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

August, 2015

Acknowledgement

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

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2. Buhweju District: Mr. Ahimbisibwe Nathan- Ag. Chief Administrative Officer, Birungi Clemencia-District Environment Officer and Mr. Kintu David, Assistant Chief Administrative Officer.
3. Bushenyi District: Ms. Nakamate Lillian-Chief Administrative Officer, Mr. Vincent Kataate,-District Environment Officer and Mr. Natwebembera Amon - District Agricultural Officer.
4. Mitooma District: Mr.Turyaheebwa Kafureeka Willy-Chief Administrative Officer, Mr. Naboth Baguma-District Environment Officer and Dr. Muhumuza Godfrey-District Veterinary Officer.
5. Kiruhura District: Ms. Marion Pamela Tukahurirwa-Chief Administrative Officer, Ms. Namara Deborah-District Environment Officer and Kansiime Robertson-Senior Agricultural Officer and
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Hon. Hilary O. Onek

Minister for Relief, Disaster Preparedness and Management

Executive Summary

Uganda has over the past years experienced frequent disasters that range from drought, to floods, landslides, human and animal disease, pests, animal attacks, earthquakes, fires, conflicts and other hazards which in many instances resulted in deaths, property damage and losses of livelihood. With the increasing negative effects of hazards that accompany population growth, development and climate change, public awareness and proactive engagement of the whole spectrum of stakeholders in disaster risk reduction, are becoming critical. The Government of Uganda is moving the disaster management paradigm from the traditional emergency response focus toward one of prevention and preparedness. Contributing to the evidence base for Disaster and Climate Risk Reduction action, the Government of Uganda is compiling a national atlas of hazard, risk and vulnerability conditions in the country to encourage mainstreaming of disaster and climate risk management in development planning and contingency planning at national and local levels.

This assignment was carried out by a team of consultants and GIS Specialists between June and July 2015 under the overall technical supervision by the Office of the Prime Minister. The assignment aimed at mapping and producing Multi Hazard, Risk and Vulnerability (HRV) Profiles.

Hazard, risk and vulnerability assessment was done using a stack of methods including participatory approaches such as focus group discussions (FGDs), key informant interviews, transect drives and spatial and non-spatial modelling. Key informant interviews and Focus Group Discussions were guided by a checklist. Key informants for this assessment included: the Districts Senior Forest Officer, Production and Marketing Officer, Environment Officer, Veterinary Officer, Health centre medical workers and Sub-county/parish chiefs on multi-hazards, risks and vulnerability in the District. The information provided by key informants was used as basis for selection of two Sub Counties to conduct focus group discussions. During the FGDs, participants were requested through a participatory process to develop a community hazard profile map. The identified hazard hotspots in the community profile maps were visited and mapped using a handheld Spectra precision Global Positioning System (GPS) units, model: Mobile Mapper 20 for X, Y and Z coordinates. The entities captured included: hazard location, (Sub-county and parish), extent of the hazard, height above sea level, slope position, topography, neighbouring land use among others. This information generated through a participatory and transect approach was used to validate modeled hazard, risk and vulnerability status of the district. The spatial extent of a hazard event was established through modeling and a participatory validation undertaken.

In the case of Mitooma district, hazards can be classified as:

a. Geomorphological or Geological hazards including mudslides, landslides and hilltop

cracks.

b. Climatological or Meteorological hazards including river-line floods, floods, drought, hailstorms, strong winds, lightening and hill-slope surface runoff.
c. Ecological or Biological hazards including livestock pests and diseases, crop pests and diseases, bush fires.
d. Technological hazards including road accidents.

The study results show that it is drought; hailstorms, human-wildlife conflicts, deforestation, pests and diseases that predispose the Mitooma district community to a high vulnerability state.

It was established that Mitooma has over the last three decades increasingly experienced hazards especially strong winds, crop and livestock pests, parasites and diseases; hail storms and lightening putting livelihoods at increased risk. However, the limited adaptive capacity (and or/resilience) and high sensitivity of households and communities in the district increase its vulnerability to hazard exposure necessitating urgent external support. Indeed, counteracting vulnerability at community, local government and national levels should be a threefold effort hinged on:

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

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List of acronyms

GIS	:	Geographical Information Systems
UNDP	:	United Nations Development Programme
ToR	:	Terms of Reference
HRV	:	Multi hazard, Risk and Vulnerability
DLG	:	District Local Government
OPM	:	Office of the Prime Minister
NEMA	:	National Environmental Authority
DWRM	:	District Water Resources Management

Definition of key terms

Disaster Risk: Disaster risk signifies the possibility of adverse effects in the future. It derives from the interaction of social and environmental processes, from the combination of physical hazards and the vulnerabilities of exposed elements (Cardona et al., 2012). The hazard event is not the sole driver of risk, and there is high confidence that the levels of adverse effects are in good part determined by the vulnerability and exposure of societies and social-ecological systems (UNDRO, 1980; Cardona, 2011; UNISDR, 2009; Birkmann, 2006).

Disaster risk is not fixed but is a continuum in constant evolution. A disaster is one of its many 'moments' (ICSU-LAC, 2010), signifying unmanaged risks that often serve to highlight skewed development problems (Wijkman and Timberlake, 1984). Disasters may also be seen as the materialization of risk and signify 'a becoming real' of this latent condition that is in itself a social construction (Renn, 1992).

In a nutshell, **risk** is the probability of harmful consequences, or expected losses (deaths, injuries, property loss, livelihoods and economic activity disruption or environment damage) resulting from interactions between hazards (natural, human-induced or man-made) and vulnerable conditions.

Hazard: Hazard refers to the possible, future occurrence of natural or human-induced physical events that may have adverse effects on vulnerable and exposed elements (UNDRO, 1980; UNDHA, 1992; Birkmann, 2006). Although, at times, hazard has been ascribed the same meaning as risk, currently it is widely accepted that it is a component of risk and not risk itself. Generally, **the hazard** is a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Exposure: Exposure refers to the inventory of elements in an area in which hazard events may occur (UNISDR, 2009). Hence, if population and economic resources were not located in (exposed to) potentially dangerous settings, no problem of disaster risk would exist. While the literature and common usage often mistakenly conflate exposure and vulnerability, they are distinct. Exposure is a necessary, but not sufficient, determinant of risk. It is possible to be exposed but not vulnerable (for example by living in a floodplain but having sufficient means to modify building structure and behavior to mitigate potential loss). However, to be vulnerable to an extreme event, it is necessary to also be exposed.

Vulnerability: Vulnerability refers to the propensity of exposed elements such as human beings, their livelihoods, and assets to suffer adverse effects when impacted by hazard events (UNDRO, 1980; Blaikie *et al.*, 1994). Vulnerability is related to predisposition,

susceptibilities, fragilities, weaknesses, deficiencies, or lack of capacities that favor adverse effects on the exposed elements.

Coping and adaptive capacity: Capacity refers to the positive features of people's characteristics that may reduce the risk posed by a certain hazard. Improving capacity is often identified as the target of policies and projects; based on the notion that strengthening capacity will eventually lead to reduced risk. In a nutshell, coping capacity also refers to the ability to react to and reduce the adverse effects of experienced hazards, whereas adaptive capacity refers to the ability to anticipate and transform structure, functioning, or organization to better survive hazards (Saldaña-Zorrilla, 2007).

CHAPTER ONE

Background and context

1.1 Introduction

Uganda has over the past years experienced frequent disasters that range from drought, to floods, landslides, human and animal disease, pests, animal attacks, earthquakes, fires, conflicts and other hazards which in many instances resulted in deaths, property damage and losses of livelihood. With the increasing negative effects of hazards that accompany population growth, development and climate change, public awareness and proactive engagement of the whole spectrum of stakeholders in disaster risk reduction, are becoming critical. The Government of Uganda is moving the disaster management paradigm from the traditional emergency response focus toward one of prevention and preparedness. Contributing to the evidence base for Disaster and Climate Risk Reduction action, the Government of Uganda is compiling a national atlas of hazard, risk and vulnerability conditions in the country to encourage mainstreaming of disaster and climate risk management in development planning and contingency planning at national and local levels.

From 2013 UNDP has been supporting the Office of the Prime Minister to develop district hazard risk and vulnerability profiles in the Sub-regions of Rwenzori, Karamoja, Teso, Lango, Acholi and West Nile covering 42 districts. During the exercise above, local government officials and community members actively participated in the data collection and analysis. The data collected was used to generate hazard risk and vulnerability maps and profiles. Validation workshops were held in close collaboration with ministries, district local government (DLG), development partners, agencies and academic/research institutions.

The developed maps show the geographical distribution of hazards and vulnerabilities up to Sub county level for each district. The analytical approach to identify risk and vulnerability to hazards in the pilot Sub-regions visited (Rwenzori and Teso), was improved in Subsequent Sub-regions. Based on lessons learnt, UNDP engaged an Individual Consultant to facilitate the process of conducting and producing HRV profiles and maps for 5 districts in Western Uganda. The districts considered included Mitoma, Buhweju, Ibanda, Kiruhura and Bushenyi.

1.2 Overview of the complex interaction of disaster/hazard, risk and vulnerability

The severity of the impacts of extreme and non-extreme weather and climate events depends strongly on the level of vulnerability and exposure to these events. Trends in vulnerability and exposure are major drivers of changes in disaster risk and of impacts when risk is realized. Understanding the multi-faceted nature of vulnerability and exposure is a prerequisite for determining how weather and climate events contribute to the occurrence of disasters, and for designing and implementing effective adaptation and disaster risk management strategies (Lundgren and Jonsson, 2010; Cardona *et al*., 2012).

Vulnerability and exposure are dynamic, varying across temporal and spatial scales depending

on economic, social, geographic, demographic, cultural, institutional, governance, and environmental factors (Cardona *et al.*, 2012). Individuals and communities are differentially exposed and vulnerable and this is based on factors such as wealth, education, race/ethnicity/religion, gender, age, class/caste, disability, and health status. Lack of resilience and capacity to anticipate, cope with, and adapt to extremes and change are important causal factors of vulnerability.

Extreme and non-extreme weather and climate events also affect vulnerability to future extreme events, by modifying the resilience, coping, and adaptive capacity of communities, societies, or social-ecological systems affected by such events. At the far end of the spectrum – low-probability, high intensity events – the intensity of extreme climate and weather events and exposure to them tend to be more pervasive in explaining disaster loss than vulnerability in explaining the level of impact. But for less extreme events – higher probability, lower intensity – the vulnerability of exposed elements plays an increasingly important role. The cumulative effects of small or medium-scale, recurrent disasters at the Sub-national or local levels can substantially affect livelihood options and resources and the capacity of societies and communities to prepare for and respond to future disasters (Füssel, 2007).

High vulnerability and exposure are generally the outcome of skewed development processes, such as those associated with environmental mismanagement, demographic changes, rapid and unplanned urbanization in hazardous areas, failed governance, and the scarcity of livelihood options for the poor (Cees, 2009; Cutter *et al*., 2003).

The selection of appropriate vulnerability and risk evaluation approaches depends on the decision making context. Vulnerability and risk assessment methods range from global and national quantitative assessments to local-scale qualitative participatory approaches. The appropriateness of a specific method depends on the adaptation or risk management issue to be addressed, including for instance the time and geographic scale involved, the number and type of actors, and economic and governance aspects. Indicators, indices, and probabilistic metrics are important measures and techniques for vulnerability and risk analysis. However, quantitative approaches for assessing vulnerability need to be complemented with qualitative approaches to capture the full complexity and the various tangible and intangible aspects of vulnerability in its different dimensions. Appropriate and timely risk communication is critical for effective adaptation and disaster risk management.

Effective risk communication is built on risk assessment, and tailored to a specific audience, which may range from decision makers at various levels of government, to the private sector and the public at large, including local communities and specific social groups. Explicit characterization of uncertainty and complexity strengthens risk communication. Impediments to information flows and limited awareness are risk amplifiers. Beliefs, values, and norms influence risk perceptions, risk awareness, and choice of action. Adaptation and risk management policies and practices will be more successful if they take the dynamic nature of vulnerability and exposure into account, including the explicit characterization of uncertainty and complexity at each stage of planning and practice. However, approaches to representing such dynamics quantitatively are currently underdeveloped. Projections

of the impacts of climate change can be strengthened by including storylines of changing vulnerability and exposure under different development pathways.

Appropriate attention to the temporal and spatial dynamics of vulnerability and exposure is particularly important because vulnerability, hazards and vulnerability have a temporal and spatial character. In that case, the design and implementation of adaptation and risk management strategies and policies that take into consideration spatial and temporal characteristics of vulnerability are pivotal to addressing short to medium term risks and set a foundation for building longer term community and ecosystems resilience to vulnerability and exposure. For instance, in low land areas prone to intermittent flood events, dike systems have proven to be innovative and cost effective structures in reducing hazard exposure by offering immediate protection against rising tides (Cardona *et al*., 2012). Vulnerability reduction is imperative to building sustainable adaptation and foster disaster risk reduction and management that draw on a consistent merger policy and practice.

The interface between policy and practice is an important institutional framework whose cohesiveness and coherence provides a fundamental threshold for vulnerability reduction, implementation of planed adaptation mechanisms and a strategic focus on resilience building through disaster risk reduction and management. Strong institutions (e.g. laws, policies, Acts, social systems that govern social interactions, values and attitudes) have been found to improve community level hazard, risk and vulnerability reduction efforts. For instance, in South East Asia (Nepal, Malaysia and Bangladesh), instructional frameworks the support community level participation have led to an established community based disaster risk reduction mechanisms that have strengthened their livelihoods and built their resilience to extreme events (Cees, 2009; Cutter *et al*., 2003).

1.3 Rationale for the assignment

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”. Additionally, UNDP’s DRM project 2015 Annual Work Plan; Activity 4.1 mandates conducting a national hazard, risk and vulnerability (HRV) assessment including sex and age disaggregated data and preparation of district profiles.

1.4 Objectives of the assignment

The objectives of the assignment were to:

1. Collect and analyse field data generated using GIS in close collaboration and coordination with OPM in the targeted districts of Mitoma, Buhweju, Ibanda, Kiruhura, and Bushenyi.
2. Develop district specific multi hazard risk and Vulnerability profiles using a standard methodology.
3. Preserve the spatial data to enable use of the maps for future information, and
4. Produce age and sex disaggregated data in the HRV maps.

1.5 Scope of the assignment

This assignment was carried out by a team of consultants and GIS Specialists between June and July 2015 under the overall technical supervision by the Office of the Prime Minister. The assignment aimed at mapping and producing Multi Hazard, Risk and Vulnerability (HRV) Profiles for the districts of Mitoma, Buhweju, Ibanda, Kiruhura, and Bushenyi (Figure 1).

In order to effectively generate District Multi Hazard, Risk and Vulnerability (HRV) Profiles, the following specific tasks will be undertaken:

1. Collection of field data using GIS in close collaboration and coordination with OPM in the target districts of Mitoma, Buhweju, Ibanda, Kiruhura and Bushenyi; and quantify them through a participatory approach on a scale of “not reported”, “low”, “medium” and “high”, consistent with the methodology that was specified in Annex 3 to the ToR.
2. Analysis of field data and review of the quality of each hazard map accompanied by a narrative that lists relevant events of their occurrence including 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.
3. The entire district HRV Profiles were completed within the time frame provided.
4. Softcopies of the complete HRV profiles and maps for all the 5 districts were submitted for printing by the end of the duration assigned to this activity.
5. Generated and Submitted shape files for all the districts visited showing disaggregated hazard risk and vulnerability profiles to OPM and UNDP, and
6. The process of generating HRV maps and profiles was from time to time quality checked and assured by a team selected by the supervisor Subject to completion of the assignment.

