THE REPUBLIC OF UGANDA

District Multi-hazard, Risk and Vulnerability Profile for Kiruhura 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.

I especially extend my sincere thanks to the Department of Disaster Preparedness and Management in Office of the Prime Minister, under the leadership of the Commissioner, Mr. Martin Owor and the Assistant Commissioner, Mr. Gerald Menhya for the oversight and management of the entire exercise. My appreciation also goes to the District Teams:

1. Ibanda District: Mr. Nsubuga Saul Zirimenya-Deputy Chief Administrative Officer, Mr. Kirya Erry-Senior Forest Officer and Mr. Tom Wagira-Natural Resources Officer
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
6. The entire body of stakeholders who in one way or another yielded valuable ideas and time to support the completion of this exercise.

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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 for the districts of Mitoma, Buhweju, Ibanda, Kiruhura, and Bushenyi.

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 Kiruhura district, hazards can be classified following main controlling factors as:

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

The study results show that it is drought, human-wildlife conflicts and invasive plant species that predispose the Kiruhura district community to a high vulnerability state.

It was established that Kiruhura district 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 districts 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.

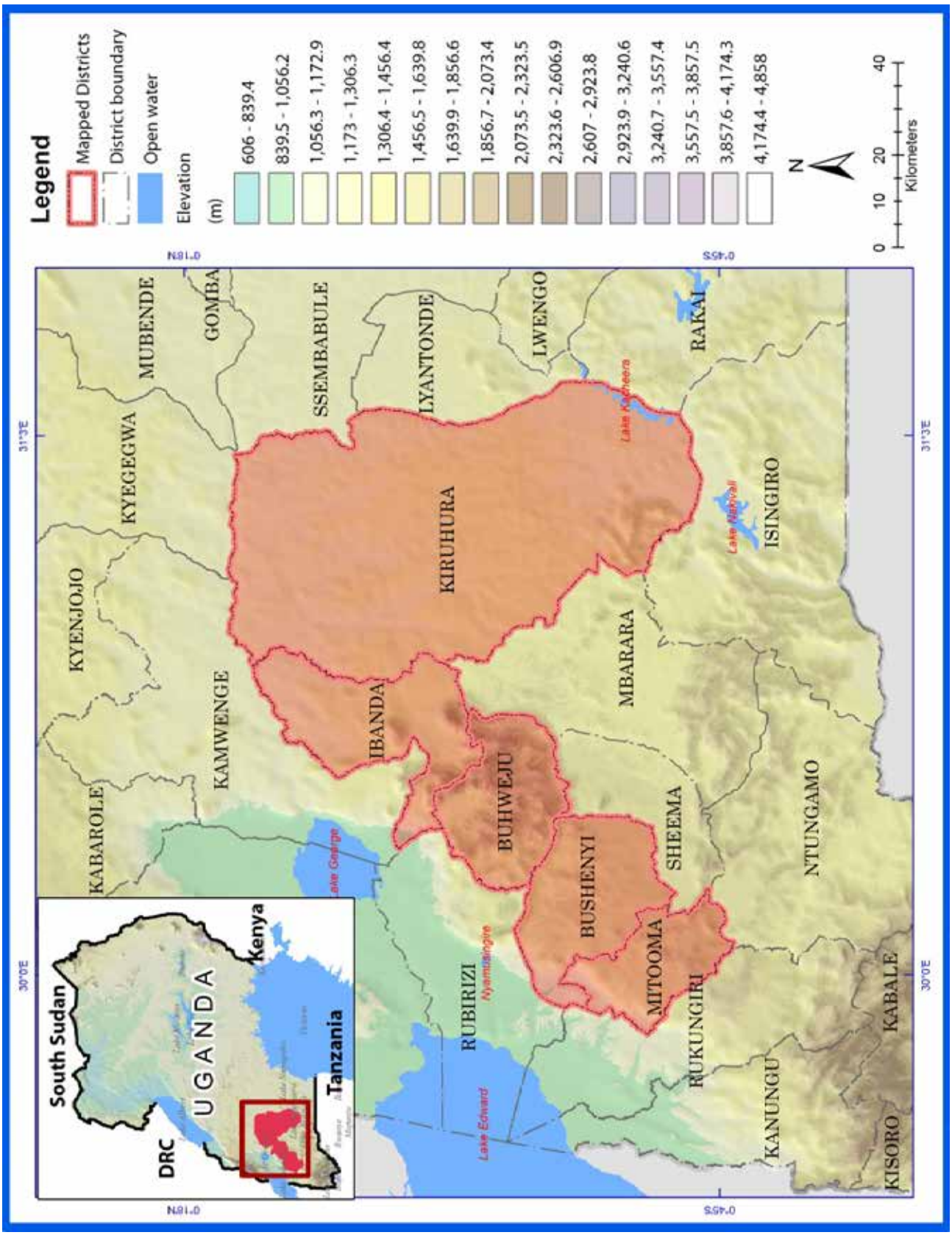


Figure 1: Study Districts

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

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

2.1 Overview of Kiruhura District

Kiruhura District (Figure 2) is located (UTM, 0259999; 9976866) in South Western cattle corridor of Uganda. It is bordered by Ibanda and Kamwenge in the North West, Mbarara District in the West, Isingiro District in the south, Rakai District in the South-East, Lyantonde District in the East, Kyenjojo and Sembabule Districts in the North and North East, respectively. The district headquarters are located in Kiruhura Town Council. It has District has 2 Counties, 15 Sub Counties, 3 town councils, 1 town board, 16 wards, 75 parishes and 565 villages with an estimated population of 328,544 (UBOS, 2014), the majority of whom (80%) survives on Subsistence farming (crop growing and livestock rearing). Other major source of livelihood include trade and commerce, formal and informal employment, mining, sand mining, stone quarrying, art and crafts industry.

On average, the District lies 1800 metres above sea level. The district is characterised by undulating landscape with short hills separated with wide valleys. 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 water bodies include Lake Kacheera and Mburo. However, the district has no natural forests (Kiruhura District Local Government 5 year Development Plan – LGDP II) 2015/2016-2019/2020. The district also has a number wetlands with peat soils covered with a mash of papyrus, palms and thickets.

The district receives a bimodal rainfall (August – November and March- May of each year) with an annual average of 915 mm. The temperature ranges from 17°C to 30°C. Like most of the highland areas of south western Uganda, the district has similarly experienced a rise in temperature.

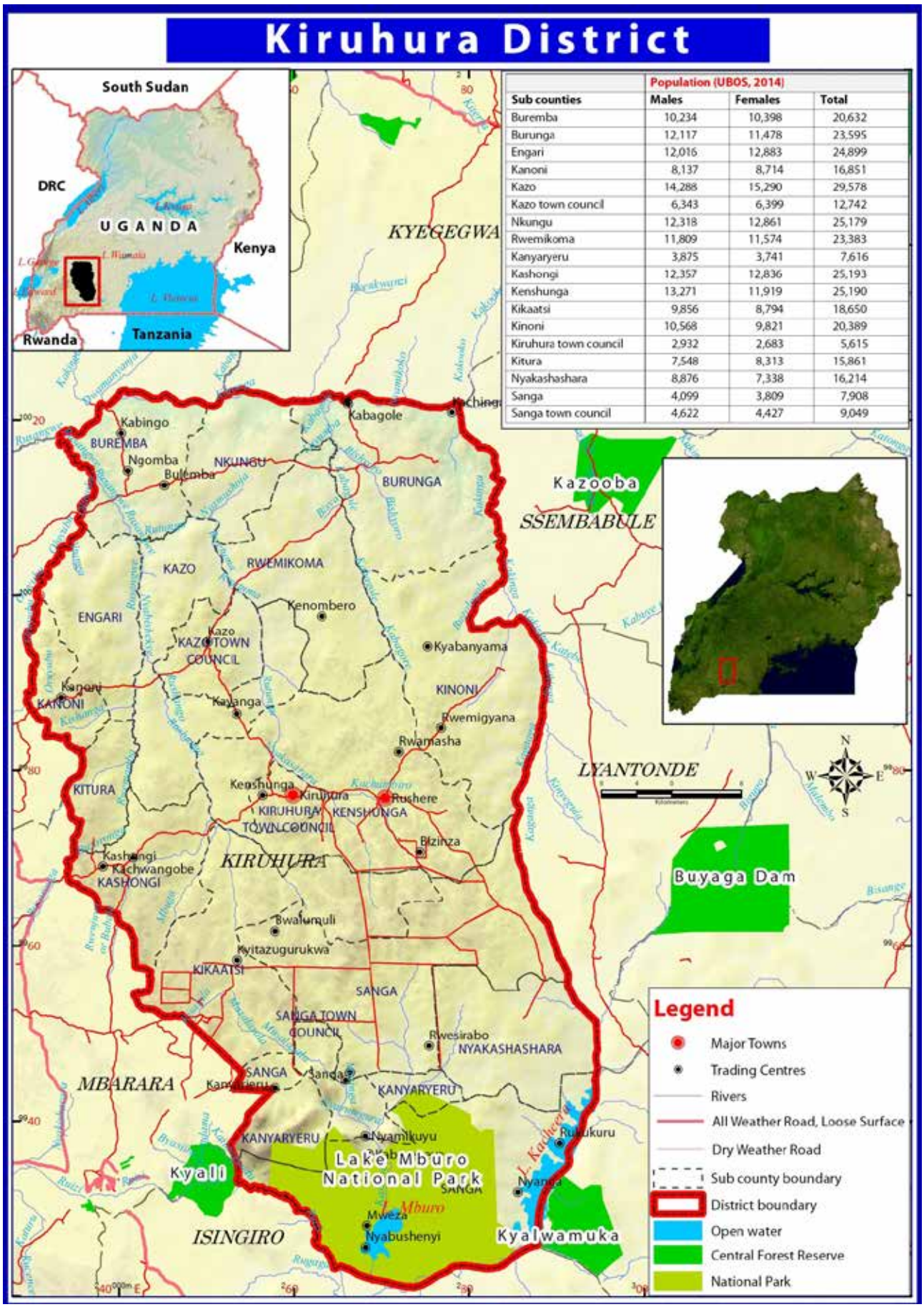


Figure 2: Kiruhura District Map

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 interview s 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 Buremba and Nyakashashara. 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 Landuse 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 for Kiruhura district was undertaken using a two period series of Landsat satellite imagery.

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

Table 1 shows the seven classifications of landuse and land cover types determined. Ground truthing was undertaken to validate the classified images to improve on the classification accuracy.

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 Kiruhura district, hazards can be classified following main controlling factors:

i. Climatological or Meteorological hazards including riverine floods, drought, hailstorms, strong winds, lightening and hill-slope surface runoff.
ii. Ecological or Biological hazards including livestock pests and diseases, crop pests and diseases, bush fires.
iii. Technological hazards including road accidents.

2.3.1 Extreme and prolonged drought

Droughts are experienced in the form of prolonged dry days without any rain event. The events occur every year starting from June to August. This shows that since 1980 to date, drought events have been on the increase in terms of frequency (experienced every rainy season), destructiveness and extent. The anticipated cause of the increased incidence of droughts is global warming attributed to overstocking of livestock, wetland degradation and deforestation accelerated by charcoal burning and termites. However, severe drought events are mainly experienced in the southern part of the district especially in Nyakashashara, Kikatsi, Sanga and Kanyaryeru Sub Counties (Figure 3). These have led to famines as a result of complete crop failures, increased incidences of bush fires, increased disease occurrences including Foot and Mouth Disease leading to livestock deaths, 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, accelerated poverty and school dropout. The eventualities also cause migration of households to other areas in search for water and pasture for livestock.

