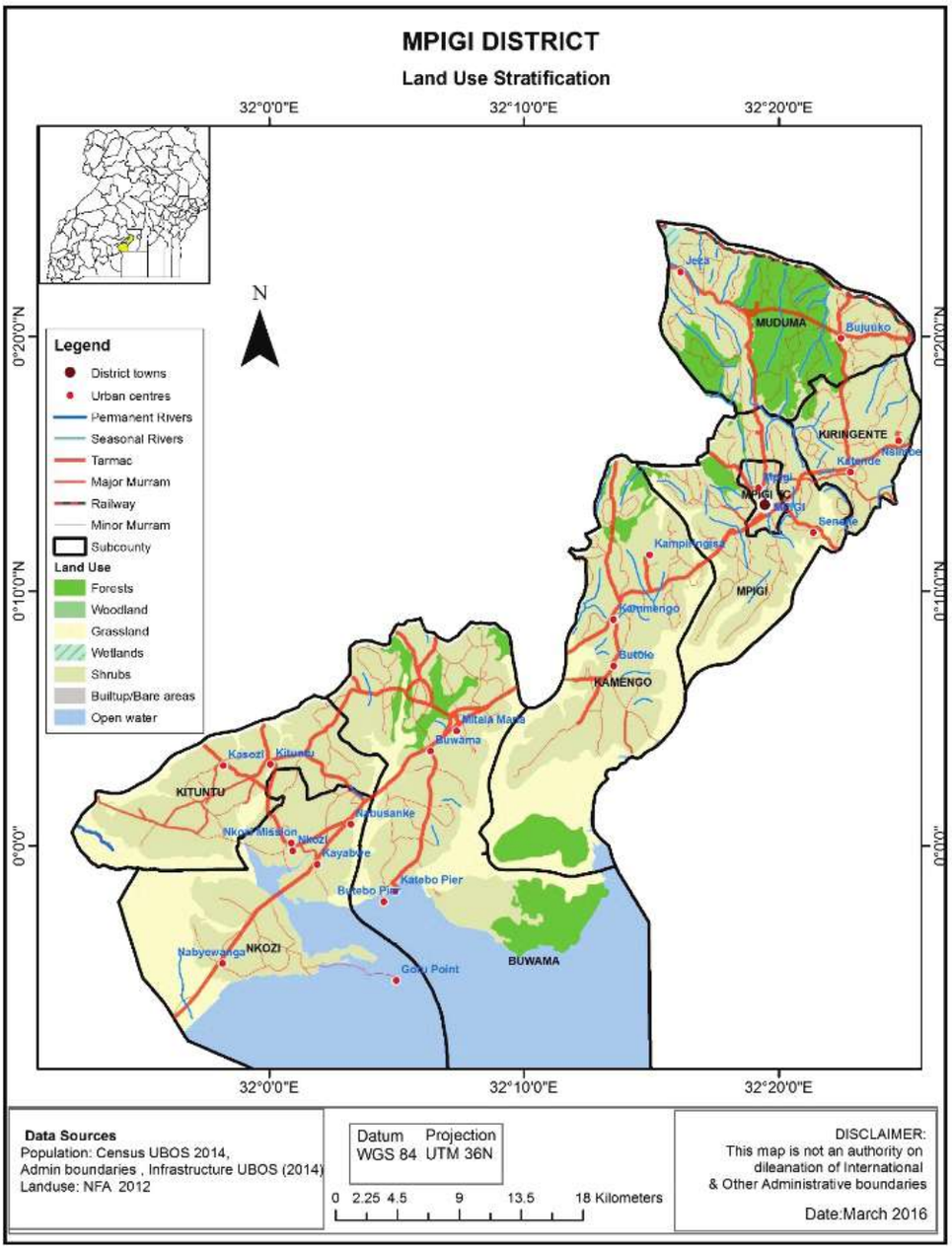

Figure 3: Land use stratification of Mpigi District

2.3 Climatic Conditions; Rainfall, Temperature, Humidity and Winds

The District experiences a bi-modal rainfall pattern with first rains occurring between March and May and second rains coming between September and November with an average rainfall amount of 1320 mm though in many areas around the Lake zone it is between 1750mm and 2000mm. Mpigi District has an average annual maximum temperatures ranging between 22.5^{0}C and 27^{0}C. Average relative humidity ranges between 80% and 95% especially in forest areas. The average monthly days of rainfall are 11. The minimum temperature in the district is 11^0 C while the maximum recorded is 27 ^{0}C.

2.4 Demographic Characteristics

According to the National Population and Housing Census 2014 Report, Mpigi District has a Population of 215,500 comprising of 125,314 males and 126,198 females, the household size in 4.1 and the annual population growth rate stands at 2.44%. The district has a population density of 163 persons per square kilometre and the children account for 57% of the population.

Table 1: Population of Mpigi district per subcounty

POPULATION					
SUBCOUNTY	AREA IN SQ KM	PARISHES	MALES	FEMALES	TOTAL
BUWAMA	203	10	23,800	22,600	46,400
KAMMENGO	170	08	17,500	17,200	34,700
KIRINGENTE	68.7	05	7,600	7,200	14,800
KITUNTU	113.5	07	11,600	11,300	22,900
MPIGI T/C	125	11	19,400	20,000	39,400
MUDUUMA	160	07	12,400	11,800	24,200
NKOZI	166	08	16,300	16,800	33,100
TOTAL	1006.2	56	108,600	106,900	215,500

Source: UBOS 2014

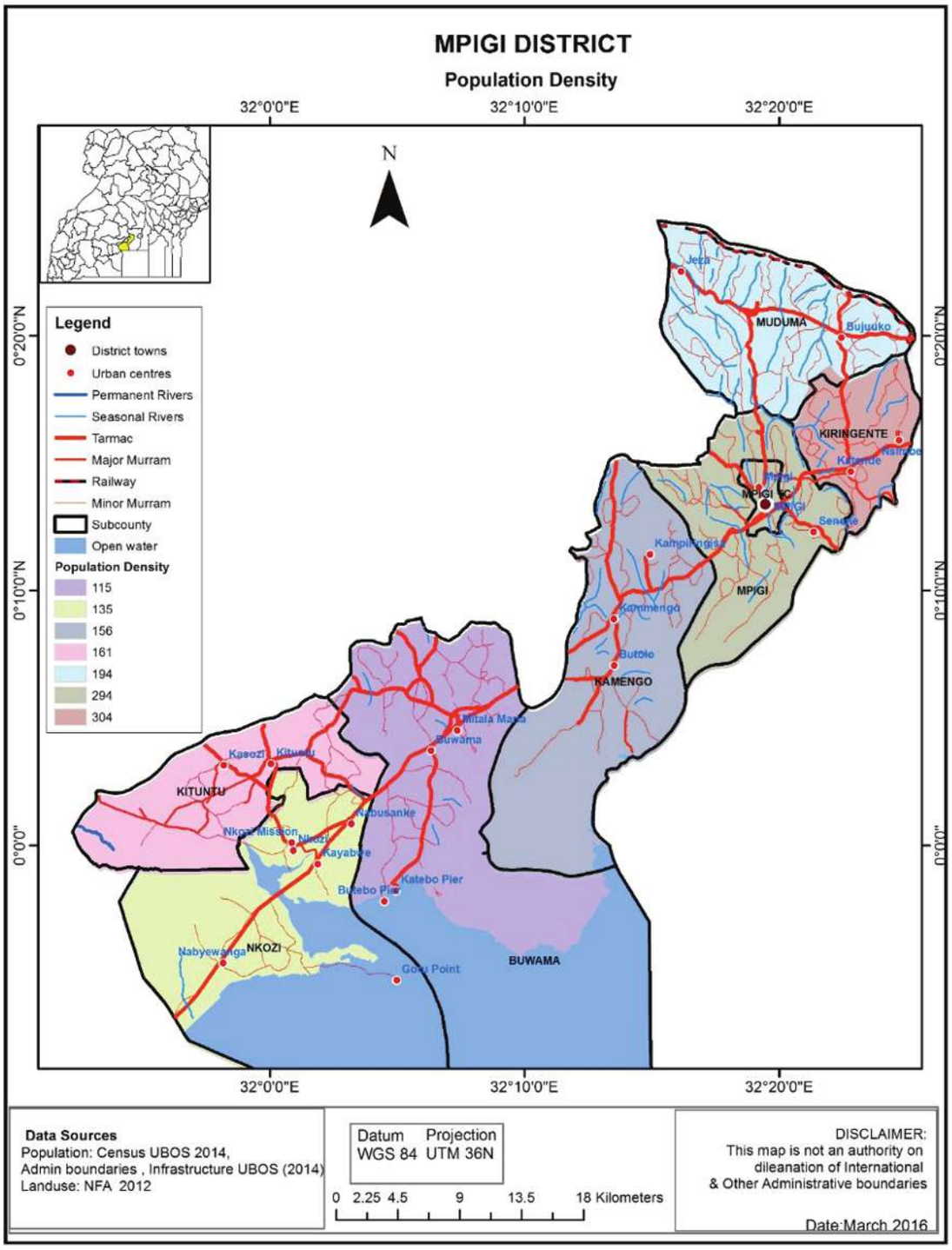

Figure 4: Population of Mpigi District

2.5 Main economic activities

The economy of Mpigi District is agro-based dominated by a few major sectors, with crop farming and livestock production being the key major sectors. Coffee and bananas are the main crops grown all over the district however there has been a steady increase in production of maize, and other crops including beans, sweet potatoes and vegetables. Fishing along the shores of Victoria is also a major activity.

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.

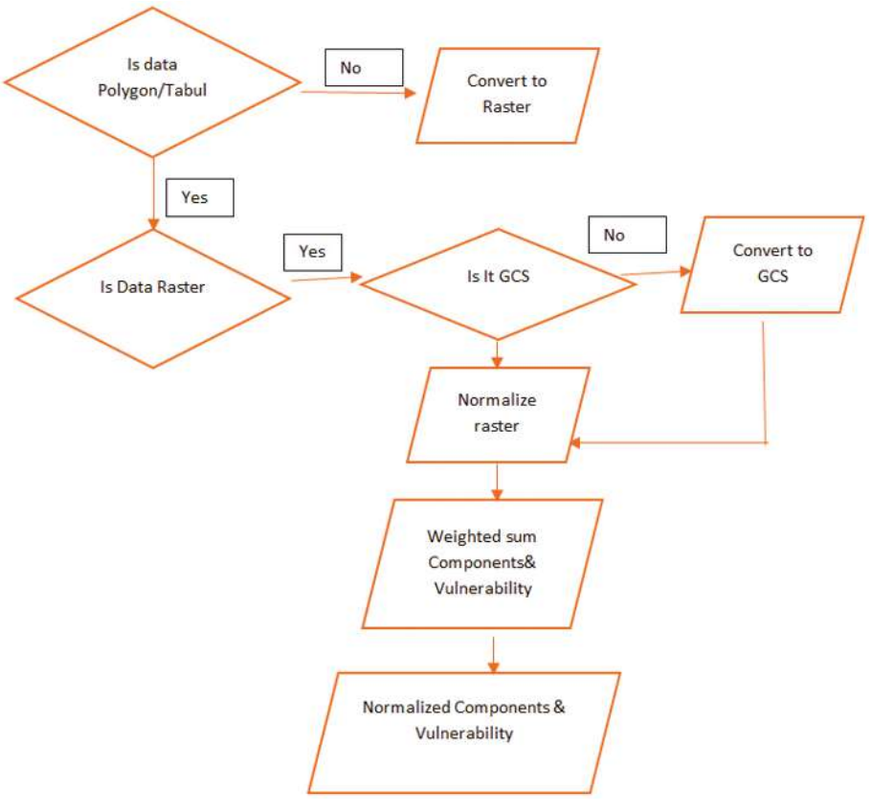

Figure 5: Data conversion work flow

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 Human disease out breaks

Malaria and HIV remain the main epidemics within the district although there have been significant efforts to control spread and impact by government and NGO'S such as distribution of mosquito nets for malaria prevention, counseling and behavioral change sensitization including use of condoms and abstinence for HIV control and preventions.

