HUMAN WILDLIFE CONFLICTS AND INTERACTION

THE IMPACT OF OIL EXPLORATION AND DEVELOPMENT IN BULIISA, UGANDA

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ABSTRACT

After discovery of an estimated 2.5 billion of commercially viable oil, worth $2 billion in annual revenue for 20 years in the Albertine graben, Uganda's pursuit for a middle state income status seemed attainable. However, the oil reserves are situated in biodiversity sensitive area, with endemic, and vulnerable species. Development of petroleum resources may thus have detrimental environmental impacts.

This study seeks to explore the relationship between oil exploration and development activities with human wildlife conflicts and interaction in Buliisa.

Due to unequal power relations between non-place based and place-based actors in wildlife conservation, political ecology was used to show how benefits are used to offset costs or sustain the socioeconomic inequalities between actors. Overtime, the state has continued to foster its preservationist and a quasi-conservationists agenda where local people have emerged losers because of the recurring challenge of aligning benefits with costs incurred.

These costs to local people are sustained by interaction between humans and wildlife with inevitably competing interests. Agricultural production close to the park boundaries acts as a pull factor for interaction and conflicts It's difficult to avoid foraging of crop and threats to human life from wild pigs, baboons, buffaloes, elephants, and other wildlife from Murchison Falls National Park.

Since 2006 the inception of exploratory drilling in or proximate to sensitive areas, the animals have increased their avoidance range away from oil exploration activities. Overtime human wildlife interactions have recurred in areas close to the park leading to conflicts between local people and park management.

The thesis provides a spatial presentation of human wildlife incidents and areas of susceptibility to conflicts. The study finds that there are relationships between incidents and distances from houses, park boundary, and drill sites. This indicates the existence of an association between oil exploration and development with human wildlife incidents occurring in communities close to the Murchison Falls National Park.

DEDICATION

I dedicate this work to the farming communities of Mubaku, Karatum, and Mvule Nunda, living proximate to the boundaries of Murchison Falls National Park and other protected areas. Regardless of the irresponsiveness of government and other conservation stakeholders after several surveys on livelihoods, they passionately shared their experiences on human wildlife conflicts and interactions in their communities retrospectively. I hope the experiences shared, and information on human wildlife incidents will be considered in transforming management of conflicts by UWA and other stakeholders to enable them to sustain their livelihoods with minimum costs due to wild conservation.

ACKNOWLEDGEMENT

Completing this piece of work was made possible by the courtesy of the following, institutions, faculty, departments, organizations, project, and individuals.

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My sincere appreciation goes to my research assistants; Bagonza Ronald, Joshua Isingoma, Kahero Swaleh, and Stellar Aliguma, for their effort in traversing the 3 villages to interview respondents in 216 households.

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ACRONYMS

CSF Conservation Society Fund

CSO Civil Society Organization

GCS Global Coordinate System

GIS Geographic Information System

GPS Global Positioning System

MFPA Murchison Falls Protection Area

MFNP Murchison Falls National Park

MUINER Makerere University Institute of Environment and Natural Resources

NEMA National Environment Management Authority

NFA National Forestry Authority

NRO Natural Resource Office

ODK Open Data Kit

PA Protected Area

UBOS Uganda Bureau of Statistics

UWA Uganda Wildlife Authority

WCS Wildlife Conservation Society

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CHAPTER ONE

1.1 Introduction

The biological diversity of Albertine graben is at risk because of the activities associated with oil exploration and development like gas flaring and exploratory drilling. Ericson (2014) argued that the ongoing developments of oil in Murchison Falls National Park are likely to facilitate behavior change for wild animals by adjusting their utilization areas. The vibrations and noise associated with oil exploration will make wildlife habitats inhabitable and this will eventually lead to movement of wildlife beyond park boundaries (EPCL, 2012). The interaction between local people and wildlife has always resulted into loss of property, foraging of crops, loss of life of livestock and people (Distefano, 2005).

Ngwedo Subcounty, is a farming community in lower Buliisa district where oil exploration and development activities are underway in areas close to, or within its boundaries. These activities are prone to have an association with human wildlife conflicts and interactions in villages that share borders with Murchison Falls National Park (MFNP). The study seeks to explore the relationship between oil exploration and development with human wildlife conflicts and interactions in Ngwedo Sub County, Buliisa district.

1.2 Research problem

Oil exploration and development have great potential to contribute to Uganda's economic development. However, the activities involved in exploration and development can have detrimental impacts on sensitive ecosystems (Ericson, 2014, p. 21). Loss of land to drill sites, and road networks may lead to increased noise by machinery, as well as increase in human and vehicular traffic this leading to changes in animal behavior (UWA, 2013).

In areas adjacent to Murchison Falls National Park, the growing human population and changes in the land use have sustained human wildlife conflicts. In Buliisa, the population has risen from 47,709 I 2001 and to 63,063 in 2002 (UWA, 2013). Further, based on the recent census population by district there was an increase from 63,400 to 113,200 between 2002 and 2014 this giving a growth rate of 4.8 per year (UBOS, 2016). The population growth coupled with the traditional farming methods and increasing shortage of land to sustain agricultural practices has exerted more pressure on land in protected areas.

Further, the lack of policy on compensation for damage on crops or injury caused by wildlife confirm a perceived neglect by the PA managers to the hardship of local communities where people also believe that PA economy thrives when animals and crops are destroyed (UWA, 2001). Also, several unresolved land conflicts between the residents and PA management leaving the boundaries of the park unclear has led to human wildlife conflicts.

Many species, for example wild pigs, and baboons are not gazetted as vermin. This restricts residents from killing them to protect their fields. Elephants, buffaloes, and hippopotami that cause damage and injury to people and property but have also not been declared vermin due to their limited population or their local and international conservation importance. These animals occasionally threaten people's lives and destroyed crops, and property but the slow or non-responsiveness of rangers to chase them away from local communities and compensate the damage has angered the residents. This again prompts killing of wild animals by local people through use of traps, snares, and other brutal means (Madden, 2004).

The Uganda Wildlife Statute of 1996 forbid, poaching, illegal PA access, and encroachment of PA boundaries. However, the same law restricts access to PA by local residents, also grants access to extractive industries to do oil exploration besides biodiversity conservation, research and recreation (MacKenzie, Fuda, Ryan, & Hartter, 2017).

The Uganda Wildlife Statute 1996, section 19(5) states that any other economic activity is permitted with in the National park. This further mandates UWA to control and monitor industrial and mining developments in wildlife PA as represent in section 6(h).

This created an opening for oil exploration in pursuit for perceived economic benefit. However, oil exploration has led to degradation of habitats, disturbance to wildlife and environmental damage (MacKenzie et al., 2017). Further research by Wildlife Conservation Society showed that elephants had receded 8km from seismic vibrations and other animals moving away from the drill pads (Plumptre, Ayebare, & Mudumba, 2015).

Further, it was noted that elephants, buffaloes, giraffes, and other wildlife in Murchison Falls National Park were significantly affected by the exploration activities hence increasing their avoidance range between 750 to 1000 meters from the activity areas (NEMA, 2010). This has increased human-wildlife conflicts and interactions. However, less is documented about the extent, and actual zones of conflict. This study seeks to explore the relationship between oil exploration

and development activities with human wildlife conflicts and interactions in Buliisa. On assumption that human wildlife conflicts and interaction decrease further away from the oil field/well.

1.3 Research objective

The study seeks to explore the relationship between oil exploration and development activities with human wildlife conflicts and interactions in Buliisa. Three villages in Ngwedo Sub County are used as case study due to their proximity to the Murchison Falls National Park boundaries. Further the thesis considers people's perception on human wildlife conflicts, and interaction vis-à-vis new developments attributed to oil discovery in the area. To achieve the objective of the study, specific objectives are;

1. To map spatial patterns for human wildlife conflicts and interaction in Ngwedo Sub County, Buliisa.
2. To explore the relationship between oil exploration and development with human wildlife conflicts.
3. To assess people's perceptions on human wildlife conflicts and interactions in proximity and away from the oil wells.

1.4 Significance of the study

Doing research on the relationship between oil exploration and development activities with human wildlife conflicts and interaction in Buliisa is quite important. First, the research seeks feedback on human wildlife conflicts and interactions and looks towards dissemination of results to inform policy and regulation reviews, and management options for associated institutions like UWA to help them overcome recurring challenges. Secondly, the maps that will show patterns of human wildlife conflicts and interactions along with conflict zones. These will help to inform PA management the areas where action is duly needed. Lastly the study intends to show the existence of association between human wildlife conflicts and interaction with oil exploration and development activities in Murchison Falls National Park and areas in proximity.

1.5 Justification of the study

As requirement for the masters' program we are required to do research in the field of Natural Resources Management. Through online search, feedback from government agencies and Civil

Society Organizations (CSOs), and review of material in libraries like National Environment Management Authority (NEMA), Wildlife Conservation Society (WCS), it become clear that less is documented on human wildlife conflicts and interactions in areas close to the Murchison Falls National Park boundaries especially in Buliisa. The PELIBIGO project have selected the Albertine graben and the oil exploration and development activities as a main focus for research and research about the impact on the communities close or within oil reserves is one of the priorities. Therefore, as a beneficiary to the project my study is about the impacts of oil exploration and development activities in Buliisa. And studies of human wildlife conflicts and interactions have not been carried out in Buliisa although reports of kills by wildlife, and crop raids have been received by UWA office in Buliisa.

1.6 Study area

The study was carried out in the villages of Mubaku, Karatum and Mvule Nunda in Ngwedo Sub County, Buliisa district.

Buliisa district is located at Lat: 2.0300, Lon: 315370 (Decimals) in the Bunyoro sub region, Mid-Western part of Uganda with its headquarters in Buliisa TC, 320km from Kampala; The district borders Nebbi and Nwoya districts in the North, Masindi in the East, Hoima in the South, and Democratic Republic of Congo in the West. The district lies mainly in the rift valley floor with the highest point at 1800 Meters above sea level. It covers an area of 3200 Km^2 comprised of open water and land. The district is surrounded by Lake Albert, Albert Nile, game reserves/park and Budongo forest. Notably, the bigger part of the land area of the district is within the MFNP, Bugungu game reserve and Budongo forest (Buliisa, 2016). Buliisa sits on rich deposits of oil and gas in the Western Rift Valley and is home to 60 oil wells.

The district has 6 sub counties and one town council; Buliisa, Biiso, Kihungya, Butiaba, Kigwera, Ngwedo sub counties and Buliisa Town council (Figure.1). The district has a total population of 113,161 people, 55,339 female and 57822 male based on the 2014 census for Uganda (UBOS, 2016). The area is inhabited by Bagungu, a sub-ethnic group of Banyoro with a characteristic dialect of Lugungu. The Bagungu pay allegiance to the Omukama, King of Bunyoro Kitara Kingdom. Predominantly they are cultivators, fisherfolks and pastoralists due to the nature of Buliisa's ecosystems (Lacher Jr & Byakagaba, 2016). In addition, the area is also inhabited by immigrants of the Alur, Okebo, Bakiga, Lugbara and Banyarwanda coming from neighboring regions.

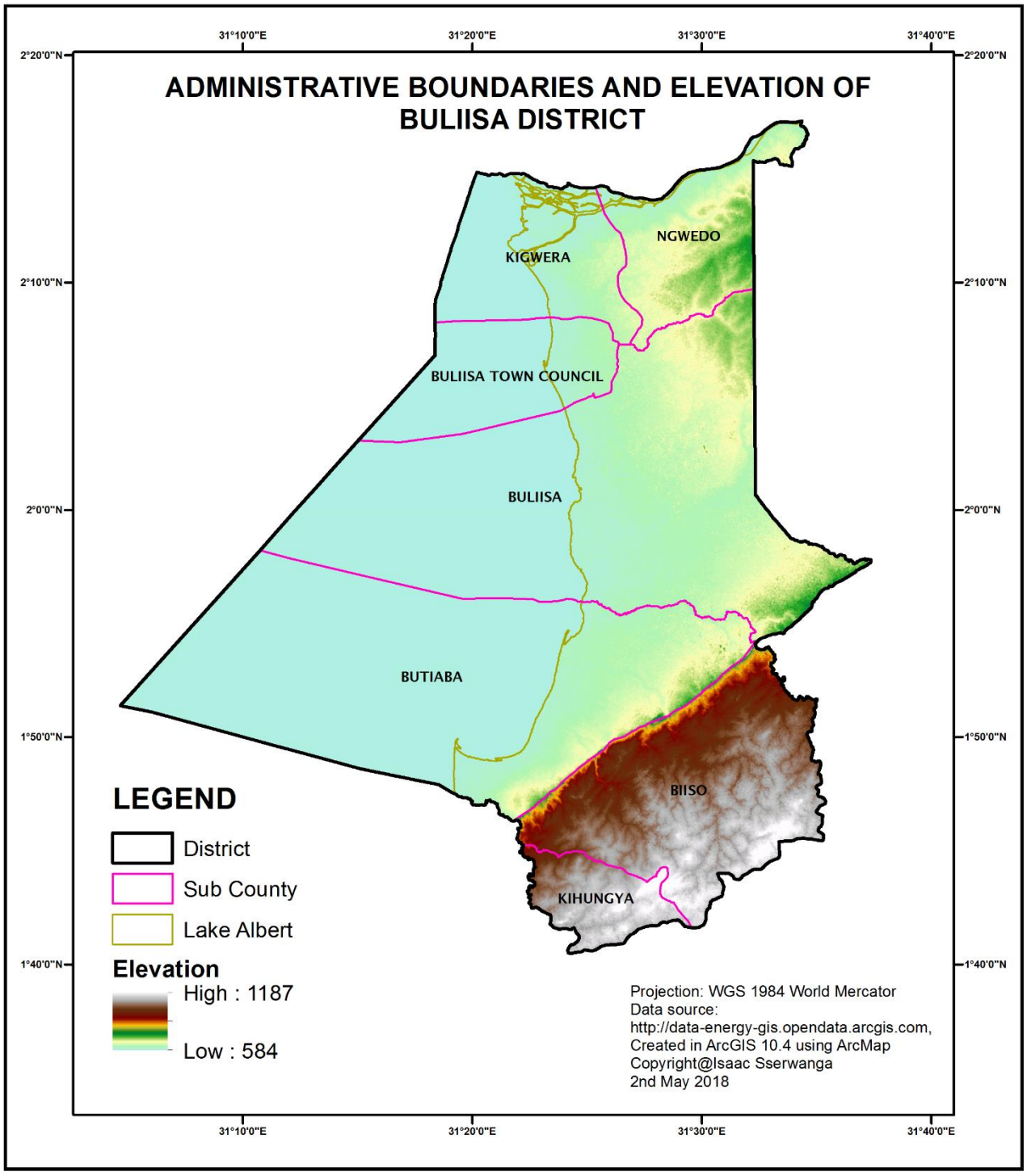

Figure 1:Map of Buliisa representing administrative boundaries

1.6.1 Climate

Rain occurs throughout the year, through a bimodal pattern with totals ranging from about 800mm per annum in Lake Albert, flat rising rapidly further away East above the escarpment to between 1250-1500mm per annum. The wet season occurs from March to May and September to November, and two drier periods of June to August and November to February.

Temperatures are moderate averaging between 19°C to 30°C with the hottest spot of Buliisa district lying in the Rift Valley. Monthly minimum temperatures vary between 12.0°C and 14.6°C and monthly maximum temperatures vary between 30.8°C and 38.5°C.

The relative humidity is highest in May and lowest in January, following the temperature pattern. For Masindi, the average long term mean humidity recorded was 42 and 87 at midday and at 6am respectively (BIMCO, 2009).

1.6.2 Land tenure and land use

In Buliisa district land tenure is under customary, freehold, and leasehold ownership. Customary ownership is the most overriding in upper and lower Buliisa. Customary ownership is both individual and communal. The communal ownership is practiced in the sub counties of Butiaba, Kigwera, Buliisa, and Buliisa Town Council (Figure.1). However, individual ownership is more common in Kihungya, Biiso and Ngwedo and in trading centers (NRO, 2016).

Freehold ownership involves the holding of registered land in perpetuity or for a period less than perpetuity which may be fixed by a condition. Freehold, enables the holder to exercise, subject to the law, full powers of ownership of land, including but not necessarily limited to using and developing the land for any lawful purpose; taking and using any, and all produce from the land; entering into any transaction relating to the land ("Land Act," 1998). However, this still awaits approval by the District Land Board Office as many individuals have applied for freehold titles and about 200 applications have been received in the district land board offices.

Leasehold ownership that is land owned by government in trust of the people, is mainly under PAs. Nevertheless, a few leases also exist in Buliisa and Kihungya Sub counties and a few companies and individuals have leasehold titles in the areas of Kabolwa and Ngwedo (NRO, 2016).

Agriculture is the dominant land use ranging from crop cultivation fields and grazing land. Cultivation is predominantly subsistence with very few commercial farmers. This is because continuous change from cash crops such as cotton, coffee, cocoa, and oranges to food crops as cassava, millet, bananas, and sorghum (NRO, 2016). The areas of cultivation include: - Biiso, Kihungya, Ngwedo, and parts of Buliisa Sub county with the rest dominated by grazing. In addition to cultivation, there is sand mining close to and in the lake, and oil exploration in lower Buliisa especially in the PAs.

Ngwedo subcounty, is in the North-Western part of Buliisa district, and shares borders with Victoria Nile in the North and MFNP in the East (Figure.3). It has a population of 17,155 people, with 8,225 males and 8,930 females, distributed among 3,217 households located in 5 parishes, and 16 villages (NRO, 2016; UBOS, 2016).