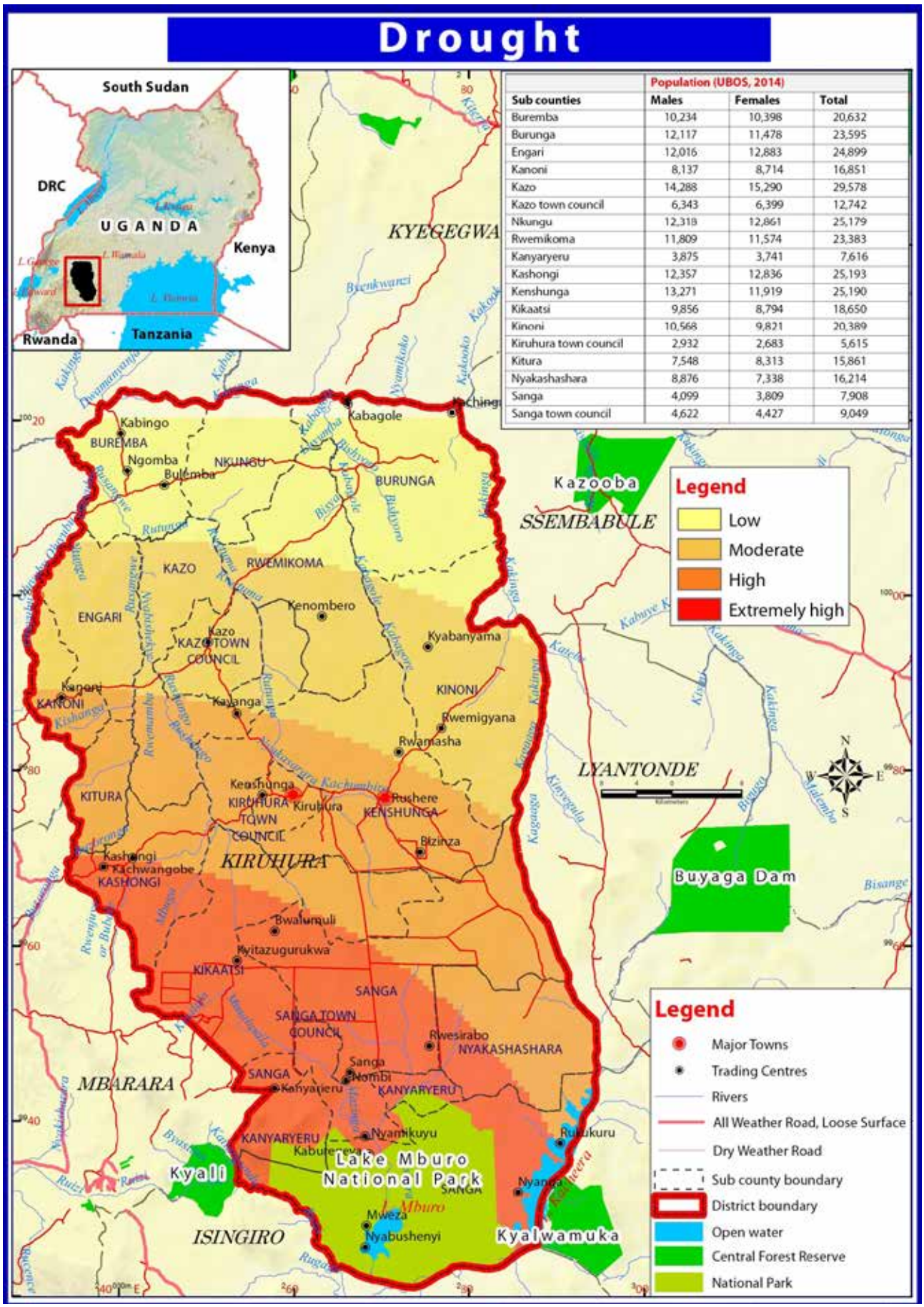


Figure 3: Hotspots for drought in Kiruhura district

2.3.2 Pests and Diseases

According to FGDs and key informants, in Kiruhura district, pests and diseases for both crops and livestock are prevalent throughout the year and are widely spread across all Sub Counties. Over the last two decades the commonest crop pests have been coffee twig borers, coffee stem borers, caterpillars, wild animals and locusts and the crop diseases include banana bacterial wilt, coffee wilt disease, 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 fake agro-inputs (drugs) with low efficacy.

On the other hand, commonest livestock parasites include ticks and biting flies, with East Coast Fever, Lumpy skin disease, rabies and Newcastle being major livestock disease in the district. These are most concentrated in Nyakashashara, Sanga and Kanyaryeru Sub Counties (Figure 4).

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 an attempt to control pests and disease, incidences of bush burning are rampant across the district. In human, diseases like Malaria, HIV/AIDS and TB have weakened the labour force resulting into low productivity.

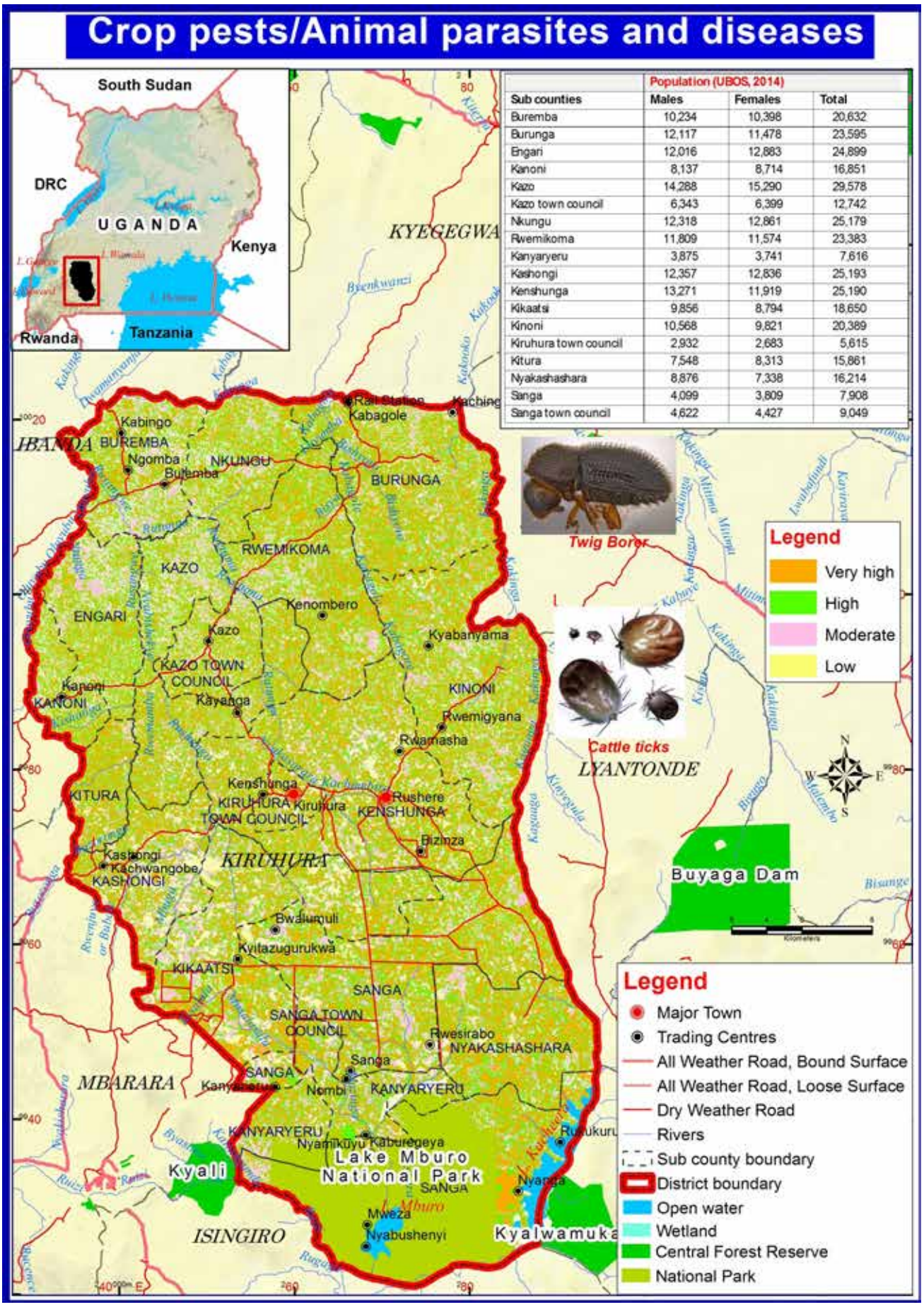


Figure 4: Hotspots for pests and diseases in Kiruhura district

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 Kiruhura District before 1990. However, from 1990 to date, they have been on the increase in terms of frequency (experienced every rainy season between August – December and February – May of each year), destructiveness and extent mainly in the months of September and October. This is largely attributed to climate change. The effects of hailstorms are more evident in Kinoni, Kikatsi, Kashongi, Kenshunga, Kazo, Rwemikoma, Nkungu and Buremba Sub Counties (Figure 5). These include loss of crops mainly broad leaved crops like banana and cassava, increase in livestock diseases and injuries as well as destruction of houses, schools and health centres.