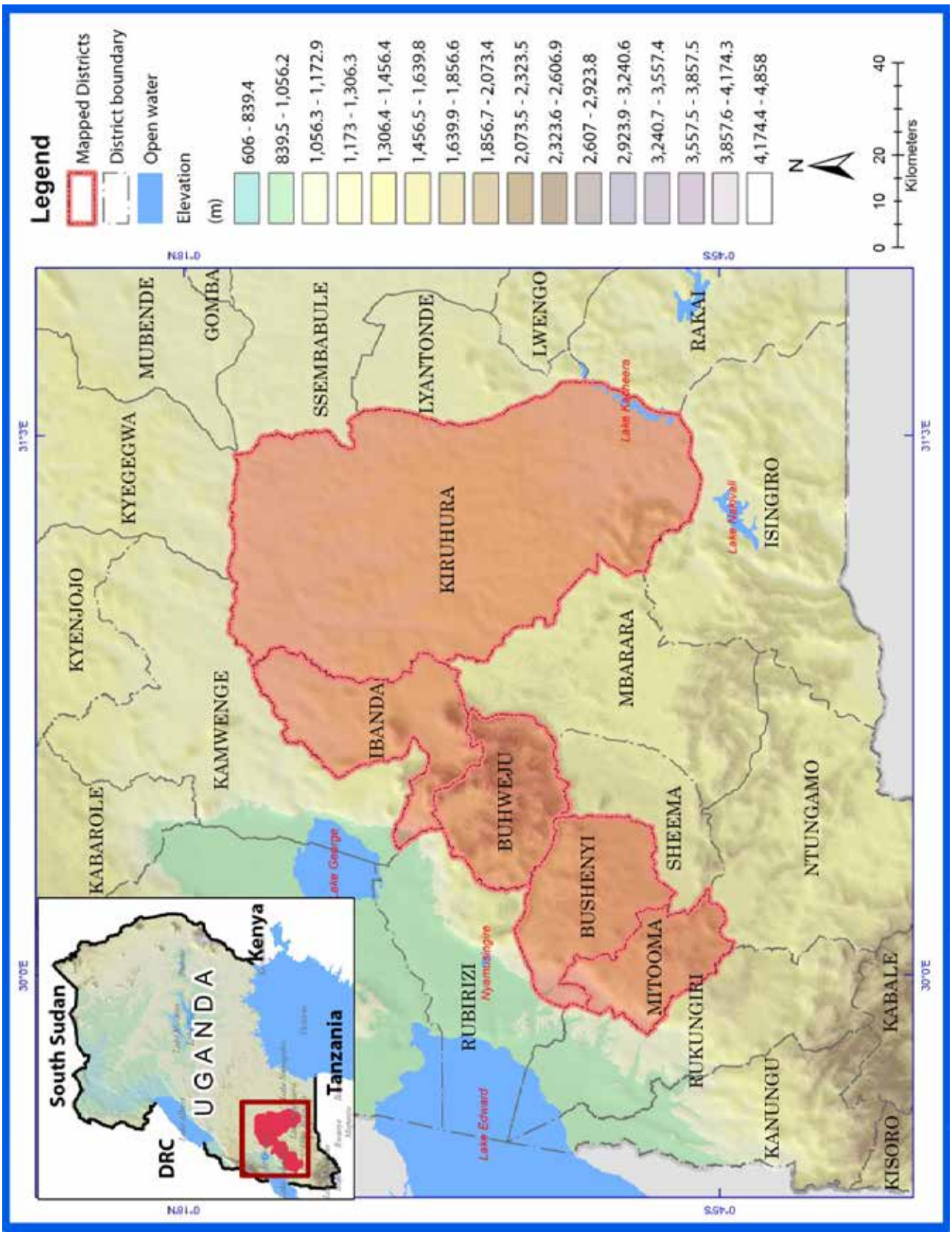


Figure 1: Study Districts

To fully deliver on each of the above activities, the following tasks were undertaken:

1. Close consultation with OPM, UNDP DRM Team and district focal persons in selected districts;
2. Review and critical analysis of the information generated from the field data collection exercise and consolidating it into the standard format for developing profiles as provided, and;
3. Facilitation of a five days regional data verification and validation workshop organized by UNDP in Mbarara drawing key district DDMC focal persons for the purpose of creating local/district ownership of the profiles.

1.6 Organisation and delivery of assignment

The consultant formed a data collection team composed of GIS specialists for the work to be thoroughly carried in a span of 31 working days across the five districts. Cognisant of the fact that the success of this assignment depended on the quality, content and coverage of the data captured and entered in the database, the consultant trained data collectors in GIS and GPS mapping using modern automated error minimising techniques. Before conducting the hands-on training, a context specific training guide was developed and agreed upon with the client to ensure that it was relevant to the assignment.

The training guide covered GIS Basics; GPS Care, Reading, Calibrating and GPS Data Uploading; Issues for Mapping Uganda at National Level such as UTM Zone 35, Zone 36 and areas North and South of the Equator; validating GPS position readings with survey control points, and quick validation of data using GIS data in ArcPAD.

CHAPTER TWO

Mitooma District Multi-hazard, Risks and Vulnerability profiles Mapping and Production

2.1 Overview of Mitooma District

Mitooma District (Figure 2) is located (UTM, 0171539; 9932133) in South Western Uganda. It is bordered by Bushenyi and Sheema in the East, Ntungamo in the South, Rukungiri in the West and Rubirizi in the North. The District headquarters are located about 15 kilometres on the Ishaka-Rukungiri road. The District has 1 county, 10 Sub Counties, 2 town councils, 62 parishes and 554 villages with an estimated population of 185,519 and density at 400 persons per square kilometre. The growth rate is estimated at 1.19% and the number of households was at 40,142 by the year 2014 (UBOS, 2014). The majority of households (85%) survive on Subsistence farming (crop growing and livestock rearing). Other major source of livelihood include trade and commerce, formal and informal employment, artisanal mining, sand mining, stone quarrying, art and crafts industry.

On average, the District lies 910-2500 metres above sea level with a total land area of 599.2 km^2. The district is generally hilly with the exception of parts of Kiyanga and Kanyabwanga Sub Counties which lie in the Western arm of the great East African rift valley. The district has savannah woodlands type of vegetation with a wide cover of thorny shrubs punctuated with scattered trees and agro-forestry plantations of pine and eucalyptus.

The district receives a bimodal rainfall (August – November and March- May of each year) with an annual range of 1500-2000 mm. The temperature ranges from 12.5°C to 30°C. In general, its climate is conducive and suitable for agricultural activities carried out in the district.

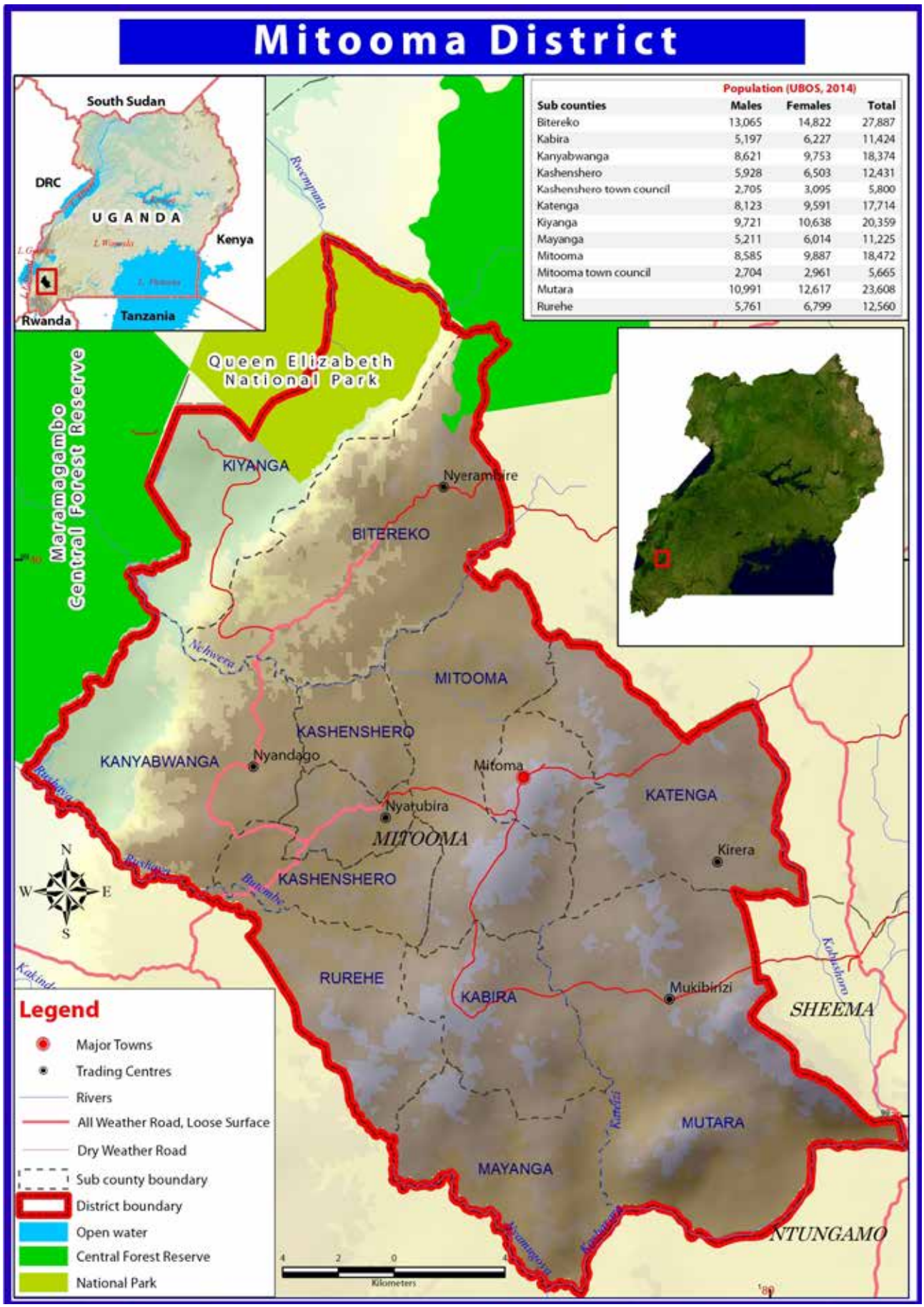


Figure 2: Mitooma District Map

2.2 Methodology

2.2.1 Hazard, risk and vulnerability assessment

Hazard, risk and vulnerability assessment was done using a stack of methods including participatory approaches such as focus group discussions (FGDs), key informant interview, transect drives and spatial and non-spatial modelling. Key informant interviews and Focus Group Discussions were guided by a checklist (Appendix 1 and 2). Key informants for this assessment included: the Districts Senior Forest Officer, Production and Marketing Officer, Environment Officer, Veterinary Officer, Health centre medical workers and Sub-county/ parish chiefs on multi-hazards, risks and vulnerability in the District. The information provided by key informants was used as basis for selection of 2 Sub Counties to conduct focus group discussions. Two FGDs comprising of 15 respondents (crop farmers, local leaders, nursing officers, police officers and cattle keepers) were conducted in Mutara and Mitooma T/C. Each Parish of the selected Sub-Counties was represented by at least one participant and the selection of participants was engendered. This allowed for comprehensive representation as well as provision of detailed and verifiable information.

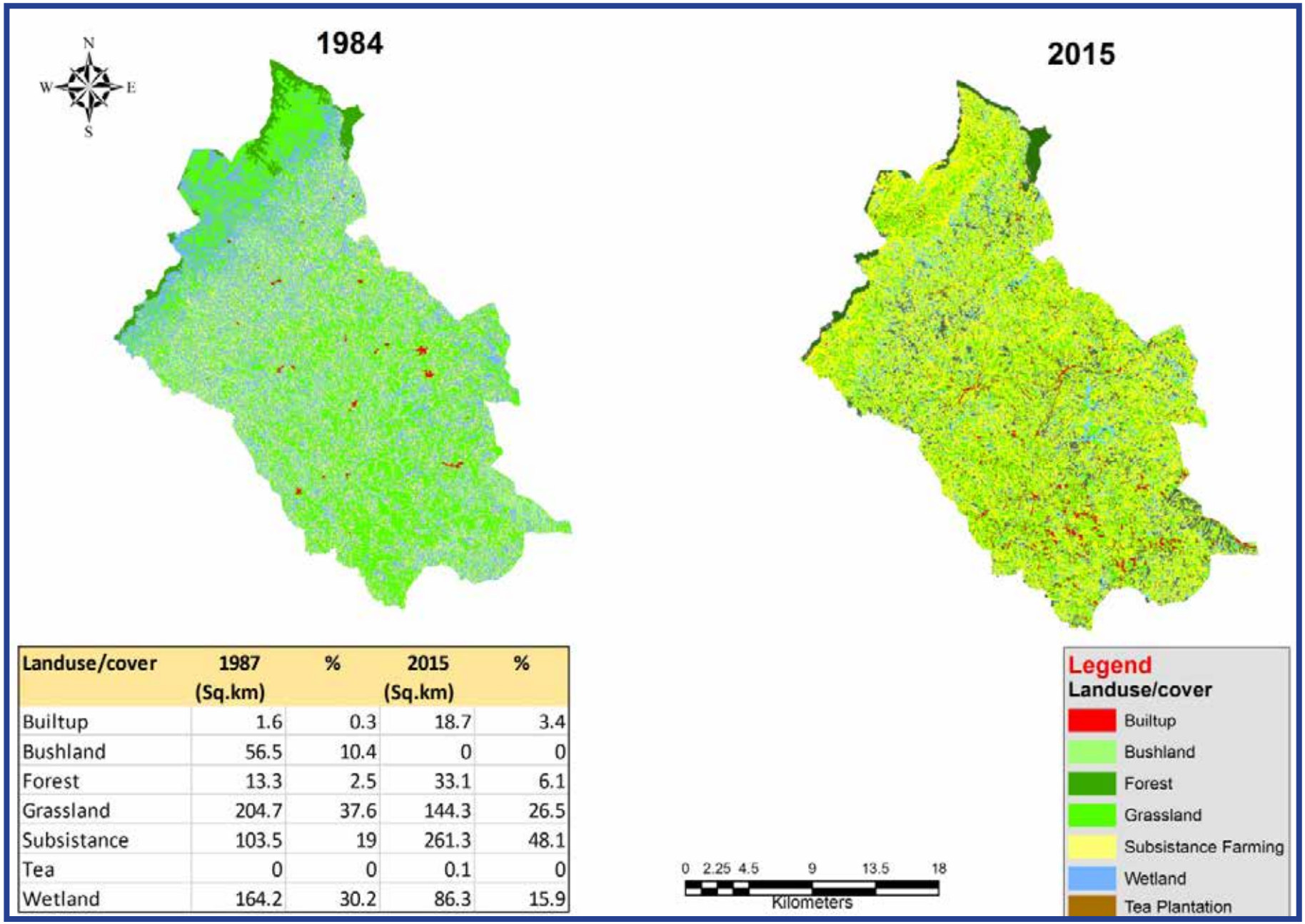
During the FGDs, participants were requested to develop a community hazard profile map. The identified hazard hotspots in the community profile maps were visited and mapped using a handheld Sepectra precision Global Positioning System (GPS) units, model: mobileMapper 20 for X, Y and Z coordinates. The entities captured included: hazard location, (Sub-county and parish), extent of the hazard, height above sea level, slope position, topography, neighbouring land use among others. This information generated through a participatory and transect approach was used to validate modelled hazard, risk and vulnerability status of the district. The spatial extent of a hazard event was established through modelling and a participatory validation undertaken.

2.2.2 Land use and land cover assessment

An important imperative in understanding the spatial determinants of hazard and risks is the spatial and temporal extent of land use and land cover of a given location. Thus; an assessment of land use and land cover (Figure 3) for Mitooma district was undertaken using a two period series of Landsat satellite imagery. Table 1 shows the seven classifications of land use and land cover types determined. Ground truthing was undertaken to validate the classified images to improve on the classification accuracy.

Table 1: Description of land use and cover changes

Land use/cover types	Description	Landscape position
Wetlands	Papyrus, palms and thickets	Valleys
Grasslands	Pasture with scattered trees	Hillslopes, valleys
Small scale farming	Banana plantations mixed with maize	Hillslopes, valleys
High tropical forest	Intact forest (broad leaved)	Valleys, moderate hills
Degraded forest	Tree samples, bushlands	Valleys, moderate hills
Tree plantations	Community forest reserves, pine and eucalyptus plantations	Valley, Hilltops
Bushlands	Shrubs and thickets	Valleys



Landuse/cover	1987 (Sq.km)	%	2015 (Sq.km)	%
Builtup	1.6	0.3	18.7	3.4
Bushland	56.5	10.4	0	0
Forest	13.3	2.5	33.1	6.1
Grassland	204.7	37.6	144.3	26.5
Subsistance	103.5	19	261.3	48.1
Tea	0	0	0.1	0
Wetland	164.2	30.2	86.3	15.9

Figure 3: Land use/cover changes in Mitooma district (1984-2015)

2.3 Multi-hazards

A hazard is a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. A hazard, and the resultant disaster can have different origins: natural (geological, hydro-meteorological and biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity, frequency, probability, duration, area of extent, speed of onset, spatial dispersion and temporal spacing (Cees, 2009).

In the case of Mitooma district, hazards can be classified following main controlling factors:

i. Geomorphological or Geological hazards including mudslides, landslides and hilltop cracks
ii. Climatological or Meteorological hazards including river-line floods, floods, drought, hailstorms, strong winds, lightening and hill-slope surface runoff
iii. Ecological or Biological hazards including livestock pests and diseases, crop pests and diseases, bush fires
iv. Technological hazards including road accidents.