The three villages of Mubaku, Karatum, and Mvule Nunda were considered for the household survey because they are in proximity to the oil wells in the MFNP. However, they are located at different distances away from the oil well. This makes it possible to assess the spatial association between human wildlife conflicts and interactions with oil exploration and development activities.

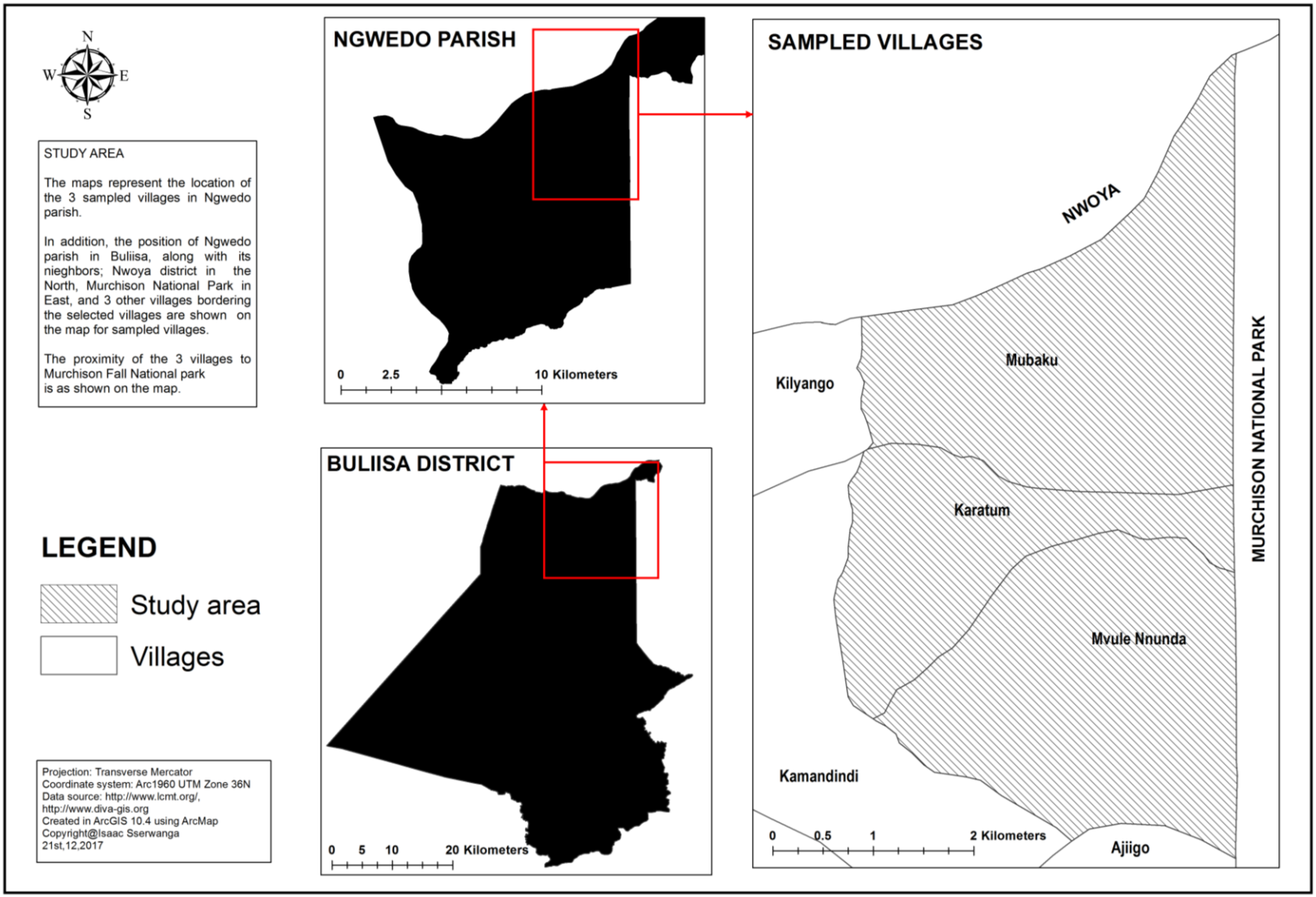

Figure 2: Map of study area showing the three-sampled village.

1.6.3 Murchison Falls Protected Area

The MFPA is considered under the study area because 40% of the oil discovered lies in the Murchison Falls Protected Area (TullowOil, 2013).

Due to an outbreak of sleeping sickness between 1898 and 1915 throughout Uganda, the government decided to evacuate people in the most infested areas. Between 1907 and 1912 a total area of 13,000 Km^2 was evacuated on both sides of Victoria Nile as it was designated as a sleeping sickness restricted area. In 1910 the Southern part was declared as Bunyoro game reserve, and in 1928 it was extended North into Gulu increasing its total area to 4,750 Km^2. By 1952, Bunyoro and Gulu Game reserves had benefited from over 40 years of no hunting pressure. This had increased the wildlife population and after announcement of the National Parks Act in 1952 the area corresponding to Bunyoro and Gulu Game reserves became the Murchison Falls National Park (UWA, 2001). Since 1952 when Murchison National Park was established, it harbored a diversity of large mammals. Though its purpose was not formally gazetted, the purpose for its establishment in the park documents was to conserve the important wildlife populations, and unique spectacle of Murchison Falls part of Uganda's national heritage, for enjoyment and future generation (UWA, 2001).

In 1996, the Uganda National Park and the Game Department were combined to form the Uganda Wildlife Authority. The management of Murchison Falls National Park, Karuma Wildlife Reserve, and Bugungu Wildlife Reserve was vested in the Chief Warden at Paraa. The three are constituents of the MFPA shown in figure 3.

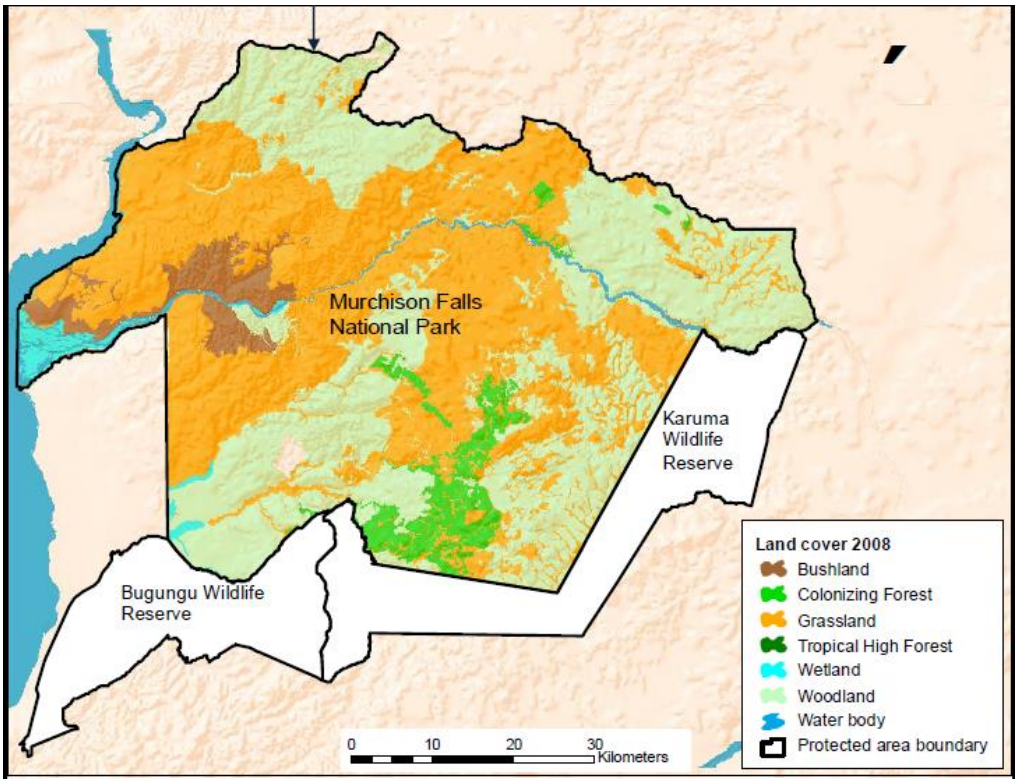

Figure 3: Map representing Murchison Falls Protection Area and land cover (NRO, 2016).

The Murchison Falls Protected Area (MFPA) is 5,072 Km^2 with Murchison Falls National Park, Bugungu Wildlife Reserve, and Karuma Wildlife Reserve covering 3893 Km^2, 501 Km^2, and 678 Km^2 of MFPA respectively (UWA, 2001).

The MFPA, is of great importance to local, national, and international scale due to the diversity of its ecosystem. It has the Murchison falls, a symbol of national heritage and an irresistible attraction for tourists. Further, the protected area is recognized as regional center for endemism in East Africa due to its Sudanian vegetation composed of mosaic of woodlands dominated by *Combretum* and *Acacia* species, as well as an extensive representation of the tall grass savanna of Albertine rift among others. This gives MFPA an internationally high accorded level of protection by world conservation union (IUCN). Regardless of high rates of poaching between 1975 and 1990, MFPA still remains a haven for big mammals like elephants, hippopotami, buffaloes, and many others (UWA, 2001).

Most importantly, the MFPA inhabits the last populations of breeding Nile crocodiles, and Rothschild's giraffe. In addition, it inhabits the largest population of Jackson's hartebeest and other endangered species like the shoebill and saddle-bill stork as part of the 450 birds' species in the MFPA. It also supports both palearctic and continental migratory birds.

Due to its tourism potential, MFPA has been divided into zones. The *Falls Zone* has a potential for hiking, fly camping, and sport fishing. However, intense tourism takes place in two zones; the *Western tourism zone and Chobe tourism zone. The western tourism zone* is mainly used for boat trips to the Nile delta, hiking along the Tangi and Nyamiska rivers and game drives in Buligi circuit. The *Chobe tourism* area is mainly for campsites at the South banks of Nile in Karuma Wildlife Reserve. In addition, in the heart of MFPA and the upstream of the mouth of Kibaa river, lies a unique wilderness zone for almost half of the large mammals in conservation area. This makes the area restricted to game viewing, sport fishing and walking safaris by concession.

The MFPA has wildness zones composed of dense bushland and thicket, low wildlife numbers, and tsetse flies' infestation which makes it unsuitable for tourists. Further has an integrated resource use zone meant for collection of selected resources in specified zones of MFPA by local communities keeping in mind the utilization guidelines of UWA. Lastly the MFPA zones of administration, these consisted of developed areas for protected area operations, and visitors' accommodation. These areas include; Paraa, Mubaku, Rabongo, Waisoke and Karuma (UWA, 2001).

MFPA has been part of the inhabitants' history from stone age settlements along the Nile, to significance of forests, falls, and islands of the Acholi, Alur, and Banyoro people of North Western part of Uganda. Its cultural heritage put it at forefront with visits from explorers in the 19th century, and along with its biodiversity MFPA has consistently been an important area for education and recreation. This is evident by the huge number of school children, university students and wildlife clubs that always visit the protected area.

To date Uganda Wildlife Authority manages the MFNP, and the two adjacent wildlife reserves of Bugungu and Karuma as a single unit. Based on the values of the MFPA its purpose is; *To protect and conserve the diversity of landscape, ecosystems, and wildlife of protect area, with focus on river Nile and the Murchison Falls, and to provide opportunities for the enjoyment and benefit of these special resources to people of Uganda and the World* (UWA, 2001)**.**

1.7 Oil discovery in Albertine graben

Traces of oil in Uganda's Albertine graben were observed as early as 1920, and first exploration drill done in 1938 (Ericson, 2014; Mugisa, 2016; TullowOil, 2013; Van Alstine, Manyindo, Smith, Dixon, & AmanigaRuhanga, 2014), but it was not until 2006 when Wildcatters Hardman Resources (Australian), Heritage Oil (Anglo-Canadian) and Tullow Oil (Anglo-Irish) made exploratory drills that confirmed the existence of commercially viable oil reserves (Kathman & Shannon, 2011; TullowOil, 2013; Van Alstine et al., 2014).

It had been estimated that between 6.5 and 8.5 billion barrels of oil lie in the Albertine graben adjacent Lake Albert (Lacher Jr & Byakagaba, 2016). In 2006 approximately 2.5 billion barrels of commercially viable oil, worth $2 billion in annual revenue for 20 years were confirmed in the Albertine graben (MacKenzie et al., 2017).

The discovery of oil prompted the formulation of the National oil and gas policy. This aims to foster continued promotion and exploration of the country's oil and gas potential and covers issues like; evaluation of the discovered oil and gas reserves; exploitation and utilization of these reserves, and revenues accruing from the country's oil and gas resources (NGOP 2006). With great potential to eradicate poverty, oil and gas development needs to be exploited sustainably in order to boost the country's capacity to social and economic development. By maximizing benefits from oil resources to strategically overcome the challenges to poverty alleviation as elaborated in the Poverty Eradication Action Plan (NGOP 2006).

The Albertine graben covers a total land area of 6,788,616 ha, with 79.1% under agriculture, settlement, and other miscellaneous land uses, and about 20% under protected areas form of land use. Protected areas include forest reserves and wild life conservation areas. Forest reserves cover a total area of 462,129 ha while wildlife conservation areas cover 957,194 ha (NEMA, 2010). Since 2006, oil exploration have been carried out in Albertine graben, including the protected areas (TullowOil, 2013). As an important bird area and biodiversity hotspot designated by Birdlife international and Conservation International respectively (Lacher Jr & Byakagaba, 2016), care must be taken to ensure exploitation of oil doesn't compromise the quality and quantity of environment resources (Thomassen & Hindrum, 2011).

Plants and animals have limitations to the rate of change to landscape given their habitat requirements and migration potential (Bürgi, Hersperger, & Schneeberger, 2004).

Studies have shown that elephants, buffaloes, and giraffes among others in Murchison Falls National Park are significantly affected by the oil exploration and development activities. One of the impacts observed was an increased movement of wildlife away from the oil activity areas at range of 750 to 1000 meters into other areas (NEMA, 2010).

Also infrastructural development has exposed wildlife habitats to fragmentation, interrupting migration patterns, animal stress, inbreeding and other behavioral changes that eventually lead to reduced wildlife productivity (Thomassen & Hindrum, 2011). Nevertheless, Uganda Wildlife Authority (UWA) has tried to manage the impacts of oil resources through strengthened capacity under the oil for development program. Preparation of General Management Plan to overcome challenges of petroleum development in PA, and development of a Sensitivity atlas for PA have been prepared, and a warden in charge of oil monitoring at Murchison Falls Protected Area (MFPA) to support oil exploration in MFPA have been employed (UWA, 2013).

1.7.1 Oil and gas industry operational cycle

During oil exploration and production in the reserves, Uganda follows an operational life cycle (Figure.4)**.**

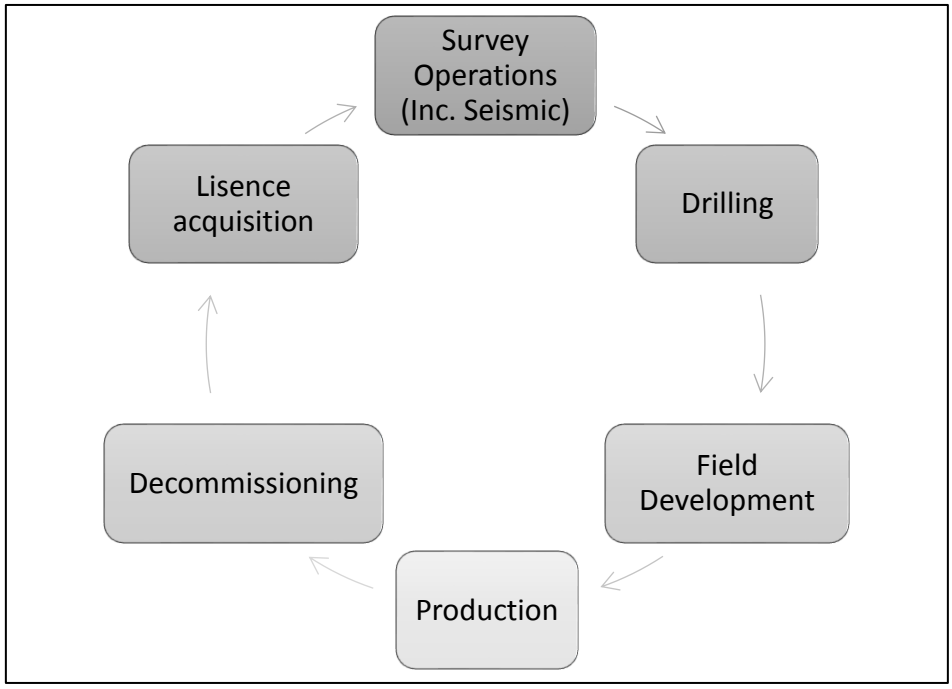

Figure 4:Typical oil and gas lifecycle (BIMCO, 2009)

License acquisition

The petroleum exploration and productional Act Cap 150 of 2000 is the principal act governing the upstream petroleum industry. It provides for the minister on application duly made to grant license under certain conditions as he may determine, a petroleum exploration license in respect to any exploration. The industry is composed of the upstream sector which includes exploration and production activities, and the downstream sector for refining and processing of oil and gas products, their distribution and marketing**.** A brief of the upstream sector is presented.

Exploration surveying

Here potential hydrocarbon bearing rock formations are identified by desk review based on studies, reviews on geological maps, and aerial photography. Furthermore, detailed information is gathered through field geological surveys. These include; magnetic survey, gravimetric survey, and seismic surveys. The preferred method in Uganda is seismic survey, it relies on the differing reflective properties of sound waves to various rock strata. The preferred energy source for the land is a generator that hydraulically transmits vibrations into the earth. dynamites can be used (BIMCO, 2009).