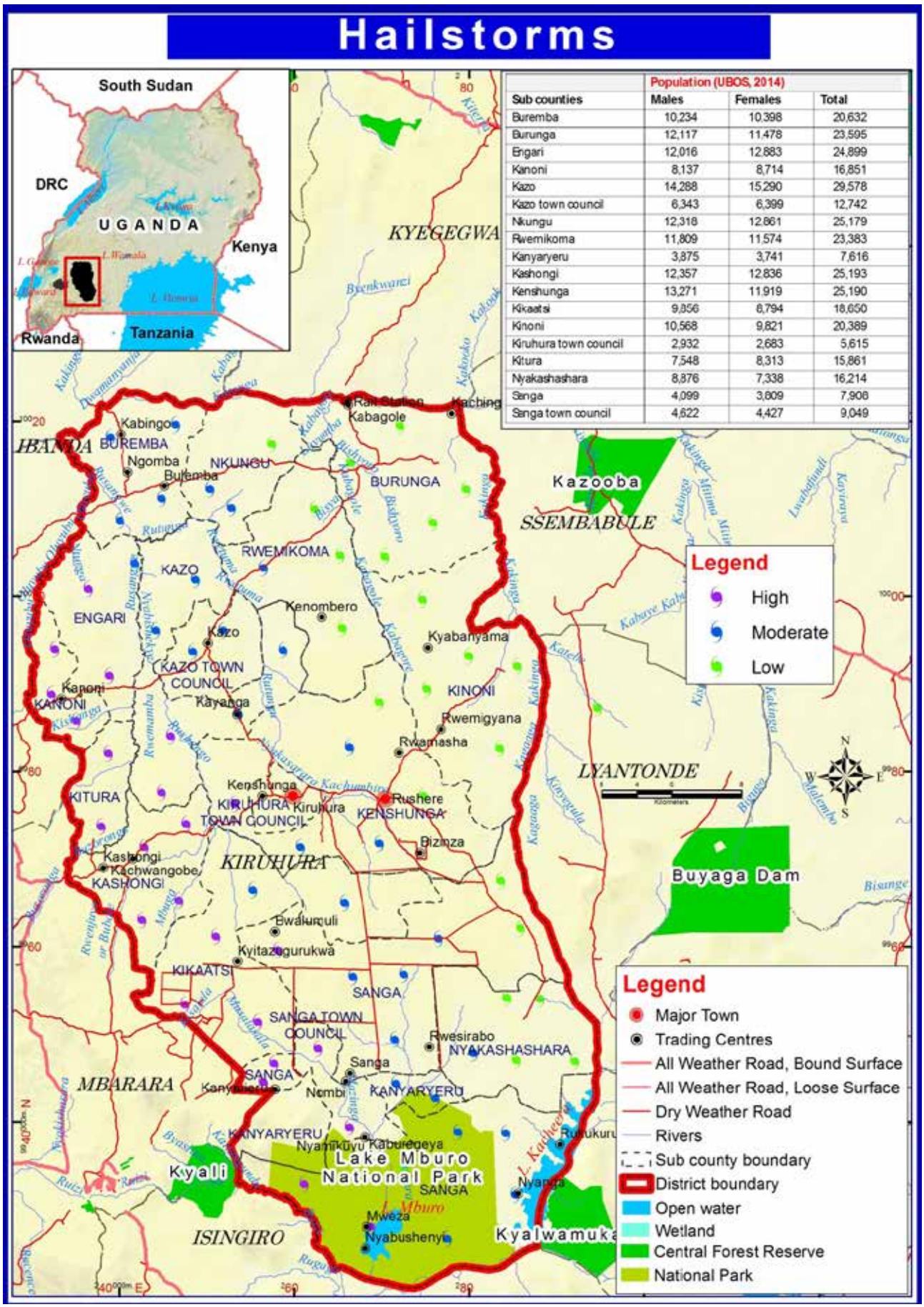
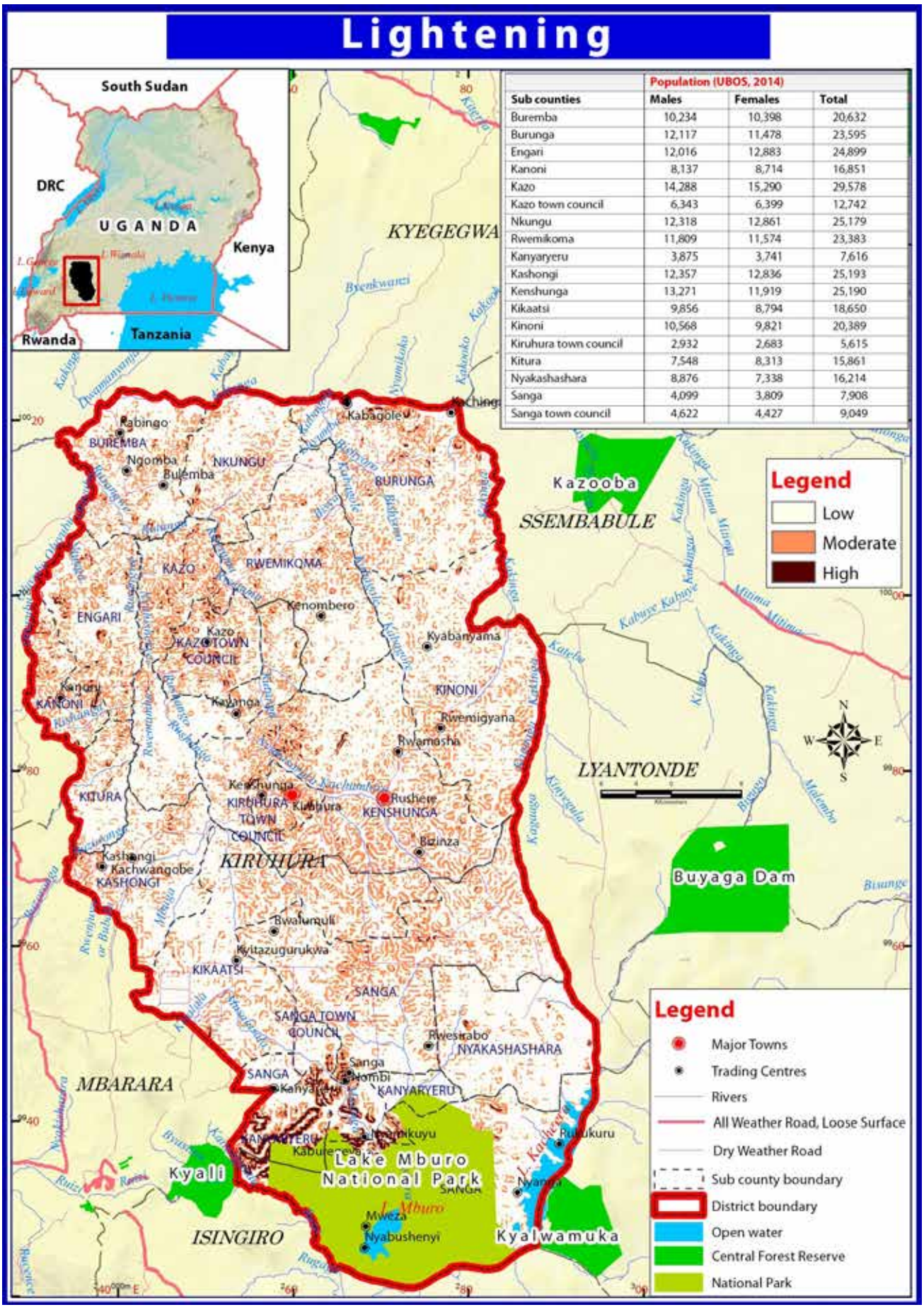


Figure 5: Hotspots for hailstorms in Kiruhura district

2.3.4 Lightening

Lightening is seasonal occurring during rainfall events especially in Buremba, Sanga, Nkungu, Kenshunga, Rwemikoma, Kazo Sub Counties (Figure 6). Lightening presents a risk of causing loss of both human and livestock lives (so far one person has died), destruction of crops and vegetation as well as destruction of schools, houses, community markets and churches. However, the incidences are higher on moderately raised hills.



Sub counties	Population (UBOS, 2014) Males	Females	Total
Buremba	10,234	10,398	20,632
Burunga	12,117	11,478	23,595
Engari	12,016	12,883	24,899
Kanoni	8,137	8,714	16,851
Kazo	14,288	15,290	29,578
Kazo town council	6,343	6,399	12,742
Nkungu	12,318	12,861	25,179
Rwemikoma	11,809	11,574	23,383
Kanyaryeru	3,875	3,741	7,616
Kashongi	12,357	12,836	25,193
Kenshunga	13,271	11,919	25,190
Kikaatsi	9,856	8,794	18,650
Kinoni	10,568	9,821	20,389
Kiruhura town council	2,932	2,683	5,615
Kitura	7,548	8,313	15,861
Nyakashashara	8,876	7,338	16,214
Sanga	4,099	3,809	7,908
Sanga town council	4,622	4,427	9,049

Figure 6: Hotspots for lightening in Kiruhura district

2.3.5 Strong winds

Key informants revealed that strong winds are seasonal, however; they occur during both the dry and rainy seasons with more frequent and severe events observed in the dry season. The strongest winds occur at the transition from dry to the rainy season. It was also noted that winds are influenced by topography being more severe on the leeward side of a hill. Severity of wind incidents have been recorded in Kazo, Rwemikoma, Nkungu, Kenshunga and Buremba Sub Counties (Figure 7). According to FGDs, strong winds blow house and school roof-tops (Nyamambo Primary School in Kazo Sub county), and cause crop logging especially banana plantations.

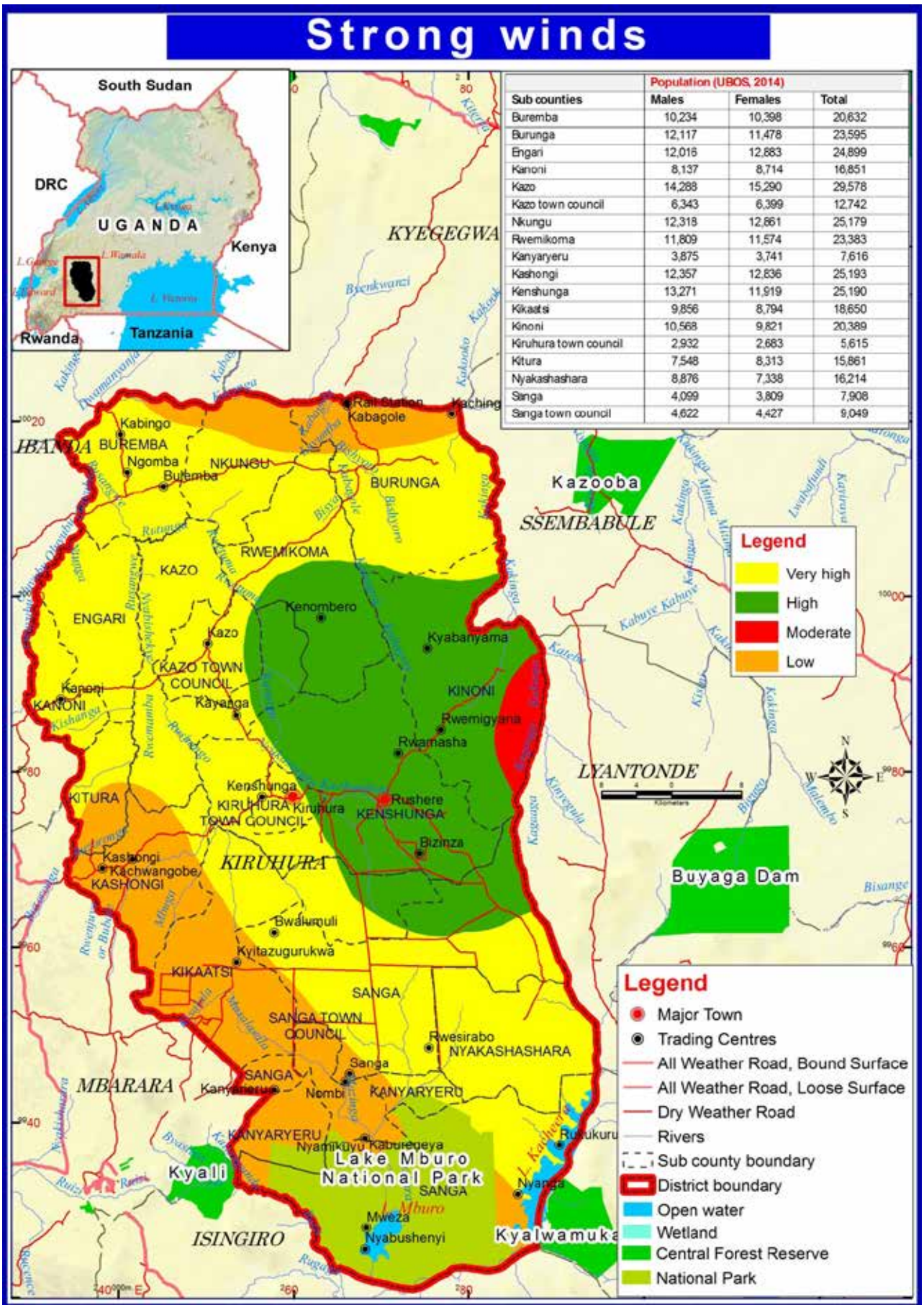


Figure 7: Hotspots for strong winds in Kiruhura district

2.3.6 Riverine floods

Key informants noted that riverine floods are frequent during the rainy season. Their increased occurance is attributed to wetland degradation, catchment degradation and poor farming methods resulting into enhanced siltation of rivers. Severe impacts have been recorded in Kanoni Sub County along river Ekyambu (Figure 8). The rivers susceptible to riverine floods include Ekyambu, Rwizi, Orushango and Katonga. Riverine floods result into washing away of road culverts and bridges resulting into road blockage, destruction of crops, loss of soil fertility and enhanced siltation.