It was noted that there was a single case for outbreak of Marburg in Mpigi a highly hemorrhagic fever virus whose source was not clearly identified. However, as a measure to counter such outbreaks, a surveillance team with a special dedicated doctor to monitor any outbreak has been formed.

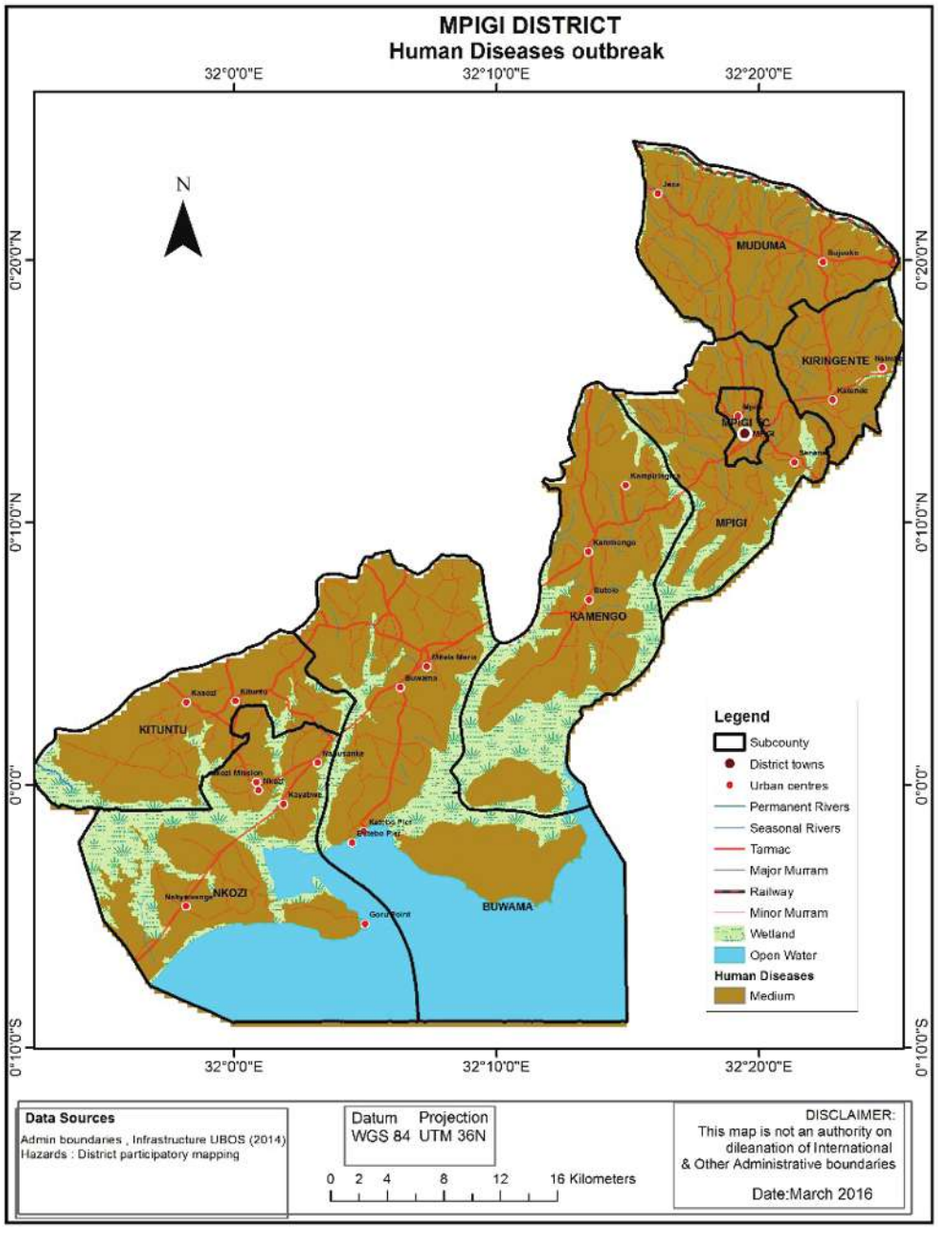

Figure 6: Human diseases outbreak in Mpigi District

4.2 Floods

Floods were noted to be occurring at low levels in the Sub Counties of Buwama, Mpigi Town, Kituntu, Muduuma and Nkozi as streams cause seasonal floods along roads and low lying areas of Nabyewanga in Nkozi. Hotspots are Kiyanja in Maziba Ward in Mpigi Town Council; Mayanja swamp in Lugyo parish-Buyala village Muduuma Sub County; Kinyika Swamp in Kantini parish Kituntu subcounty; Muge parish Lwera, Kamaliba and Nabyewanga villages in Nkozi Sub County. Women, School going children, Youth-male Fish traders are mostly affected by these floods.

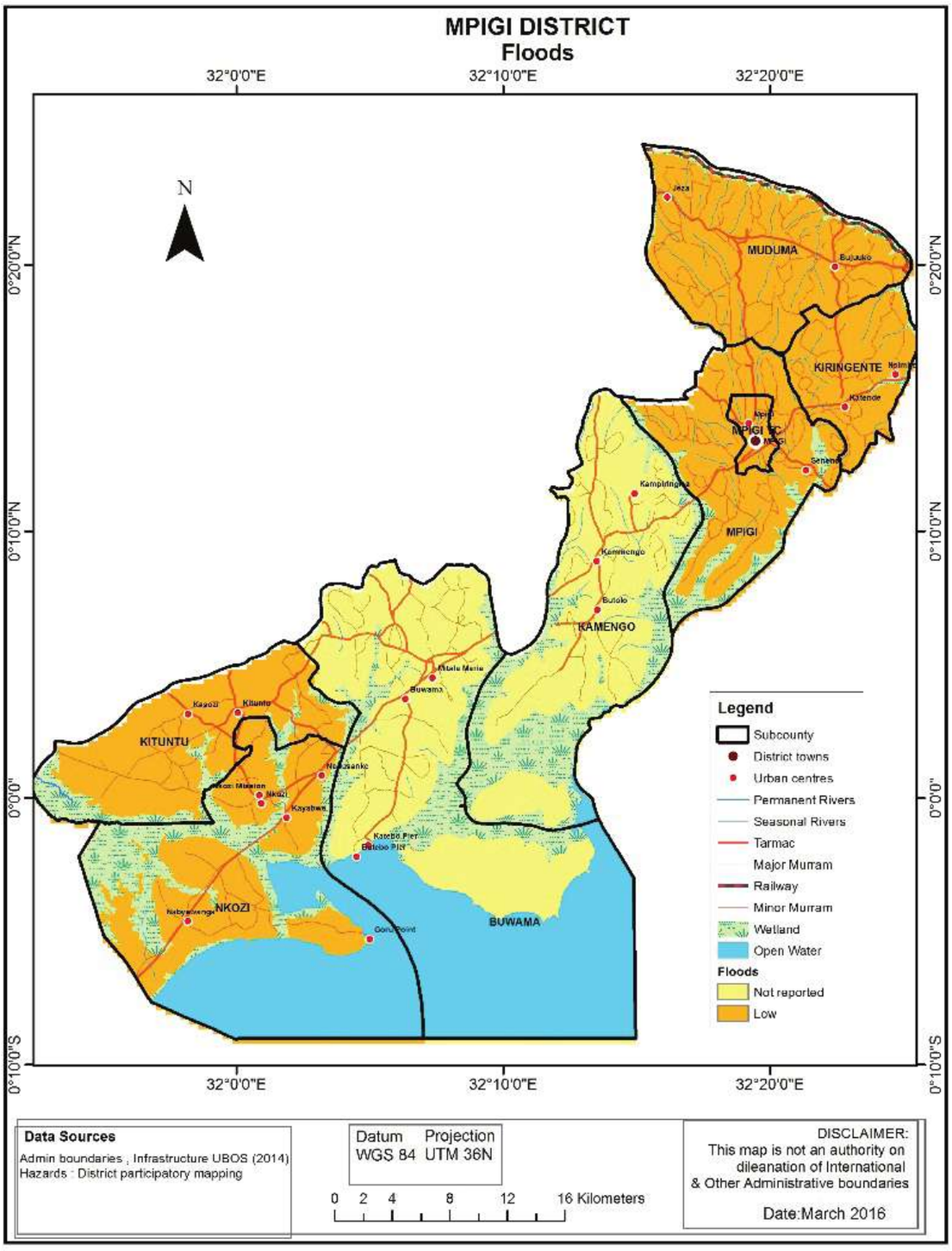

Figure 7: Floods in Mpigi District

4.3 Soil erosion

Soil erosion was highlighted as a result of unplanned development/construction around Kikondo Kaggaba and Kataba. In Mpigi Town Council- run off from Saabwe/Mbale hill, excavated marrum left ballpit at Ward A –Kalagla and other road constructions across Mpigi Town. This affects all gender and age groups.