Exploration drilling

Exploration wells are drilled to confirm presence of the hydrocarbons. In case the reservoir is on land, a pad is constructed to accommodate the drilling equipment and support services. Ideally a pad for an exploration is 4000 to 15000m^2 drilling rigs and support services are split into modules that can be transported by air, land, or sea. These include; a derrick, mud handling equipment, power generator, cementing equipment, and tanks for fuel and water. The site requires self-contained camp with, Accommodation, canteen, communication, parking or helipad, fuel handling and storage area, and collection/treatment and disposal of waste area. Camps are located away from the immediate location of the drill site upstream of the prevailing wind direction. Drilling occurs around the clock base on; depth of well and type of rock strata but usually take 1 to 2 months to complete.

When hydrocarbons are found, well testing is conducted to establish flow rates and the formation pressure. Well testing results into air emission from flaring hydrocarbon. If the well contains commercial quantities of hydrocarbon a well head valve assembly is installed, and the rig moved on to another site. Though if the well is not viable, the top joint of the casing is cut below ground and the well plugged with cement (BIMCO, 2009).

Appraisal well

If the earlier explorations are successful, more wells are drilled to determine the size and extent of the field. Here directional drilling is might by employed to reduce the land use foot print.

Development and production

When a reservoir is considered commercially viable, the development or production wells are drilled. Based on the size and geology of reservoir a range of well from 10 to 100 or more are drilled. The produced hydrocarbons are then routed to the central processing facility which gathers and separates the produced fluids. Oil must be free of gas before export and so gas should be stabilized and free of liquids and unwanted hydrogen sulphide and carbondioxide before export (BIMCO, 2009).

Decommissioning and rehabilitation

This happens after the end of the commercial life of production installation, it's between a period of 20 to 40 years. This involves removal of buildings, and equipment, restoration of the site to environmentally sound conditions, implementation of measures to encourage site revegetation, and continued monitoring of site after closure. It may also include removal of platforms and supporting infrastructure depending on the location (BIMCO, 2009).

Understanding the oil and gas lifecycle used by Uganda informed the study of the likely impacts of each stage in the cycle in relation to the EIAs, and data collected from the field. Seismic surveys, exploration drilling, development, and production have processes that impact the environment. These can be in form of noise, vibrations, increased edge effect, and displacement or retreating of wildlife from drill sites.

1.8 Outline of the thesis

The thesis is made up of seven chapters

Chapter one introduces the study with a background on the oil exploration in the Albertine graben, policy development to manage resource, and the impact of oil exploration activities in biodiversity sensitive areas. It also defines the study area's historical background, climate, land tenure and land use. The research problem is defined, and the objectives meant to achieve it. The significance of the study is presented, and the chapter ends with the justification of the study.

Chapter two presents a review of literature on impact of extractive industries on human wildlife conflicts and interactions in biodiversity sensitive areas. It introduces political ecology and a bit of history of wildlife conservation in Uganda to understand the role of power relations between different actors in influencing human wildlife conflicts and interaction in the study area. It also presents the value of wildlife by using people's experiences to analyze environment conflicts.

Chapter three presents the methods and techniques used in the study. It introduces the cross-sectional survey design to assess the association of human wildlife conflicts and interactions with oil exploration and development in Buliisa. Further defines the methods for assessing human wildlife conflicts like questionnaire and interview with help of open data kit software. It also presents the sampling method, the research process, the rapid assessment, training workshop for research assistants, and the actual field work. The chapter presents the analysis of human wildlife conflict patterns using spatial data, arithmetic mean distances, and establishing conflict zones. The chapter closes with nature of data and validity, limitations of the study, and the ethical conditions.

Chapter four explores the relationship between oil exploration and development with human wildlife conflicts through, human livelihood assessment, respondents' perception on employment and income. Further it presents results for human wildlife conflicts and interactions as experienced by the local people.

Chapter five presents the result of the analysis of human wildlife conflict patterns with the help of maps, comparison of arithmetic mean distances of houses, park, and oil wells in relation to the human wildlife incidents for 2006 and 2015. Further the relationship of the distance and human wildlife incidents as assessed with a t-test and hypothesis. The chapter closes with a trend of human

wildlife incidents from 2006 to 2017, and the human wildlife conflict zones around incidents for 2006 and 2015.

Chapter six explores the challenges to overcoming human wildlife conflicts and interactions. It also presents remedies to the challenges. The chapter also presents conservation stakeholder initiatives that have been used to prevent or control human wildlife conflicts and interaction in the study area. It closes with the recommendations of the respondents to the government and other stakeholders to possible solutions to recurring human wildlife conflicts in their communities.

Chapter seven presents the conclusion of the study.

1.9 Chapter summary

In summary the chapter, gives a brief introduction of factors that can destabilize people's livelihoods like foraging of crops, and loss of life to wildlife because of oil exploration and development in protected areas. After the research problem is introduced, which later leads us to the research objectives, then to the significance of study and its justification. The Albertine graben as the area under oil exploration and development is defined in terms of, its ecosystem and landscape. Further, Ngwedo Sub county is defined as the study area, its climate, land use, and tenure. And a historical background for MFPA is represented by different reserves its composed of, and how it came into existence. An outline for the thesis also presented and the chapter closes with a background of oil exploration and development in Uganda.

CHAPTER TWO

2.0 RESEARCH REVIEW, THEORIES, AND HISTORICAL FRAMEWORK

2.1 Introduction

This chapter presents a review of issues that have been studied and explored theoretically and empirically in the literature about extractive industries and how they can contribute to increase in human wildlife conflicts. The chapter examines political ecology and its consideration for human environment interaction, this is used to understand and assess the relationship between oil and gas exploration and human environment interaction and its outcomes.

The recent advances in satellite imagery analysis and geographic information systems allows an increasingly detailed evaluation of the impact of anthropogenic actions at various scales. This is reflected in an increase in the use of human footprint models, which incorporate proxies for human disturbance on environment/landscape such as population density, land transformation, accessibility, and electrical power infrastructure (Leu et al, 2008).

The human footprint may influence ecosystems directly by anthropogenic actions that induce land cover change or indirectly by actions that degrade ecosystem functions. Both direct and indirect changes may be facilitated via top-down processes and bottom-up processes, or both (Leu, Hanser, & Knick, 2008). Humans influence top-down processes, for example, via global climate change, or bottom-up processes by disrupting abiotic processes, such as nutrient cycling.

Increase in access to protected areas can lead to a series of impacts. Studies show that road construction is an important driver to further landscape change impacts in protected areas. The accessibility created by roads built to extract natural resources can draw new settlers to previously inaccessible areas if government policies allows or support such development (Baynard, 2011). In Uganda road construction as part of oil and gas sector developments has blocked migratory routes of elephants moving northward out of Murchison Falls National Park (UWA, 2013).

2.2 Human-wildlife conflicts

Human wildlife conflicts occur when the needs and behavior of wildlife impact negatively on the goals of humans or when the goals of humans negatively impact the needs of wildlife. These conflicts may result when wildlife damage crops, injure or kill domestic animals, threaten or kill people (Madden, 2004). Though Tumusime and Vedeld (2015) noted that establishing protected areas may improve the livelihoods of people especially where there is access to resources like fuel and bushmeat. This does not mean that they are no costs and limitations living close to the park. Usually evictions, limited access to the protected areas, and loss of crops, livestock and humans lives to the wild animals from the park are part of such conservation initiatives (Naughton-Treves, 1998; Tumusiime & Vedeld, 2015). Therefore, the significant risk posed by wildlife is likely to breed hostility and opposition to conservation programs (Naughton-Treves, 1998).

Madden (2010) argues that conflicts among humans exist within human wildlife conflicts because humans have different values, goals, attitudes, and wealth. So, they struggle for access to the resource, its control to meet their needs for survival. Therefore, Madden (2010) looks at the conflict between different actors with historical wounds, cultural differences, socioeconomic needs, and trust and communication void on sustainable conservation strategy that considers local people's well-being.

It is argued that term human wildlife conflict does not capture the broader nature of relationship between wildlife and humans. This is because of the perceived lack of knowledge of established boundaries between protected areas and communities by wild animals (Peterson, Birckhead, Leong, Peterson, & Peterson, 2010). Further, misrepresentation of human wildlife conflicts for human wildlife interaction puts wildlife at risk as they are perceived a threat to livelihood rather than an alleviation factor to their welfare through coexistence. This perceived context human wildlife conflicts can hinder uncovering of underlying conflicts due to different values, priorities, and political relations between different actors that might reinforce conflicts to levels that are hard to deal with (Hill, 2015; Peterson et al., 2010). The study adopts human wildlife interaction to represent the interactive behavior of wild animals that negatively impacts human livelihoods, and response of humans that enhances or negatively affects the wildlife conservation (Angelici, 2016).

The frequent and unstable changes in natural habitats enhanced by human activities like establishment of road networks and drilling of exploratory wells alter the habitats of wildlife. These activities affect their adaptability and coping mechanisms and eventually increasing avoidance range and a pursuit for favorable habitats equivalent to the lost habitat (NEMA, 2010). Therefore, the wild animals are forced to interact with communities close to PAs for survival.

Biodiversity related conflicts arise as result of interest of two or more parties crashing as one attempt to assert its interests at the expense of the others. Therefore, an assumption is made on the consent of their interest and that of humans especially the intentions of animals to pursue their interests at the cost of humans (Peterson et al., 2010).

To some extent wild animals will always pursue their interests at all cost especially were their survival is dependent on foraging crops plantations and, killing livestock, thereby threatening human livelihoods. Insufficient efforts taken by the protected area management to compensate people for the losses has led to an increase in animal kills. Therefore, drastic measures like fencing, use of disruptive sounds, and red pepper fumes among others are used by communities close to protected areas to limit the damage (Treves, Wallace, Naughton-Treves, & Morales, 2006).

Sanchez-Vasquez et al (2016) argued that there is no direct or linear link between environmental factors and conflicts. Rather conflicts are conditioned by social and institutional factors, resource use relationship by people and environment, and the traits of the ecosystem itself. Therefore, the social effects would cause conflicts, and the direct environment causes should be considered as at secondary causal level (Sanchez-Vazquez, Espinosa, & Eguiguren, 2016).

Its argued that the increase in human wildlife conflicts is attributed to lack of effective ways to deal with it locally, and lack of inclusion of people living adjacent protected areas in decision making on conservation (Hill, 2004). In addition, external factors like resettled population, poaching, restriction to access laws and regulations are known to set trends of human wildlife conflicts in reserves (Gillingham & Lee, 1999).

In Albertine graben, most of the oil wells are in protected areas. Oil development in these areas is most likely to cause change in wildlife behavior like migration and change in utilization area and population (Ericson, 2014). The migration of animals retreating from oil development is prevalent

as asserted by the wildlife experts. Further experts attribute this to noise and vibrations, with great fear that movement of animals will disrupt human settlements, and crop growth. This is anticipated to worsen as the production phase starts with the local wildlife affected most (BIMCO, 2009; EPCL, 2012; Ericson, 2014).

It is argued by conservationists that the problem of human wildlife conflict escalates as the growing rural population settle in or near wildlife habitats. Further experts noted that this had led to crop damage and loss of lives for humans and livestock (Distefano, 2005; Naughton-Treves, 1997). In Africa, the victims abandoned their farmland due to high cost of reestablishment and in response to the damage caused by wildlife (Naughton-Treves, 1997).

Traditionally in Africa conflicts between local people and wildlife have been resolved by creating barriers to animal movements. This has been through digging trenches and fencing reserves. Nonetheless, some of these initiatives have not managed to restrict movement of small sized wildlife, and possess an ecological impact to migratory species by distracting their movement (Newmark, Manyanza, Gamassa, & Sariko, 1994). In Kenya wildebeest have destroyed fences set up to protect farms to reclaim their traditional migratory routes from dispersal areas to the parks (Musimbi, 2013).

Oil development may cause noise that is influencing animal behavior. During exploratory drilling in Murchison Falls Protected Area studies showed that the background noise exceeded the maximum permissible noise levels for environmental and recreational sites of 45 and 35 Leq dB(A) during day and night respectively. The on-site measurements results were between 50 to 81 Leg dB(A), which makes the habitats of the wild animals inhabitable (EPCL, 2012).

2.3 Political ecology of wildlife conservation.

Like most PAs, Murchison Falls Protected Area in Uganda is exposed to numerous conservation challenges. These involve destruction of wildlife habitat, decline of wildlife species in and outside the PA, and interaction between wildlife and people living close to the parks.

To understand the environmental problems with in a broad context, political ecology can be used to explore and explain the relationship between socioeconomic and political structures and

processes that determine the strategies used to manage resources and its deterioration (Akama, Lant, & Burnett, 1996).

It considers interaction of humans with the environment under the influence of power relations. This at times involves the ability of one actor to control the environment of the other(Bryant, 1998; Bryant & Bailey, 1997; Mjema, 2015). It's evident that inequalities in power relations between different actors facilitate environmental changes on land, air, and water.

For example, limiting access to PA resources to conserve wildlife without consideration of local people's livelihoods and their connectedness to PA resources. This comes with resistance like poaching big game in the national parks (Bryant, 1998). Further, political ecology acknowledges that the costs and benefits of environmental change are not equally shared. This has a tendency of enhancing or reducing socioeconomic inequalities which has consequences for different actors in relation to those that weld the power (Robbins, 2011).

Akama, Lant and Burnett (1996) argued that socioeconomic processes and structural interactions between different interest groups constitutes a chain of causalities which help to explain the causes of different group conflicts and resource deterioration.

In political ecology, the factors that influence environment destruction are within or far from the site of destruction to other areas where political-economic relations are far from the affected areas. For example, states may formulate conservation policies with no attention towards catering for competing interests. However, if actions that sustain conflict between conflicting groups are considered in developing the policies, natural resource deterioration becomes a social issues, and this initiative is proven to define resource use challenges at different spatial scales (Akama et al., 1996).

As more effort is put in ecological model research and technical conservation strategies, less focus is put on research on social values in assessing feasibility of conservation strategies. Therefore, issues like lack of alternative sources of income, sharing of wildlife benefits and costs, and political constraints placed upon the local people are not dealt with satisfactorily. In case of failure of the devised ecological and biological strategies without considering social values, forces may arise, and the state may be forced to protect the ecosystem from the local people who use it as their

livelihood (Akama et al., 1996). It's also important to acknowledge that even the weak actors have power to act as they pursue their interest (Bryant & Bailey, 1997, p. 25).

This unequal balance of power at times leads to conflicts over access to use of natural resources. Therefore, to further understand the role of the actors and influence of the unequal power to shaping of the conservation interventions in colonized states, the study set the current wildlife policies and conflicts in a historical context. During colonialism people were exposed to world dominated global system of capitalistic production that often was detrimental to their livelihoods (Bryant, 1998; Mjema, 2015). Therefore, it is vital to consider how people interacted with the environment from pre-colonial to colonial period and then post-independence period.

In addition, the study considers the historical trend of interaction between different actors and how they have evolved over time to influence the patterns of human environment interaction in the study area. The information collected from households in the study area on perception and analyzed patterns of human wildlife conflicts and interaction in relation to oil exploration and development will be used to expose the actors that benefit from the wildlife conservation initiatives and those that lose based on the cost of the initiatives overtime.

The study considers the local people living close to Murchison Falls National Park as placed based actors because of the experience with human wildlife conflicts and interaction and their impact on their livelihoods. The UWA represents the state as a non-place-based actor that welds the power to access PAs and resource management. Bryant and Bailey (1997) identified the category of actors that are vital in assessing the interaction between the different actors and their influence on human environment interaction overtime.

2.4 Power relations within wildlife conservation in Uganda

2.4.1 Precolonial period

Before the invasion of the colonialists, the ownership of land resources was communal in Uganda. The interaction with nature was based on local people's needs, regular activities, and there was limited need for external trade. Overtime, the societies formally made public certain rules and regulations on resource use and these were precisely enacted by the cultural leaders and embedded in their culture (Baker et al., 2013).

The communities were socially organized in kingdoms, chiefdoms, and clan systems. The power of access was vested in the kingdom, and the resources were communally owned or under free access. Though free access was not an implication of irresponsible use of wildlife resources. Like forests, norms and practices were passed on from one generation to the other through strict instruction to the young from the old using proverbs, stories, taboos, and songs. During this period it was evident that wild animals were not seen on communal land as currently with protected areas (Baker et al., 2013). Nonetheless due to hunting, the wildlife populations were always sustained.

In addition, culture considered many animals, birds, and fish sacred, and held in regard with respect and high reverence. And in case of any violation of a taboo there were supernatural sanctions. Therefore, conservation existed inform of hunting areas, cultural and spiritual areas protected by practices specific to a given area (Baker et al., 2013). For example, in Buganda kingdom the people who belong to the different clans represented by totems like elephant, lion, leopard, kob, civet, buffalo and many others are forbidden to hunt or kill such wildlife.

This shows that power to access of resources was vested with political and cultural leaders. It was not until the coming of colonialists that changes in the interaction of humans with environment started to emerge (Mjema, 2015).

2.4.2 Colonial period

In 1894 Uganda was declared a British protectorate as result of the scramble for Africa by European countries. This was to pursue their interest in the providing raw materials to bolster their industries that had started being competitive due to the industrial revolution. To fulfil their intent, the colonial administration introduced control of land resources through land tenure systems. In addition, they vested resource management under the kingdoms and introduced new regimes like designating large areas as crown property not accessible to the local people (Baker et al., 2013).

Focus was directed to wildlife management because of culling of the elephants and this was to control crop damages by elephants that moved into people's crop field. This led to establishment of the Elephant Control Department, with role of preventing crop damage by elephants. The killing of elephants was done all over Uganda, with the meat given to the locals and the ivory sold for revenue.