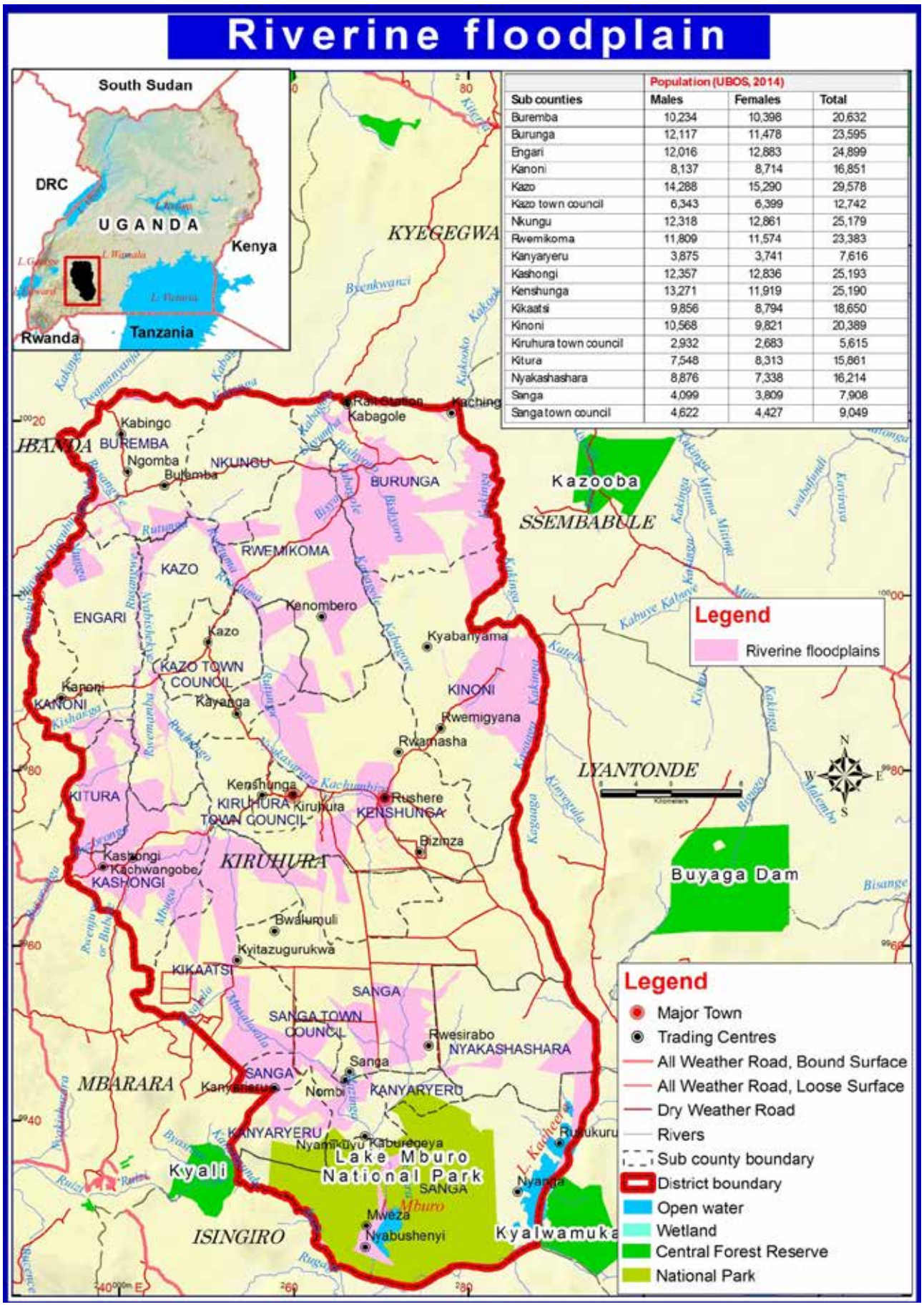


Figure 8: Hotspots for riverine floods in Kiruhura district

2.3.7 Road and Water accidents

Road accidents mainly occur on the highways especially along Masaka-Mbarara highway, Kiruhura-Ibanda and Lake Kacheera (Figure 9) leading human and livestock injuries and disabilities,loss of human and livestock lives; and loss of property and income. When parent die at a young age, their children are forced to grow up as orphans. Road accidents are attributed to the narrow roads, sinking of roads as a result of poor workmanship while water accidents are attributed to strong winds.

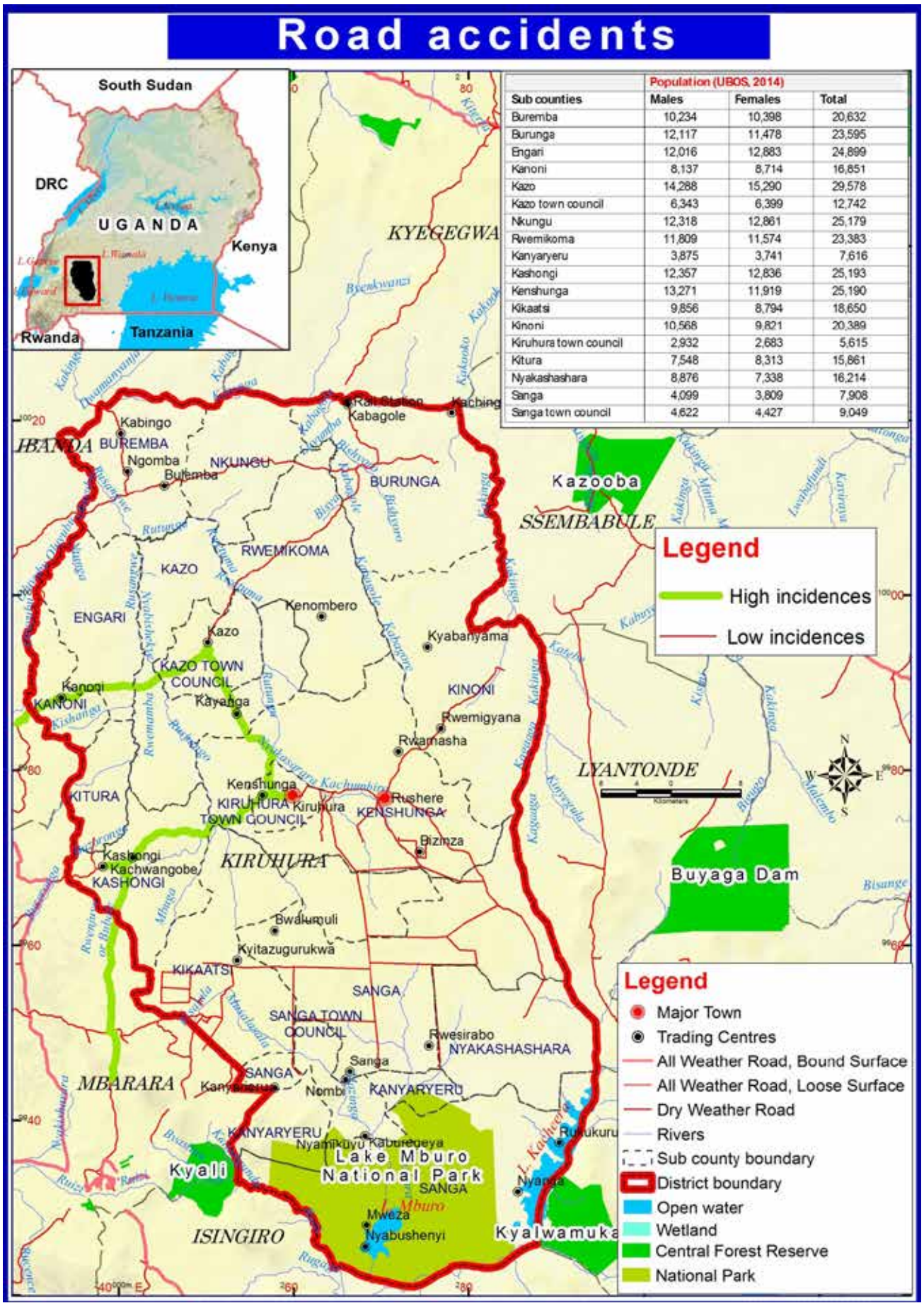


Figure 9: Hotspots for road and water accidents in Kiruhura district

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 Kiruhura District

No	Multi-Hazards	Coping strategies
2	Drought	- Rain water harvesting - Reduction over grazing activities - Excavation of dams - Reforestation
	Riverine floods	- Awareness on proper agricultural practices e.g. terracing - Construction of bands - Planting hedge rows - Mulching - Strip cropping - Making makeshifts - Construction of trenches - Construction of temporary bridges
3	Soil erosion	- Mulching - Construction of soil bands - Agro-forestry - Trenching - Intercropping - Contour ploughing - Strip farming
5	Hailstorms	- Practising agro-forestry - Farmland boundary tree planting - Seeking relief aid from government - Stacking banana plants
6	Lightening	- Installation of lightening conductors on newly constructed schools - Awareness
7	Pests and diseases	- Awareness - Roughing (uprooting) infected plants - Spraying - Vaccination of livestock - Fencing - Culling off diseased animals
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 plants

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.