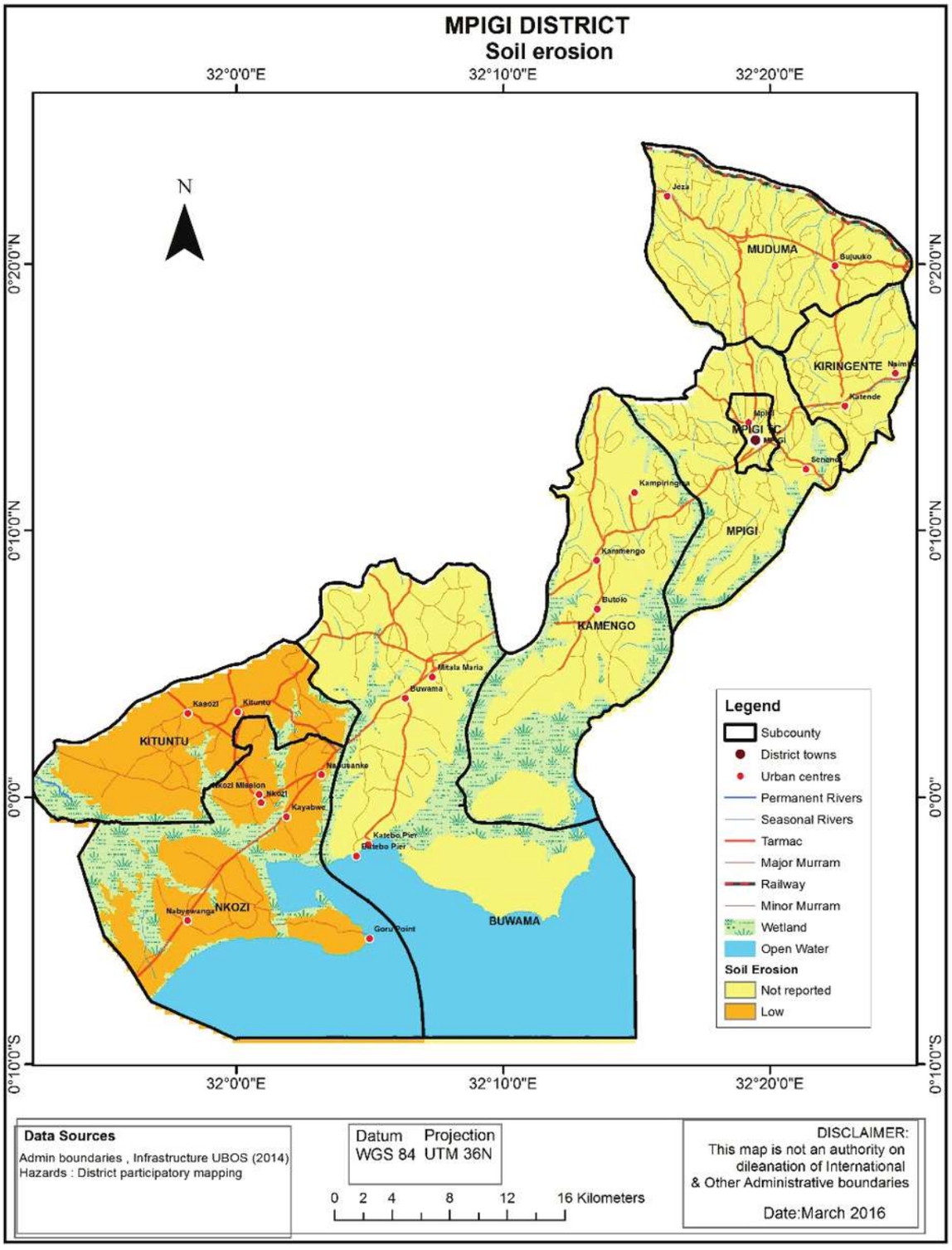

Figure 8: Soil Erosion in Mpigi District

4.4 Crop pests and diseases

The major crop diseases that have become a challenge to farmers in Mpigi district include: Banana bacterial wilt which is severe in the entire district, coffee twig bora which causes all the bearing leaves to dry up is also rampant in the entire district, coffee wilt (this has become manageable with planting of resistant varieties), cassava brown strip virus and cassava mosaic. The issue of fake inputs like maize seeds and chemicals (herbicides) continues to increase the burden and persistence of some of these pests and diseases. Soils have also become over used and become infested with bacteria which are especially affecting crops in the Solanum family such as tomatoes. It was noted that Giant lopper caterpillars have become a serious threat to crops in the district. They normally attack crops round April and May and have been appearing every year for the last 3 years (2013, 2014, and 2015). Although these caterpillars have been in existent for many years in forests, the severe degradation of forests within the district destroyed their original habitats. Caterpillars used to eat leaves in the forest which are no longer available and thus when they hatch in big numbers they attack crops.

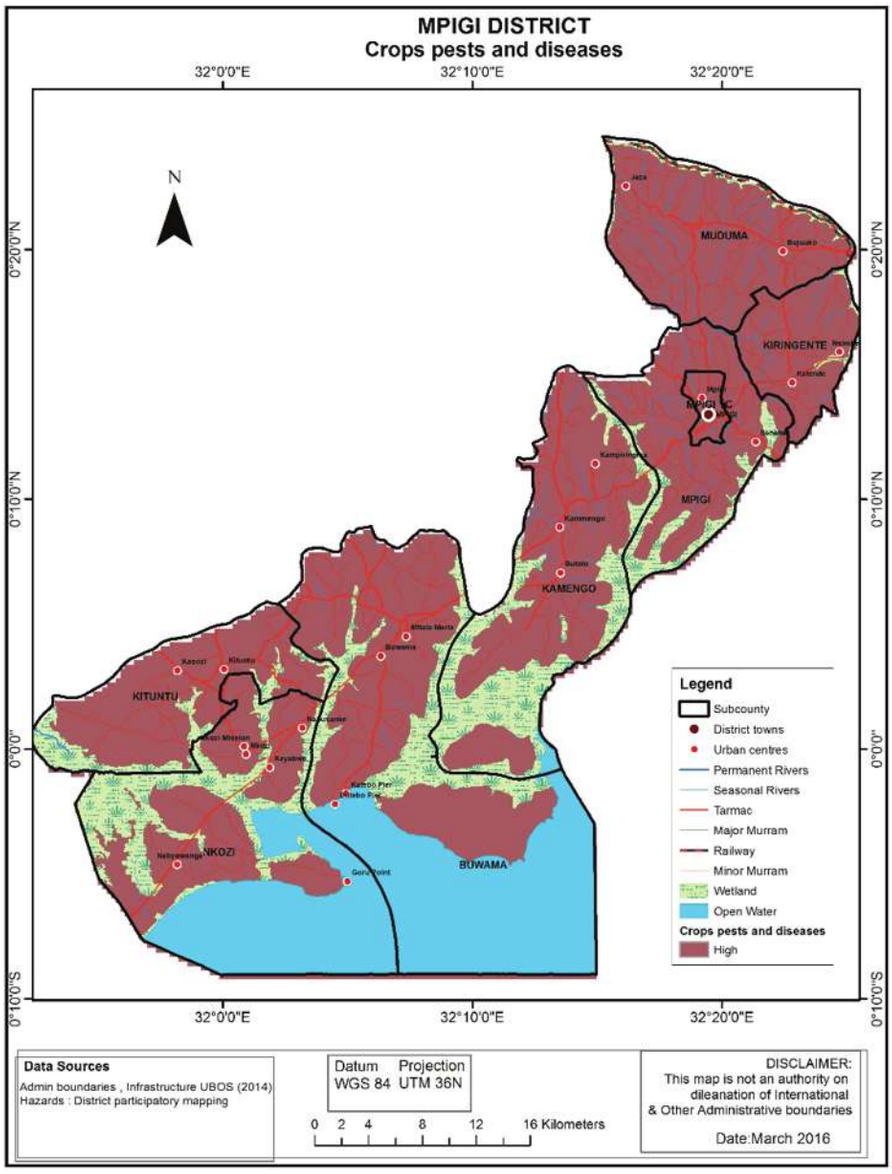

Figure 9: Crops pests and diseases in Mpigi District

4.5 Land conflicts and fragmentation

Due to urbanization, many real estate developers are taking over many parts in the District; it is becoming had to find a big chunk of land in one place for farming which threatens food security. In addition, renting out of land is no longer possible because of land fragmentation. Also because of unclear land policies and tenure system, there is a lot of land grabbing which is fueling up conflicts.

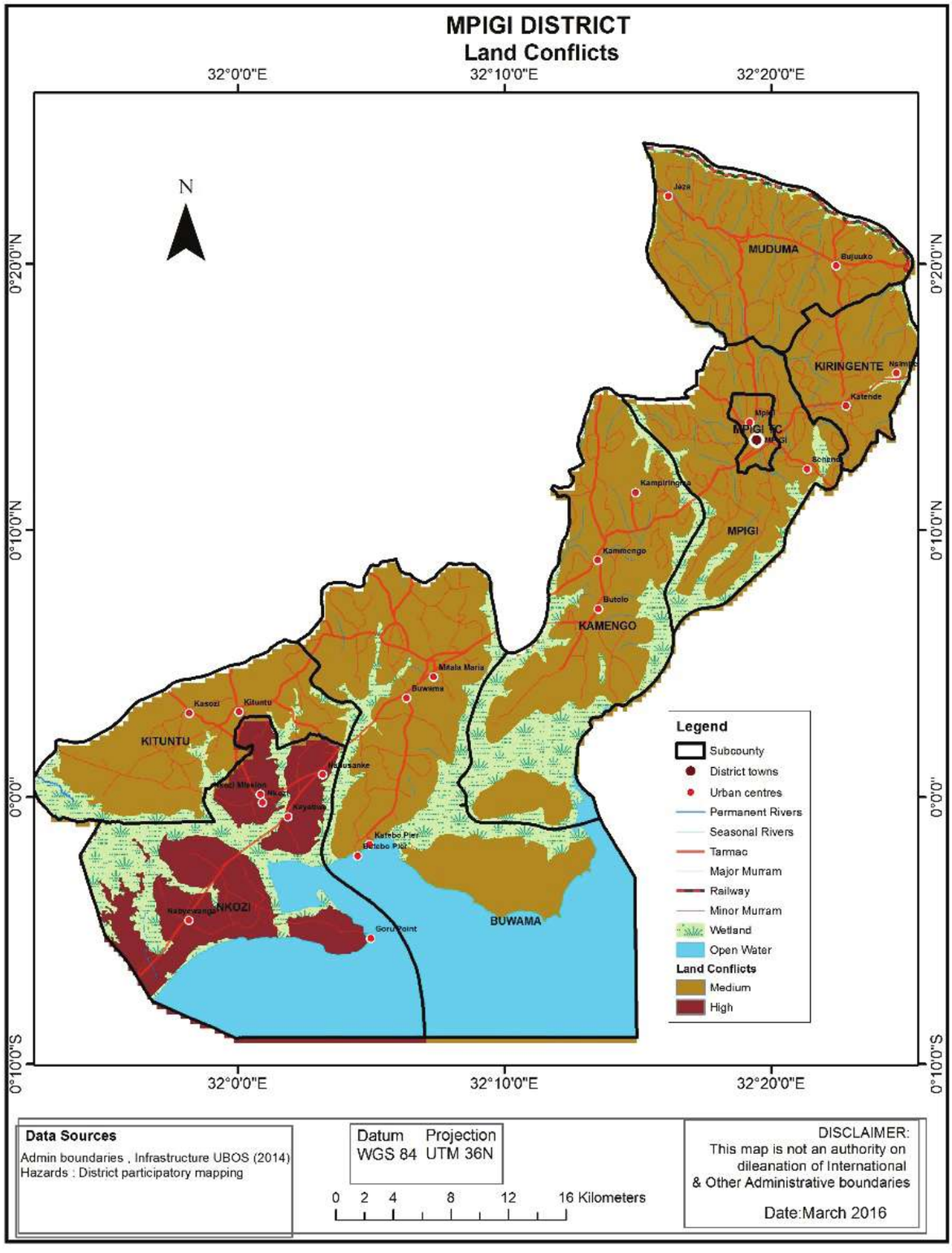

Figure 10: Land conflicts in Mpigi District

4.6 Livestock pests and diseases

African swine fever was noted to be rampant and has no treatment. Mpigi is one of the big pig producers with uncontrollled movement of pigs within the district. It is also an entry point to Kampala market for most pigs produced in western uganda. In addition, reservoirs of this virus still persist is bush pigs in the forest fragments' and swamps within the district making control of ASF difficult. Foot and mouth disease is also of regular occurrence given that Mpigi is an entry route to all cattle destined for Kampala market. This has been controlled by routine vaccination regime programme every year. Out breaks of rabies have also been occurring at least twice in a year. Mpigi Town Council, Livestock pests and diseases are medium because of high prevalence of swine fever. For kituntu, cases reported were not alarming. However, for Muduma it was noted that incidences are high due to high prevalence of Foot and mouth disease cases reported. All gender are affected although women and youth are mostly impacted with children getting malnourished.