2.3.1 Drought

Droughts are experienced in the form of prolonged dry days without any rain event. The events are seasonal starting from June to August. However there has been a shift in the onset of droughts which sometimes starts in May to early September. This shows that since 1980 to date, drought events have been on the increase in terms of frequency (experienced every year), destructiveness and extent. The anticipated cause of the increased incidence of droughts is global warming attributed to wetland degradation and deforestation. However, severe drought events are mainly experienced in the rift valley Sub Counties of Kiyanga, Bitereko, and Kanyabwanga (Figure 4). These have led to famines as a result of complete crop failures, increased incidences of bush fires, increased disease occurrences including Anthrax in Kibira Sub County, scarcity of water and reduced pastures and livestock productivity leading to loss of income and dust pollution. The reduced production and productivity leads to increased prices for both livestock and crop products.

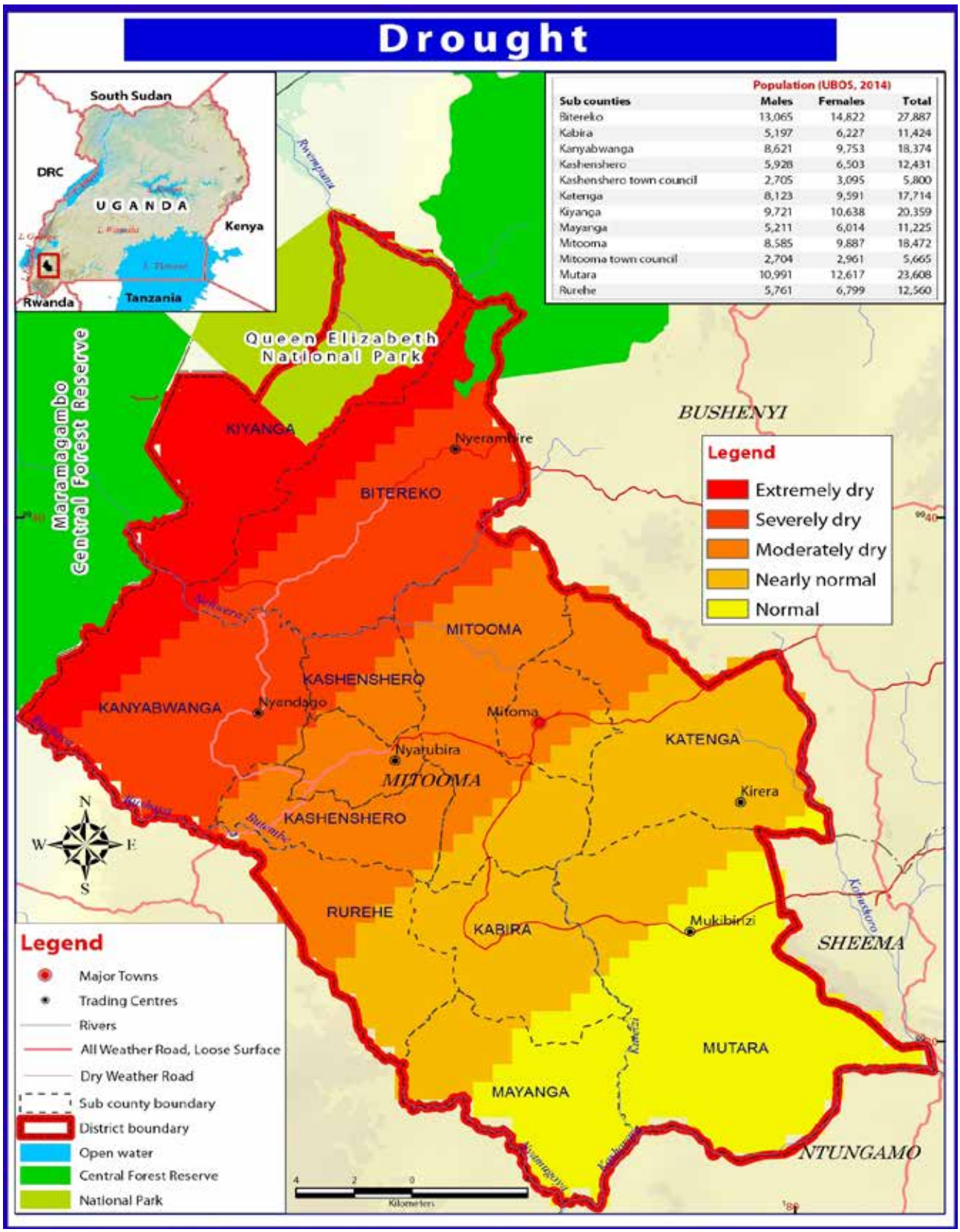


Figure 4: Hotspots for drought in Mitooma district (1984-2015)

2.3.2 Pests and Diseases

According to FGDs and key informants, in Mitooma district, pests and diseases for both crops and livestock are prevalent throughout the year and are widely spread across all Sub Counties (Figure 5). Over the last two decades the commonest crop pests have been black coffee twig borers, caterpillars, wild animals and locusts and the crop diseases include banana bacterial wilt, coffee wilt disease, coffee stem borers, bean root rot, cassava mosaic and coffee berry disease. The most destructive disease is banana bacterial wilt that causes yellowing of banana leaves and stunted growth leading to complete crop failures in most instances. The high prevalence for pests and diseases are attributed to ignorance, poor farming methods, climatic conditions, swamp reclamation and adulterated agro-inputs (drugs) with low efficacy.

On the other hand, commonest livestock parasites across all Sub Counties include ticks, biting flies, with East Coast Fever, Lumpy skin disease, rabies and Newcastle being major livestock disease in the district.

Crop and livestock pests and diseases have led to: a) complete crop failures in extreme cases translating into low productivity b) reduction in quality and quantity of both crop and livestock products and c) enhanced food and income insecurity steaming from reduced production and productivity. In human, diseases like Malaria, HIV/AIDS and TB have weakened the labour force resulting into low productivity.

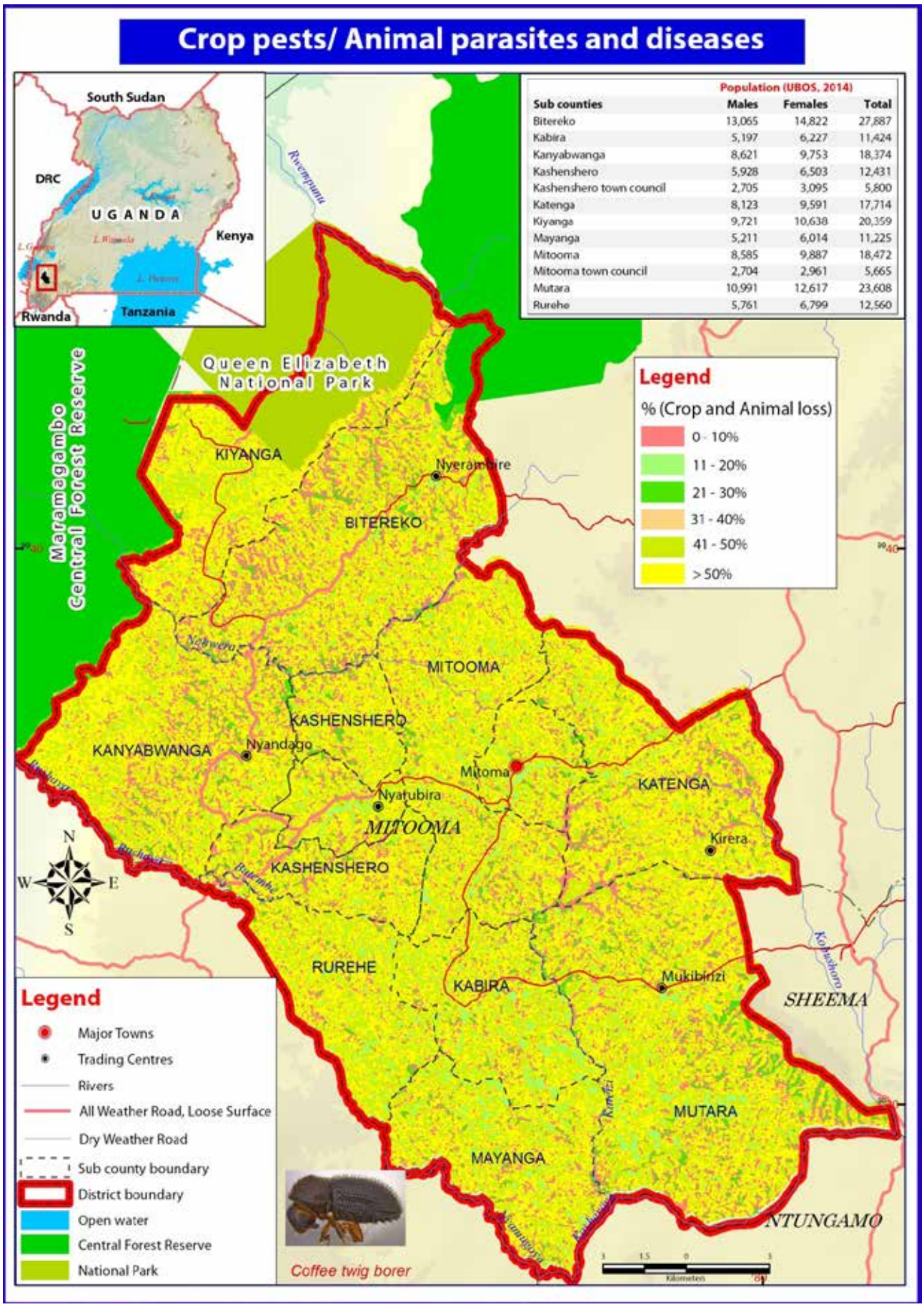


Figure 5: Hotspots for pests and diseases in Mitooma

2.3.3 Hailstorms

Across all Sub Counties, hailstorms are perceived by the community in the form of iced storms experienced during excessive rainfall events that last for approximately 2 hours. However, according to the FGDs, hailstorms were never experienced in Mitooma District before 1990. However, from 1990 to date, they have been on the increase in terms of frequency (experienced every rainy season), destructiveness and extent mainly in the months of September and October. This is largely attributed to climate change. The effects of hailstorms are evident across Sub Counties of the district (Figure 6). These include loss of crops mainly broad leaved crops like banana and cassava, increase in livestock diseases and injuries, soil erosion as well as destruction of houses, schools (e.g. Muti and Rubiriz Primary Schools in Mutara Sub County were destroyed in 2014) and health centres.

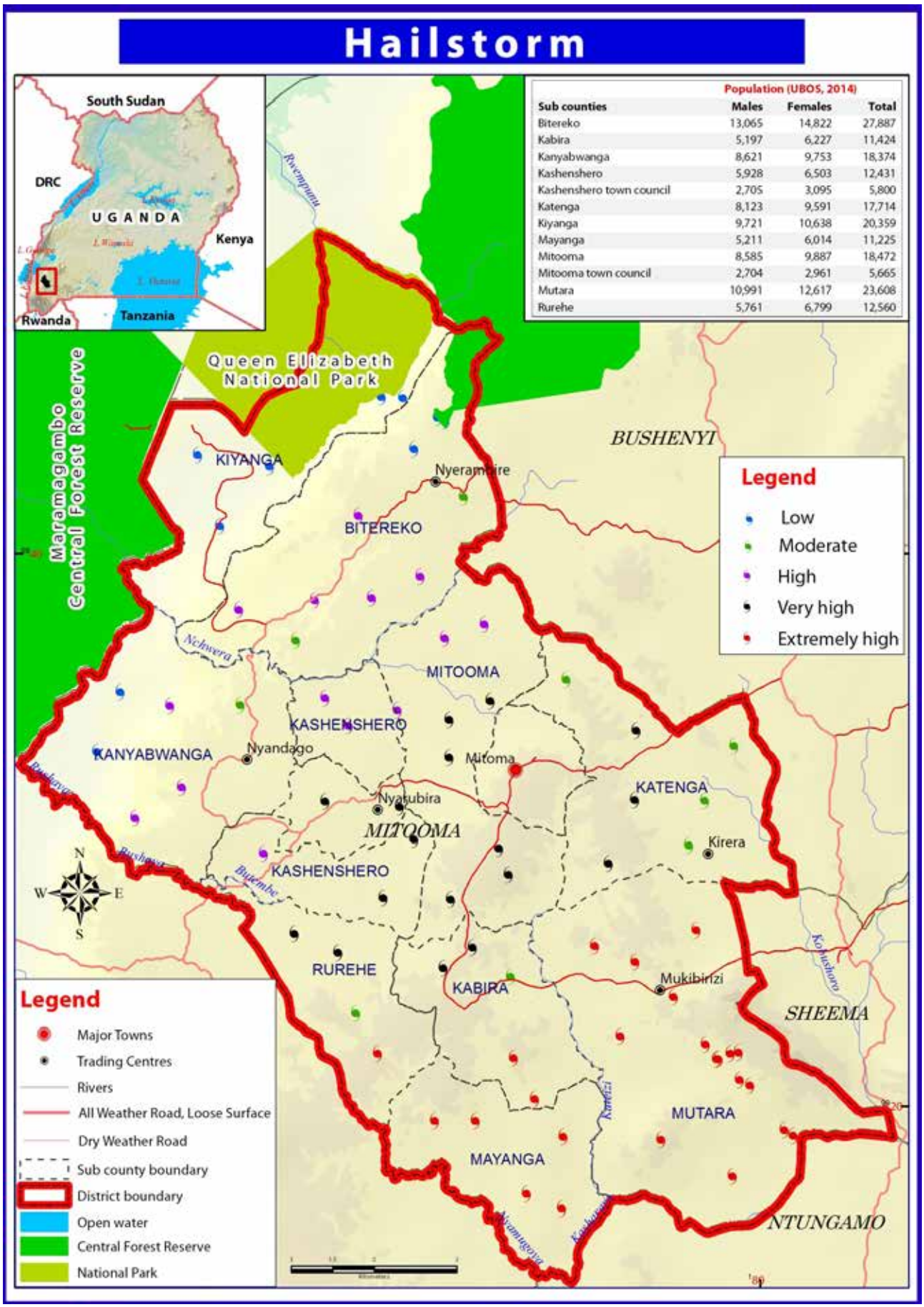
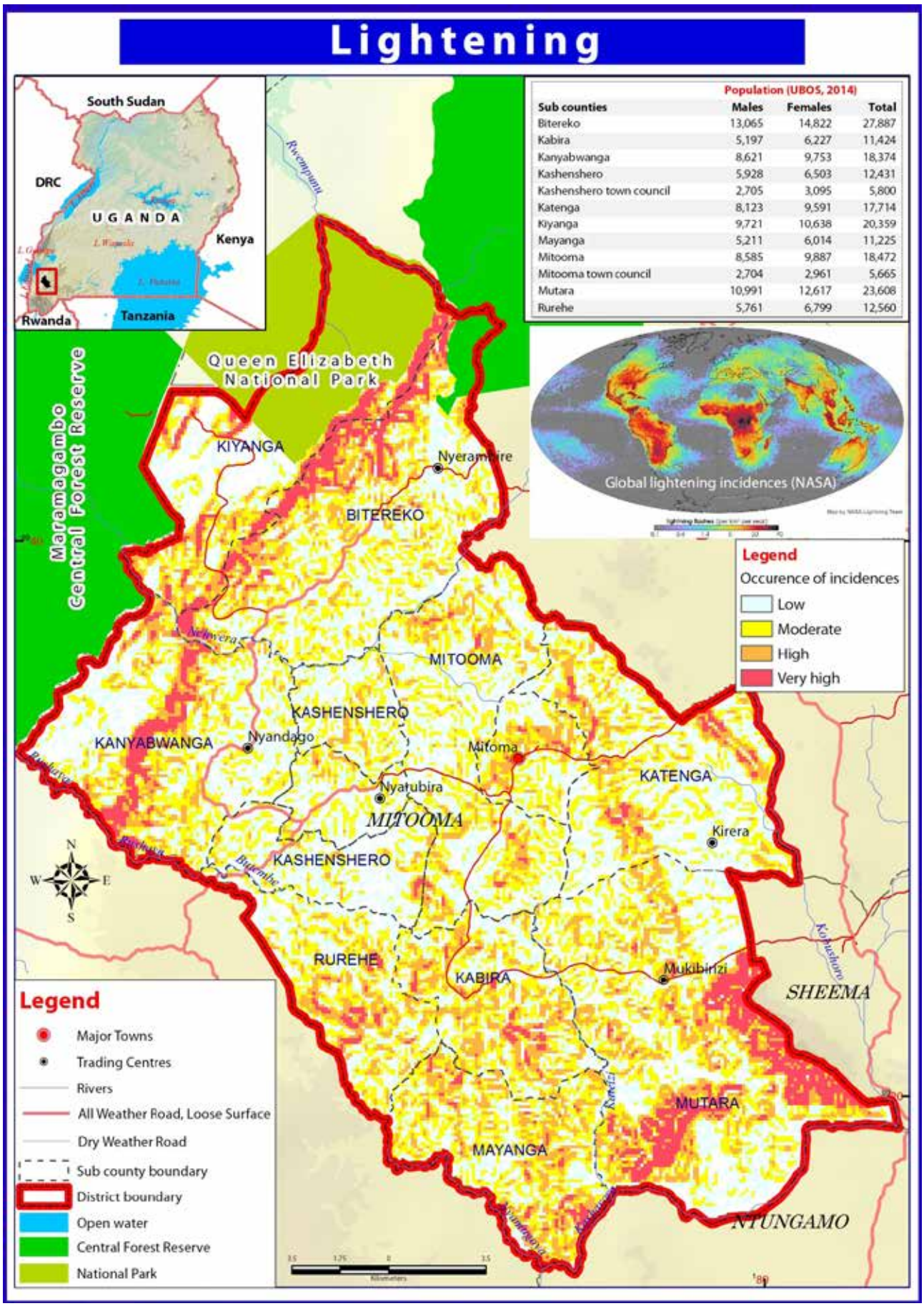


Figure 6: Hotspots for hailstorms in Mitooma

2.3.4 Lightening

Lightening is seasonal occurring during rainfall events (in particular the months of April, September and November) especially in Mitooma, Mayanga, Mutara, Kanyabwanga and Bitereko Sub Counties (Figure 7). According to FGDs and Key informants, incidences are more frequent on higher steep hilltops. Lightening has caused loss of both human and livestock, destruction of crops and vegetation, as well as loss of property (schools, houses, churches). Previous incidences include the striking of Mutara Central Primary School (2014), Bitereko trading centre (2015) and loss of human life in Kanyabwanga (2014).