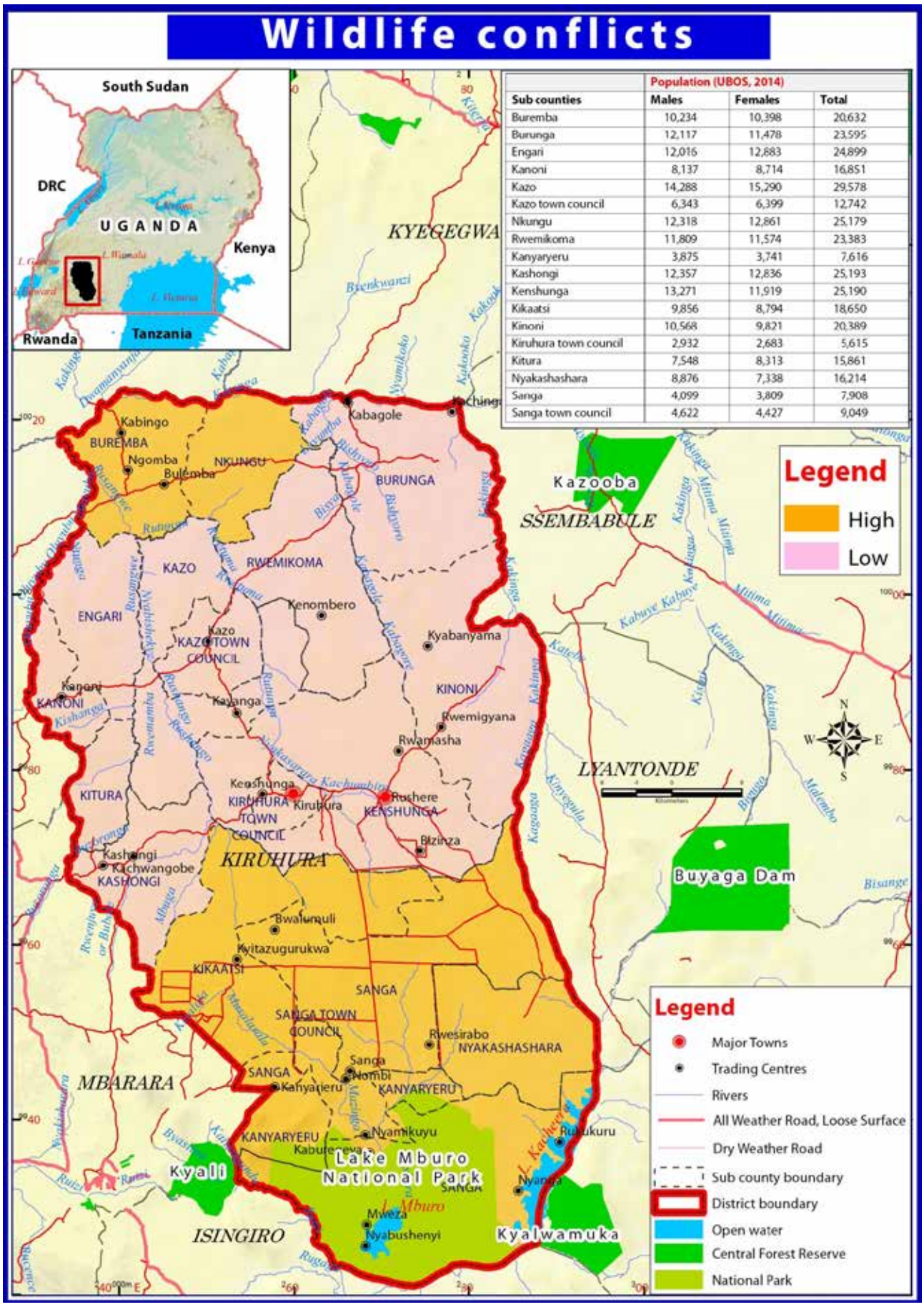
2.5.1 Human and wildlife conflicts

Human-wildlife conflicts results from wildlife invasion of household farmlands especially zebras, wild pigs, baboons, buffaloes and monkeys. Also, livestock keepers do graze their livestock within the Lake Mburo National Park whose boundaries are unclear.

These are common in communities around the Lake Mburo National Park and Katonga wildlife reserve and are more severe in Nyakashashara, Kikatsi, Kenshunga, Sanga, Kanyaryeru and Kikaatsi in the south while Buremba, Burunga and Nkungu in the northern part of District (Figure 10).

The wildlife invasions have led to reduced crop yields (wildlife destroys the foliage which is productive industry of the crop) especially for banana, millet, Potatoes and Sweet Potatoes). They have led to increased outbreaks of communicable livestock and human diseases like FMD, Marburg and Ebola and associated deaths; and increased competition for water and pasture.

Plate 1: Source of human-wildlife conflicts



Sub counties	Population (UBOS, 2014) Males	Females	Total
Buremba	10,234	10,398	20,632
Burunga	12,117	11,478	23,595
Engari	12,016	12,883	24,899
Kanoni	8,137	8,714	16,851
Kazo	14,288	15,290	29,578
Kazo town council	6,343	6,399	12,742
Nkungu	12,318	12,861	25,179
Rwemikoma	11,809	11,574	23,383
Kanyaryeru	3,875	3,741	7,616
Kashongi	12,357	12,836	25,193
Kenshunga	13,271	11,919	25,190
Kikaatsi	9,856	8,794	18,650
Kinoni	10,568	9,821	20,389
Kiruhura town council	2,932	2,683	5,615
Kitura	7,548	8,313	15,861
Nyakashashara	8,876	7,338	16,214
Sanga	4,099	3,809	7,908
Sanga town council	4,622	4,427	9,049

Figure 10: Hotspots for human-wildlife conflicts in Kiruhura district

2.5.2 Deforestation

Key informants and FGDs noted that increasing human population has increased pressure on existing forest reserves due to increased demand for construction materials (poles and timber); increased demand for charcoal in urban centres (due to lack of energy alternatives); and cultivation/grazing lands. Deforestation is pronounced throughout the district (Figure 11). The impact has been loss of forest cover and vegetation biodiversity; accelerated climate change leading to prolonged droughts, reduced pasture quality and quantity (due to enhanced proliferation of invasive species), soil erosion enhancing siltation of rivers and reduced firewood availability.

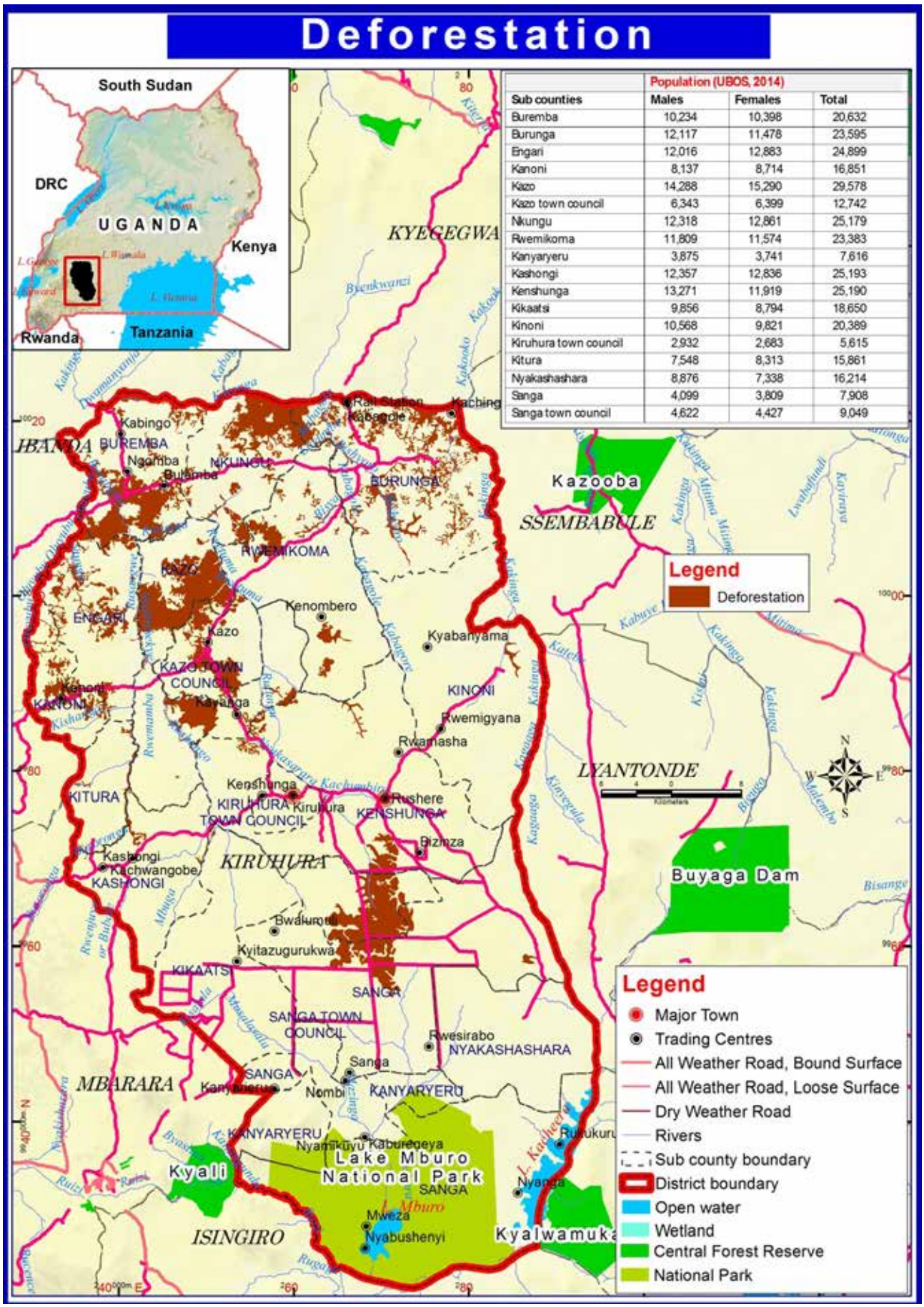
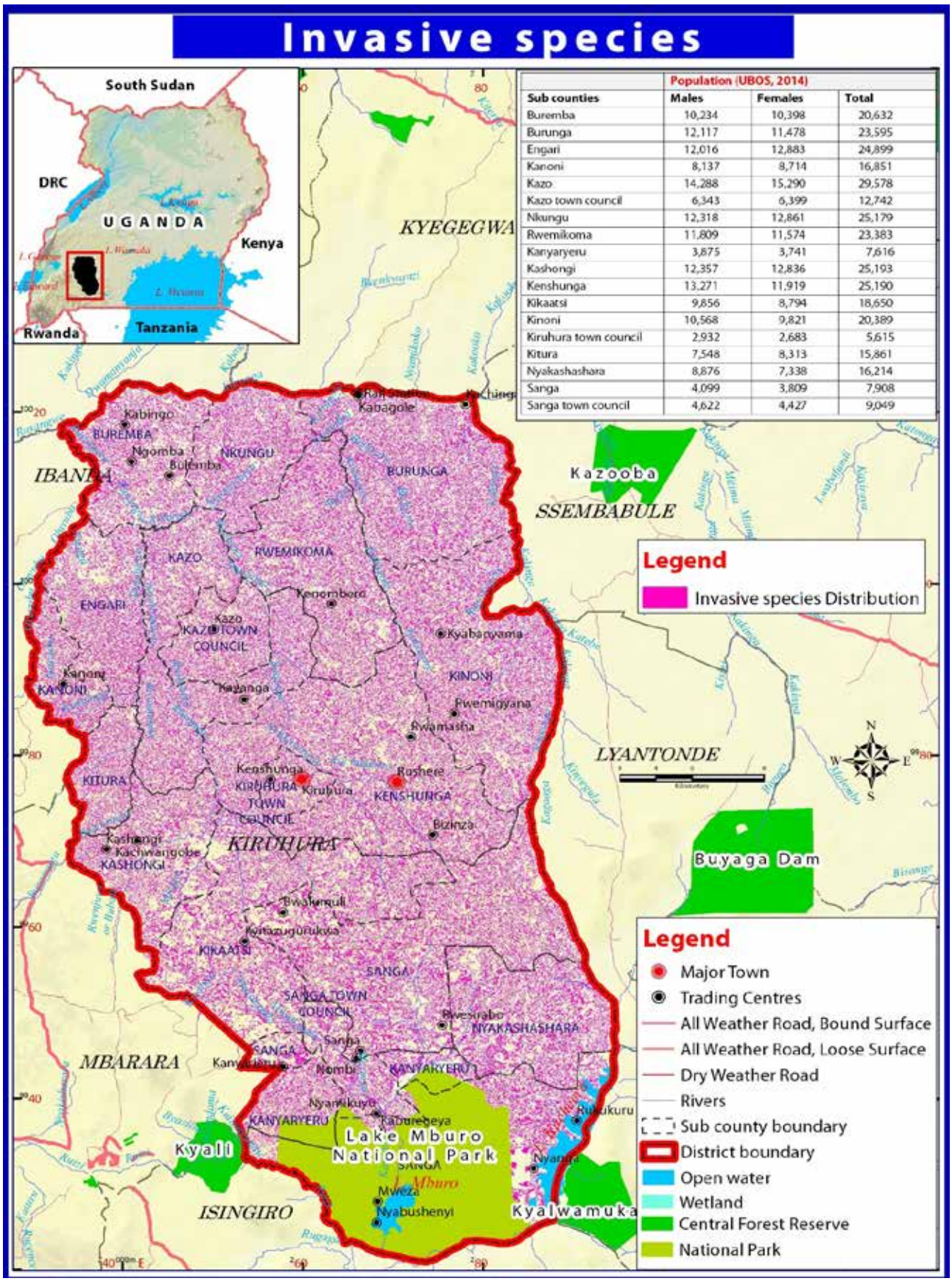


Figure 11: Extent of deforestation in Kiruhura district

2.5.3 Invasive species

The commonest invasive species is *Lantana camara* mainly across all sub counties in the district (Figure 12). Other invasive species is the water weed that invades the valley dams. Some of these species are toxic and have led to livestock (cattle) deaths.