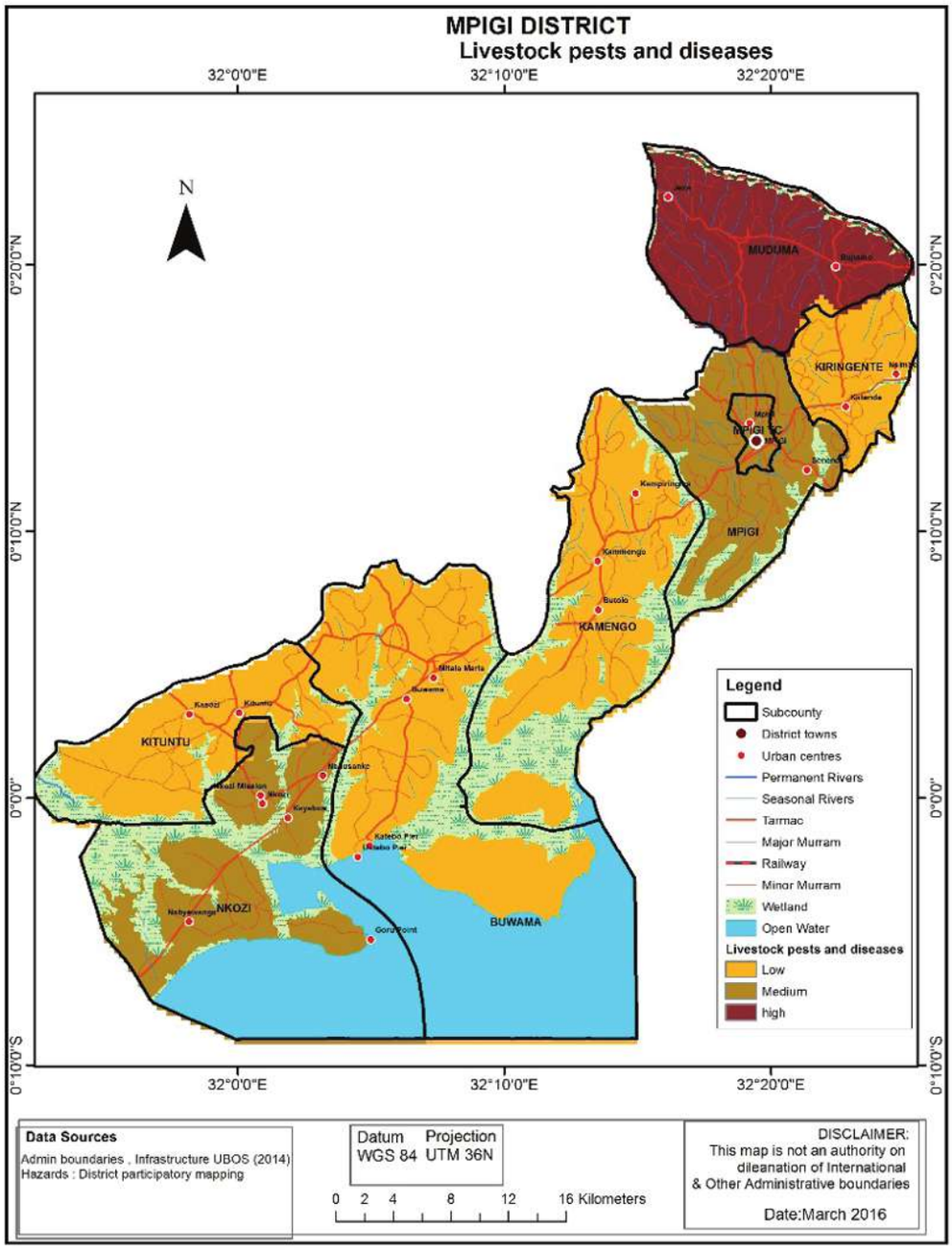

Figure 11: Livestock pests and diseases in Mpigi District

4.7 Droughts/ prolonged dry spells

Mpigi has a relative tropical environment. However, in the sub counties of NKwozi and Kituntu they are often faced with prolonged droughts in the dry seasons which severely affect local food security to the extent that they ask for food assistance. This is probably because of the effect of being at the equator and also because of deforestation. Communities have not taken up irrigation and thus continue to suffer from these severe prolong dry spells.

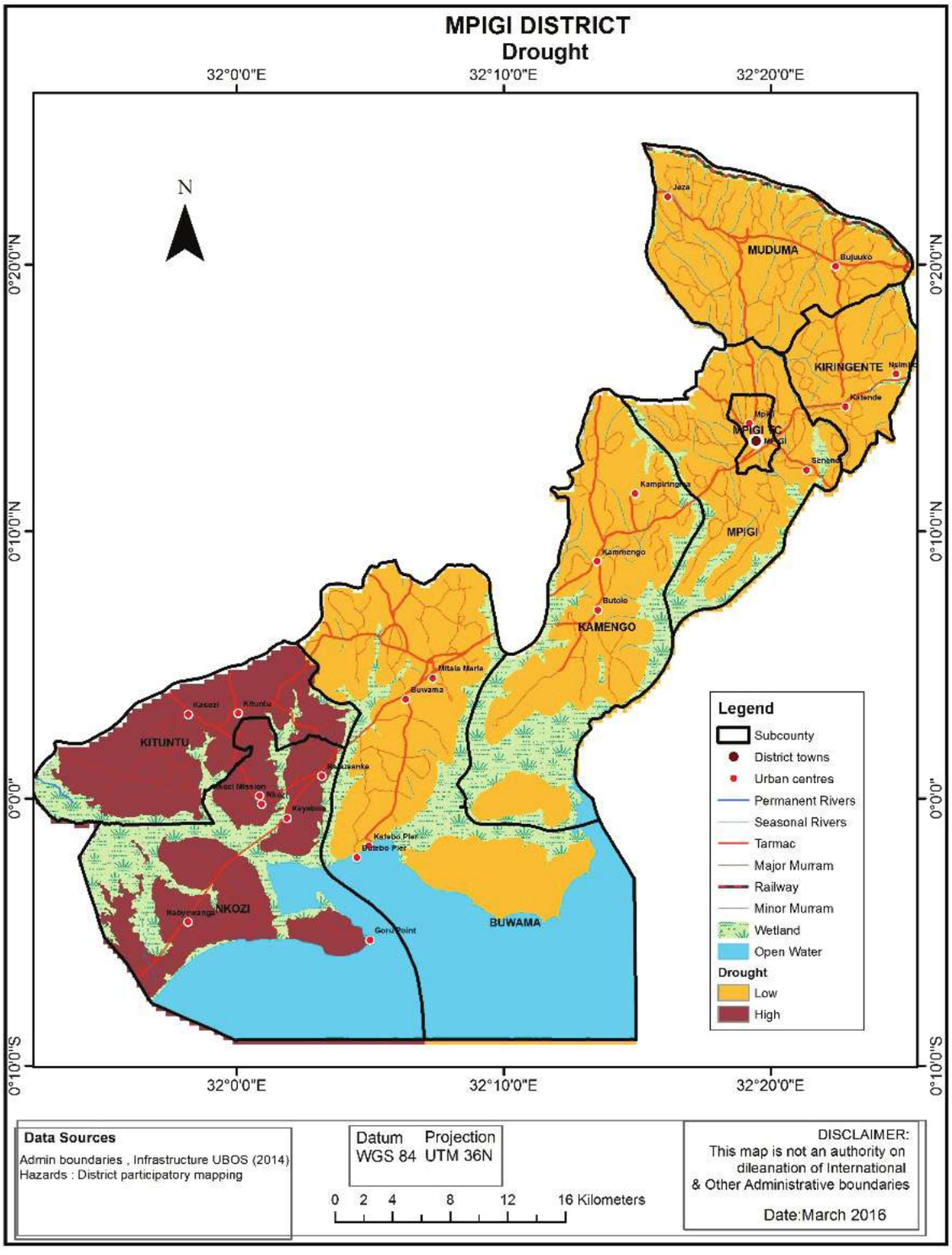

Figure 12: Drought in Mpigi District

4.8 Road Accidents

Mpigi being on the high way to Kampala, it was noted that there are several spots were accident cases are common. Many cases reported are due to narrow and slippery road, reckless driving, sharp corners, poor visibility (morning hours in wetland areas) and lack of road signs and marking Hotspots Buwama subcounty – Mitara Maria and Kalandazzi in Bbongole parish, Nkozi Sub County- Nabyewanga and Lwera in Muge parish, Kammengo Sub County- Kikunyu, Kyansonzi and Kabira in Kyanja Parish, Mpigi Town Council- Kalagala and Mpambire, Kiringente – Kavule and Katende in Kavule parish, Muduuma Sub County- Nswajere in Malima and Wantayi in Tiliboggo.

Water Hyacinth affects water transport, water quality and harbors vectors. Hotspots at Kammengo Sub County- Buvumbo and Sanya landing sites; Buwama- Katebo, Foloza, Kasansala Landing sites; Nkozi- Namirembe, Namugeye, Kiwanga, Nakaziba and Kamaliba landing site were noted.