Sub counties	Population (UBOS, 2014) Males	Females	Total
Bitereko	13,065	14,822	27,887
Kabira	5,197	6,227	11,424
Kanyabwanga	8,621	9,753	18,374
Kashenshero	5,928	6,503	12,431
Kashenshero town council	2,705	3,095	5,800
Katenga	8,123	9,591	17,714
Kiyanga	9,721	10,638	20,359
Mayanga	5,211	6,014	11,225
Mitooma	8,585	9,887	18,472
Mitooma town council	2,704	2,961	5,665
Mutara	10,991	12,617	23,608
Rurehe	5,761	6,799	12,560

Figure 7: Hotspots for lightening in Mitooma

2.3.5 Strong winds

According to key informants, strong winds are seasonal, although they occur during both the dry and rainy seasons. However, the incidences are more frequent and severe in the dry season with the strongest winds experienced at the climax of the dry season. The winds accelerated by season and topography (leeward side). They are severe in Mitooma, Katenga, and Mitooma town council Sub Counties (Figure 8). FGDs revealed that strong winds blow house roof-tops, and cause crop logging especially banana plantations. These have also increased disease incidences such as flue due to dust, fire occurrences as well as hearing and visual impairments.

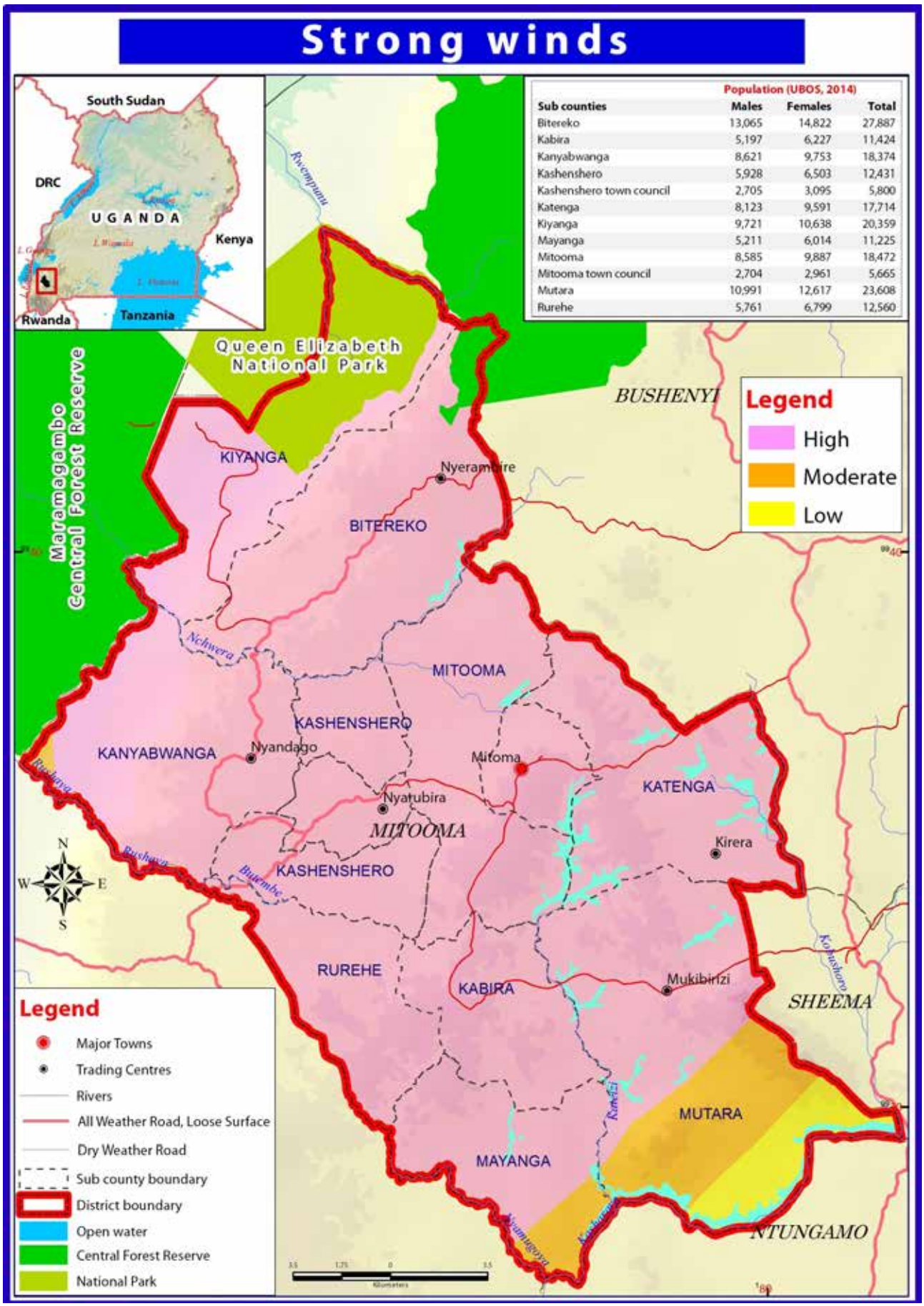


Figure 8: Hotspots for strong winds in Mitooma

2.3.6 Riverine floods

Key informants noted that riverine floods are frequent during the rainy season. Their increased occurrence is attributed to wetland degradation, catchment degradation and poor farming practices resulting into enhanced siltation of rivers. These are accelerated by steep hillslopes which are bare with well a developed network gulleys.

Severe impacts have been recorded in Mutara, Mitooma, Katenga, Mitooma town council, and Kiyanga Sub Counties (Figure 9). The rivers susceptible to riverine floods include Nyindo, Nyamugoye, Nyamuhizi, Nyamirembe,and Ncwera which pour their waters into Lake Edward. Riverrine floods result into washing away of road culverts and bridges resulting into road blockage, destruction of crops, loss of soil fertility and enhanced siltation.

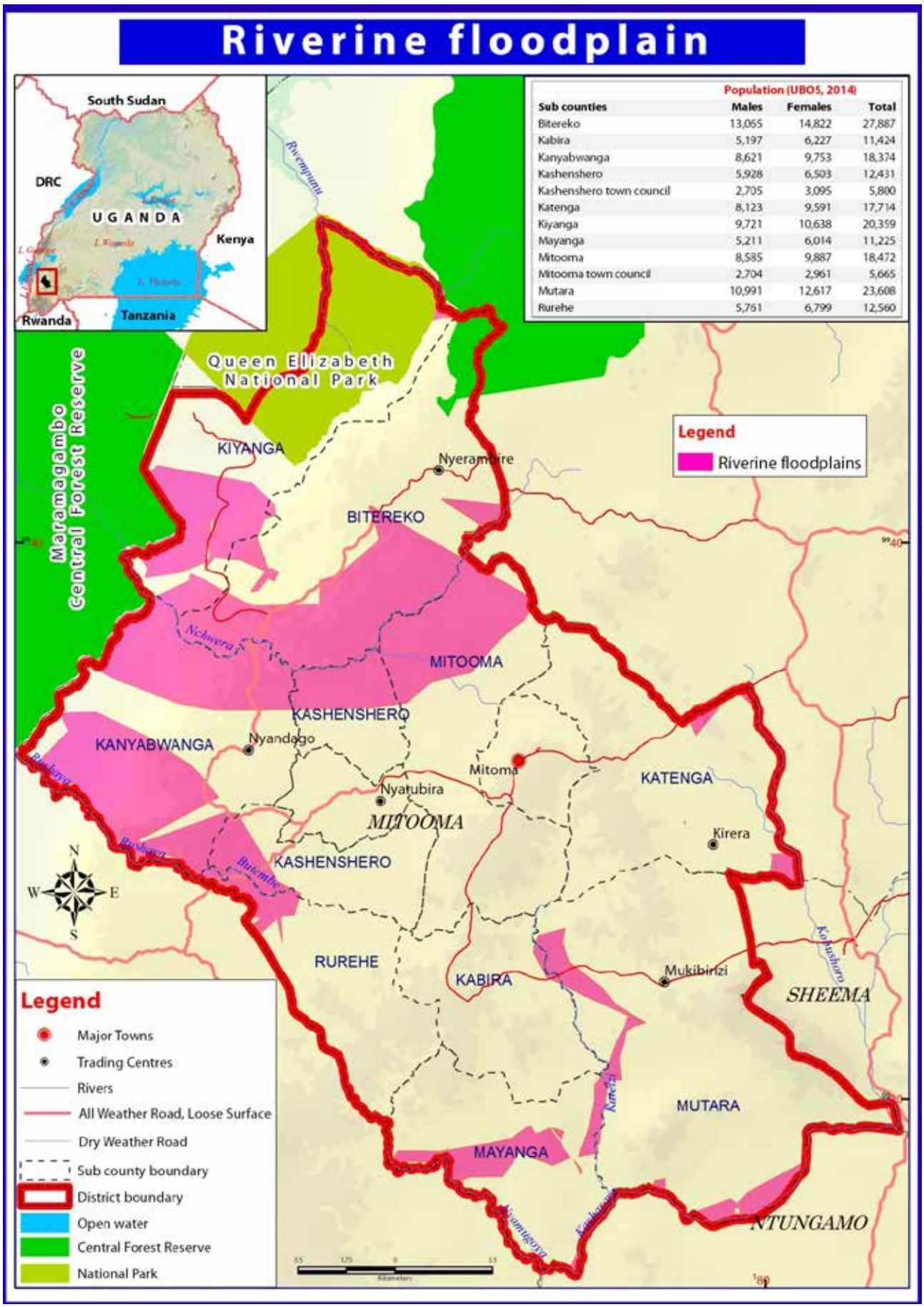


Figure 9: Hotspots for riverine floods in Mitooma

2.3.7 Road and waters accidents

Road accidents mainly occur on the highways especially along Ishaka-Rukingiri highway and Bitereko road (Figure 10) leading human and livestock injuries and disabilities, loss of human and livestock lives and loss of property and incomes. The accidents are attributed to the narrow roads and poor workmanship and reckless driving while water accidents are attributed to strong winds that sweep away boats crossing River Nyamugoye.

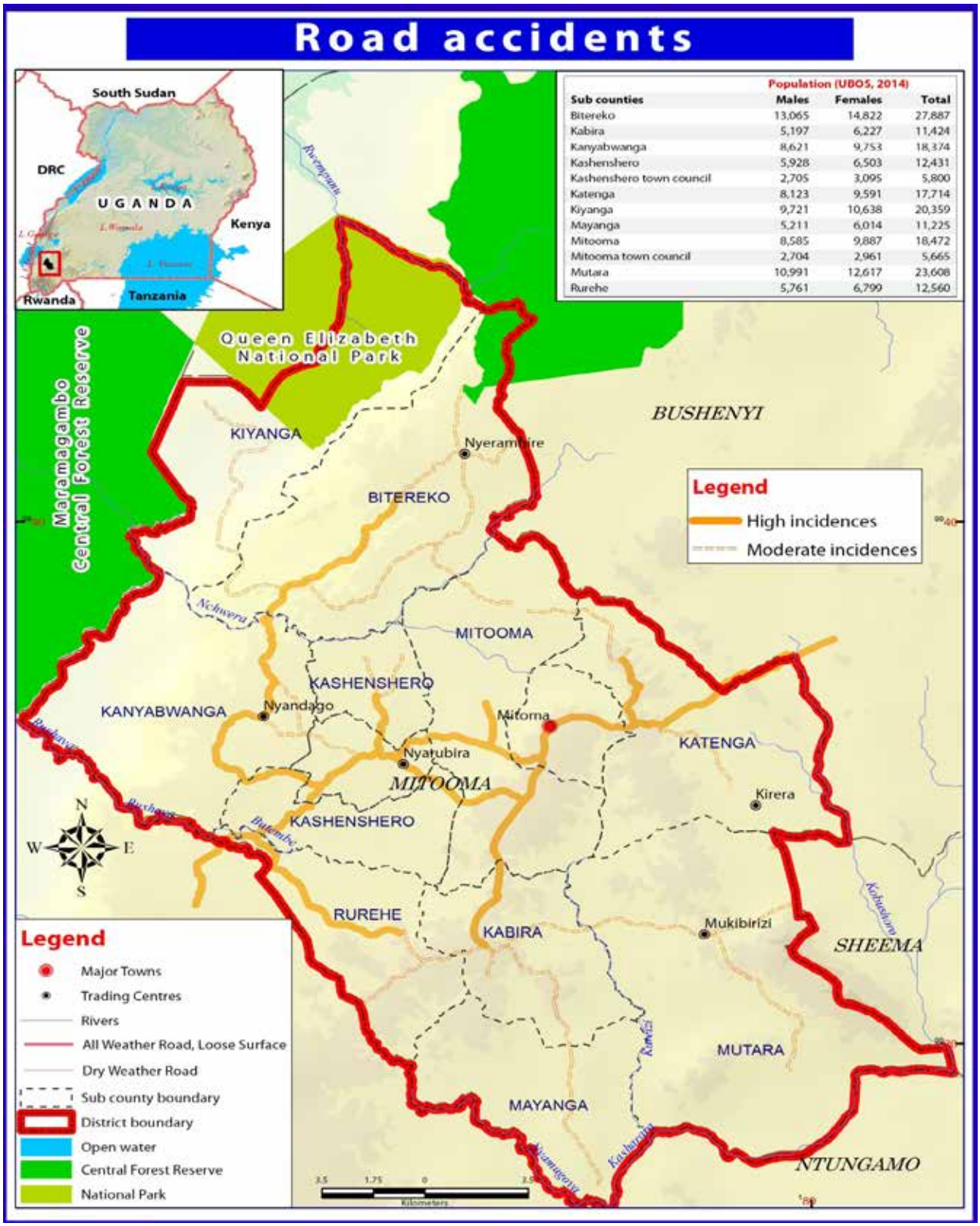


Figure 10: Hotspots for road and water accidents in Mitooma

2.3.8 Mudslides

Key informants noted that mudslides are frequent during the rainy season due to mass movement of loosened and water saturated soils. This is attributed to the loosening of the soil structure during construction of roads on steep hills coupled with poor farming methods. They also occur along rivers due to human activities such as farming with river buffer zones which distabilise riverbank stability and integrity. Mudslides are more evident on murram roads especially in Bitereko, Mutara and Kiyanga Sub Counties (Figure 11).

Mudslides destroy crops, block roads curtailing transportation of both crop and livestock products and also further destabilise the soil structure. They also lead siltation of rivers, loss of agricultural land and riverine floods.