Their increasing incidence in the district is attributed to poor farming methods, deforestation 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.



	Population (UBOS, 2014)		
Sub counties	Males	Females	Total
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Sanga	4,099	3,809	7,908
Sanga town council	4,622	4,427	9,049

Figure 12: Hotspots for invasive plant species in Kiruhura district

2.5.4 Land conflicts

Land conflicts are rampant across all Sub Counties (Figure 13) in the district ranging from those between households, communities as well as between local governments and communities. These are ignited by unclear boundary demarcations for example both Lake Mburo and Katonga wildlife reserves have unclear boundaries leading to the reserve authorities accusing neighbouring communities of encroachment, family land inheritance, high population growth rates leading land fragmentation, poor land management (documentation) and tenure systems, appreciation of land value which enhances greed and land grabbing. In addition, there is conflict at community level for allocating land to crop production vis-à-vis livestock grazing.

Extreme cases have resulted into loss of land, human death, and forced migrations. This in turn leads to reduced community growth and development.

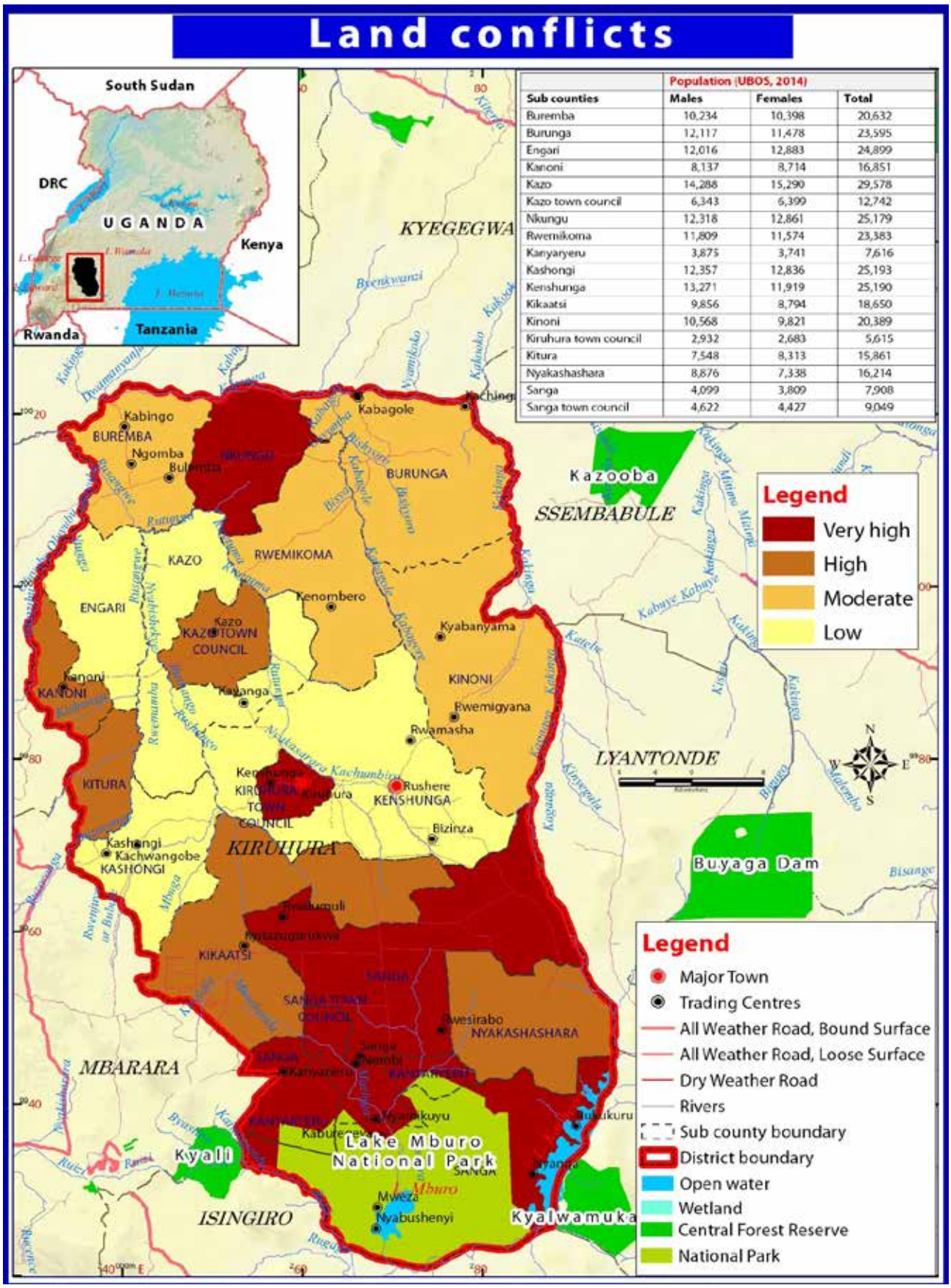

Figure 13: Extent of land conflicts in Kiruhura district

2.5.5 Wetland degradation

FGDs revealed that wetland degradation is high and on the increase especially in Nyakashashara, Sanga, Kinoni, Buremba, Burunga, Kenshunga and Kanoni Sub Counties (Figure 14) due to reclamation for intensification of agricultural activities, sand extraction, and brick making. Wetland degradation is also attributed to over grazing, prolonged droughts and poor farming methods. It is caused by increased population growth rates, and weak enforcement by responsible officials due to inadequate funding. Key informants revealed that encroachment on wetlands is fuelled by prolonged drought, population pressure and limited agricultural land.

Over time, wetland degradation have led to increased siltation of water sources leading to reduction in water levels, loss of wetland biodiversity and increased outbreaks of water borne diseases like diarrhoea 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).

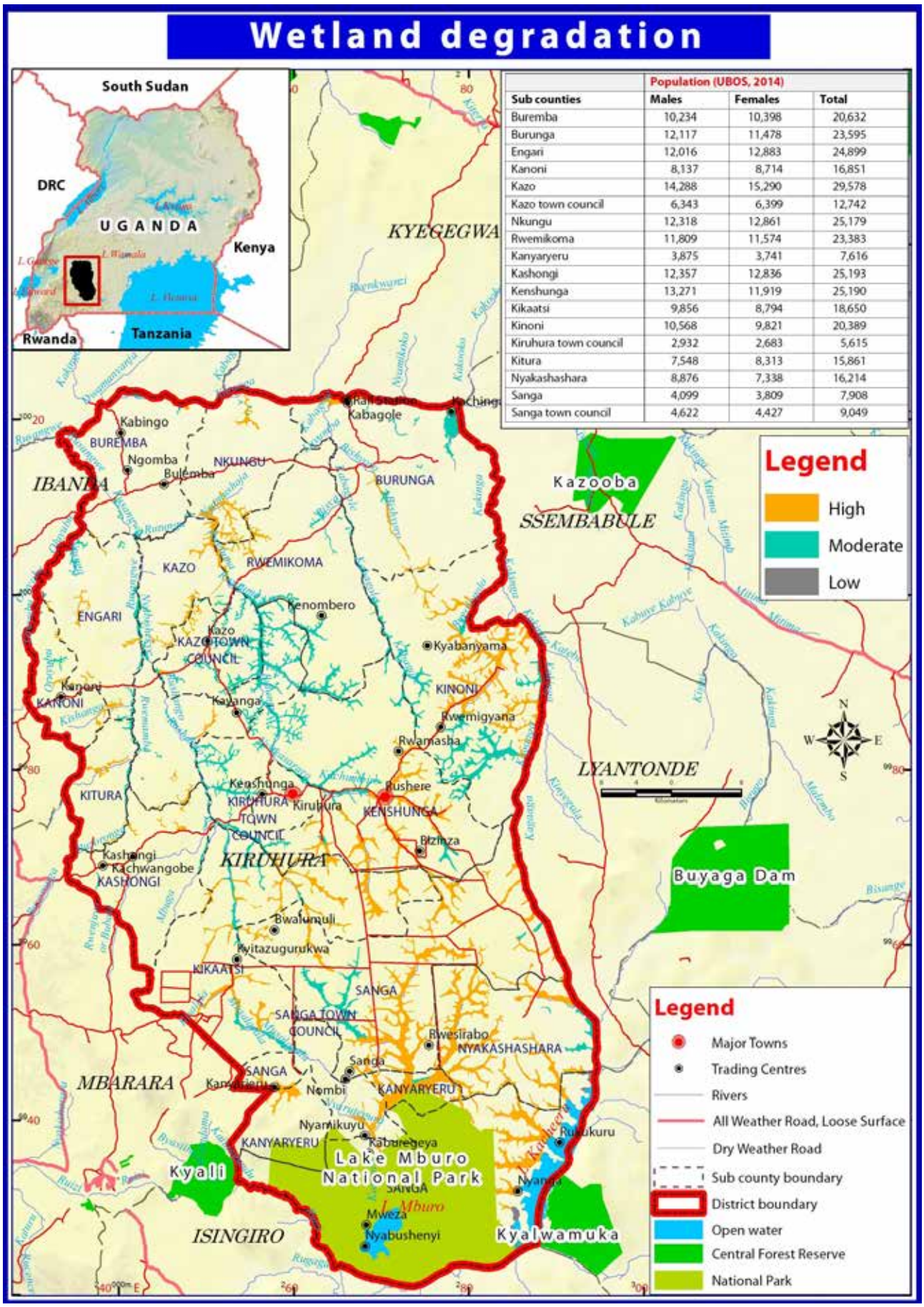

Figure 14: Hotspots for wetland degradation in Kiruhura district

2.5.6 Soil erosion

Based on key informants, FGDs and field observation, soil erosion is prevalent in Nyakashashara, Burunga, Kazo T/C, Buremba, Kinoni, Sanga, Kanyaryeru and Kikatsi Sub Counties (Figure 15) due to intensive cultivation on hill slopes, over grazing and bush burning. Over time, soil erosion has led to reduced soil and rangeland quality productivity, reduced crop and livestock 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.