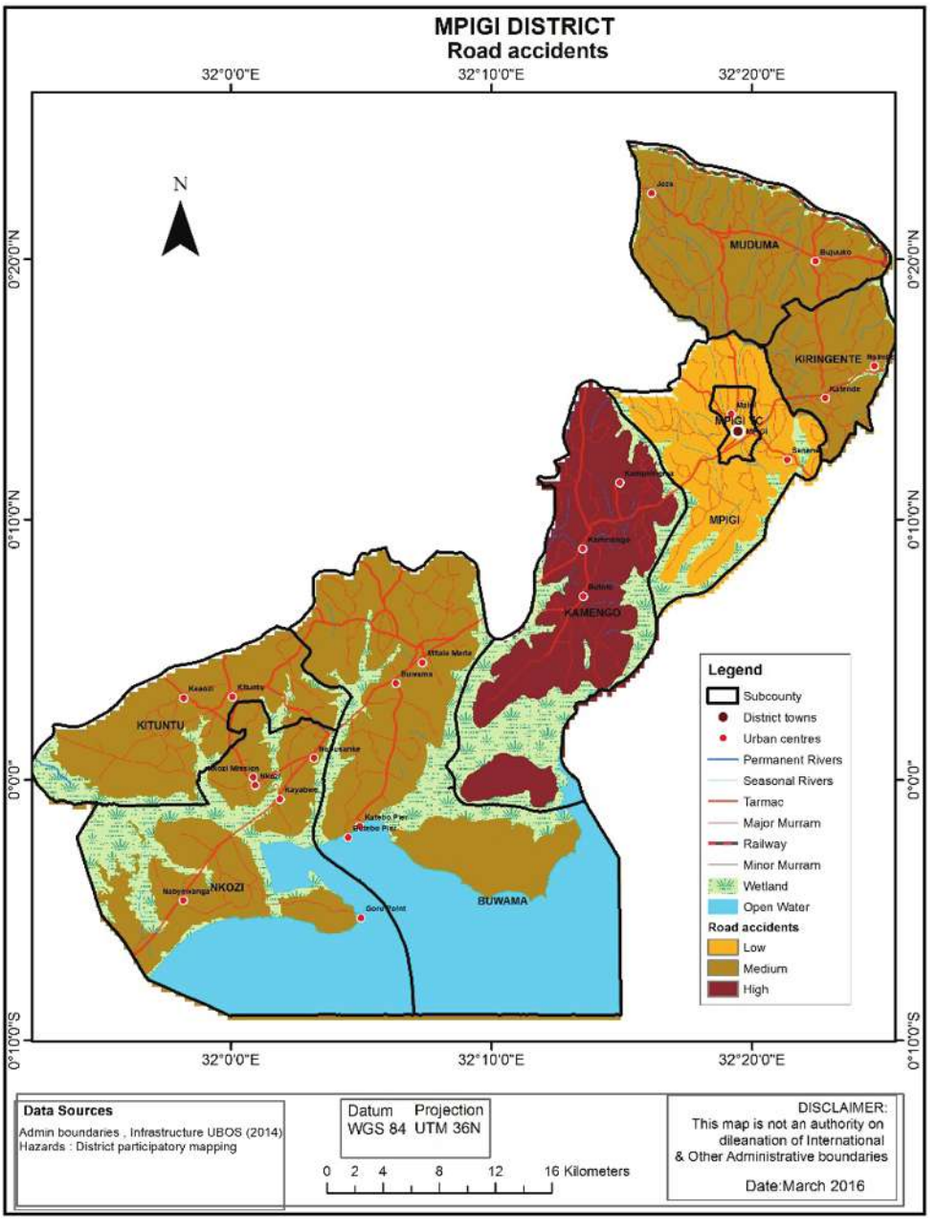

Figure 13: Road accidents in Mpigi District

4.9 Strong winds, Hailstorms & Lightning

It was noted that strong winds appear at the end of the dry season although at low levels in most parts of the district. Hailstorms regularly occur in all parts of the district although Muduma Sub County was heavily hit in 2013 and 2014. Lightning incidences are common and normally occurs annually around September when the rains are about to start.

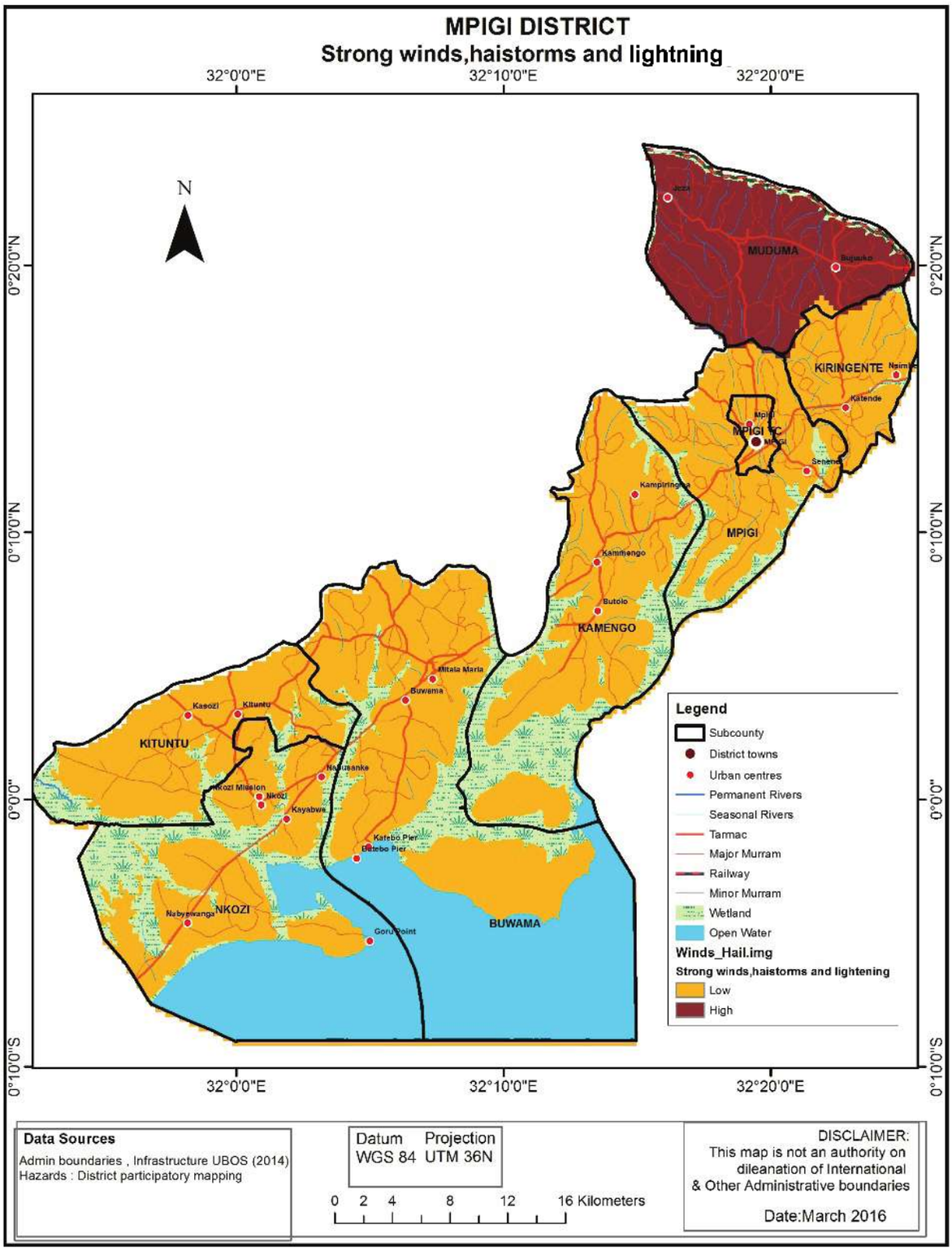

Figure 14: Strong winds, hailstorms and Lightning in Mpigi District

4.10 Environmental degradation

Wetland reclamation and deforestation were highlighted as the main environmental issues. Waste management especially in the emerging urban town centers was also noted to be a challenge were they just dump in wetlands. Katonga river catchment has also been encroached on and water levels of the river are going down because of the encroachments.Mpigi district has lost most of its forests with remarkable deforestation in the sub counties of Muduma, Bujuko where scoters settled on forest reserve land. For Kirigente, Kyanja and Kamengo, deforestation is mainly due to industrial developments. Unplanned urbanization which is creating a lot of slums that could potentially become a big threat to the government infrastructure causing sanitation and crime prevention challenges. Sand mining and stone quarrying: are other potentially hazardous risk that present significant challenges for Mpigi district.

There are several quarries in Lwera Nkwozi subcounty and Bukasa in Kituntu sub-county. This has been an ongoing activity for the last 10years. However, it is increasingly becoming uncontrollable with many big players coming on board without addressing issues of safety measures and standards. In addition, pits left behind present a significant risk as breeding areas for mosquitoes and a hazardous spots for children since they can drown in such places. Run off from such pits could also be a threat to neighbouring families.

Hotspots were identified in Nkozi mostly in the sand mining areas of Nabyewanga, Kamaiba and Lwera in Muge parish, Kankobe stone quarying in Nnindye parish; Kituntu in the sand mining areas of Katindiggo in Kantini parish; Buwama in degraded forest sites in Munyonyo and Kinyinabo Bunjakko parish, Kalandazzi in Bongole/Buyijja parish and Buwere in Nabiteete parish; Mpigi Town Council degraded forest reserve at Mpanga in lwanga Ward, Kkonkoma and Kafumu Ward, constructions on Mbale hill and marrum excavation at Kikondo in Ward A; Muduuma –degraded forest sites in Katuulo and Katonga and Bulamazzi in Mbazzi parish, Bujjuko and Malube in Lugyo parish, Lwamunda and Nswanjere in Malima parish; Kiringente- Brick making at Nakirebe in Kikondo, Sand mining in Luvumbula; Fishing malpractices (beach seining) at landing sites in Buwama and Nkozi Sub counties.

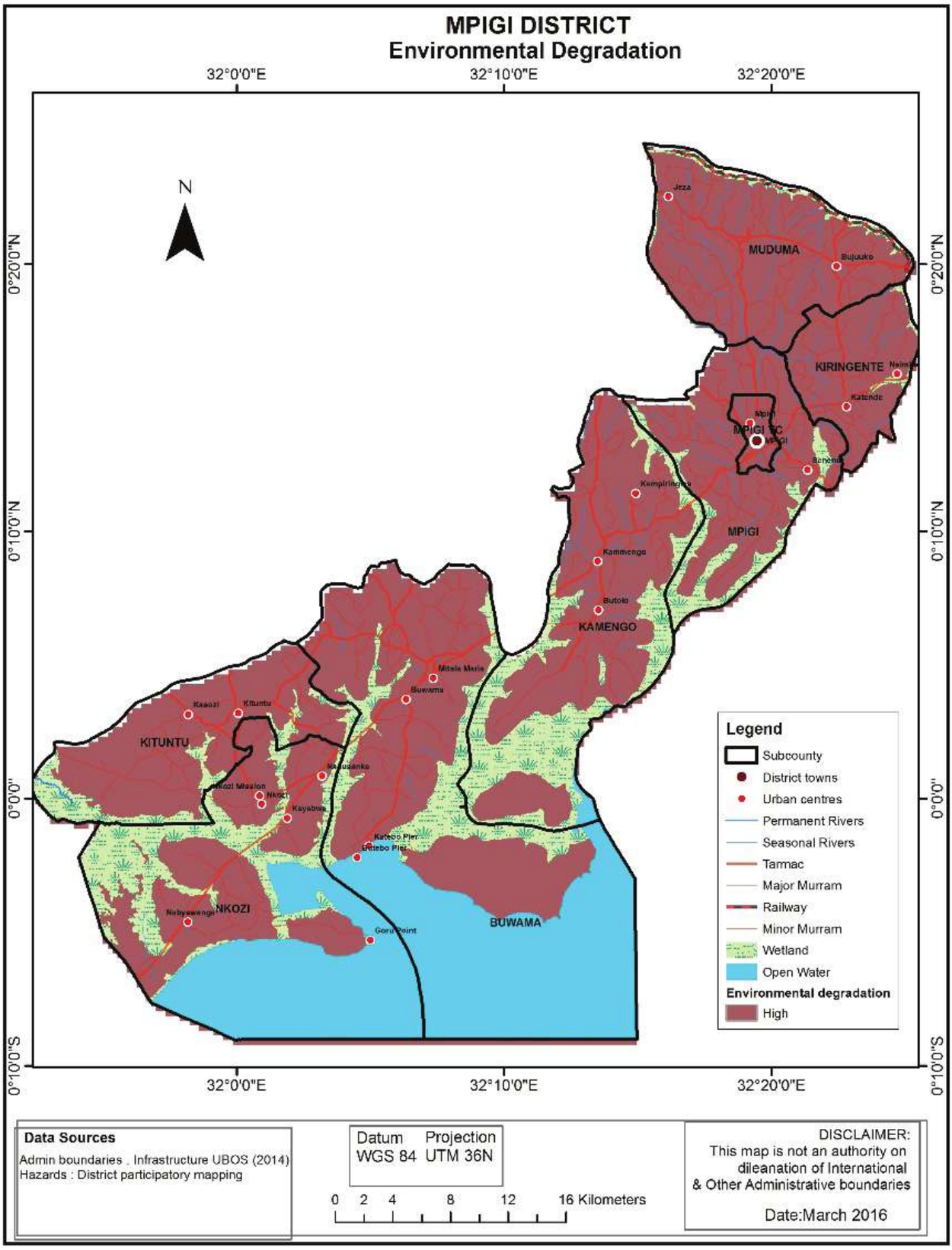

Figure 15: Environmental degradation in Mpigi District

4.11 Vermin's and wildlife animal attacks

Because of deforestation, most monkeys such as red colobus, vervets and black and white colobus have been displaced as their habitats have been destroyed. Crop raiding from these vermin's is a regular occurrence although they continue to poison and trap these monkeys.