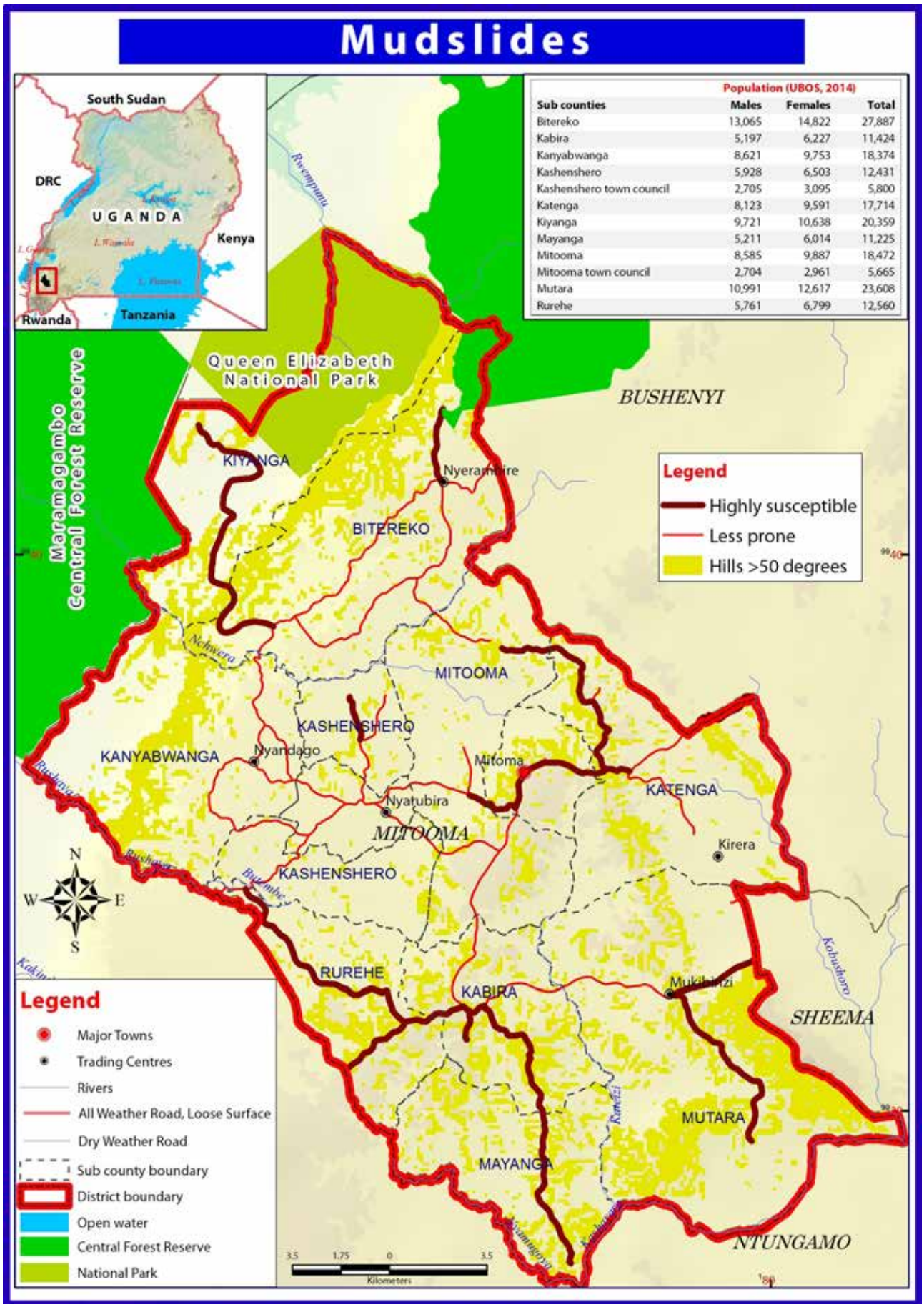


Figure 11: Hotspots for mudslides in Mitooma

2.3.9 Landslides

Key informants and FGDs are perceived as land mass displacement off a hillslope destroying features at the foot of the hill. They are frequent during erratic rain events and are attributed to poor agricultural practices, vegetation clearance on hills, bush burning as well as excessive rain events. Landslides have only been experienced in Kiyanga Sub County (Figure 12).

Landslides destroy crops and natural vegetation, block roads curtailing transportation of both crop and livestock products and also further destabilise the soil structure. They also lead siltation of rivers, loss of agricultural land and destruction of livelihood infrastructure including households, schools and hospitals as well as water supply systems. Landslides are anticipated to cause more harm if poor farming practises continue.

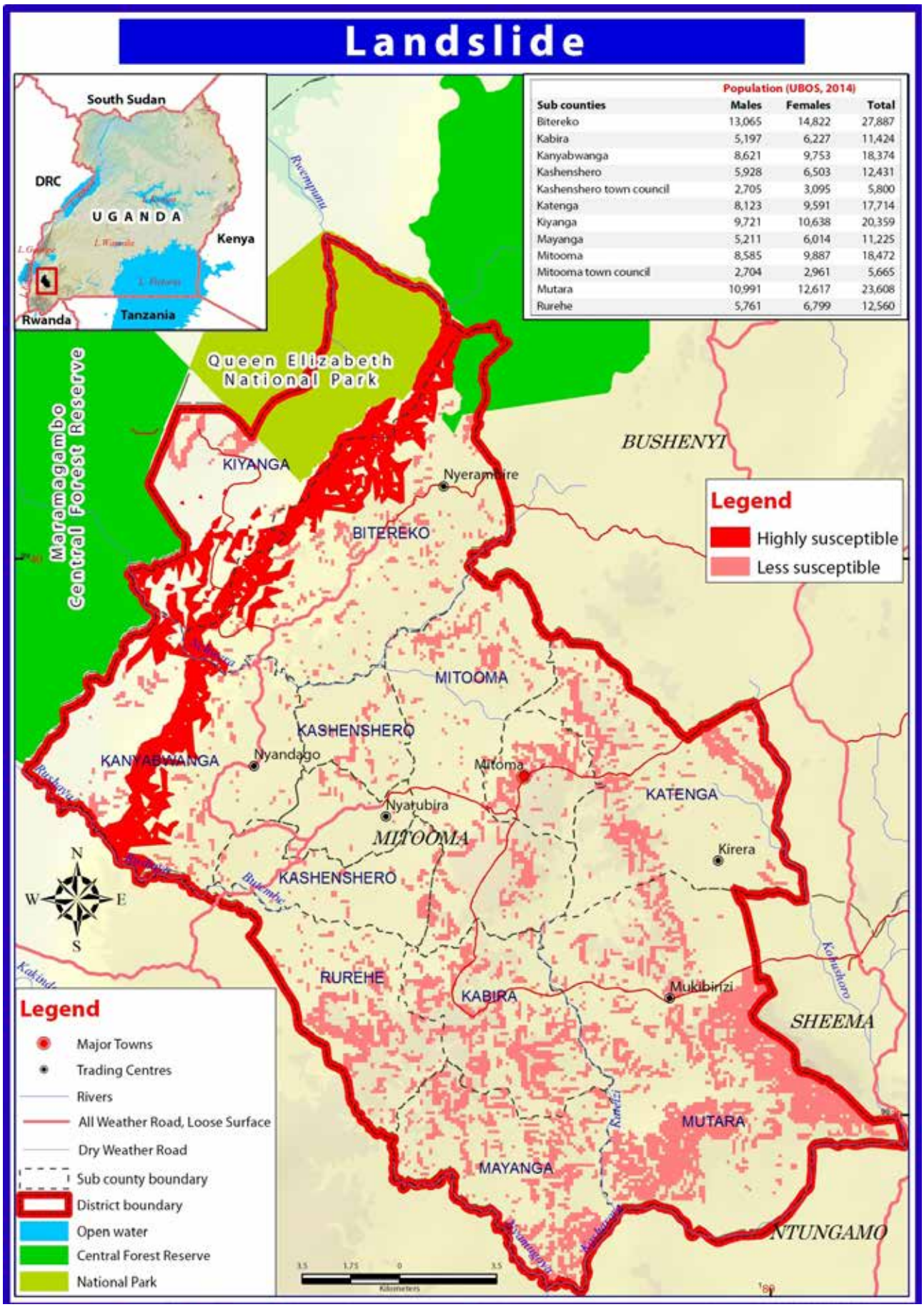


Figure 12: Hotspots for landslides in Mitooma

2.4 Coping strategies

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

Table 2: Coping strategies to climate change induced and technological hazards in Mitooma District

No	Multi-Hazards	Coping strategies
1	Mudslides	- Mulching - Construction of soil bunds - Planting of more cover crops - Tree planting
2	Drought	- Wetland restoration - District provision of drought resistant varieties in coffee, beans, bananas - Conservation of dry foods e.g. millet, cassava and grains - Construction of granaries - Improve water and soil conservation practices - Agroforestry - Rain-Water harvesting tanks - Drip irrigation - Planting of early maturing crops and timely planting - Use of meteorological weather forecast data - Tree planting
	Riverine floods	- Awareness on proper agricultural practices e.g. terracing, buffer zones along rivers and streams - Construction of bands - Planting hedge rows - Mulching - Strip cropping - Using makeshift boats to cross rivers and streams - Construction of trenches - Construction of temporary bridges - Enforcement of Riverbank, Lakeshore Management Regulations (2000)
3	Soil erosion	- Mulching - Construction of soil bunds - Agro-forestry - Trenching - Intercropping - Contour ploughing - Strip farming - Green buffer zones across the slope
5	Hailstorms	- Practising agro-forestry - Farmland boundary tree planting - Seeking relief aid from government - Stacking banana plants - Planting hedges/ hedgerows
6	Lightening	- Installation of lightening conductors on newly constructed schools - Awareness - Educating communities to avoid taking shelter under trees during rains
7	Pests and diseases	- Planting disease resistant varieties - Awareness - Roughing (uprooting and burning diseased plants) - Spraying pests - Vaccination of livestock - Inter cropping - Abandoning cattle rearing in sub-counties adjacent to Queen Elizabeth National Park - Planting early - Enforcement of the Banana Bacteria Wilt Ordinances 2013
8	Road accidents	- Awareness - Erection of humps - Periodic road maintenance - Deployment of traffic officers along the major roads
9	Strong winds	- Planting of wind breakers - Planting root tubers like yams - Farmland boundary tree plantation - Agro forestry - Mulching - Stacking banana plantations using poles
	Mudslides	- Planting of elephant grass to buffer the river
	Landslides	- Tree planting - Temporary migrations

2.5 Risks

A risk is the probability of harmful consequences, or expected losses (deaths, injuries, property loss, livelihoods and economic activity disruption or environment damage) resulting from interactions between hazards (natural, human-induced or man-made) and vulnerable conditions.

2.5.1 Land conflicts

Land conflicts are rampant in the district ranging from those between households, communities as well as between communities and government institutions. For example, a there is a conflict between communities in Kiyanga and Bitereko Sub Counties, Queen Elisabeth National Park and Kalinzu Central Forest Reserve with the park authority and NFA accusing communities of encroachment (Figure 13).

According to key informants, land conflicts have majorly been triggered by increased population growth rates leading to increased land fragmentation, family misunderstandings (misuse of inheritance rights), greed, and unregistered land title holdings. Additionally, Key informant noted that conflicts also arise as a result of, unemployment, unequal distribution of resources by government such as factories and unclear compensation claims between Uganda National Road Authority and the communities

Extreme cases have resulted into loss of land, human death, loss of wildlife and livestock, famine and poverty as well as forced migrations especially for the socially marginalised households.

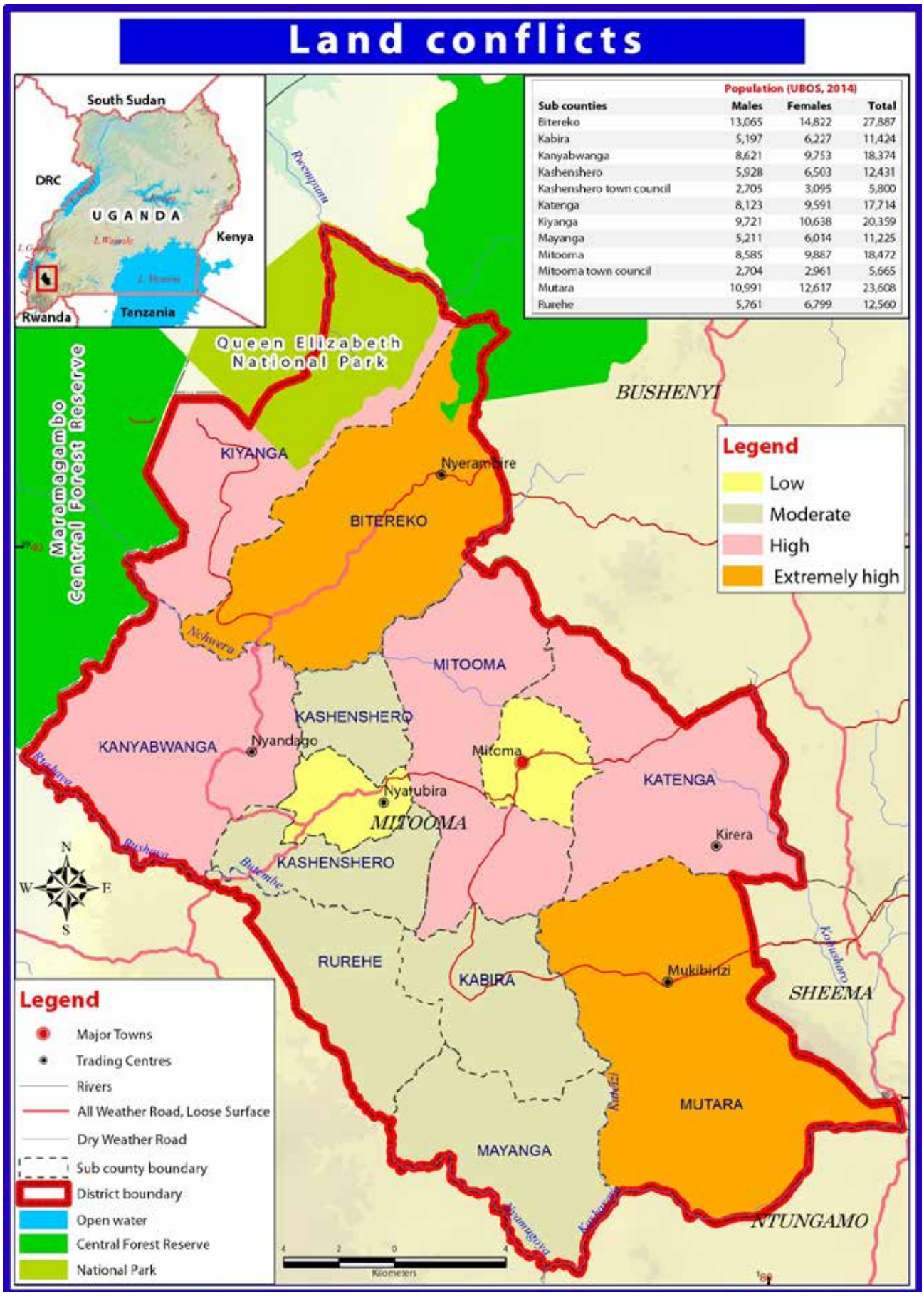


Figure 13: Hotspots for land conflicts in Mitooma

2.5.2 Deforestation

Key informants revealed that the increasing human population has increased pressure on existing forest reserves due to increased demand for construction materials (poles and timber), fuels (charcoal) and cultivation land as well as community ignorance about the importance of vegetation in terms of ecosystems services. Deforestation is rampant on the hillslopes especially in Kiyanga, Bitereko, and Kanyabwanga Sub County (Figure 14). The impact has been loss of forest cover, accelerated climate change resulting into increased occurrences of extreme events (floods and drought), soil erosion and reduced firewood availability.