In 1925 the Elephant Control Department became the Game Department. The department employed local people as vermin guards to protect the communities from elephants and other wildlife from game reserves (Baker et al., 2013).

In 1926, the Game Ordinance gave power to the Game Department to control hunting and other forms of utilization that involved permitting hunting by foreigners while local people excluded from hunting. This was further consolidated by establishing protected areas like game reserves and hunting areas.

And by 1950, the African Guard of the Game Department was established in all communities close to protected areas with aim of controlling vermin. Nonetheless with time, conflicts between the communities and the Game Department arose. This was because of their failure to meet the demands of the communities in regard to protecting their field from crop damages (Baker et al., 2013; Madden, 2004).

In 1952, the National Park Ordinance led to the establishment of the Uganda National Park with the mandate to manage and protect national parks (Baker et al., 2013; Namirimu et al., 2013). During the same time lake George and Edward game reserves were gazetted into Queen Elizabeth National Park, and the Murchison Falls National Park was established, and they remain Uganda's largest national parks today. Their establishment led to exclusion of people from their traditional hunting grounds and involved eviction of people from their traditional land. The Uganda National Park was given a task to enforce the ban on hunting, grazing in parks, and natural resource collection. It also introduced tough penalties for the offenders (Baker et al., 2013).

The establishment of the parks was based on a protectionist agenda that considered relocation of indigenous people outside PAs to create wilderness for protecting the intrinsic and ecological values of species with in the PAs (MacKenzie et al., 2017). This was evident in the laws enacted, and the behavior of institutions created and responsible for changing the relationship between communities and PAs under legal regimes (Baker et al., 2013). This involved excluding local people to set aside hunting and forest reserves for colonial elites (Baker et al., 2013; MacKenzie et al., 2017).

2.4.3 Post-Independence period

In 1962, Uganda attained her independence though the conservation polices did not change. The colonial legal instruments and conservation laws were published in the laws of Uganda in 1964. The power of control of crown property like forests was shifted to the independent government of Uganda. However, with decentralization governance kingdoms and local government both managed forests to get the best benefit out of them.

In 1967, the constitution was formally revoked, and the kingdoms were abolished, and everything that was controlled by Kingdoms fell in the hands of the central government.

In 1970s they were changes in conservation extent and by 1972 the Aswa-Lorim game reserve was degazetted and the Kilak controlled hunting area revoked to pave way for private ranches (Baker et al., 2013; UWA, 2013).

From this time there was no change in conservation policy due to political instability sustained by Idi Amin dictatorship. In 1970s the Nile crossing Paraa was a frontline for conflict between different militias following downfall of Amin's regime. The armies looted lodges and massively slaughtered wildlife. The herds of elephants and buffaloes in the MFNP were almost annihilated (UWA, 2013) This continued until Milton Obote overthrew him by 1979, and later Milton Obote fell to an insurgency by National Resistance Movement. During the civil war of 1980s, the department's effort to control vermin for the farmers ended due to the political instability.

By 1986 the National Resistance Movement captured power, and this set a new course for conservation policy in Uganda. Nonetheless in 1980s Murchison Fall National Park experienced one of the largest scale of destruction in East Africa. This was orchestrated by militias that used automated gun to kill animals and members of staff for the Game Department. This led to initiation of donor funded projects in 1992 to rehabilitate the park (UWA, 2013).

In 1990s a new conservation discourse emerged that blamed policy failure and acclaimed market-oriented solutions to sell nature to save it. Therefore, an economic value was attached to nature as a product for sale and a valuable service (MacKenzie et al., 2017). Again, the unequal purchasing power of the North for a tourism experience in relation to the South seemed more profitable compared to less lucrative land use activities that sustain local livelihoods.

This made it easier for the state to exclude the local communities from exploiting PA resources so that they can be used for tourism. Nonetheless, community conservation has been integrated in wildlife management to appreciate the role of local communities in shaping nature and improve their livelihood through sharing benefits to offset costs for living close to PAs (MacKenzie et al., 2017).

In 1996, Uganda Wildlife Authority was established as a merger between Game Department and Uganda National Parks. It led to development of conservation policies and these include; the Uganda Wildlife Policy1999, Uganda Tourism Policy 2003. Uganda Wildlife Act, Cap 200 and the Community Conservation Policy 2004 (Namirimu et al., 2013).

The Uganda Wildlife Policy 1999 recognizes the wildlife estate as an important resource for environmental education for people of all ages. The goal of conservation education and communication is to promote positive attitudes, knowledge and change of behavior of the neighboring communities and the public towards wildlife conservation in general.

The Uganda Wildlife Act 2000 vests ownership of wildlife in the state and provides for any person to own wildlife that is lawfully taken. This involves implementation of wildlife user rights with the private sector, land owners and local governments especially for management of wildlife outside protected areas on communal and private land.

The Uganda Wildlife Act Cap 200 of 2000, provides for revenue sharing of 20% of the park entry fees given to the local government of the area surrounding the PAs. It also provides for regulated access and use of resources in PAs and gives power to the executive director of UWA to award permits to harvest a resource within a PA.

The goal of the Community Conservation Policy 2004 is to strengthen conservation of wildlife resources through sustainable and equitable distribution of conservation benefits and/or costs among all stakeholders. It also provides for collaborative management and partnership, benefit sharing and community-based tourism management with local communities, local governments, private sector, and others for wildlife resource sustainable management.

In 2017, UWA submitted the Uganda Wildlife Bill 2017 for tabling in the Parliament this will provides for a compensation scheme. The scheme shall be used for financing compensation claims for human death, injuries or damage to property caused by a wild animal outside a protected area

(UWA, 2017). This will prevent terrible retaliations like the recent poisoning of 11 lions (8 cubs and 3 lionesses) by a local living close to Queen Elizabeth National Park because of loss of livestock to the carnivores (Actman & Bale, 2018). So, more emphasis should be put in optimizing wildlife values to society rather than increasing wildlife populations without considering underlying factors like unequal distribution of benefits and costs between different actors that sustain human wildlife conflicts (Musimbi, 2013).

Therefore, formulation of policies to meet the mandate of UWA clearly shows that power to control of access to resources through exploring user rights is vested in the state. Progressively local people were excluded and relocated to areas that contradicted with their way of life. Using the historical approach enabled understanding of how power struggles to control access to natural resources defines how local people and state interact with the environment overtime and its outcome.

2.5 Valuing wildlife

The role of perception in analyzing environmental conflicts gives great attention to the threats (Sanchez-Vazquez et al., 2016) posed by vermin and problem animals to communities.

In rural communities, place identity is related to people's traditional way of life, and subsistence. For example, in India the Hindus regard monkeys as sacred therefore regardless of the damage made they ought to be revered and protected. This tolerance to Wildlife is built with in their tradition and culture due to the symbolic meanings them have contrary to the utilitarian values and their appearance (Distefano, 2005; Hill, 2015). Further, Hill (2015) argued that it's important to understand the competing representation of animals in terms of what is hated and negatively inferred to a pest, and much loved as well as valued species. This because the authority to define a problem results into authority to define a solution. Therefore, place identity is essential for setting up resistance to activities that breed conflicts in their communities. In farming communities, physical barriers like fences are erected to avoid crop foraging and depredation by wildlife (Distefano, 2005). Further prior historic experiences to similar conflicts in the communities is quite important (Sanchez-Vazquez et al., 2016). This helps to assess the trends of conflicts, and their causal factors.

Therefore, the recorded human wildlife conflicts and interactions, associated with oil exploration and development in communities in proximity to the drill sites or oil wells represent the impacts of the activities on affected communities and their perception. This is vital for assessing future trends in human wildlife conflicts and interaction.

2.6 Chapter summary

The chapter has a review of literature on human wildlife conflicts and interaction, land use cover change, and oil exploration and its impact on the environment. It also elaborates on the framework and concepts to be used to guide the study. It elaborates the use of political ecology in a historical context of wildlife conservation to understand role of power relations in human environment interaction. It closes with the use of perception to analyze environmental conflicts with emphasis on place identity which defines people's way of life and how they react to changes in the environment.

CHAPTER THREE

3.0 METHODS AND TECHNIQUES

3.1 Introduction

The chapter elaborates the methods and techniques used in the study to achieve the objectives of the study. Further, sampling of households, and collection and capture of data from different households and incident areas are presented. The chapter closes a presentation of methods used to analyze both spatial and aggregated data, limitation of the study and ethical aspects.

3.2 Research design

The empirical part of the study is based on a combination of survey data and a spatial analysis of human wildlife incidents. Across-sectional survey on human wildlife conflicts and interactions was carried out using the Open Data Kit (ODK) data collection software. In total, 216 respondents were interviewed in the 3 villages; Mubaku, Karatum, and Mvule Nunda. The 3 villages where selected in consideration of their proximity to the oil wells in the Murchison Falls National Park, shared border with the park, and existence of human wildlife incidents as informed by the rapid assessment done prior data collection.

The sampled households were interviewed using a questionnaire. Further, the use of ODK data collection tool to collect data for human wildlife conflicts and interactions was vital for mapping and establishing conflict zones elaborated in the research structure (Figure 5).

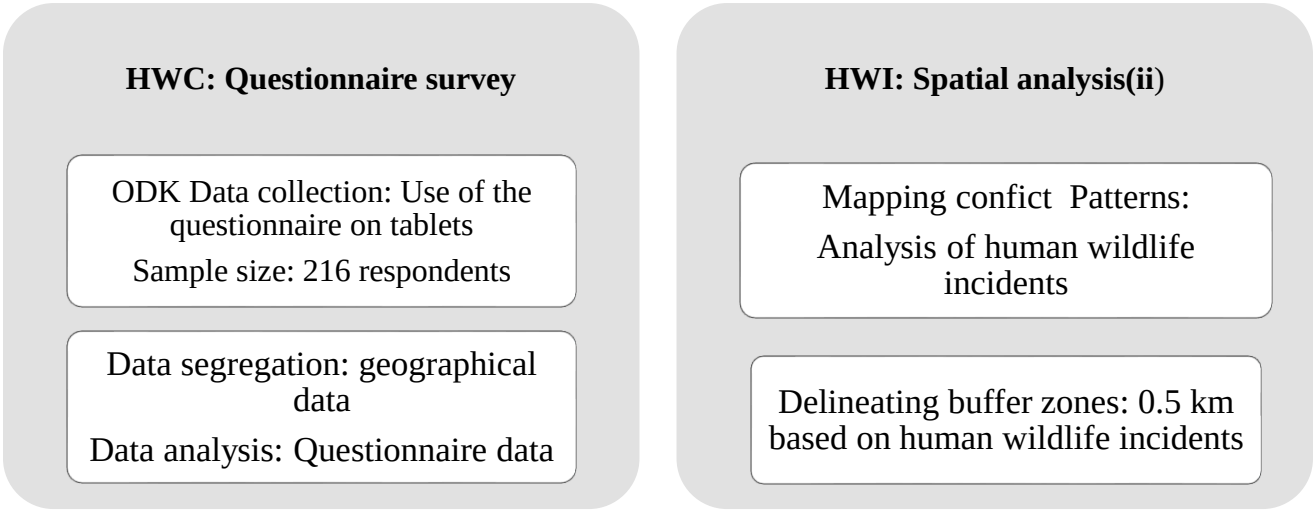

Figure 5:Research design structure

3.3 Methodology for Assessment of human-wildlife conflicts

3.3.1 Data collection and tools

Data was collected digitally using Kobo platform; a humanitarian data collection tool kit that hosts the Open Data Kit (ODK) system, which researchers or humanitarian workers can access and use at no cost. The questionnaire was digitized and installed on tablets used to collect and relay the data to the ODK platform. The tablet had GPS and GLONASS that were used to collect GPS coordinates of houses, and human wildlife Incidents in the 3 villages. Four research assistants; 3 male and 1 female assisted with field work and visited all the 216 selected households. However, were they needed elaboration without provision on the questionnaire, the research assistants used notebooks to record such information during the data collection process in the sampled villages. Once all data was received in the ODK platform, it was tabulated and summarized in an excel sheet in readiness for analysis using the SPSS statistic tool.

3.3.1.1 Questionnaire

The questionnaire was developed to achieve the set objective of the research study that seeks to explore human wildlife conflicts and interaction in 2006 and 2015.

The questionnaire covered sections on livelihoods assets; land ownership, occupation of respondent, and income generating activities.

To cover landscape changes, I asked about factors that influence change, and perceptions on changes. Further, human wildlife conflicts were investigated through the following aspects; if respondents had seen wild animals, their perceptions on human wildlife conflicts and interactions, challenges to prevent human wildlife conflicts, steps taken to control the human wildlife conflicts and interaction by residents, PA management, and initiatives by other shareholders. The questionnaire also examined recommendations from the people leaving close to Murchison Falls National Park, effects of oil exploration on employment, and income of people in community, and the influence of oil development on the community.

The use of ODK, enabled me to integrate an option of collecting GPS coordinates for human wildlife incidents and location of houses in the sampled villages. The last section of the questionnaire had an option of inquiries on research project, requests and improvements on method used for research.

A total of 216 respondents between the age of 29 and 70 plus were interviewed with help of a questionnaire in the villages of; Mubaku, Karatum and Mvule Nunda in Ngwedo Sub county. It was imperative to consider respondents with 29 years as the lower age limit since by 2006 they should have been 18 years, old enough to give valid responses on the changes in their community.

The questionnaire collected data in consideration of the variables selected to represent the association of human wildlife conflicts and interactions with oil exploration and development (Figure.6).

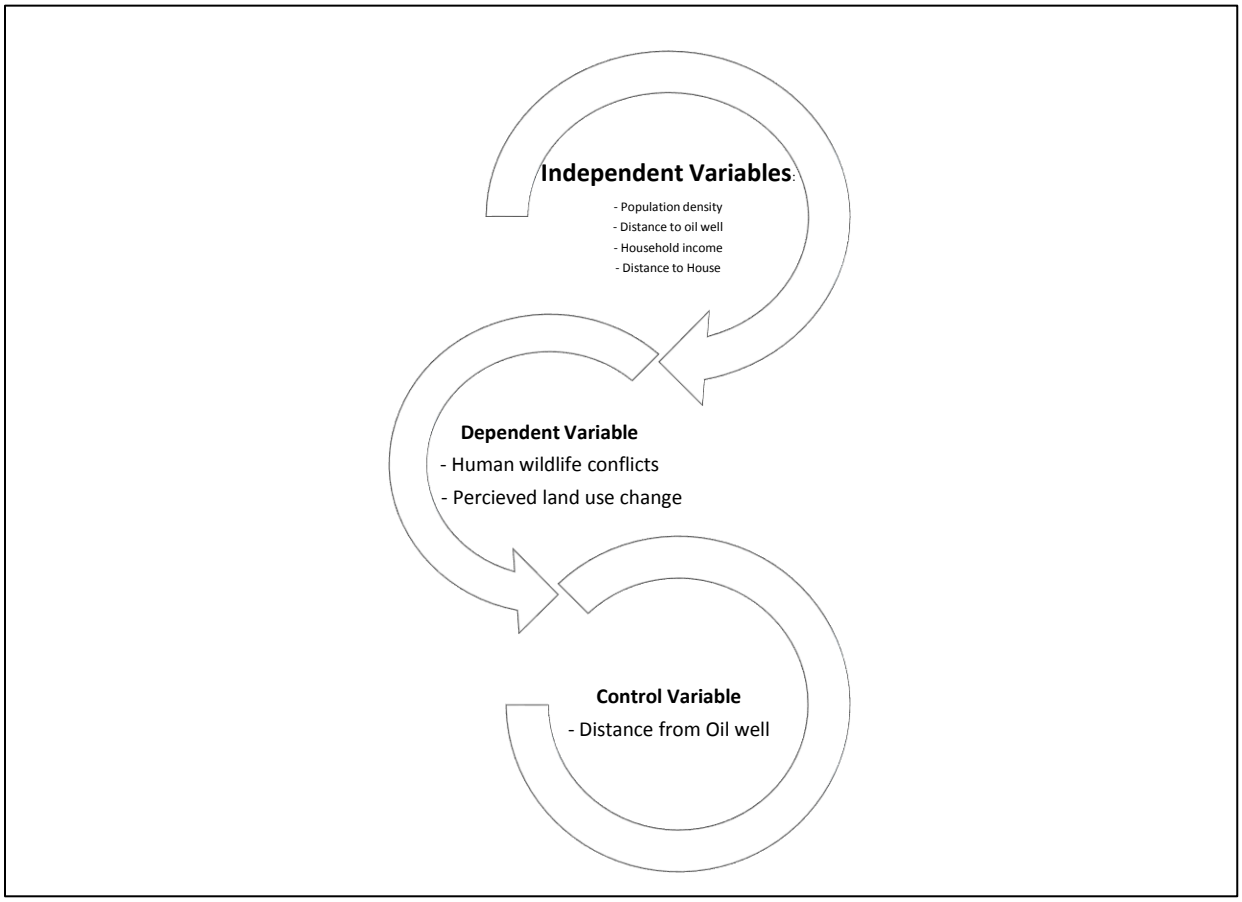

Figure 6: Interaction of process that impact the dependent variables

Independent variables are factors that can influence the frequency and intensity of human wildlife conflicts and interaction. Therefore, activities during oil exploration like drilling cause noise and vibrations which represent disturbance that was key to human wildlife conflicts.

The occupation of respondents, this was used categorically to check for relationships with changes to land use cover influenced by respondents work and its impact on human wildlife conflicts and interactions.