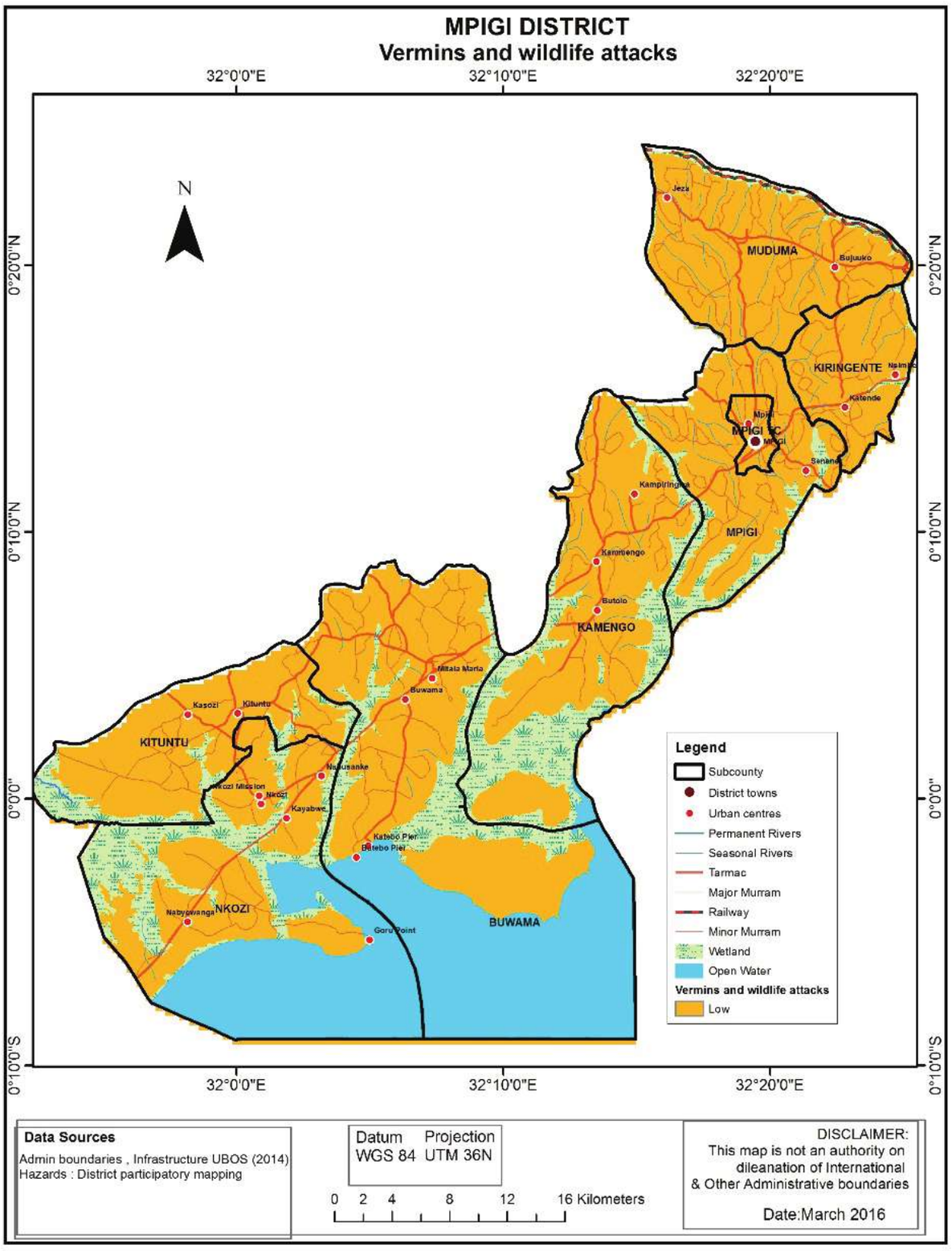

Figure 17: Vermins and wildlife attacks in Mpigi District

4.12 Landslides

There are no known spot in the district for landslides; however, collapsing of pit latrines due to weak soils has been noted in counties of kituntu and Nkwozi.

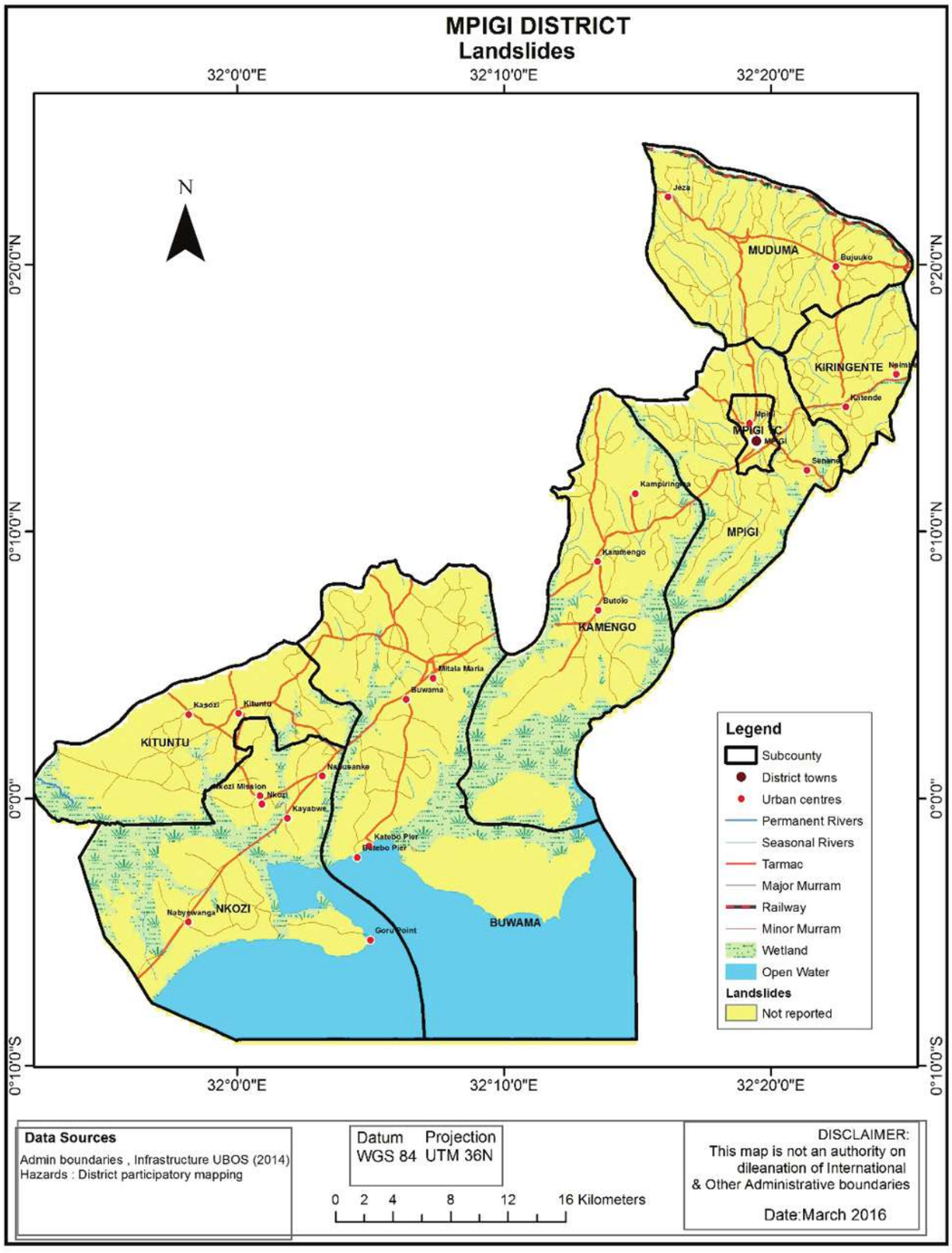

Figure 18: Landslides in Mpigi District

4.13 Bush fires

Bush fires especially in the wetlands were noted to be a common occurrence. In Kintutu Sub County cattle keepers are used to burning grass to have new grass regenerate. Overall bush fires are very low and non existent since holdings are small and there were minimal cases of land fallowing in those sub counties