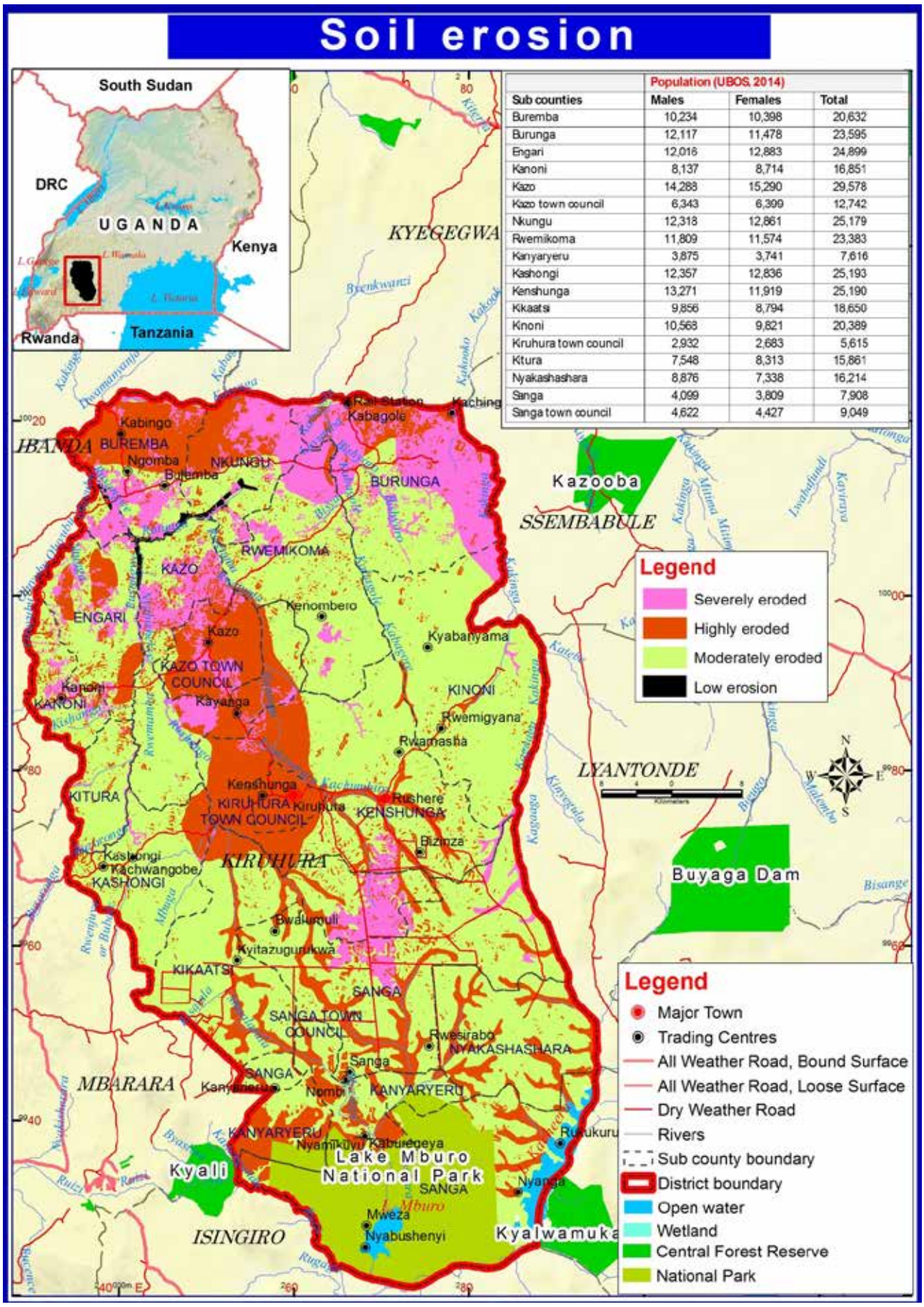

Figure 15: Hotspots for soil erosion in Kiruhura district

2.5.7 Bush fires

Bush fires in Kiruhura district are widespread in Sanga and Nyakashashara Sub Counties (Figure 16). 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 (June to August; January to Mid-March). 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 structure destabilisation leading to soil erosion and eventually soil fertility and productivity decline food and income insecurity, and accelerated climate change leading to severe events such as prolonged droughts and proliferation of invasive plant species.

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

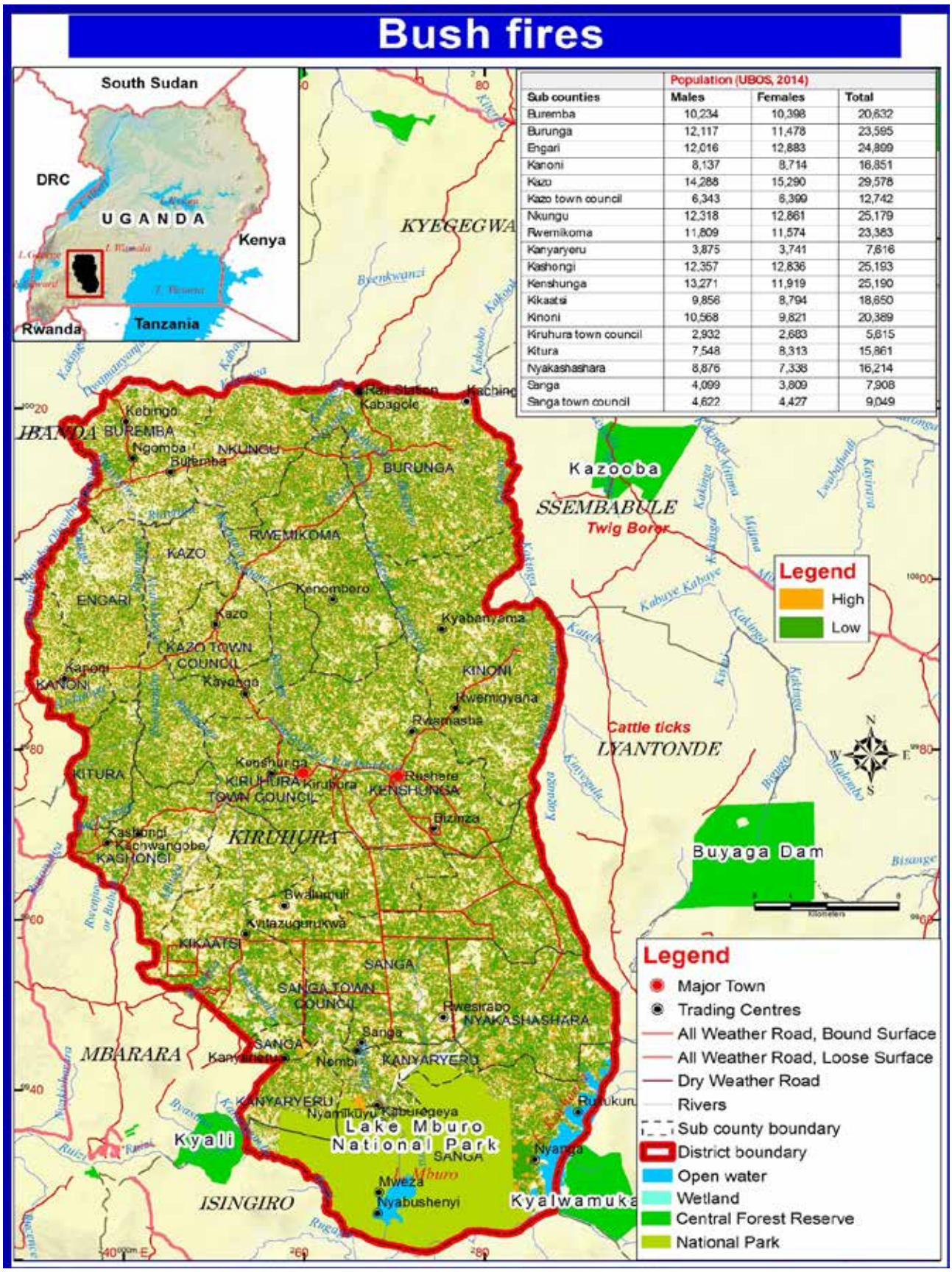

Figure 16: Hotspots for bush fires in Kiruhura district

2.6 Coping strategies

According to key informants and FGDs, the following strategies (Table 20) have been employed by communities to cope with risks they experience.

Table 3: Coping strategies in Kiruhura District

No	Risks	Coping strategies
1	Wetland degradation	- Enforcement of wetland management laws - Wetland demarcation - Community awareness campaigns - Evictions
2	Deforestation	- Reforestation - Awareness
3	Soil erosion	- Awareness - Terracing - Strip cropping - Mulching - Tree planting
4	Bush fires	- Community sensitization - Law enforcement
5	Human wildlife conflicts	- Awareness - Fencing of kraals and gardens - Digging of trenches along the park boundary - Controlled poaching - Hunting (sport hinting) - Development of conservancies around the park
6	Land conflicts	- Awareness - Migration - Mediation
7	Invasive species	- Community sensitisation - Uprooting

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 Kiruhura 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, socio-ecological in terms of human-wildlife conflicts and ecological in form of invasive plant species predispose the community to high vulnerability state. The occurrence of pests and diseases and deforestation, also create a moderate vulnerability profile in the community (Table 5).

Table 4: Components of vulnerability in Kiruhura District

Vulnerability components	Exposure		-	Susceptibility	-	Resilience	Resilience
	Hazards	**Elements at risk**	**Geographical scale**	**Potential impacts**	**Geographical scale**	**Coping strategies**	**Geographical scale**
	Drought	- Human and livestock populations - Crops	District	- Death of livestock - Scarcity of water - Proliferation of livestock diseases - Limited pasture - School drop outs - Migration in search of water and pasture for livestock	District	- Support from government - Planting early maturing crops - Rain water harvesting - Construction of dams - Reforestation - Afforestation	District
	Wild fires	- Human and livestock populations - Crops	District	- Accelerated soil erosion - Reduced livestock and wild life forage - Enhanced human-wildlife conflicts - Change in the diversity of crops	District	- Community team up to stop fires - Law enforcement	District
	Pests and diseases	- Human and livestock populations - Crops	District	- Death of livestock - Crop failures - Increased incidences of bush burning kill livestock pests	District	- Vaccination - Spraying - Quarantine - Fencing to avoid contact between wild and domestic animals - Culling off diseases animals	District
	Hailstorms	- Human and livestock populations - Crops - Infrastructure including homes, schools and hospitals	Parish	- Loss of lives - Stunted growth of crops	Parish	- Staking of banana plants	Parish
	lightening	- Human and livestock populations - Crops - Infrastructure including homes, schools and hospitals - Natural vegetation including trees	Village	- Death of livestock - Loss of human lives - Destruction of vegetation -	Village	- Install lightening conductors - Keep indoors during heavy ran events	Village
Social component	Invasive species	- Livestock - Crops - Natural vegetation biodiversity	District	- Reduced pasture quality - Reduced land productivity - Animal diseases like skin diseases, blindness and in extreme cases deaths	District	- Uprooting	District

	Land conflicts	- Human and livestock populations - Crops - Community development	District	- Deaths - Forced migration	District	- Law suits in the courts of law - Arbitration by land office, RDC and Local Councils	District
	Wild life conflicts	- Human and livestock populations - Crops	Sub county	- Livestock and human deaths - Increased incidences of communicable livestock disease - Competition for resources with domestic animals - Destruction of crops - Destruction of land boundary fences	Sub county	- Fencing - Killing trespassing wildlife - Digging trenches around the farms - Sharing of revenue from sport hunting - Construction of dams	Sub county
	Soil erosion	- Human and livestock populations - Crops - Social infrastructure especially feeder roads	Sub county	- Reduced soil and crop productivity	Sub county	- Sensitisation - Mulching - Terracing - Tree planting	Sub county
	Road accidents	- Human and livestock populations	Sub county	- Deaths - Fatal injuries	Sub county	- Enforce Traffic laws - Building humps on roads	Sub county
	Deforestation	- Human and livestock populations - Crops - Natural vegetation including trees	District	- Leads to drought - Enhanced soil erosion - Decline in soil fertility - May lead to Flash floods	District	- Tree planting - Awareness campaigns - Reforestation - Afforestation	District
	Wetland degradation	- Human and livestock populations - Crops - Natural vegetation biodiversity	Sub county	- Low water levels - Reduced water quality - Reduced biodiversity -	Sub county	- Planting trees in degraded wetlands - Sensitisation - Demarcation of wetlands	Sub county