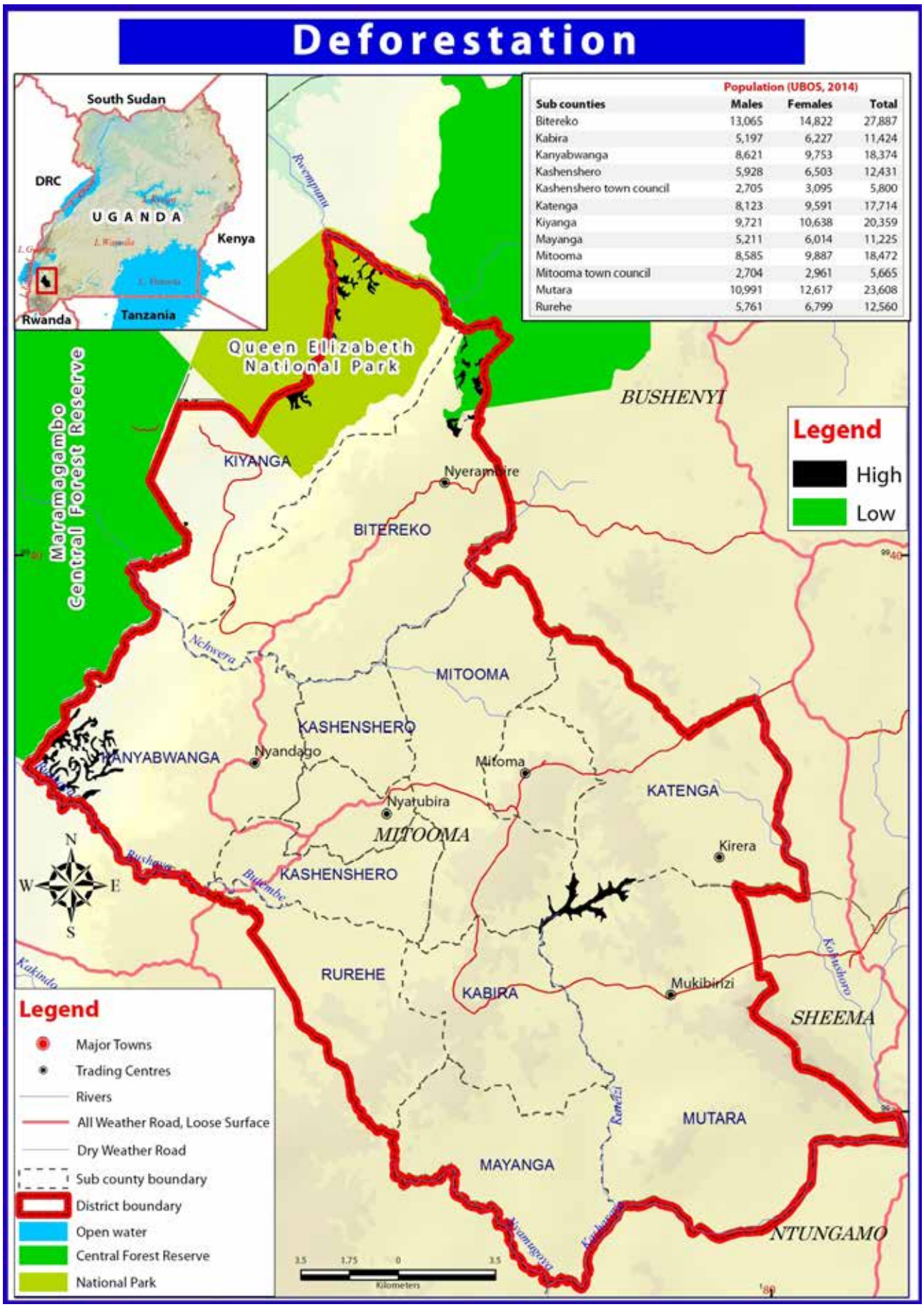


Figure 14: Hotspots for deforestation in Mitooma

2.5.3 Wetland degradation

FGDs revealed that wetland degradation is high and on the increase especially in Mutara, Katenga, Mitooma, Bitereko, and Kashenshero Sub Counties (Figure 15) due to reclamation for intensification of agricultural activities, sand extraction, and brick making. Wetland degradation is also attributed to over stocking and poor farming methods. It is caused by increased population growth rates, and weak enforcement by responsible officials due to inadequate funding

Over time, wetland degradation have led to increased siltation of rivers, loss of wetland biodiversity and increased outbreaks of water borne diseases like diarrhea as a result of decline in water quality. It has also increased global warming; thus climatic changes leading droughts, reduced crop and livestock productivity, water scarcity and drying up of water sources (springs and wells).

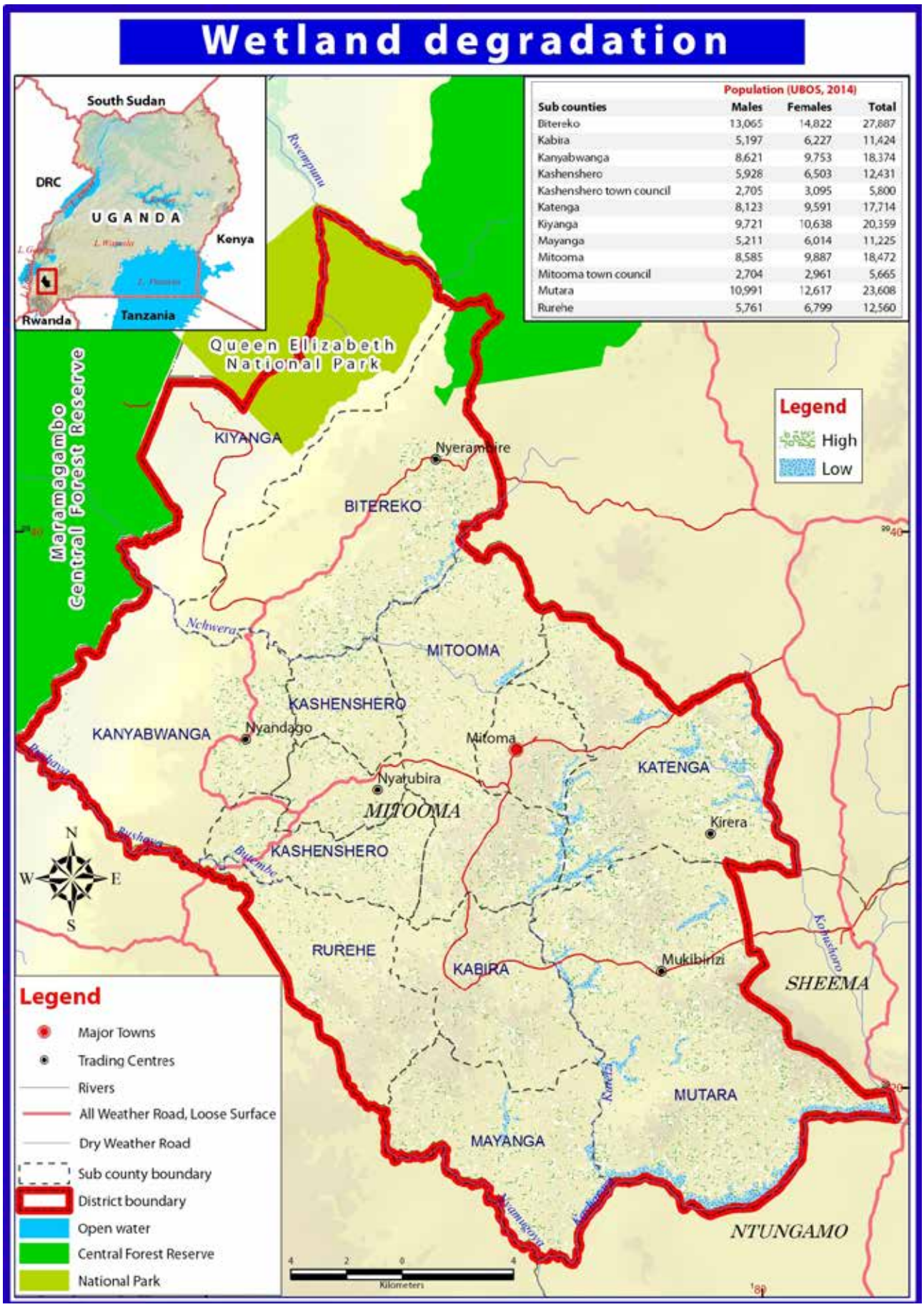


Figure 15: Hotspots for wetland degradation in Mitooma

2.5.4 Soil erosion

Based on key informants, FGDs and field observation, soil erosion is prevalent in Bitereko, Kiyanga, Kanyabwanga and Mutara Sub Counties (Figure 16) due to intensive cultivation (monoculture) of hillslopes, over stocking, deforestation, increasing infrastructure development and high population density augmented with increasing erratic rain events. Over time, soil erosion has led to reduced soil fertility and productivity, reduced crop yields, siltation of wetlands and rivers, and increased outbreaks of water borne diseases as a result of decline in water quality. It also lead to destruction of infrastructure especially feeder roads; thus increasing their maintenance costs.

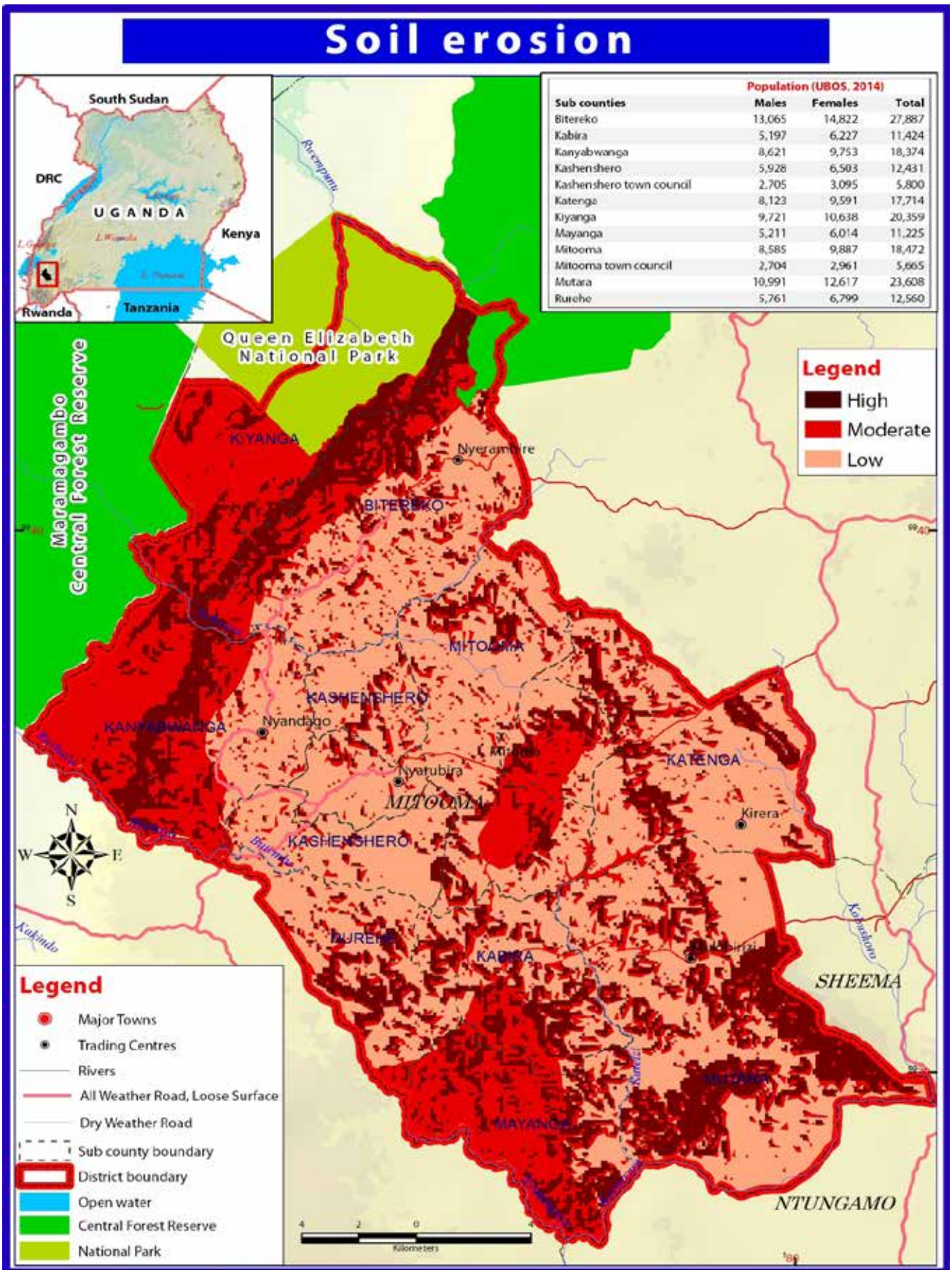


Figure 16: Hotspots for soil erosion in Mitooma

2.5.5 Human and wildlife conflicts

Human-wildlife conflicts results from wildlife invasion of household farmlands especially elephants, baboons, wild pigs, buffaloes and monkeys. These are common in communities around the Queen Elizabeth National Park, Maramagambo, Kalinzu Central Forest Reserves and wetlands. Human-wildlife conflicts are more severe in Kiyanga, Kanyabwanga, and Bitereko Sub Counties (Figure 17). The wildlife invasions have led to destruction of crops leading to reduced crop yields (wildlife destroys the foliage which is productive industry of the crop) especially for banana, millet, Potatoes and Sweet Potatoes) and loss of livestock (especially pigs and goats. They have led to increased incidences of communicable diseases like Marburg and Ebola.

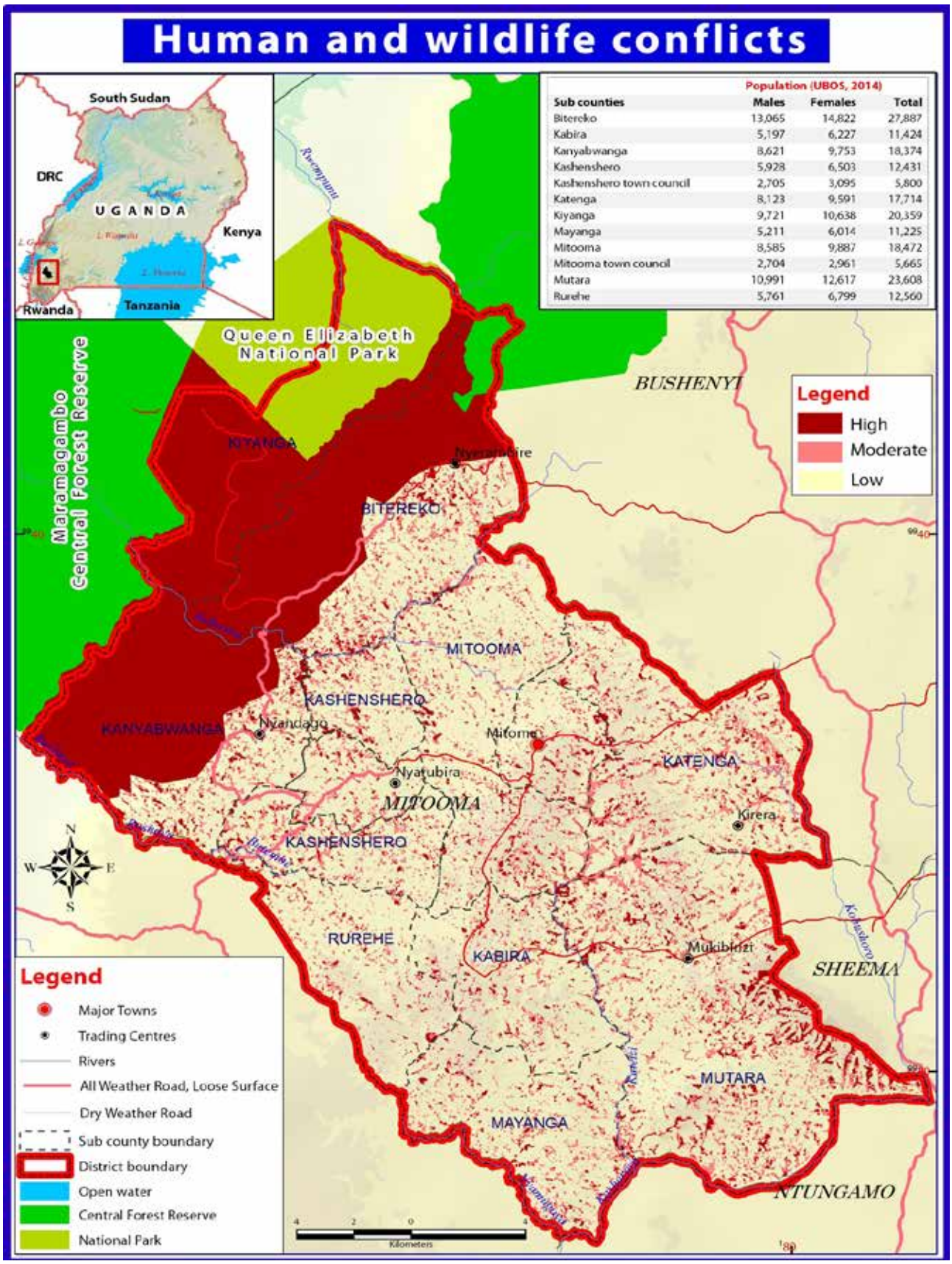


Figure 17: Hotspots for human and wildlife conflicts in Mitooma

2.5.6 Bush fires

Bush fires in Mitooma district are widespread in Kanyabwanga, Mutara, Katenga, Bitereko and Kiyanga Sub Counties (Figure 18). Most of the fires experienced are man-made especially on hillslopes. This is done in anticipation that burning allows for regeneration of forage/pastures for livestock. Most fires are lit during the dry season (January and February and June and July). Other reasons for bush burning are arson out of ignorance, firewood harvesting, hunting, tick management, and poor farming methods (soil burning during seedbed preparation).