Population density, the rising population in each village due to oil exploration and development and forecasted opportunities in form of employment, and assets acquisition was vital to understanding the underlying factors causing pressure on available resources.

Distance from oil well and human wildlife incidents was used to measure the distance between human wildlife incidents from the sampled villages.

Household income, the different income generating activities before and after oil exploration and development are key attributes to standards of living which influence use of resources in proximity to the household.

Distance from house, this was used to measure the distance between the house and human wildlife incidents in relation to the location of oil exploratory drill sites in Murchison Falls National Park.

Dependent variables are factors that will be influenced by the independent variables. Especially the experienced land use and cover change by respondents.

Human wildlife conflicts and interaction, these come as result of independent variables influencing people's livelihoods and response of wildlife to changes in their habitats. This is recognized through damage of crops and property, loss of life, and conflicts with PA management.

Control variable

After considering the relationship between the independent and dependent variables in the three villages in proximity to boundary of oil well in the Murchison Falls National Park. This was done to find out if the relationship between human wildlife incidents and drill sites in park and the

distances between settlements/houses and drill sites. And how and why they were related and examine if the relationship was the same for all villages.

Distance from oil well, this was used to consider retreating of wild animals from oil exploratory drill sites in the MFNP. This is aligned with the working assumption, that the further the communities are from the oil well the less the human wild incidents in communities.

3.3.2 The research process

The research proposal development started with a desk review in Trondheim, where I reviewed different reports, journal articles, and newspaper feed with information on oil exploration and development in Uganda. However, selecting the area of interest was a bit direct since the research area was already predetermined to be in the Albertine graben.

Therefore, I had to choose a narrower area, and topic where I could apply the two or one of the methodologies I had acquired; GIS and quantitative methods. Based on the data reviewed especially the Sensitivity Environment Atlas, I found out that there was a gap on the impact of oil exploration and development activities on wild animals in MFNP because of the change in their activity ranges. Therefore, to contribute to covering the gap, I had to choose Buliisa since it was an area in the Albertine graben with oil exploration and development since 2006 but with less information published on human wildlife conflicts especially in areas close to MFNP.

During the developing of the proposal I sought guidance from my supervisor and co-supervisor. Later I was able to present it twice to fellow students, and their supervisors, and researchers at the Faculty of Natural Science for feedback. Their feedback informed my research design, and objective of study. After considering all their input and the gap to be covered by the study my objective was to find the association/relationship of the oil exploration and development activities with the human wildlife conflicts and interaction in Buliisa.

I travelled back from Trondheim on 30th August 2017, and short by a few days on schedule for research. Therefore, I immediately reached out to different organizations that I thought would provide access to data that will enrich my research study.

These included Makerere University Institute of Environment and Natural Resources (MUINER), the National Biodiversity Databank, Wildlife Conservation Society, NFA, CSF, Total Uganda.

However, my pursuit for spatial data for biodiversity distribution at MUINER led to being referred to WCS-Uganda, who were able to provide information on alternative routes for pipeline construct in Buliisa and informed me that they've been working on resettlement of people in Murchison Fall National Park landscape.

Therefore, through their Country Director, I was referred to CSF, Total Uganda, that were working on human wildlife conflict in Nwoya, and NFA for spatial data on landscape assessment.

After sharing a one pager project brief, I was advised to make consideration for a rapid assessment to check for existence of conflicts in Buliisa, and consideration of Nwoya as study area. This led to my next stage of doing a rapid assessment in the study area as elaborated in next section.

3.3.3 Rapid assessment/ reconnaissance trip

On 3rd to 6th October 2017, I travelled to Buliisa and payed courtesy visits to the relevant offices at the District, Ngwedo Subcounty, and Uganda Wildlife Authority in MFNP. This was meant to introduce myself as researcher from NTNU by using the introduction letters from NTNU and Makerere University, and a project brief to Natural Resources Office, make a formal request for access to their data on human wildlife conflicts and Interaction. Besides, I also had to do a rapid assessment after the courtesy visits, and its aim was to assess the occurrence of human wildlife conflicts and Interaction in villages in proximity to the boundaries of MFNP.

After reaching out to Wildlife Conservation Society, I was advised to consider Nwoya since they were elephant human conflicts, and they had doubts on existence of conflicts in Buliisa. However, after my visit to the UWA office in Murchison Falls National Park, and my engagement with Community Conservation Warden, she said they had crocodiles and hippopotami conflicts especially along Victoria Nile. She also informed me of the conflicts in Nwoya, though she mentioned that there was a court case that was filed by people against Total Uganda who believe oil exploration was a factor to fueling the elephant human conflicts.

This changed my research to Buliisa since the would-be study area in Nwoya was under a court case, and in order not to interfere with investigations and confronting hostile communities.

In addition, since no one or organization was sure of existence of conflicts in Buliisa, I was prompted to carry out a rapid assessment.

I was able to rapidly assess households through short interviews in Kilyango, Mubaku, Mvule Nunda, and Karatum, as well as District Natural Resources Officer and LC III chairperson of Ngwedo Subcounty. Natural Resources Officer consistently mentioned existence of conflicts instigated by crocodiles and hippopotami along the Victoria Nile due to the reports received.

However, he said in other areas conflicts might exist but since there are no reports he could not be sure. Based on the interview with the LCIII chairperson Ngwedo, he emphasized that besides crocodiles, and hippopotami, the villages close to MFNP had seen their crops raided by wild animals, and people had lost their lives to buffaloes.

This was enough to go further with rapid assessment on human wildlife conflicts in some households in 5 villages of Ngwedo Subcounty. The respondents confirmed that human wildlife conflicts and interactions existed, and involved deaths by Buffaloes, locally known as Empeeta in addition to foraging crops.

Further, respondents were asked about their preferred language, and they also gave their perception on human wildlife conflicts and interaction in relation to oil exploration and development. They were also asked if they had seen wild animals in their backyard, and their interaction with wildlife before and after oil exploration and development activities.

The results from the rapid assessment helped me to select the villages to consider for the study; Mubaku, Karatum, and Mvule Nunda. Further knowing the two most used languages and the impact it would have on the entire interview in cost and time I was compelled to consider local language proficiency as selection criteria for research assistants. The most used local languages were Lugungu, and Alur, very few people could speak English. Therefore. I reconsidered using assistant from Kampala to use those from Buliisa.

Through my network, I was able to get 4 research assistants from Buliisa, 1 female and 3 male who were familiar with Buliisa, and proficient with English, Lugungu and Alur (Figure.8).

Figure 7:The four assistants; Stellar, Ronald, Joshua, and Swaleh in Karatum (Photo: Author, 2017.10.23).

I was also able to control the challenge of accessibility to narrow and impassable roads to households in proximity to Murchison Falls National Park by changing from using a car to motorcycles. This also saved time, and cost on transport since it was more flexible and a bit cheaper than using hired car.

3.3.4 Open Data Kit software

The questionnaires were administered with the help of Open Data Kit (ODK) software, a free and open-source set of tools which helps to manage mobile data collection solutions. It gives provision for users to build a data collection form or survey questionnaire in excel format, collect the data using a mobile device and upload it to a server, then aggregate the collected data on a server and extract it in useful format for analysis in a preferred software (Figure.8).

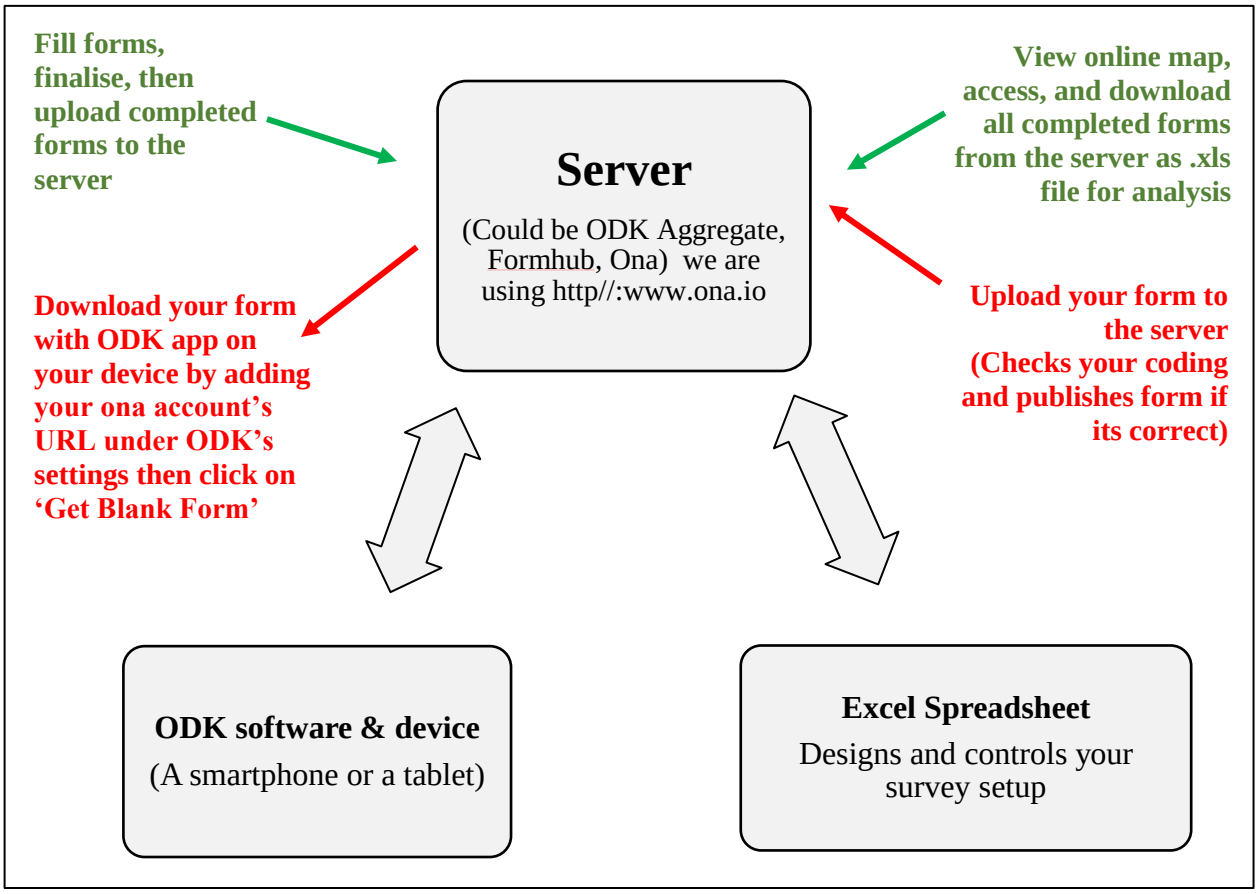

Figure 8:Work flow of ODK data collection tool and server.

Some multiple-choice questions were asked, other questions required respondents to agree or disagree on statements representing certain views, and some open-ended questions gave an opportunity to provide extra information. The questionnaire was retrospective in nature comparing status in 2006 and situation in 2015 (Appendix.1). Four interviewers were used for improved quality control and cost reduction.

The interviewers were selected from Buliisa to bridge the gap of language barrier. These were trained together to sustain a uniform standard while taking advantage of the reduced cost of training interviewers for a long time (Figure.9).

3.3.5 ODK training workshop

From 16th-17th October 2017, I facilitated an ODK training workshop from 9am to 4pm, for the four research assistants at Adonia hotel in Buliisa. The assistants were familiar with the study area specifically Buliisa. This was attested to by their work with World Vision where they had carried out household surveys in Biiso, the upper part of Buliisa.

The aim of the workshop was to familiarize the research assistants with the research project objectives, build their capacity in using ODK with help of tablets, and introduce them to the field routine.

During day one of the workshop I was able to give an elaborative field work description to the assistants, this included the does and don't, specific skills like presentation, and probing to mention but a few, risks and how to overcome them. Further, introduced the project, its aims, why it was interesting like the opportunity to see nice landscape and meeting interesting respondents, the outcomes like maps for location of conflicts, and what the assistants would learn from the project like the use of ODK with help of smart devices.

Further, taught them how to use ODK and the tablets, and online forms as elaborated on Figure.7. After, we reviewed the questions that were answered by the interviewees, this was to get a clear understanding of the requirement for each question by the interviewers.

Later, I grouped the assistants in pairs (interviewer and interviewee) to have a hands-on experience with ODK, this was aimed at estimating the time an interview would take, and the ability of the respondents to translate the questions in a consistent and diverse manner.

After, we had a session of questions and issues arising to cater for questions that were hard to interpret, like What factors have been influenced by oil development in your community? This was a bit hard to understand, so it was reframed to; What activities or changes have you experienced because of oil exploration and development in your community? This made it clearer

for the assistants and framing it to their respondents for response in local languages was much easier.

On day two, there was an opportunity for the research assistants to test the questionnaires amongst themselves with emphasis put on introduction of project to interviewees and getting an informed consent from them (Appendix.1)

.

Figure 9: Research assistants taking part in role play during the ODK training workshop (Photo: Author, 2017.10.16).

Therefore, they had a bit of role play to simulate the field's environment between the interviewer and interviewee (Figure.9). This was done in two local languages as one assistant translated for me every response in English to check if the questions are not altered. After, I gave them an elaborate field routine, that showed what to do before, during, and when they came back from the field. Further informed them of the importance of time management and steps to follow when back from the field, and data upload. This was because, I needed to review all saved questionnaires before they were uploaded to the server as elaborated in next section.

The two-day workshop ended with discussion and clarification on anything the assistant found a bit unclear during the workshop. The workshop created an opportunity for me to know the assistants a little more during the breaks, and their responses after the presentations.

3.3.6 Sampling of households

During the reconnaissance trip to the study area, I carried out random interviews for local people in five villages; Mubaku, Kilyango, Karatum, Mvule, and Mvule Nunda to assess their knowledge on human wildlife conflicts and interactions, as well as changes in land use cover in relation to oil exploration and development. The responses from the rapid assessment showed existence of human wildlife conflicts and interaction in their communities. Further, it gave me an opportunity to design a sampling method based on the set up of the settlements.

Purposive sampling was preferred, and respondents were deliberately chosen because of their knowledge and experience based on the involvement and interaction with wildlife, and prevalence of human wildlife conflicts in their communities. In addition, their willingness to participate, and ability to communicate their experiences, and perceptions in an articulate, expressive, and reflective manner (Palinkas et al., 2015). Therefore, purposive sampling was more realistic than randomization in terms of time, effort and cost needed in finding respondents.

The study in the end covered three villages; Mubaku, Karatum, and Mvule Nunda in Ngwedo Sub county, and the respondents were sampled by village. The village differ as regards to proximity to the oil well and shared border with Murchison Falls National Park. This was because the study sought to find a spatial association between human wildlife conflicts and interactions with oil exploration and development activities.

Purposive sampling/ judgmental sampling is based on judgement of researcher when considering a representative sample. This sample represents typical units and must be under investigation (Bless, Higson-Smith, & Kagee, 2006 and Tongco 2007)

The sampling criteria considered; a) distribution of households in each village to avoid getting the same responses from clustered households and to get a representative coverage of the sampled villages, b) accessibility to the villages to get the best means of transport to reach the households.

Further, people's consent and approval of research was quite important to build rapport and trust to collect information from our respondents, and c) the time of the day was also important since crop cultivation is a dominant activity in the sampled villages therefore, respondent had to be reached after the days' work in the field. Some villages had quite several households yet others like Mvule Nunda had slightly above 50. Therefore, those with more like Mubaku and Karatum had more representative samples drawn (Table.1).

Table 1:Population of study area by village, households, and sex (UBOS, 2011).

Sub County	**Village**	**Households**	**Female**	**Male**
Ngwedo	Mubaku	151	341	389
	Karatum	131	202	148
	Mvule Nunda	50	133	126
Total		**332**	**676**	**663**

In the study a household refers to a group of persons who usually eat and live together. In addition, a household may be comprised of one or more persons provided they share the same meal and sleep under the same roof (UBOS, 2017). The persons may be related usually in a family setting or may not be related. Further the head of the household is normally a primary income earner, who was either a father, mother, or grandparent. In absence of the head of household, we considered any member of the household as a respondent at an eligible age of 27 to 70 years of age to be interviewed based on the study.

Some villages had less households sampled due to limited time, resources, and distribution purposes meant to have a representative sample. For example, in Mvule Nunda, the village had less households (Table.2), therefore 64 households were sample. Nevertheless, this was close to average, and was compensated for in Mubaku, and Mvule Nunda that had more households.

Table 2: Representation of sampled household and respondents in respective villages.

Village	**Households Sampled**	**Female respondents**	**Male respondents**
Mubaku	76	39	37
Karatum	75	48	27
Mvule Nunda	64	33	31
Total	**215**	**120**	**95**

3.3.7 In the field

Access to the study area was granted on presentation of introduction letters from Makerere University and NTNU to the Natural Resources Management office at Buliisa District Headquarters, and Ngwedo Sub county LCIII Chairperson's office. Further, the latter requested the LCIs to mobilize respondents their respective villages prior data collection. Nevertheless, the leaders at local council were facilitated with fuel and airtime to inform the people in their villages about students coming to do a research survey. This enabled us to have access to respondents and interact freely during the interviews.

An appropriate time for field work was selected since the three sampled villages of; Mubaku, Karatum, and Mvule Nunda in Ngwedo Sub county predominantly thrive on agriculture. Therefore, we had to see our respondents after their work in the fields. That is why all interviews almost started at 11 am, and on average every research assistant was meant to do 5-6 interviews, and where they felt a bit unwell, or angered as well as insecure they had to stop for the day. However, throughout the data collection process, only one assistant felt a bit sick and had an early day off but still this did not affect the collection since each village was allocated 2 days.