Economic component	Drought	- Human and livestock populations - Crops	District	- Reduced productive period - Low crop and animal production - Loss of income leading to low standards of living - Increased cost of production	District	- Support from government - Planting early maturing crops - Rain water harvesting - Construction of dams - Reforestation	District
	Wild fires	- Human and livestock populations - Crops	District	- Low yields hence low incomes - Enhanced proliferation of invasive species	District	- Community team up to stop fires - Law enforcement	District
	Pests and diseases	- Human and livestock populations - Crops	District	- Low production of both crops and livestock - Loss if income	District	- Vaccination - Spraying - Quarantine - Fencing to avoid contact between wild and domestic animals - Culling off diseases animals	District
	Hailstorms	- Human and livestock populations - Crops - Infrastructure including homes, schools and hospitals	Village	- Low crop production - Low income - Loss of government revenue	Village		Village
	Lightening	- Human and livestock populations - Crops - Infrastructure including homes, schools and hospitals - Natural vegetation including trees	Village	- Low income - Loss of government revenue	Village	- Install lightening conductors - Keep indoors during heavy rain events	Village
	Invasive species	- Livestock - Crops - Natural vegetation biodiversity	District	- Low income in the long run as a result of poor yield and low productivity - high costs of removal - increased costs of production	District	- Uprooting	District
	Land conflicts	- Human and livestock populations - Crops - Community development	District	- Delayed implementation of personal as well community development projects - Loss of lives	District	- Law suits in courts of law - Arbitration by district Officials	District

	Wild life conflicts	- Human and livestock populations - Crops	Sub county	- Human and livestock deaths - Crop failures - Reduced crop production - Loss of income - Loss of government revenue	Sub county	- Fencing - Killing trespassing wildlife - Digging trenches around the farms - Sharing of revenue from sport hunting - Development of a conservancy in Rurambira Parish	Sub county
	Soil erosion	- Human and livestock populations - Crops - Social infrastructure especially feeder roads	Sub county	- Reduced crop yields - Increased maintenance costs for feeder roads	Sub county	- Sensitisation - Mulching - Terracing - Tree planting	Sub county
	Road accidents	- Human and livestock populations	Sub county	- Human and livestock deaths	Sub county	- Enforce Traffic laws - Building humps on roads	Sub county
	Deforestation	- Human and livestock populations - Crops - Natural vegetation including trees	District	- Loss of biodiversity - Enhanced greenhouse gas emissions leading to climatic changes - Enhanced flooding leading to loss of property	District	- Tree planting - Awareness - Reforestation - Afforestation	District
	Wetland degradation	- Human and livestock populations - Crops - Infrastructure including homes, schools and hospitals - Natural vegetation biodiversity	Sub county	- Loss of biodiversity - Reduced water quality - Increased incidences of water borne diseases	Sub county	- Planting trees in degraded wetlands - Sensitisation	Sub county

Environmental component	Drought	- Human and livestock populations - Crops	District	- Desertification - Limited pastures - Wetland reclamation and/or degradation - Enhanced climate changes	District	- Support from government - Planting early maturing crops - Rain water harvesting - Construction of dams - Reforestation - Afforestation	District
	Wild fires	- Human and livestock populations - Crops	District	- Leads to soil erosion - Lack of pastures - Change in the diversity of crops	District	- Community team up to stop fires - Law enforcement	District
	Pests and diseases	- Human and livestock populations - Crops	District	- Enhanced bush/ crop residue burning - Loss of vegetation cover from bush clearing	District	- Vaccination - Spraying - Quarantine - Culling off diseases animals	District
	Hailstorms	- Human and livestock populations - Crops - Infrastructure including homes, schools and hospitals	Village	- loss of trees - crop failures	Village		Village
	lightening	- Human and livestock populations - Crops - Infrastructure including homes, schools and hospitals - Natural vegetation including trees	Village	- loss of biodiversity	Village	- Install lightening conductors - Keep in doors	Village
	Invasive species	- Livestock - Crops - Natural vegetation biodiversity	District	- Competition for resources with crops - Reduced pasture quality	District	- Uprooting	District
	Land conflicts	- Human and livestock populations - Crops - Community development	District		District	- Law suits in courts of law	District
	Deforestation	- Human and livestock populations - Crops	District	- Leads to drought - Enhanced soil fertility loss through erosion - Increased proliferation of invasive plant species	District	- Tree planting - Awareness campaigns - Reforestation - Afforestation	District

	Wetland degradation	- Human and livestock populations - Crops - Social infrastructure especially feeder roads	Sub county	- Low water levels - Enhanced siltation - Drought - Loss of biodiversity - Deterioration of water quality	Sub county	- Planting trees in degraded wetlands - Sensitisation - Wetland demarcation	Sub county
	Soil erosion	- Human and livestock populations	Sub county	- Loss of soil fertility - Reduced crop productivity - Reduced rangeland productivity	Sub county	- Sensitisation - Mulching - Terracing - Tree planting	Sub county
	Road accidents	- Human and livestock populations - Crops - Natural vegetation including trees	Sub county		Sub county	- Enforce Traffic laws - Building humps on roads - Establishing road signs	Sub county

Physical components	Drought	- Human and livestock populations - Crops	District	- Loss of vegetation cover - Lowering of water levels in dams and lakes - Increased dust levels - Death of livestock - Scarcity of water - Proliferation of livestock diseases - Limited pasture - School drop outs - Migration in search of water and pasture for livestock	District	- Support from government - Planting early maturing crops - Rain water harvesting - Construction of dams - Reforestation - Afforestation	District
	Wild fires	- Human and livestock populations - Crops	District	- Accelerated soil erosion - Reduced livestock and wild life forage - Enhanced human-wildlife conflicts - Change in the diversity of crops	District	- community team up to stop fires - Law enforcement	District
	Pests and diseases	- Human and livestock populations - Crops	District	- Death of livestock - Crop failures - Increased incidences of bush burning kill livestock pests	District	- Vaccination - Spraying - Quarantine - Fencing to avoid contact between wild and domestic animals - Culling off diseases animals	District
	Invasive species	- Human and livestock populations - Crops - Infrastructure including homes, schools and hospitals	District	- Reduced pasture quality - Reduced land productivity - Animal diseases like skin diseases, blindness and in extreme cases deaths	District	- Uprooting	District
	Land conflicts	- Human and livestock populations - Crops - Infrastructure including homes, schools and hospitals - Natural vegetation including trees	District	- Livestock and human deaths - Increased incidences of communicable livestock disease - Competition for resources with domestic animals - Destruction of crops - Destruction of land boundary fences	District	- Law suits in courts of law	District
	Wild life conflicts	- Livestock - Crops - Natural vegetation biodiversity	Sub county	- Livestock and human deaths - Forced migration	Sub county	- Fencing - Killing - Trenches around the farms	Sub county
	Soil erosion	- Human and livestock populations - Crops - Community development	Sub county	- Reduced crop yields - Increased maintenance costs for feeder roads	Sub county	- Sensitisation - Mulching - Terracing - Tree planting	Sub county

	Soil erosion	- Human and livestock populations - Crops - Community development	Sub county	- Reduced crop yields - Increased maintenance costs for feeder roads	Sub county	- Sensitisation - Mulching - Terracing - Tree planting	Sub county
	Road accidents	- Human and livestock populations - Crops	Sub county	- Livestock and human deaths - Fatal injuries	Sub county	- Enforce Traffic laws - Building humps on roads	Sub county
	Deforestation	- Human and livestock populations - Crops - Social infrastructure especially feeder roads	District	- May lead to flash floods leading to destruction of houses and crops especially around lake Kakyera - Loss of vegetation cover on hills (bare hills) prone to erosion	District	- Tree planting - Awareness - Reforestation - Afforestation	District
	Wetland degradation	- Human and livestock populations	Sub county	- Loss of biodiversity - Reduced water quality - Increased incidences of water borne diseases	Sub county	- Planting trees in degraded wetlands - Sensitisation	Sub county

Table 5: Vulnerability profile for Kiruhura District

	PROBABILITY	SEVERITY OF IMPACTS	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*	
Droughts	5	**5**	**25**	Sanga TC, Sanga Kanyaryeru, Nyakashashara, Kikaatsi, Buremba, Engari, Kanoni, Kitura, Buremba, Kinoni, Kenshuga, Rwemikoma, Kazoo, Kenshunga
Wild fires	3	**1**	**3**	Sanga TC, Sanga Kanyaryeru, Nyakashashara, Kikaatsi, Engari, Kanoni, Kitura, Buremba, Kinoni, Kenshuga, Rwemikoma, Kazoo,
Pests and diseases	3	**5**	15	Sanga TC, Sanga Kanyaryeru, Nyakashashara, Kikaatsi, Engari, Kanoni, Kitura, Buremba, Kinoni, Kenshuga, Rwemikoma, Kazoo,
Deforestation	3	**5**	**15**	Sanga TC, Sanga Kanyaryeru, Nyakashashara, Kikaatsi, Buremba, Engari, Kanoni, Kitura, Buremba, Kinoni, Kenshuga, Rwemikoma, Kazoo,
Road accidents	3	**1**	**3**	Sanga TC, Sanga Kanyaryeru, Nyakashashara, Kikaatsi, Engari, Kanoni, Kitura, Buremba, Kinoni, Kenshuga, Rwemikoma, Kazoo,
Land conflicts	3	**5**	**10**	Sanga TC, Sanga Kanyaryeru, Nyakashashara, Kikaatsi, Engari, Kanoni, Kitura, Kinoni, Kenshuga, Rwemikoma, Kazoo,
Human- Wild life conflicts	5	**5**	**25**	Nyakashashara, Kikaatsi, Sanga TC, Sanga, Kanyaryeru
Wetland degradation	3	**1**	**3**	Nyakashashara, Buremba, Kanoni, Sanga, Burunga
Soil erosion	2	**1**	**2**	Sanga TC, Sanga Kanyaryeru, Nyakashashara, Kikaatsi, Buremba, Engari, Kanoni, Kitura, Buremba, Kinoni, Kenshuga, Rwemikoma, Kazoo, Kazo T/C
Invasive species	5	**5**	**25**	Sanga TC, Sanga Kanyaryeru, Nyakashashara, Kikaatsi, Buremba, Engari, Kanoni, Kitura, Kinoni, Kenshuga, Rwemikoma, Kazoo, Kikatsi, Burunga

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 Kiruhura district has over the last three decades years 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 Kiruhura districts increase their vulnerability to hazard exposure necessitating urgent external support.

Hazards experienced in Kiruhura district can be classified as:

i. Climatological or Meteorological hazards including riverine floods, drought, hailstorms, strong winds, lightening and hill-slope surface runoff;
ii. Ecological or Biological hazards including livestock pests and diseases, crop pests and diseases, bush fires;
iii. 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. Increased awareness campaigns aimed at sensitizing farmers/communities on disaster risk reduction initiatives and practices.
iii. Revival of disaster risk committees at the district levels
iv. Periodic maintenance of feeder roads to reduce on traffic accidents
v. Promotion of drought and disease resistant crop seeds
vi. Establish a mechanism to minimise human-wildlife conflicts around Lake Mburo National Park
vii. Compensate individual victims of wildlife attacks
viii. Support extensive research on the occurrence and frequency of disasters prior to disaster management
ix. Improve the communication channel between the disaster department and local communities
x. Office of the prime minister should decentralise their activities at the district level
xi. OPM should strengthen the district disaster committees by developing guidelines and trainings
xii. Establishment of disaster fund at the district levels

xiii. Fund and equip recruited extension works
xiv. Establish a fund 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. Review laws on bush burning
xviii. Provide support in form of free seedlings to promote afforestation and reforestation especially on barehills
xix. Increase funding and staff to monitor wetland degradation and non-genuine agro-inputs
xx. Promote observation of the principle of rangeland carrying capacity among livestock keepers.

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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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United Nations Development Programme
Plot 11, Yusuf Lule Road
P.O. Box 7184
Kampala, Uganda
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