Fires have caused loss of forest land and flora/fauna biodiversity, destruction of tree plantations and homesteads, increased soil erosion leading to soil fertility and productivity decline, and accelerated climate change leading to severe events such as prolonged droughts.

Fires are also responsible for migration of wildlife enhancing human-wildlife conflicts, reduced livestock grazing land leading to neighbourhood conflicts and low livestock productivity.

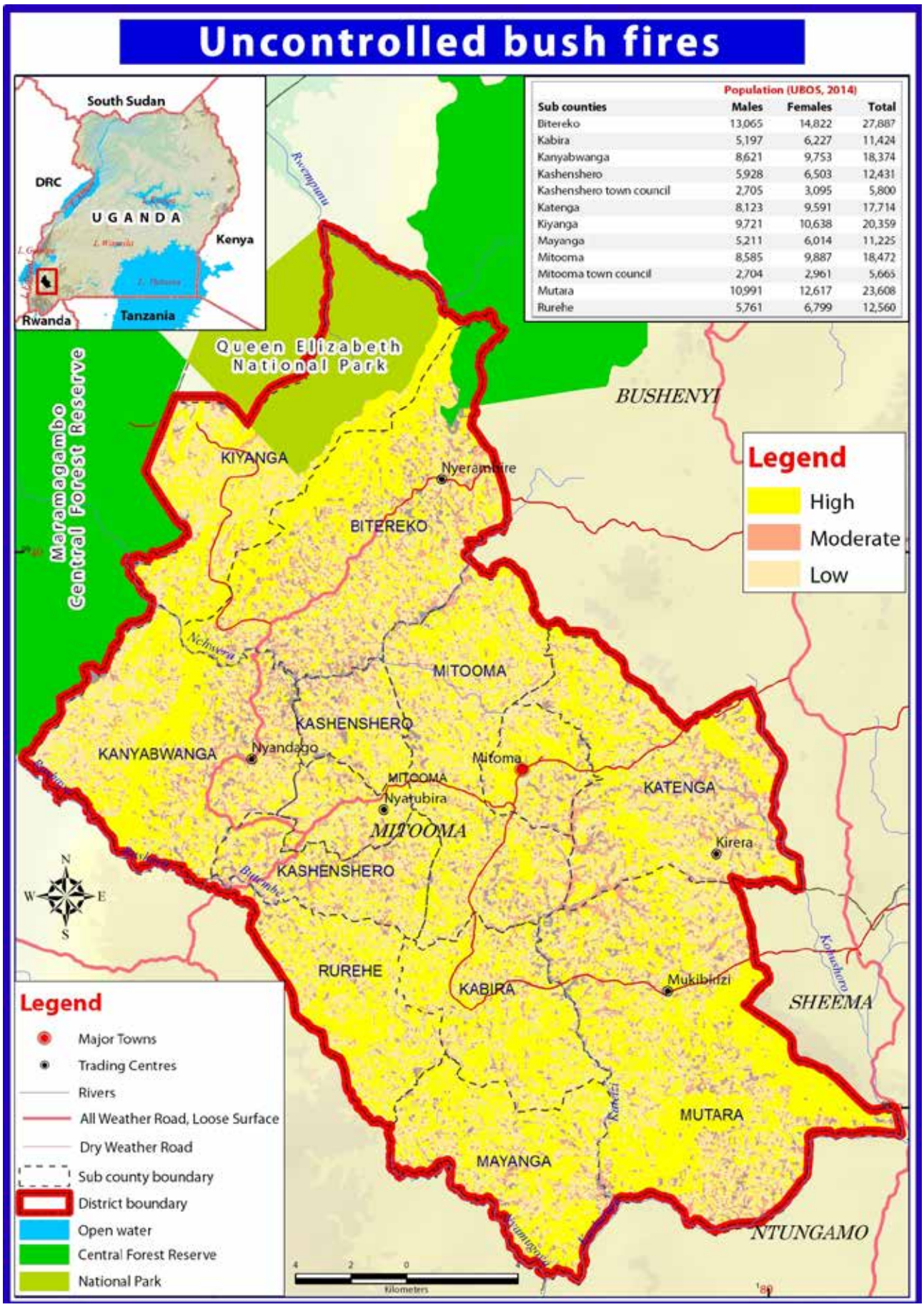


Figure 18: Hotspots for bush fires in Mitooma

2.5.7 Invasive species

The commonest invasive species are *Lantana camara* and *Pasparum Spp* mainly in the Sub Counties of Bitereko, Kiyanga and Kanyabwanga (Figure 19). Some of these species are toxic and have led to livestock (cattle) deaths. Additionally, invasive weeds are non-palatable thus their colonisation of rangelands through suppression of highly palatable species reduces the grazing area.

Their increasing incidence in the district is attributed to poor farming methods and prolonged drought. Invasive species have reduced productivity of farm and pasture lands yet their management is almost impossible at household/community level due to the high costs involved in their removal. Communities have tried to control these invasive species by bush burning.

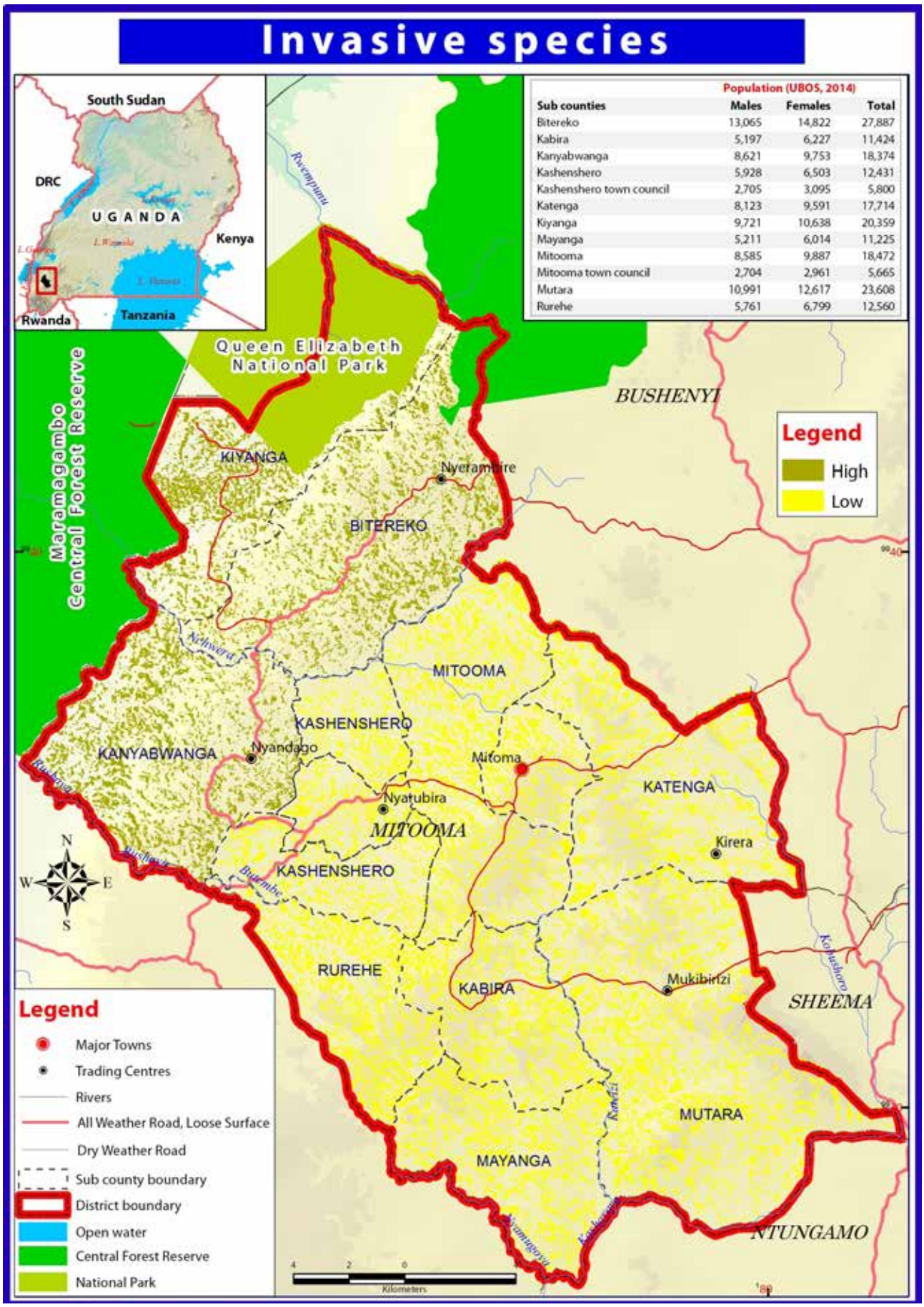


Figure 19: Hotspots for invasive plant species in Mitooma

2.5.8 Political risks

Environmental stewardship by the community is a function of the existing policy and political frameworks; thus if not well implemented, policy and political frameworks do present risks especially emanating from conflict of interest. A number of policy and political risks according to key informants and focus Group Discussion include: a) weak enforcement of conservation management and environmental protection policies and b) weak penalties to offenders e.g. penalties on illegal timber dealers. FGDs revealed that political risks are severe in the election and bye-election periods. These have resulted into household migration (especially marginalised households), death as a result of unhealthy conflicts and violence and depletion of land cover; limited ability to advocate for better incentives for farming communities leading to low agricultural productivity (poor yields) and agricultural produce price fluctuations. Additionally, these have retarded development, loss of jobs and community trust, poor service delivery, poverty increment and creation of poor leadership.

2.6 Coping strategies

According to key informants and FGDs, the following strategies (Table 3) have been employed by communities to cope with risks they experience.

Table 3: Risk coping strategies in Mitooma District

No	Risks	Coping strategies
1	Wetland degradation	- Awareness campaigns - Enforcement of wetland management laws - Using a multi-sector approach by involving other government departments such as RDCs and DPCs
2	Deforestation	- Reforestation and afforestation - Increased monitoring of forest reserves by National Forestry Authority - Increased collaborations between National Forestry Authority, Uganda Wildlife Authority and the District - Awareness campaigns - Enforcement of the National Forestry and Tree Planting Act, 2003 through licensing forestry products
3	Bush fires	- Collaboration between Queen Elizabeth National Park and district has led to the establishment of a camp near communities that foresees illegal activities - Community sensitization
4	Human wildlife conflicts	- Strengthening monitoring and recruitment of vermin control guards - Awareness - Revenue sharing from Queen Elizabeth National Park to improve relations with the surrounding communities - Signing of Memorandum of Understanding between communities and the management of Queen Elizabeth National Park to access the reserve - Surrendering or handing over destructive tools to the park authorities - Creating trenches along the park boundary - Planting thorny trees along the boundary e.g. the Mauritius thorns - Beekeeping along the park boundary
5	Political risks	- Sensitisation - Reconciliation of political opponents
6	Wetland degradation	- Community awareness campaigns - Evictions
7	Land conflicts	- Arbitration - Negotiation - Reconciliation - Community policing - Sensitisation - Mediation
8	Invasive species	- Burning - Community sensitisation - Uprooting - Chemical spraying

2.7 Vulnerability profiles

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

Four broad vulnerability areas were participatory identified in the district, these being social, economic, environmental and physical components of vulnerability. In each of these vulnerability components, participants characterised the exposure agents, including hazards, elements at risk and their spatial dimension. They also characterised the susceptibility of the district including identification of the potential impacts, the spatial disposition and the coping mechanisms. Participants also identified the resilience dimension at different spatial scales (Table 4)

Table 5 (vulnerability profile) shows the relation between hazard intensity (probability) and degree of damage (magnitude of impacts) depicted in the form of hazard intensity classes, and for each class the corresponding degree of damage (severity of impact) is given. It reveals that climatological and meteorological hazards in form of drought and hailstorms; socio-ecological in the form of human-wildlife conflicts; and ecological in form of deforestation, pests and diseases predispose the community to high vulnerability state. The occurrence of, strong winds, lightening, road accidents, mud slides also create a moderate vulnerability profile in the community (Table 5).

Table 4: Components of vulnerability in Mitooma District

Vulnerability Components	Exposure	-		Susceptibility	-	Resilience	
	Hazards	**Elements at risk**	**Geographical Scale**	**Potential impacts**	**Geographical Scale**	**Coping strategies**	**Geographical Scale**
Social component	Mud slides	- Human and livestock populations - Crops - Infrastructure including homes, schools and health units	Sub County	- Destruction of crops leading to famine and hunger - Reduction in the agricultural lands - Block the flow of water hence leading to flooding - Blockage of roads	Sub County	- Planting elephant grass along the banks of the rivers and streams	Sub County
	Floods (Riverine)	- Human and livestock populations - Crops - Infrastructure including homes, schools and health units	Sub County	- Blockage of roads - Retards education since crossing is difficult - Washing way of top soils - Displacement of peoples' livelihoods	Sub County	- Practise proper farming methods like terracing - Strip cropping - River buffer zones - Wetland conservation - Integrated watershed management	District
	Drought	- Human and livestock populations - Crops	District	- Change in crop growing patterns/ seasons leading to crop failure - Loss of pasture - Leads to livestock diseases like Anthrax - Death of animals - Outbreak of wild fires	District	- provision of drought resistant seedlings - Storage of dry food - Provision of drought tolerant crops	District
	Wild fires	- Human and livestock populations - Crops - Air/atmosphere - Infrastructure including homes, schools and health units	Sub County	- Conflict with neighbours - Low crop yields - Air pollution	Sub County	- Collaboration between district and Queen Elizabeth National Park for easy monitoring - Surveillance of bush fires - Sensitisation	Sub County
	Strong winds	- Crops - Infrastructure including homes, schools and health units	Sub County	- Destroy crops like banana plantations - Plants dry very first - Boosts spread of airborne diseases like flu - Spreads fires during the dry season	Sub County	- Planting wind breakers - Agro forestry - Boundary tree planting - Crop diversification	Sub County
	Pests and diseases	- Human and livestock populations - Crops	District	- Loss of crop production and productivity - Death of animals - Price fluctuation - Increased poverty level	District	- Vaccination - Plant pest and disease resistant crops - Early planting - Spraying - Inter cropping - Shift from cattle raring to crop production as a result of tsetse flies	District

	Hailstorms	- Crops - Infrastructure including homes, schools and health units	District	- Destruction of crops - Destruction of homes - Destruction of schools	District	- Agro forestry - Boundary tree planting - Growing of Hedges - Crop diversification	District
	Lightening	- Human and livestock populations - Crops - Infrastructure including homes, schools and health units	Sub County	- Loss of lives (Human and livestock) - Destruction of infrastructures like schools - Destroys crops and trees	Sub County	- Install lightening conductors - Keep in doors - Encourage residents to wear rubber shoes - Avoid taking shelter under trees during rains - Avoid getting into contact with metals during rain events	Sub County
	Theft	- Human and livestock populations - Crops - Social structures including schools and health units	Sub County	- Loss of property and income - Loss of lives - Family conflicts	Sub County	- Communal security - Collaboration between neighbouring districts	District
	Land conflicts	- Human and livestock populations - Crops - Infrastructure development including homes, schools and health units	District	- Death of humans and animals - Time wastage - Land fragmentation - Increased number of landless people - Displacement of people	Sub County	- Migration - Sensitisation - Mediation - Court litigation	District
	Accidents	- Human and livestock populations	District	- Human and livestock deaths - Disabilities after injuries	District	- Sensitising - Establishment of road signs - Construction of humps - Deployment of Traffic officers to enforce traffic laws	District
	Wild life conflicts	- Human and livestock populations - Crops	Parish	- Destruction of crops - Livestock deaths - Human deaths	Sub county	- Sensitisation - Sharing funds from the park with the community to improve relations - Signing memorandum of understanding between the park and communities - Trenching the boundary - Hanging beehive to avoid elephants from intruding	Sub County
	Invasive species	- Livestock populations - Crops	Sub county	- Reduced livestock production - Human injuries/ poisoning	Sub county	- Uprooting and burning - Sensitisation - Chemical spraying - Promotion of sound rangeland/pasture management practices - Establishing fodder banks/ pasture farms	Sub county
	Soil erosion	- Aquatic systems - Crops - Infrastructure mainly feeder roads	Sub county	- Soil degradation through loss of nutrients - Siltation in rivers - Loss of vegetation - Gullies in feeder roads	Sub county	- Construction of soil bunds - Mulching - Community policing - Intercropping - Agro forestry - Awareness campaigns	Sub county