Each day's work started at 8am with a meeting at the guest house to give feedback on the data collected by research assistants. And to make clarification on the collected data with queries after review before it was uploaded to the server. This was the time to share common mistakes and how to overcome them based on the review of questionnaires saved by every assistant. In addition, there was viewing of the map to show the extent covered by every assistant to guide them when moving on the second day in the village.

After, we had breakfast at 9am with a chat on the challenges and other questions that assistants had as well as sharing interesting field experiences. By 10.30 am, the entire team inclusive the motorcyclists that made a team of 10 people received information on which village we were to head to.

By 11am we were always at a selected village and when at the village of interest, I engaged the assistants on how to sample the households to be considered for interviews based on the distribution of households, and other challenges like absenteeism, irresponsiveness by certain respondents.

Each day of the survey, I accompanied a given research assistant to assess their presentation, response to multiple field challenges, and note where they might need immediate help (Figure.10). I also had an opportunity to carry out a few interviews with the assistants as interpreters.

Figure 10: Ronald interviewing a respondent living close to MFNP in the background (Photo: Author, 2017.10.19).

The assistants had packed lunch and a liter of water to reenergize themselves since the process was energy demanding, and it was hot with an average daily temperature of 29 °C.

At 5 pm the respondents were always informed to be doing the last interview since that was the time agreed for the end of the day's work. The motorcyclists picked the respondents from the field and returned them to the guest house where we were accommodated. I received the tablets and requested for quick feedback if any and could not wait for the next day.

From 6 pm to 7:30 pm, I reviewed all the survey questionnaires that were saved to check for inconsistence of responses, spelling mistakes, meaning of certain fragmented phrases, altered household identification numbers, and the extent covered by the assistants in the field by viewing the map with location of households.

3.3.8 Analysis of livelihood asset assessment using SPSS

Data analysis was done by analyzing descriptive statistics while employing tools like charts, distribution tables, graphs and tables using SPSS. Also, inferential statistics like cross tabulation, Pearson's correlation, coefficients, and factor analysis tests were obtained from the study variables to illustrate the net effect of the oil and gas exploration on these variables.

A cross tabulation was carried out to assess the relationship between the mentioned variables. The aim was to explain the spread and irregularities of the data. In addition, row and column marginals and percentage frequencies will be used to check for patterns (Bryman & Cramer, 2011).

Further, a correlation was done to check on the strength of the relationship between variables. In addition, scatter plots were used to illustrate the direction and strength of the relationship of variables in question (Bryman & Cramer, 2011).

The data analysis aligned the data collected with the research objectives and resulted in useful conclusions and recommendations for the research study.

3.4 Methodology of analyzing Human Wildlife Conflict patterns

3.4.1 Geographic Information Systems

GIS refers to a computer system for capturing, storing, querying, analyzing, and displaying geospatial data. Geospatial data describes both the location and attributes of a spatial feature (Chang, 2016).

To analyze the spatial pattern of human wildlife conflicts and interactions, ArcGIS was used to create layers from secondary data from different open source platforms. Further, primary data captured and other aggregated data from institutions that work with conservation has been added.

The Generate Near Table and Near tool for ArcGIS were used to measure the geodesic distances from points representing human wildlife incidents, and nearest point to the park boundary. Later, the geodesic distances of points representing human wildlife incidents to the oil wells in the park were calculated. Lastly a statistical test was carried out to check for significant difference of the mean considering, human wildlife incidents in 2006 and 2015, and variables for distance; distance to oil wells in the park and distance to park boundary.

3.4.2 Acquiring spatial data

The access to spatial data was done in two ways. First, I used credible open sources for spatial data and these included Open Street Maps, Protected planet database, Data energy GIS-open data, and DIVA. These did not require any form of registration, I accessed data through their websites by specifying the country, and category of layer that I wanted. The queries made on the open source websites like administrative layers to village level, and land use cover.

Secondly, I obtained data formally by putting in a request for access to spatial data to organizations mandated to do spatial assessments in Uganda like Uganda Bureau of Statistics, National Forest Authority, and Uganda Wildlife Authority. In addition to spatial data I was able to get aggregated data too to enrich the analysis.

3.4.3 Data processing

After acquiring the data from open source, using ArcMap 10.4 I created a file geodatabase for the research project and imported topologically correct shapefiles of Uganda. These included one for Villages, Sub counties, and Districts. I was also able to transfer layers from other geodatabases in ArcCatalog 10.4 from my earlier project work about Uganda. After, I created subsets of the areas of interest with clear boundaries, and these included one for villages; Mubaku, Karatum, and Mvule Nunda, Ngwedo Sub county, and Buliisa district. All these were exported as feature classes and stored using geographic coordinates (GCS WGS 84) as stored coordinates. This was done to clearly establish the line features that outline the study area and its neighbors. The primary data in form of GPS coordinates for human wildlife conflicts and interaction collected from the field was exported along with the other data from ONA server in an excel format. Later, the GPS data was disaggregated from other data for preparation before it was imported in ArcMap 10.4.

The GPS data collected for households was used to make a point feature using the tool make XY event layer found in ArcToolbox. I set the spatial reference to the WGS84 datum using a geographical coordinate system (GCS), I also set the layer properties to show the displayed map layers as GCS to avoid the points to be offset from the map. After I stored the point feature layer as a permanent shapefile feature class.
After I created another feature class for human wildlife conflicts and interactions using the GPS coordinates captures by research assistants in the different villages for 2006 and 2015. Using the same procedure as above, I stored a permanent layer as shapefile feature class.

A feature class layer for location of exploratory oil wells (drill sites) in Murchison Falls National Park was also created using coordinates obtained from an updated map at USGS on 14th March 2017 at 10.00am East African Time. These could not be obtained directly using the GPS, as the area was restricted.

Further I used the select tool and selected human wildlife incidents that took place in 2006 and 2015. Later, I created subsets of permanent feature class layers representing the data and stored it in the file geodatabase for the research project.

The fields were joined based on spatial location to easily calculate distances from the human wildlife incidents to the households if one has "from" coordinates (human wildlife incident) and "to" coordinates (household locations) in the same attribute table. The "from" coordinates already existed in the human wildlife conflicts and interaction dataset and "to" coordinates I got them from the shapefile dataset of households.

Lastly, I used the near tool in ArcGIS 10.4 to calculate the distance of human wildlife incidents from the households, and the distance between human wildlife incidents for 2006 and 2015 from the three oil exploratory wells/ drill sites in Murchison Falls National Park.

3.5 Human wildlife conflict pattern analysis

The layers created were analyzed to show patterns of human wildlife conflicts and interaction in the three villages and Murchison Falls National Park.

The visual outputs in form of maps enhance the qualitative outcome and foster better understanding of the proximity of occurrences. This is will be vital for planning and can be used as baseline data. In addition, the spatial analysis concretized the outcome drawn from the interviews.

3.5.1 Measurement of distance

Using Generate Near Table and Near tool, geodesic distances were calculated from points representing human wildlife incidents to the park boundary and the nearest oil exploratory wells/ drill sites in Murchison Falls National Park respectively. Further, the Alter Field tool was used to rename field to a more appropriate name like distance to park and distance to drill sites.

In addition, I calculated geodesic distances from points representing human wildlife conflicts and interactions to the houses. The features used were stored using geographical coordinate systems, and those not stored in GCS, I used the tool Project to project the feature classes to GCS WGS 84.

3.5.2 Arithmetic means of the distance measures

The arithmetic means for the human wildlife incidents in 2006 and 2015, for the two distance measures, and their standard deviations for the human wildlife incidents in 2006 and 2015 for the

two distance measures were calculated. This was with the help of the statistics function available from the drop-down menu when you right-click on the column headings in the attribute table.
With all distance measures for 2006 and 2015 as considered time for the human wildlife incidents. All I needed were the means and standard deviations for each of these. This involved selecting them before calculating the statistics and taking note of the count, mean and standard deviation.

3.5.3 Distance to oil well and household assessment

Statistical representation of the relationship between distance of exploratory oil wells/drill sites and human wildlife incidents for 2006 and 2015 in the villages of Mubaku, Karatum and Mvule Nunda.
This involved doing a statistical t-test to check whether the mean differences are significant. A comparison of human wildlife incidents for 2006 and 2015 was done for two variables; distance to oil wells in MFNP and distance to households/houses.
However, to perform the test I formulated a null-hypothesis; H0: there is no significant difference between the means, and the selected a level of significance at $\alpha = 0.05$, identified degree of freedom, used a t-table to find the critical values (tc). For example, if df > 120 use the row for infinity. If 60 < df < 120 use 1.99 as critical value.
The observed t-values (to) was calculated using the formula below. The difference between the means makes up the numerator, and the amount of variation within and between each of the two groups makes up the denominator.

$$t_o = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left[\frac{(n_1 - 1)\, {s_1}^2 + (n_2 - 1)\, {s_2}^2}{n_1 + n_2 - 2}\right]\left[\frac{n_1 + n_2}{n_1 n_2}\right]}}$$

where $\bar{X}_1 - \bar{X}_2$ is the difference in means between two subsets (as we use a two-tailed test, we use the absolute value), ${s_1}^2$ and ${s_2}^2$ are the variance for the two subsets, and n_1 and n_2 are the number of events in the two subsets.
In conclusion, if to > tc reject H0 then there is indeed a significant difference, and if to < tc keep H0 then there is no significant difference.

3.6 Human wildlife conflict zones

The conflict zones represent the areas that are susceptible to human wildlife conflicts and Interaction. This is where; loss of life, loss of property and crop damages are represented with a buffer zone of 500 Meters around each human wildlife incident. The section also presents a trend of human wildlife incidents from 2006 to 2017 to examine the association of the trend with oil exploration activities. The trends of human wildlife incidents and maps show information relevant for PA management, and other bodies especially those responsible for compensation of residents and furthering their concerns on existence of human wildlife conflicts and interaction in the communities.

3.7 Nature of data and validity

Generalization, as a way of reasoning and drawing broad conclusions based on instances. e.g. the change in landscape under certain impact factors like drilling oil and associated noise and vibrations might affect utilization range for animals. With this research inference can be made on other areas with same landscapes as the research area in the Albertine graben (Polit & Beck, 2010).

Validity and reliability, the instrument selected to extract and analyze data can consider all aspects set to meet the objectives. The use of a well-structured and specific questionnaire assures reliability since when the same information is used consistent data will be collected. However, since the research focuses on changes using the questionnaire would give different result due to change in time scale (Heale & Twycross, 2015). Based on 216 surveys done, the questionnaire on ODK data collection tool was able to collect consistent results as per the questions raised to the respondents. In addition, the tool captured GPS data and images to support spatial analysis and consolidate qualitative results of the study respectively.

As the assistants collected data from different households the people were quite responsive and willing to participate in the study. This was mainly attributed to assistant's ability to introduce the research project, its aim as a study and to the people in the area and their relations with the PA management, and most importantly emphasizing confidentiality as well as the choice of the respondent to stop the interview at any moment they felt uncomfortable with what was asked or due to urgent matters that required their physical presence. Although we did not mention giving a

Kilogram of sugar or its equal in shillings as token to respondents after the interview, they were willing since the questions asked were pertinent and the kind of inquiry had not been done in the sampled villages.

However, a few household heads were not able to take the interview due to their households not having people above 29 years, others had just moved into the sampled villages, and the rest were not settled due to household problems. Nevertheless, this did not affect the number of respondents required for the study as well as sampling method since in some places the households where clustered, and the alternative households was always approached, and for scattered household a later time was sought.

However, to limit low response we chose the time for interviews to be after respondents were back from the field at 11 am, so most were interviewed while preparing their meals, and peeling food. In addition, the mobilization made by the LC III Ngwedo Sub county and LC Is of Mubaku, Karatum and Mvule Nunda of the chairperson made the respondent aware of the household survey, and they were expecting assistant to come and interview them.

3.7.1 Limitations of the study

Insufficient data due to gaps, especially as the database for human wildlife conflicts was not up to date, hence leading to comparison of data for 2006 with that of 2015. Even at UWA, the data on conflicts as far as 2000 to date was missing with few cases reported. This left the study with less baseline information.

Seasonal bias, cloudy weather, and erratic rains occasionally interfered with data collection especially for GPS data collection, cloudy weather reduced their precision and much time was used to record stable points. Further, the feeder roads to respondents' houses were impassable due to splash floods, and narrow nature along the boundaries of crop fields. This slowed down the research assistants and imposed a high energy requirement since the research assistant had to go by foot. However, to reduce the distance covered we used motorcycles to reach greater distances.

Recall bias this reduced the number of human wildlife incidents GPS data collected since respondents could not recall the exact locations of some incidents.

In addition, certain areas were inaccessible since they had grown into thickets overtime. And the use of high resolution imagery for the 3 villages to digitize human wildlife incidents location was too costly to consider for the study. Therefore, only accessible location data was registered and used for the study.

Gender bias this was contributed to by the nature of societies. Most Ugandan societies are patriarchal hence getting the view of females amidst their male counterparts limited the number of female respondents taking part in survey. However, this was not significant enough to affect the number of respondents by sex.

Reliance to respondents' self-reporting and not directly recording actual incidents of conflict might have led to exaggeration of loss by the people. However, the many surveys done reduce the systematic bias that would have been made (Karanth, Gopalaswamy, Prasad, & Dasgupta, 2013).

3.7.2 Ethical conditions

As a researcher, my judgment was that consent of respondents should be out of their will, and it should not only be requested at the start of the interview but throughout the entire process. This was meant to ensure that respondents decided to take the interview immediately, or after some advice based on information of the survey like who's conducting research, subject and coverage of interview, information giving being voluntary, confidentiality, and why the interviewee was selected (Lewis & Graham, 2007).

In addition, different methods of communication were used before survey like, community mobilization by local council leaders in the 3 sampled areas was considered to make people feel safer and make the survey legitimate. Notably, appropriate, and natural interaction with interviewees / respondents was also considered, while keeping the questions relevant and coherent. The conditions above were aimed at sustaining honest and protecting integrity while upholding academic values

3.8 Chapter summary

In summary, the chapter introduces cross sectional survey design adopted to assess association of human wildlife conflicts and interaction with oil development activities. Further, exposes the tools for data collection like the ODK data collection tool and defines how purposive sampling was done for the 216 households. The method selected was based on the assessment to be done on the data collected, these included, questionnaires, and tablets with GPS and GLONASS to collect spatial data for assessment of human wildlife incident patterns. Further, it elaborates on the use of data collection tools. The same chapter introduces the variables of the study and defines them.

Gives a detailed description of field procedures, and all other activities done prior field work like reconnaissance trip, ODK training workshop for research assistants, and data access from different organizations. The chapter also examines the different methods for analyzing human wildlife conflicts and interaction, like SPSS, spatial analysis using ArcMap 10. The chapter closes with the nature of data and validity, limitations to the study, and ethical aspects.

CHAPTER FOUR

4.0 ASSESSMENT OF HUMAN WILDLIFE CONFLICTS

4.1 Introduction

This chapter explores the relationship between oil exploration and development with human-wildlife conflicts. This chapter also assess people's perceptions on human wildlife conflicts and interactions in proximity and away from the oil field with the help of interview data.

4.2 Human livelihood assessments

During the survey, the respondents were asked their primary language used in the household, this was meant to ascertain if they were immigrants from neighboring communities of Alur, Okebo, Lugbara, Bakiga, and Banyarwanda to sampled villages in Ngwedo Subcounty. The areas of study were predominantly occupied by the Bagungu but, over 81 % and 71 % of the households interviewed used Alur and Lugungu respectively in addition to other languages (Figure.11). This meant that over time, the Alur had migrated to Ngwedo where there is land to support agriculture.

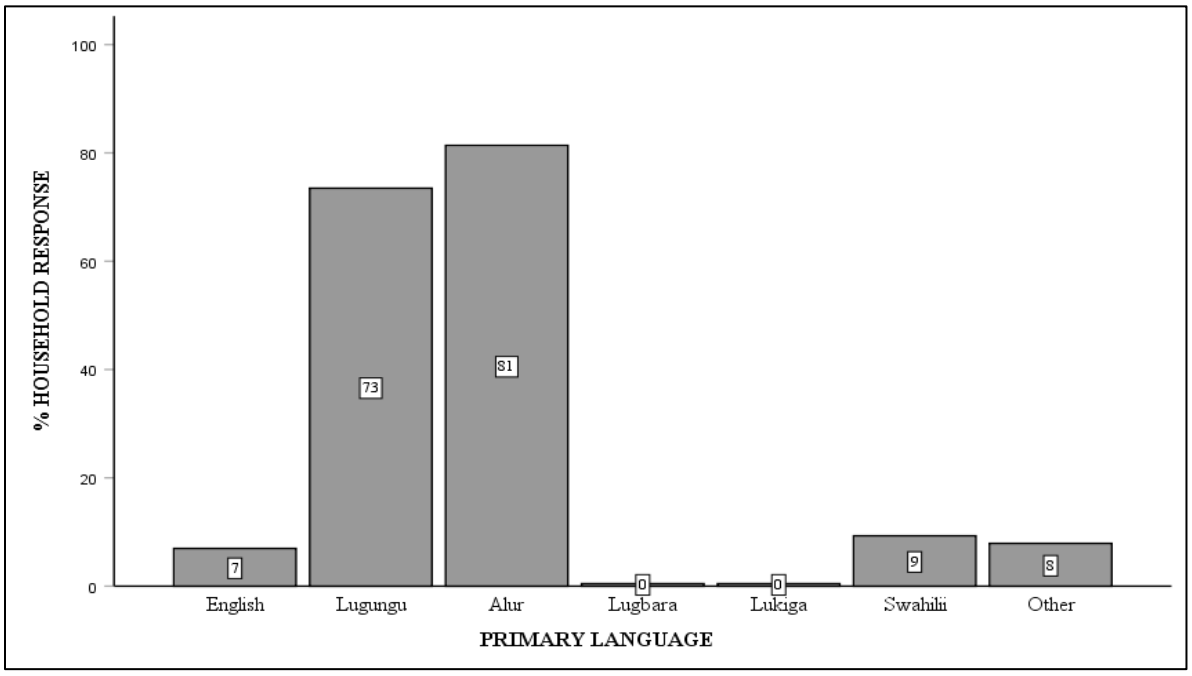

Figure 11: Representation of primary language used in a household

4.2.1 Ownership of household

The study considered the ownership of the house and land, and was categorized as owned, rented, and other forms of ownership. Of the 215 households considered for analysis from the survey 89 % own their land and houses, and 5 % rent their houses leaving the 6 % with other kinds of ownership like inheritance. With a greater number of respondents having permanent homes, their influence on how to use and protect their land essentially determines their survival.