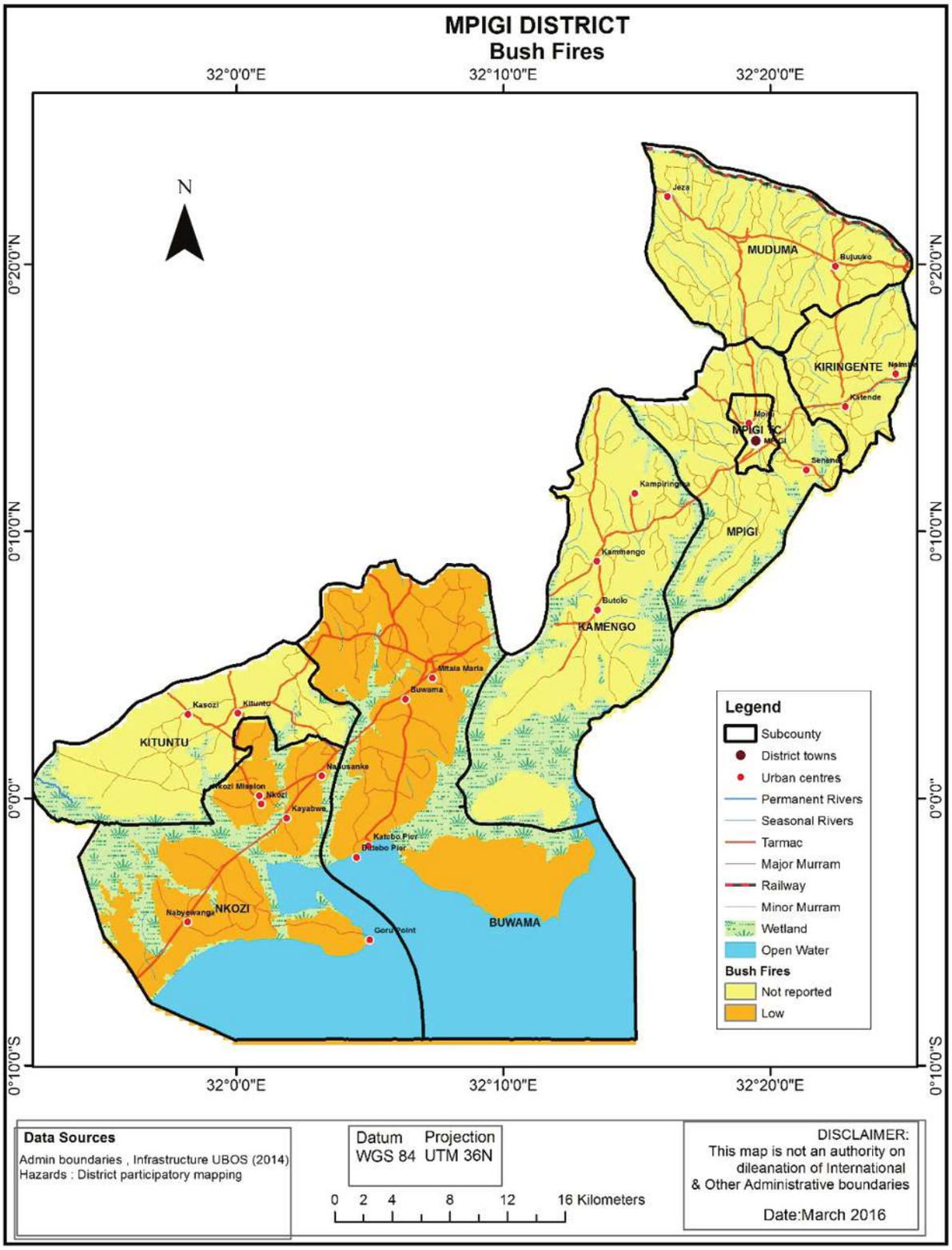

Figure 19: Bush fires in Mpigi District

5.0 Coping Strategies

Table 2: Coping strategies of Mpigi district

Hazard	Rank for the hazard	Coping strategies
Crop Pests and Diseases	1	Gap filling and capacity enhancement for LLGs. Trainings, demonstrations and sensitizations. Plant clinics in all LLGs Distributing improved technologies.
Environmental Degradation	2	Sensitization and Issuing improvement notices especially in sand mining areas. Tree planting campaign in Shoreline protection zone and Katonga Catchment area. Environmental screening of Local Government projects and follow-up to ensure implementation of the recommendations. Construction of energy saving stoves at Schools Compliance monitoring of wetland management regulations.
Livestock Pests and Diseases	3	Trainings, demonstrations and sensitizations. Animal Movement check points manned at Bujjuuko & Lungala. Disease quarantine for FMD and swine fever where reported Routine vaccination. Construction of cattle crushes and bucket spray pumps. A functional laboratory established to handle disease samples. Disease surveillances in all LLGs. Certification and issuing permits to drug dealers. Licensing and Improved technologies distributed. Enhance budget support for certification and extension service delivery
Land Conflicts	4	Mediation between land lords and tenants. Sensitization of communities on land laws. Assisting families in acquiring letters of administration to enable them process land titles. Land office helps to make land searches and surveys before land titles are acquired.
Human Disease Outbreak	5	Massive sensitization and immunization. Staffing at all health centers. Community health outreaches conducted
Road Accidents	6	Repair and servicing of Health Centre V ambulances used during road accidents. Collaborating with area Member of Parliament and district political leadership to secure more ambulance services for the district.
Drought	7	Trainings, demonstrations and sensitizations. Distributing Improved technologies (Drought –tolerant) Construction of water harvesting structures and distribution of treadle pumps. Promoting agro-forestry
Floods	8	Carrying out spot improvements and Installation of culverts along wetlands roads.
Water hyacinth	9	Procureming manual Water hyacinth removal equipment. Water hyacinth campaign and water hyacinth days. Weevil rearing centre for water hyacinth control established at Katebo L/S
Soil Erosion	10	Sensitization and training on good farming practices.
Vermin and Wild life animal attack	11	Sensitization of communities to encourage them to take their animals for vaccination.
Strong Winds	12	Planting trees in some of the degraded areas along the shore line of lake victoria.

6.0 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 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

6.1 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.

PPTCV + AVGPPT + AVGTEMP + FLOOD + DROUGHT = **EXPOSURE**

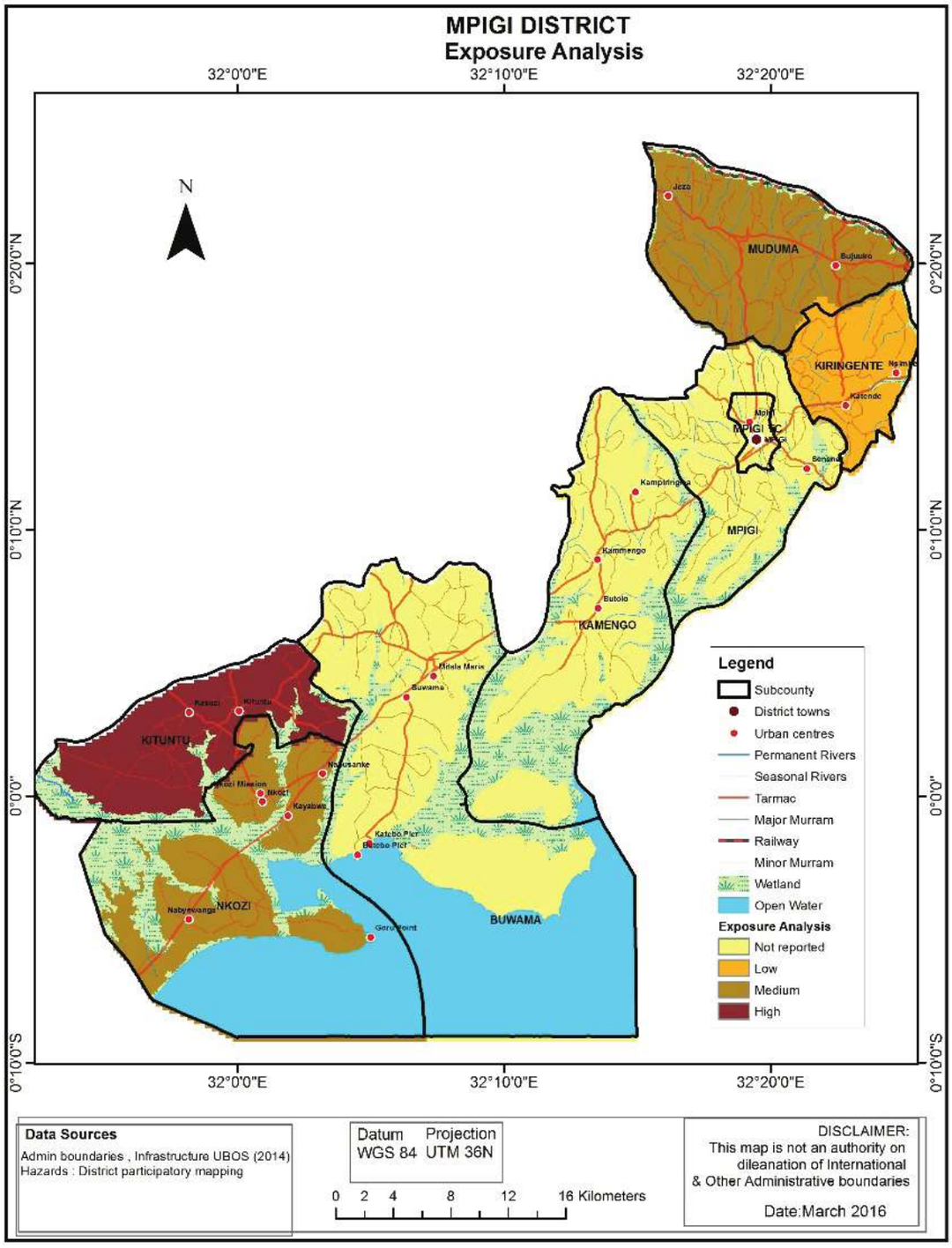

Figure 20: Exposure of climatic conditions in Mpigi District

Drought due to low annual average precipitation and high average annual temperatures influenced the exposure of Mpigi area with Kituntu experiencing the highest exposure levels.

6.2 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.

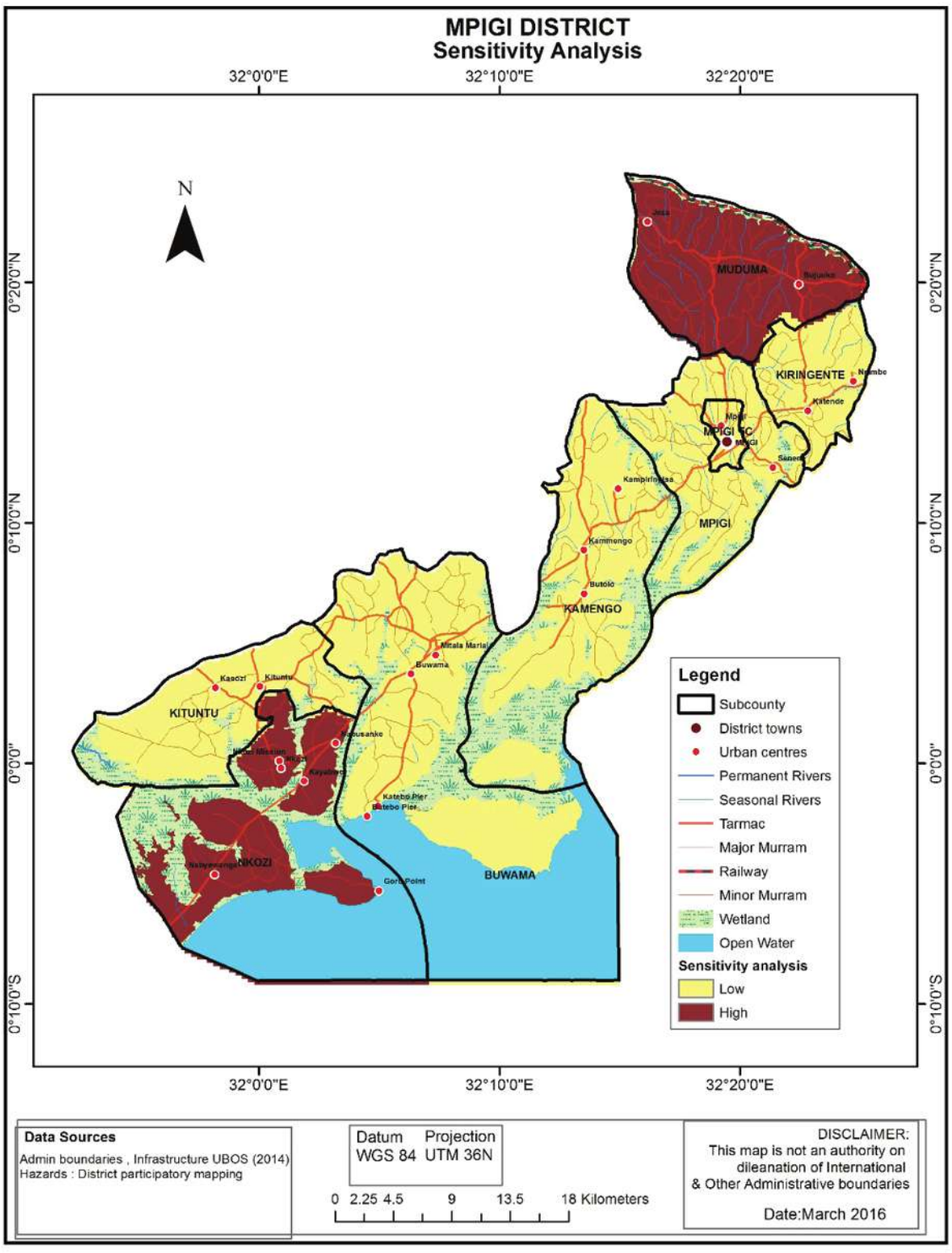

Figure 21: Sensitivty of stressors in Mpigi District

Land Conflicts, Winds and hailstorms and Livestock diseases influenced the sensitivity of the area with Nkozi and Muduuma experiencing the highest vulnerability to hazards.