	Mud slides	- Human and livestock populations - Crops - Infrastructure including homes, schools and health units	Sub County	- Loss of income - Loss of government revenue and infrastructure	Sub County	- Planting elephant grass along the banks of the rivers and streams	Sub County
	Floods (Riverine)	- Human and livestock populations - Crops - Infrastructure including homes, schools and health units	Sub County	- Loss of income - Loss of government revenue - Unequal and inequitable distribution of livelihoods resources - Loss of economic time	Sub County	- Practise proper farming methods like terracing - Strip cropping - Integrated catchment management - Wetland conservation	Sub County
	Drought	- Human and livestock populations - Crops	District	- Loss of income - Reduced crop and livestock production and yields hence no excess to sell - Increased poverty levels	District	- Provision of drought resistant seedlings - Storage of dry food	District
	Wild fires	- Human and livestock populations - Crops - Natural vegetation including trees - Infrastructure including homes, schools and health units	Sub County	- Low crop yields hence low incomes - Destruction of commercial trees	Sub County	- Collaboration between district and queen Elizabeth N.P for easy monitoring - Surveillance of bush fires - Sensitisation	Sub County
	Strong winds	- Crops - Infrastructure including homes, schools and health units	Sub County	- Loss of income as a result of crop destruction - Blockage of roads disrupting business	Sub County	- Planting wind breakers - Agro forestry - Boundary tree planting	Sub County
	Pests and diseases	- Human and livestock populations - Crops	District	- Reduced livestock and crop production and productivity - Price fluctuation - Increased poverty level - Loss of working hours as sick labour force not being very productive	District	- Vaccination - Plant pest and disease resistant crops - Early planting - Spraying - Inter cropping - Shift from cattle raring to crop production as a result of tsetse flies especially for communities adjacent to Queen Elizabeth National Park	District

Economic component	Lightening	- Human and livestock populations - Crops - Natural Vegetation including trees - Infrastructure including homes, schools and health units	Sub County	- Loss of human lives - Loss of government revenue through destruction of schools and health centres - Destruction of productive crops - Destruction of commercial trees	Sub County	- Install lightening conductors - Keep indoors during heavy rain events - Reporting to OPM	Sub County
	Deforestation	- Human and livestock populations - Crops	Sub-county	- Loss of income - Accelerated soil erosion leading to reduced crop production/ productivity and poorer livelihoods	Sub-county	- Tree planting - increased monitoring - Collaboration between NFA, District, and Queen Elisabeth National Park to improve the monitoring - Enforcement of the law	Sub-county
	Land conflicts	- Human and livestock populations - Crops - Infrastructure development including homes, schools and health units	District	- Loss of incomes through litigation/ retaliation and destruction of crops	Sub County	- Migration - Sensitisation - Mediation - Land registration/ titling	District
	Accidents	- Human and livestock populations	District	- Loss of bread winners leading to livelihood disruptions - Loss of livestock hence loss of income	District	- Sensitisation - Construction of humps - Deployment of Traffic officers to enforce traffic laws	District
	Wild life conflicts	- Human and livestock populations - Crops	Sub county	- Loss of incomes resulting from crop destruction and death of livestock (especially pigs and goats)	Sub county	- Sensitisation - Community policing - Sharing funds from the park with the community to improve relations - Signing memorandum of understanding between the park and communities - Trenching the boundary - Hanging be-hive to prevent elephants from intruding	Sub County
	Invasive species	- Livestock populations - Crops	Sub county	- Reduced livestock production and productivity through pasture reductions	Sub county	- Uprooting and burning - Sensitisation - Chemical spraying	Sub county
	Soil erosion	- Human and livestock populations - Crops - Infrastructure mainly feeder roads	Sub county	- Soil degradation leading to reduced land value - Siltation in rivers - Increased maintenance costs for feeder roads - Reduced crop yields	Sub county	- Construction of soil bunds - Mulching - Community policing - Intercropping - Agro forestry - Green buffers	Sub county

Environmental component	Mudslides	- Crops - Infrastructure including homes, schools and health units	Sub County	- Block the flow of water hence leading to flooding - Deterioration of water quality - Destruction of vegetation	Sub County	- Planting elephant grass along the banks of the rivers and streams	Sub County
	Floods (Riverine)	- Vegetation - Water - Fauna	Sub County	- Loss of vegetation and flora through suffocation - Water pollution	Sub County	- Practise proper farming methods like terracing - Strip cropping - Enforcement of environmental laws - Observe buffer zones along rivers and streams	Sub County
	Drought	- Natural vegetation - Water	District	- Limited livestock forage - Livestock deaths - Change in vegetation - Scarcity of water	District	- Tree planting - Wetland conservation	District
	Wild fires	- Natural vegetation including trees - Wildlife	Sub County	- Loss of vegetation - Climatic change - Soil degradation - Migration of wildlife - Loss of biodiversity (flora and fauna)	Sub County	- Collaboration between district and queen Elizabeth National Park for easy monitoring - Surveillance of bush fires - Sensitisation - Formation and capacitating village level committees	Sub County
	Strong winds	- Vegetation - Air	Sub County	- Loss of vegetation - Air pollution	Sub County	- Planting wind breakers - Agro forestry - Boundary tree planting	Sub County
	Hailstorms	- Vegetation - Birds - Crops	District	- Crop failures - Destruction of trees - Loss of birds	District	- Agro forestry - Boundary tree planting - Growing of Hedges	District
	Lightening	- Natural Vegetation including trees	Sub County	- Destruction of trees	Sub County	- Plant more trees to replace those destroyed	Sub County
	Deforestation	- Crops - Trees - Wildlife (birds and microorganisms)	Sub-county	- Loss of indigenous vegetation - Environment effects like erosion - Drought - Increased greenhouse gas emissions leading to global warming - Shifting and migration of wildlife and birds - Loss of biodiversity	Sub-county	- Tree planting - Increased monitoring - Collaboration between NFA, District and Queen Elisabeth National Park to improve the monitoring - Enforcement of the law	Sub-county
	Land conflicts	- Land - Vegetation	District	- Loss of vegetation - Land fragmentation	Sub County	- Migration - Sensitisation - Mediation - Litigation	District
	Wild life conflicts	- Wildlife	Sub county	- Loss of wildlife	Sub county	- Sensitisation - Community policing - Sharing funds from the park with the community to improve relations - Signing memorandum of understanding between the park and communities - Trenching the boundary - Hanging beehives to prevent elephants from intruding	Sub County
	Invasive species	- Vegetation	Sub county	- Loss of indigenous species - Loss of biodiversity	Sub county	- Uprooting and burning - Sensitisation - Chemical spraying	Sub county
	Soil erosion	- Land - Vegetation - Air - Water	Sub county	- Soil degradation - Siltation in rivers - Loss of vegetation - Gullies in feeder roads - Water pollution	Sub county	- Construction of soil banks - Mulching - Community policing - Intercropping - Agro forestry	Sub county

Physical components	Mud slides	- Rivers/ streams - Land - Air - Crops - Infrastructure including homes, schools and health units	Sub County	- Destroy crops - Reduction in the crop lands - Block the flow of water hence leading to flooding - Land degradation	Sub County	- Planting elephant grass along the banks of the rivers and streams	Sub County
	Floods (River line)	- Rivers/ streams - Land - Air - Crops - Infrastructure including homes, schools and health units	Sub County	- Blockage of roads - Blockage of rivers/ streams	Sub County	- Practise proper farming methods like terracing - Strip cropping	Sub County
	Wild fires	- Land/ soil - Infrastructure including homes, schools and health units	Sub County	- Loss of vegetation - Shifting of wildlife - Soil degradation	Sub County	- Collaboration between district and queen Elizabeth National Park for easy monitoring - Severance of bush fires - Sensitisation	Sub County
	Strong winds	- Soil - Infrastructure including homes, schools and health units	Sub County	- Loss of lives - Destroy crops like banana plantations - Plants dry very first - Boosts diseases like flu - Spreads fires during the dry season - Air pollution	Sub County	- Planting wind breakers - Agro forestry - Boundary tree planting	Sub County
	Hailstorms	- Crops - Infrastructure including homes, schools and health units	District	- Destruction of homes - destroy Destruction of schools	District	- Agro forestry - Boundary tree planting - Growing of Hedges	District
	Deforestation	- Land/ soil	Sub-county	- Loss of indigenous vegetation - Accelerated soil erosion as a result of emergence of bare lands - Soil degradation	Sub-county	- Install lightening conductors - Tree planting - Increased monitoring - Collaboration between NFA, District, and Queen Elisabeth National Park to improve the monitoring - Enforcement of the law	Sub-county
	Land conflicts	- Crops - Social structures including schools and health units	District	- Time wastage - Land fragmentation - Soil degradation	Sub County	- Migration - Sensitisation - Mediation - Litigation	District
	Invasive species	- Rangelands	Sub county	- Colonisation of grazing lands - Suppression of other vegetation	Sub county	- Uprooting and burning - Sensitisation - Chemical spraying	Sub county
	Soil erosion	- Land - Crops - Social infrastructure especially feeder roads	Sub county	- Soil degradation - Siltation in rivers - Loss of vegetation - Gullies in feeder roads	Sub county	- Construction of soil banks - Mulching - Community policing - Intercropping - Agro forestry	Sub county

Table 5: Vulnerability profile for Mitooma District

	PROBABILITY		RELATIVE RISK	VULNERABLE SUB COUNTIES
	Relative likelihood this will occur	*Overall Impact (Average)*	*Probability x Impact Severity*	
Hazard	*1 = Not occur 2 = Doubtful 3 = Possible 4 = Probable 5 = Inevitable*	*1 = Low 2= Moderate 5 = High*	*1-10 = Low 11-20 =Moderate 21-25 = High*	
River line floods	3	**2**	**6**	Mutara, Katega , Mitooma T/C, Kiyanga
Droughts	5	**5**	**25**	Rift valley Sub Counties (Mayanga, Kanyabwanga, Bitereko)
Mud slides	3	**5**	**15**	Mutara , Katega, ,Mitooma T/C, Kanyabwanga , Mayanga,
Hail storms	5	**5**	**25**	Mutara ,Katega , Kabira,Ruhehe , Kashenshero s/c,kashenshero T/C, Mitooma, Mitooma T/C, Kanyabwanga, Bitereko, Mayanga
Wild fires	2	**2**	**4**	Mutara,Katega, Kabira, Ruhehe, Kashenshero, kashenshero T/C, Mitooma, Mitooma T/C, Kanyabwanga, Bitereko, Mayanga
Lightening	4	**5**	**20**	Mutara,Katega, Kabira,Ruhehe, Kashenshero,kashenshero T/C, Mitooma, Mitooma T/C, Kanyabwanga , Bitereko, Mayanga
Pests and diseases	5	**5**	25	Mutara,Katega , Kabira,Ruhehe, Kashenshero,kashenshero T/C, Mitooma, Mitooma T/C, Kanyabwanga, Bitereko, Mayanga
Deforestation	5	**5**	**25**	Kanyabwanga, Bitereko , Mayanga
Strong winds	4	**5**	**20**	Mitooma, Mitooma T/C
Political risks	2	**5**	**10**	Mutara, Katega, Kabira, Ruhehe, Kashenshero, kashenshero T/C, Mitooma, Mitooma T/C, Kanyabwanga, Bitereko, Mayanga
Human-Wildlife conflicts	5	**5**	**25**	Kiyanga, Kanyabwanga, Bitereko
Road accidents	4	**5**	**20**	Mutara, Katega, Kabira, Ruhehe, Kashenshero, kashenshero T/C, Mitooma, Mitooma T/C, Kanyabwanga, Bitereko, Mayanga

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

Key for Relative Risk

H	High
M	Moderate
L	Low

2.8 General conclusion and programmatic recommendations

It was established that Mitooma district has over the last three decades increasingly experienced hazards including landslides, wild fires, strong winds, pests and diseases for crops and livestock, hail storms and lightening putting livelihoods at increased risk. The limited adaptive capacity (and or/resilience) and high sensitivity of households and communities in Mitooma districts increase their vulnerability to hazard exposure necessitating urgent external support.

Hazards experienced in Mitooma district can be classified as:

i. Geomorphological or Geological hazards including mudslides, landslides and hilltop cracks.
ii. Climatological or Meteorological hazards including river-line floods, floods, drought, hailstorms, strong winds, lightening and hill-slope surface runoff.
iii. Ecological or Biological hazards including livestock pests and diseases, crop pests and diseases, bush fires.
iv. Technological hazards including road accidents.

However, counteracting vulnerability at community, local government and national levels should be a threefold effort hinged on:

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

Recommended policy actions targeting vulnerability reduction include:

i. Improved enforcement of policies aimed at enhancing sustainable environmental health;
ii. Quickly review the animal diseases control act because of low penalties given to defaulters;
iii. Establishment of systems to motivate support of political leaders toward government initiatives and programmes aimed at disaster risk reduction;
iv. Increased awareness campaigns aimed at sensitizing farmers/communities on disaster risk reduction initiatives and practices.
v. Revival of disaster risk committees at the district levels
vi. Periodic maintenance of feeder roads to reduce on traffic accidents
vii. Relocation of communities in the affected areas in the district
viii. Promotion of drought and disease resistant and tolerant crop seeds
ix. Support extensive research on the occurrence and frequency of disasters prior to disaster management
x. Improve the communication channel between the disaster department and local communities
xi. Office of the prime minister should decentralise their activities to the district level
xii. Tree planting along road reserves
xiii. Fund and equip recruited extension works
xiv. Government should allocate funds aimed at disaster preparedness and management at district levels
xv. Removal of taxes on the importation of lightening conductors
xvi. Support establishment of a disaster risk early warning systems
xvii. Uplifting the ban on the construction of health centre IIs.

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Appendices

Appendix One: Focus Group Discussion tool

DATE:		X		Data collection sheet no	
District		y			
Sub-county		Z		Data collectors	
Parish		GPS accuracy			
		Units			

1. Mention the hazards experienced in your area in the last 30 years
   - ✓ 1980-1989
   - ✓ 1990-1999
   - ✓ 2000-2009
   - ✓ 2010-2015

2. Kindly rank these hazards in the order of importance/frequency of occurrence

Hazard	1980-1989			1990-1999			2000-2009			2010-2015		
	F	D	E	F	D	E	F	D	E	F	D	E
Floods												
Droughts												
Landslides												
Earth quakes/tremors												
Hail storms												
Wild fires												
Lightening												
Pests and diseases												
Deforestation												
Strong winds												
Road accidents												
Key: F=Frequency; D=Destructiveness; E=Extent												

3. Indicators of destructiveness

Hazard	Categorise by Sub-county	List indicators of destructiveness
Floods		
Droughts		
Landslides		
Earth quakes/tremors		
Hail storms		
Wild fires		
Lightening		
Pests and diseases		
Deforestation		
Strong winds		
Road accidents		
Key: F=Frequency; D=Destructiveness; E=Extent		

4. Return period

Hazard	Duration of events	Return period of hazards
Floods		
Droughts		
Landslides		
Earth quakes/tremors		
Hail storms		
Wild fires		
Lightening		
Pests and diseases		
Deforestation		
Strong winds		
Road accidents		
Key: F=Frequency; D=Destructiveness; E=Extent		

5. Together we are going to develop resource map of your district showing the following features
   - ✓ Floods
   - ✓ Drought
   - ✓ Landslides /mudslides
   - ✓ Earth quakes and tremors
   - ✓ Hailstorms
   - ✓ Wild fires
   - ✓ Lightening
   - ✓ Pests and Diseases
   - ✓ Deforestation

6. Livelihoods strategies

Household Livelihood strategy	Rank of importance

7. Copies strategies

Hazard	1980-1989	1990-1999	2000-2009	2010-2015
Floods				
Droughts				
Landslides				
Earth quakes/ tremors				
Hail storms				
Wild fires				
Lightening				
Pests and diseases				
Deforestation				
Strong winds				
Road accidents				

Appendix Two: Field sheet

Hazard	**X**	**Y**	**Z**	**Observations (soil type, extent, water depth, effect/damage)**
Floods				
Droughts				
Landslides				
Earth quakes/tremors				
Hail storms				
Wild fires				
Lightening				
Pests and diseases				
Deforestation				
Land conflicts				
Climate risks and shocks				
Uncontrolled bush fires				
Environmental risks (land degradation and soil erosion status)				
Policy and political risks				
Human and wildlife conflicts				
Biological risks (pests, Diseases and contamination)				
Labour and health risks (illness, death and injuries)				

Indicator analysis for each hazard (floods, drought, diseases etc)

Indicators: Vulnerability needs to be reflected through indicators. An indicator, or set of indicators, can be defined as an inherent characteristic which quantitatively estimates the condition of a system; they usually focus on small, manageable, tangible and telling pieces of a system that can give people a sense of the bigger picture.

Vulnerability	Exposure	-	Susceptibility		-	Resilience
	Exposure	Geographical scale	Susceptibility	Geographical scale	Resilience	Geographical scale
Social component						
Economic component						
Environmental component						
Physical components (eg flood duration, slope,						

Geographical scale: D=district; S=Subcounty; P=parish; V=village

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