4.2.2 Major source of household income

In the study area, 97 % of the respondents practiced subsistence farming. The percentage respondents getting their income from livestock was 1.4%, and 1.4% had main income from other activities like carpentry, security, burning charcoal, and leadership at local government.

None of the interviewees were employed in the oil industry or related activities. Farmers predominantly earned a living through subsistence farming, which involves growing crops like cassava, millet, cotton, sim-sim, ground nuts, and maize among others. The cassava is mainly dried on the surface, and later ground into flour that is sold, and rest is used as food.

The infertility of the soil was of great concern and most of the respondents attributed it to oil exploration activities which involved blasting certain materials while others attributed it to the low rainfall. The deterioration in fertility of the soils was evidenced with rotting of cassava, and sweet potatoes. However, according to the State of Environment Report for Buliisa District, deterioration in soil fertility and crop yields is generally attributed to cultivation practices like mono-cropping. This has led to soil exhaustion, and application of agricultural chemicals such as pesticides, herbicides, and acaricides that pollute the soil. This has made farmers resort to fallowing of their land (NRO, 2016). Nevertheless, this remains a point of discussion on the most profound cause for the deterioration of soil resources in three villages.

4.2 3 Employment opportunities and income for households

The respondents were asked whether they had experienced more employment opportunities or income due to the oil and gas exploration and development activities.

People's experience with employment opportunities and income did not differ so much as respondent agreed to no change in employment opportunities and income with a 45 % and 41 % response respectively. (Figure.12). However, they were more responses on increased employment opportunities compared to income with 45% and 33% respectively. This means that more expected a decreased income compared to fewer employment opportunities represented by 24% and 7% respectively

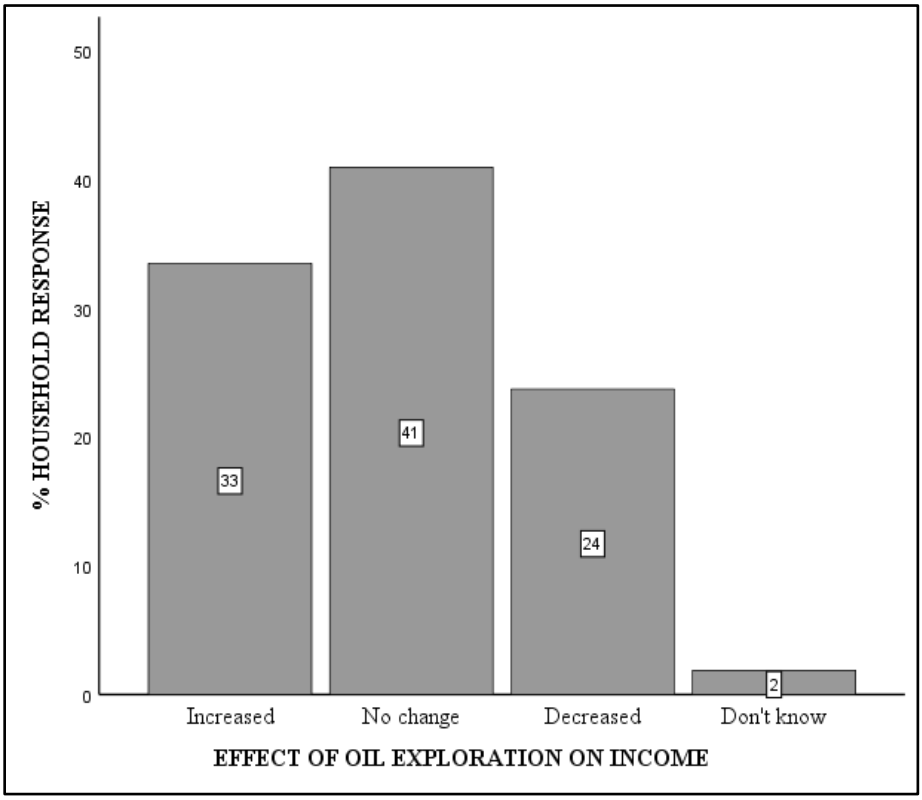

Figure 12:Representation of respondents' experience on income due to oil exploration

4.3 Oil exploration and development

The respondents were asked about what kind of changes they had seen due to oil exploration and development in their communities. Of the 215 respondents, 104 (26%) responded that it has led to infrastructural development like health centers, settlement camps, waste consolidation sites, and improved roads. Ninety-four (24%) associated it with increased human wildlife conflicts, 85 (22%) with improved employment opportunities like casual labor, 82 (21%) other changes, and 30 (8%) in migrations.

The Other category on the negative side were; Soil exhaustion and poor yields, land grabbing, Increased poverty, high prices of products, opening of feeder roads, noise from machines which could scare animals hence pushing them further to people's homes, displacement of people, low compensation for the land set for oil activities. On the positive side, a few respondents acknowledged improvement of the standards of living as they have managed to get money from oil activities like casual labor, and others received compensation on land which enabled many people to pay school fees for their children. Further, an increase in household income, and market for their farm produce had been experienced. These represent positive responses to people's experiences with changes due to oil exploration and development.

4.4. Human wildlife conflicts

The exploratory drilling in sensitive ecosystems like MFPA has come under criticism from environmental organizations and residents in communities adjacent to the drill sites due to possible negative environmental impact of the activities. The EIAs carried out by consulting companies have covered impacts like pollution, noise, and vibrations as well as feasible mitigation measures. However, human wildlife conflicts, and interaction was undermined and not considered as a concern (BIMCO, 2009).

Since inception of oil exploration and development in 2006 local people have experienced human wildlife conflicts and interaction. This is delineated by the trend of human wildlife incidents from 2006 to 2017 (Figure. 15). And evidenced by occurrence of damages to crop, property, and threat to lives of local people living close to protected areas that have exploratory drill sites especially in the farming communities of Mubaku, and Karatum in Ngwedo Sub county.

An interview with Juma Muhamad, head of rangers in MFPA, made profound the limited data on human wildlife interactions outside the MFNP and its buffer zones.

"…our concern is mainly to do with animals in the park and the problem animals, the mandate for handling vermin lies with District vermin control so we mainly collect data on poaching, animals killed, and arrests", Juma Muhamad.

Statement made by the head of rangers, confirms what people have experienced overtime in this study. This refutes the assertion made by UWA community conservation warden at Paraa office that human wildlife conflicts and interactions that were recorded had no association with oil exploration and development activities with communities bordering the Murchison Falls National Park where drill sites had been established. This was solely based on self-reporting to the UWA office by the people in the community. Besides, self-reporting might not be a reliable source of information when a human wildlife incident involving death of a problem animal is shadowed by fear of sanctions to the local people by PA management. In addition, the fact that there is no compensation directly apportioned to the households as result of damages is a demotivation to the local people.

The 215 respondents in Mubaku, Karatum, and Mvule Nunda, were asked if they had experienced an increase, decrease or no change to human wildlife conflicts in their communities in 2015 compared to 2006. In 2015, 55% of the respondents had experienced a decrease, 33 % an increase and 12 % had not seen not any change in human wildlife conflicts in their community (Figure.13).

Contrary to 2015, the respondent had experienced more human wildlife conflicts in 2006. With 179 respondents recalled having experienced an increase, 23 no change, and 13 a decrease in human wildlife incidents.

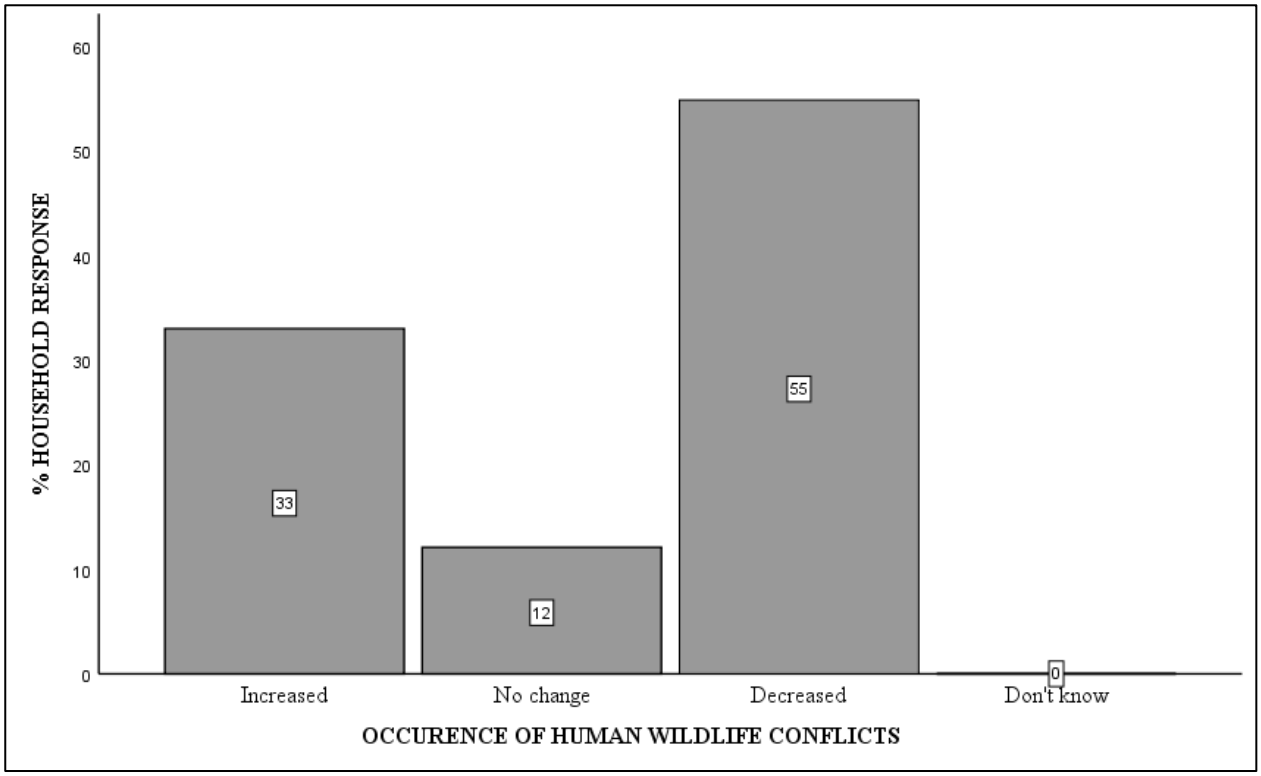

Figure 13:Occurrence of human wildlife conflicts in 2015.

This decline in conflict level was explained by respondents and attributed to reduced activity by oil companies in 2015, more engagement with PA management to control wildlife escapees from the parks to adjacent communities, and community conservation initiatives.

4.5 Human wildlife incidents

In the research study a human wildlife incident refers to an occurrence of interaction between humans and wildlife at a given place in time leading to loss of lives (of people and livestock) and damage to property and crops.

4.5.1 Wildlife beyond borders

To know the wildlife responsible for the interaction with human, the respondents were asked if they had seen the following animals around their homestead; Monkey(s), Baboons, Chimpanzees, Elephants), Antelopes/kobs, Buffalo(s), Wild pigs, Rodents; rats, squirrels, Lion(s), Hippopotamus or any Other.

Out of the 215 respondents, 183 had seen Wild pigs, 175 Baboons, 170 buffaloes, 91 monkeys, 82 Elephants, 50 Lions,36 Hippos, 35 Rodents, 15 Antelopes, and 3 had seen other wildlife with in the surrounding environment of the household. (Figure.14).

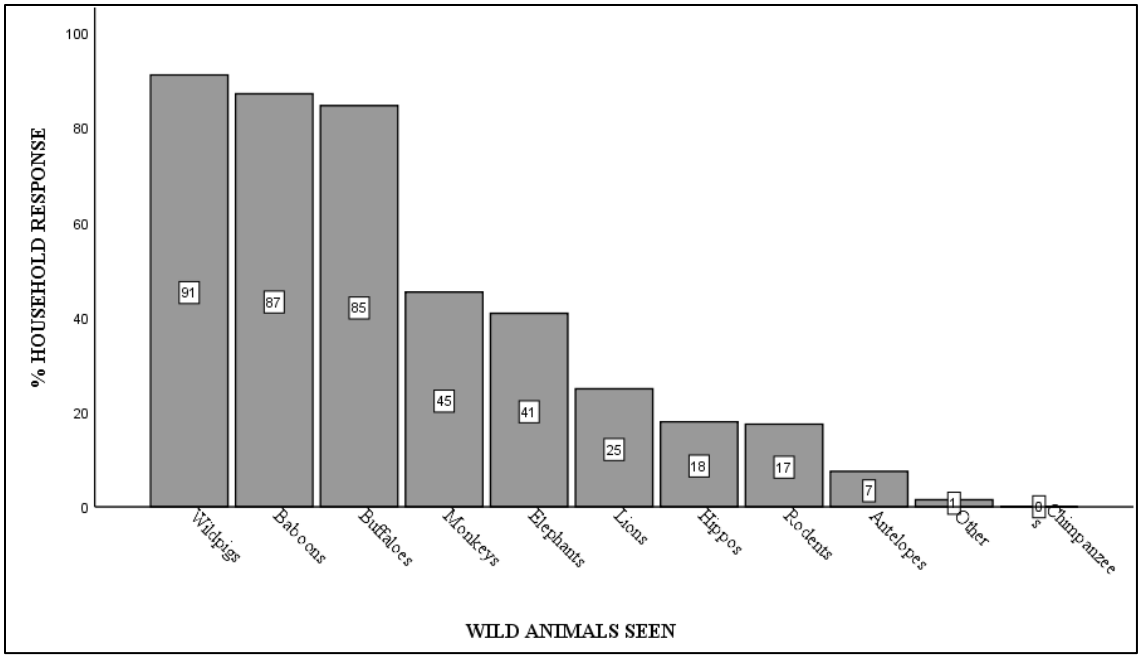

Figure 14:Percentage response from surveyed household on wildlife seen in their backyard.

The most common human wildlife incidents experienced by respondents were, crop damage by wildlife, injured domestic animals, threats to people by wildlife, kills by wildlife, kills of wild animals by people, and retaliation between people and UWA, and other. Referring to 2006 only 16 respondents had then experienced such incidents, whereas 43 had experienced this in 2015 (for more details see the next chapter).

In 2015 the respondents saw more crop damages, and threats to people by wild animals with 30.2% and 28 % of responses respectively compared to other incidents like, 19 % kills by people, 14% injured domestic animals, and 9.3 % kills by the wildlife in order of responses to the seen incidents.

4.5.2 Human wildlife interaction

The respondents were asked how they interacted with the wildlife in 2006 before oil exploration. They had experienced rampant crop damages, loss of livestock, and people lost their lives to wildlife like hyenas and lions. In retaliation local people killed wild animals that threatened their lives and destroyed their crops and others used to eat game meat. To control the human wildlife interactions, people used to stay out all night guarding their crops and planted sisal to guard their crops from wild animals. Some people also abandoned their farming areas since they could easily be damaged by wild animals. The local people also engaged park rangers to take problem animals and chase other animals. There were further engagements through communal sensitization and information dissemination especially on dangers of wild animals, how to deal with them, and their movement from PA management. And more information was delivered timely incase an escapee animal from the park.

The respondents were asked how they interacted with wild animals after oil exploration had started. Many had experienced crop damages and even loss of people's lives and in retaliation they killed the animals. Further threats to people's lives forced them to relocate. This was because the rate at which animals damaged crops had increased over the years. Nevertheless, the local people shared information with the PA management about the wild animals that crossed the park boundary. In addition, local people set up of fences to control crop raids, and others deserted their gardens to grow crops far away from conflicts zones. PA management educated people on importance of park and how to protect themselves from conflicts and sensitized them on the impacts of poaching and distance to establish houses from the park. The local people received extra financial help especially widows and other people to pay school fees for their children. In addition, the boundary of the community and PA were clarified, and groups were created to benefit from 20% revenue sharing scheme.

4.6 Chapter summary

The chapter presents the results of the study in order of the assessments made and based on the results, the most used language in the surveyed households was Alur followed by Lugungu. Most of the houses where owned and a few were rented. The households surveyed earned their income through agricultural production especially, subsistence farming and a bit of livestock.

The respondent experienced an increase in employment opportunities, however, most experienced a reduction in the income in the face of oil exploration and development. Nonetheless, many have experienced infrastructural development like improved roads and health centers.

The people's experience on human wildlife incidents showed an increase in 2015 compared to 2006. This was attributed to interactions like foraging of crops, loss of life of people and wildlife, among others. Wild pigs, baboons, and buffaloes ranked high on the most seen wildlife in the households' backyard as well as in terms of impact on communities' livelihood.