6.3 Lack of Adaptive Capacity

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

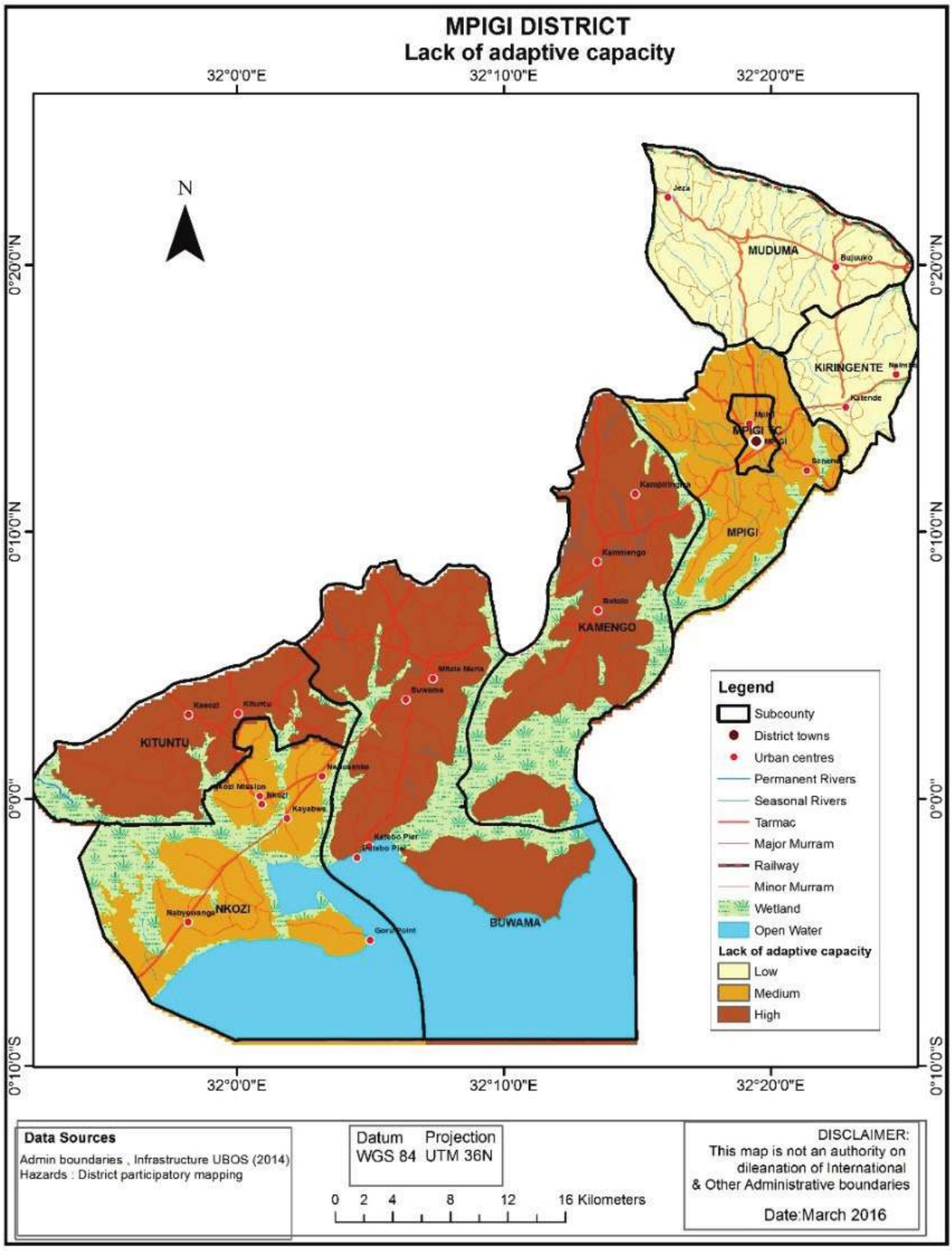

Figure 22: Lack of adaptive capacity in Mpigi District

Both layers influenced the capacity of the area to withstand climate shocks and hazards. Buwama, Kituntu and Kamengo displayed a low adaptive capacity due to their lack of access to markets coupled with medium poverty index.

6.4 Vulnerability assessment

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

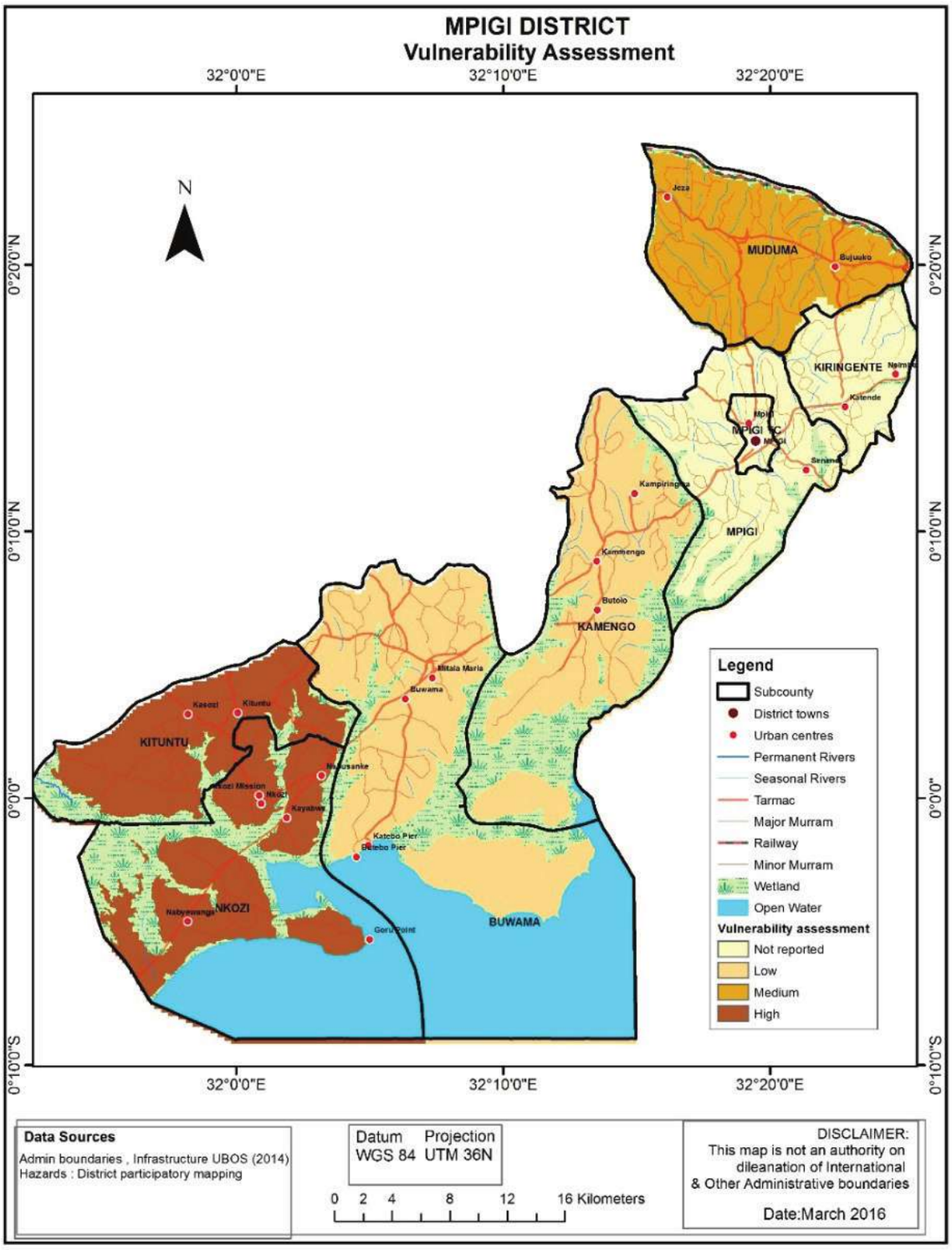

Figure 23: Vulnerability assessment of Bukomansimbi District

Exposure and sensitivity layers influenced the overall vulnerability of Mpigi with Kituntu and Nkozi Displaying the highest overall vulnerability to climate stressors and hazards while lacking the capacity to adapt.

7.0 General Conclusions and Recommendations

7.1 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.

7.2 Recommendations

Crop Pests and Diseases

- Ordinances/ byelaws on movement of planting materials.
- Registration and certification of agro-chemical dealers.
- Enhance budget support for certification, plant clinics and extension service delivery

Environmental Degradation

- Include Environment among the grant-aided sectors.
- Recruitment and enhance capacity for Environmental staff.
- Strengthening the financial and technical capacity environment committees.
- Putting in place a District Environmental Ordinance (On-Going).
- Provide more tree seedlings and support to energy saving technology access.
- Strengthening compliance to environmental laws enforcement.

Livestock Pests and Diseases

- Enhance budget support for certification and extension service delivery.
- Regulating private service providers in a bid to control quality of services.
- Provision of constant power supply for Cold chain.
- Increasing stock for ant-rabbies vaccines at health centers

Land Conflicts

- Constituting area land committees.
- Human Disease Outbreak
- Improve stock outs and other consumables.
- Rehabilitation of health centers and improvement of staff houses.
- Budget enhancement for health centers

Road Accidents

- Sensitization and enforcement on Traffic High way code for all road users.
- Installation of road signs and marking.
- Installation of warning signs at black spots.
- Involvement of communities in maintenance of road signs.

Drought

- Enhance budget support for drought tolerant/ climate adaptation and resilient measures.
- Enhance budget support for water harvesting and simple irrigation technologies.

Floods

- Di-silting of streams along wetlands.
- Sensitization of communities along wetlands catchment areas on proper wetland use and good farming practices.
- Implementation of land fund policy

Soil Erosion

- Budget support to carry out the sensitizations.

Vermin and Wild life animal attack

- Budget support for vaccination and sensitization.
- Enforcement.

Strong Winds

- Intensification of tree planting throughout the district especially where there is severe degradation.

Hail storms

- Dissemination of information on weather forecasts

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

Mpigi district							
Sub-county							
Hazard	Buwama	Kammengo	Kiringente	Kituntu	Mpigi TC	Muduuma	Nkozi
Floods	L	N	N	L	L	L	L
Drought	L	L	L	H	L	L	H
Landslides	N	N	N	N	N	N	N
Erosion	N	N	L	L	L	N	L
Strong winds	L	L	L	L	L	L	L
Hailstorms	L	L	L	L	L	H	L
Lightning	L	L	L	L	L	L	L
Crop pests and Diseases	H	H	H	H	H	H	H
Livestock pests and Diseases	L	L	L	L	M	H	M
Human disease outbreaks	M	M	M	M	M	M	M
Vermin and Wildlife animal attacks	L	L	L	L	L	L	L
Land conflicts	M	M	M	M	M	M	H
Bush fires	L	N	N	L	N	N	L
Environmental degradation	H	H	H	H	H	H	H
Earthquakes	L	L	L	L	L	L	L
Road accidents	M	H	M	L	M	M	M

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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