CHAPTER FIVE

5.0 ANALYZING HUMAN WILDLIFE CONFLICT PATTERNS

5.1 Introduction

This chapter represents the results obtained by using geospatial data to further analyze human wildlife conflicts patterns. This was done in three ways; measurement of distances from human wildlife incidents to oil wells in Murchison Falls National Park and houses, arithmetic mean of distances, and statistical representation of distance of oil well and human wildlife incidents in 2006 and 2015. Lastly a representation of conflict zones based on the data collected during the household survey closes the chapter.

5.2 Human wildlife conflict patterns

According to the process-pattern principle, one expects a relationship between processes like exploratory drilling and the patterns of human wildlife conflicts and interactions. In a way, these processes are associated with noise and vibrations that are likely to create, modify, or maintain the pattern of human wildlife conflicts. In return a pattern will constrain, promote, or neutralize the process (Li & Wu, 2004). For example, the association of oil exploration and development activities with human wildlife incidents will not promote exploratory drilling in the Murchison Falls National Park and if the trends increase then it will totally neutralize exploratory drilling in any protected area. Therefore, spatial patterns of human wildlife incidents when described and quantified along with the impacts of the exploratory drilling will show existence of a given pattern and why it exists.

Since 97.3% the households surveyed are dependent on subsistence farming it's inevitable that people will experience crop foraging, damages, and threat to human life from wild animals in Murchison Falls National Park. With time the cost inflicted on people in communities by wild animals leads to a negative attitude towards wildlife and reserves, and this fails the conservation efforts hence sustaining the conflicts (Distefano, 2005).

Table 3: Comparison of human wildlife incident experienced by community in 2006 and 2015

Human wildlife incidents experienced in the community	**Responses**			
	2006		**2015**	
	N	**Percent**	**N**	**Percent**
Crop damage by wild animals	4	25.0	13	30.2
Injured domestic animals	3	18.8	6	14.0
Threats to people by wild animals	4	25.0	12	27.9
Kills by wild animals	1	6.3	4	9.3
Kills by people/humans	4	25.0	8	18.6
TOTAL	**16**	**100**	**43**	**100**

The respondents were asked which human wildlife incident(s) they had experienced in their community in 2006 and 2015. Their comparative responses showed that few human wildlife incidents were experienced in 2006 compared to 2015 (Table.3). Crop damage by wild animals was the most experienced human wildlife incident in both years, followed by threats to people by wild animals, then kills by human, and the rest as represented (Table.3).

Also, the other years were local people experienced human wildlife incidents were considered to examine the trend of human wildlife incidents experienced by respondents' overtime from 2006 to 2017 (Figure.15). The human wildlife incidents peaked in 2009 and 2015 both representing a period of high oil exploration activities. Also, the trend of human wildlife incidents since the first peak in 2009 had progressively increased from 2010 to 2013, dropped in 2014 and increased rapidly to set a new peak in 2015. It later dropped in 2016 and started to rise in 2017 (Figure.15).

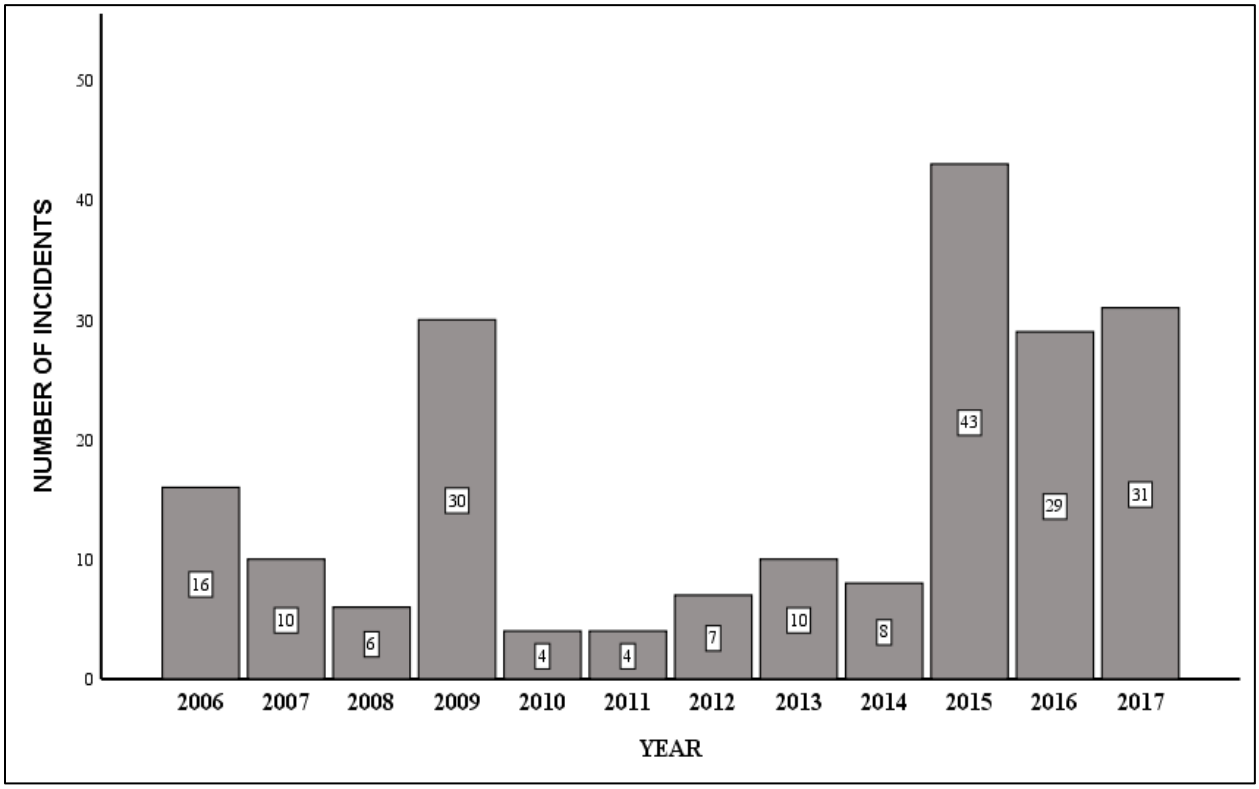

Figure 15:Trend of human wildlife incidents from 2006 to 2017 in the 3 villages

According to the survey, 198 human wildlife incidents were experienced by respondents in their communities from 2006 to 2017. The human wildlife incidents peaked in 2015 and dropped in 2016 since the exploratory drilling was put on hold during that period. So, after resuming drilling in 2017 the number of human wildlife incidents started to rise. Besides the trend of human wildlife incidents presented (Figure.15), it's vital to show the areas of activity of the certain wild animals responsible for the occurrence of the most human wildlife incidents based on respondents' experience with different wild animals close to their houses (Figure.18).

5.3 Mapping conflicts

After acquiring data sets from open source platforms, and spatial data from study area, I was able to produce area maps for the study area (Figure.2). In addition, the GPS coordinates captured were used to produce a point feature for human wildlife incidents, houses, and oil wells situated in the Murchison Falls National Park. The outputs were vital in analysis of the human wildlife incident patterns in study area.

The data collected using ODK in the xls-format was sorted and converted to comma delimited csv-format to create a database in Microsoft access. Later a table of attributes was created with data of different conflicts, wildlife, and specific areas that were used to give a clear image of the human wildlife conflicts status in the 3 sampled villages.

The outputs are represented in the maps that are aimed at highlighting the status of human wildlife incidents in relations to the household location (Figure.16). We also have a closer look at the location of oil wells/ drill sites in the Murchison Falls National Park, its boundaries, and villages in its proximity (Figure.17).

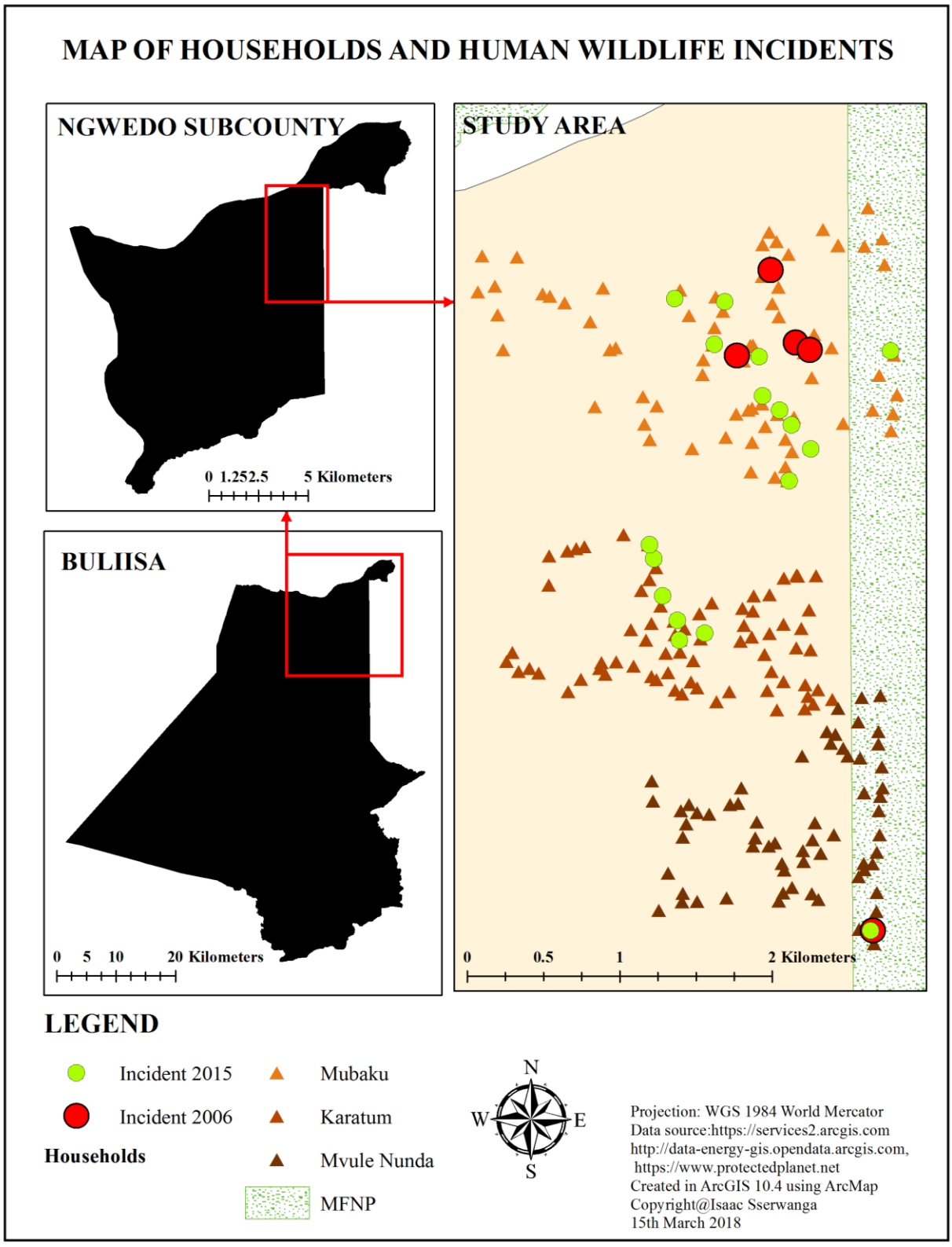

Figure 16: Representation of sampled households and human wildlife incidents in 2006 and 2015

5.4 Measurement of distances

Using the point and line features with the help of the Generate Near Table and Near tool in ArcMap 10.4, the distances of human wildlife incidents to houses, park boundary, and exploratory oil wells/ drill sites were measured. These were added to the attribute tables for households and human wildlife incidents for 2006 and .2015.

5.5 Arithmetic means of distances

The means for the distance measured from point features represented human wildlife incidents to the households, park boundary, and exploratory oil wells/ drill sites. Based on the measurements the human wildlife incidents were on average 2152.48 and 2652.47 Meters from the reference drill site in 2006 and drill sites in Murchison Falls National Park in 2015 respectively. Also, the location of human wildlife incidents in 2006 and 2015 were on average 395.9 and 759.99 Meters from the park boundary respectively in the villages of Mubaku, Karatum, and Mvule Nunda (Figure.17).

In addition, the human wildlife incidents were 1131.89 and 559.62 Meters on average in 2006 and 2015 respectively from the households in the sampled villages (Table.4). These are vital for establishing an association between oil exploration and development human wildlife conflicts and interaction in study area.

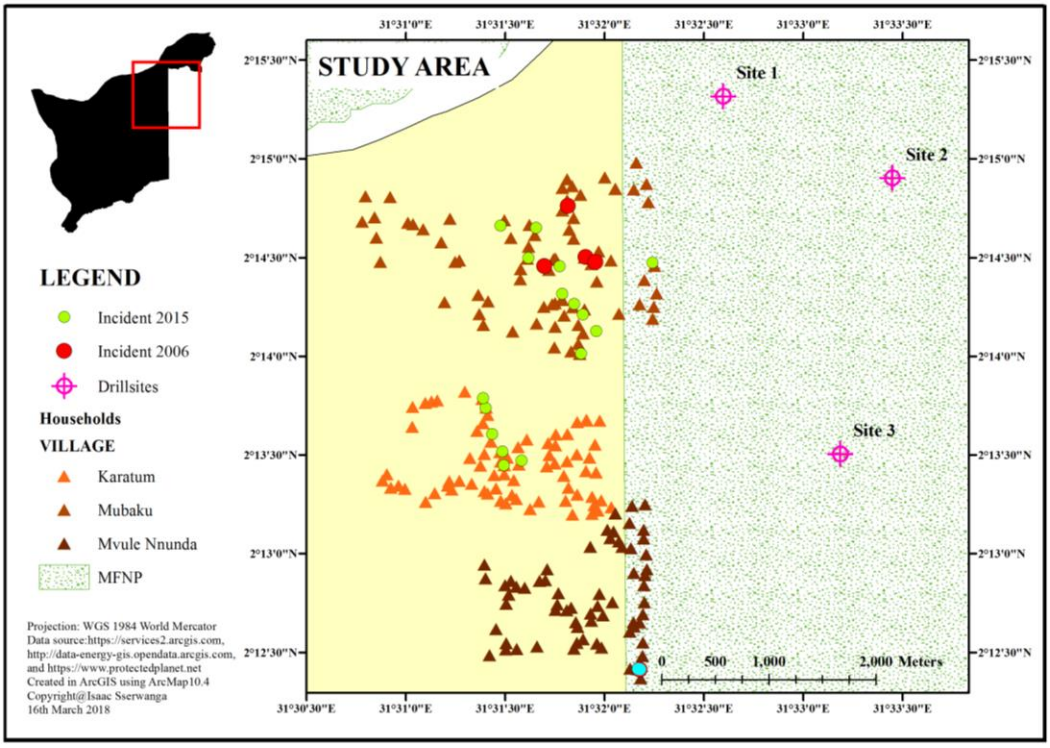

Figure 17: A map of study area showing proximity of incidents and households to the oil drill sites.

5.6 Comparison of arithmetic mean of distances

Based on the study I compared the mean distances of human wildlife incidents in 2006 and 2015 in relation to location of drill sites in Murchison Falls National Park, park boundary, and the houses in the 3 sampled villages. The aim was to answer, whether there is a tendency of human wildlife incidents to be higher in areas close to park boundaries in proximity to oil wells in Murchison Falls National Park. And, if there's increase in human wildlife incidents with households close to the park boundaries but not close to oil wells/drill sites in the Murchison Falls National Park. The results showed that the human wildlife incidents increased in communities closer to the park boundary and reduced as you move further away from the park boundary in 2006. Therefore, households living in proximity to the park boundaries interacted more often with wildlife compared to those that lived furthest. However, in 2015 human wildlife incidents occurred far away from the park boundary and closer to the houses transversely in the 3 villages (Figure.17). Also, the human wildlife incidents occurred far from the oil wells/drill sites in 2015 compared to 2006 (Table.4).

In 2006, the human wildlife incidents occurred quite further from the local people's houses and more to the areas close to park boundaries as represented by a high mean distance value of 1131.9 Meters compared to low mean distance value of 559.6 Meters from houses to human wildlife incidents in 2015 (Table.4). This shows that in 2015 human wildlife incidents occurred close to the local people's houses than in 2006 (Figure.17).

Table 4: Comparison of the arithmetic means for the selected years of incidence and distance from the household, park boundary, and drill sites in MFNP

1.Human wildlife incidents 2006	**2.Human wildlife incidents 2015**
Distance to Oil well/Drill site	**Distance to Oil Well/ Drill site**
Minimum: 1776.56	Minimum: 1690.88
Maximum: 2748.27	Maximum:3371.12
Mean: 2152.48	Mean:2651.47
Distance to Park boundary	**Distance to Park boundary**
Minimum: 131.334	Minimum: 116.67
Maximum: 734.28	Maximum:1313.14
Mean: 395.90	Mean:759.99
Distance to House	**Distance to House**
Minimum:5.28	Minimum:7.57
Maximum:2514.94	Maximum:1393.70
Mean:1131.89	Mean:559.62

Note: The distance to oil well for human wildlife incidents in 2006 is a reference distance for comparing before with after drill sites were set up in Murchison Falls National Park

5.7 Distance assessment: t-test and null hypothesis

The t-test was used to check for the significance of the results based on the null hypothesis. Therefore, the differences between the distance to the oil well/ drill sites and houses with human wildlife incidents in 2006 and 2015 were attributed to the explanations for the assumption of the study. The study assumes that human wildlife conflicts and interactions transversely decrease away from the oil well in the three villages.

Under significance level 0.05, I used 1.96 as my critical value because the degree of freedom for all subset comparisons was above 120. In Table.3, subset 1 and 2 are represented by human wildlife incidents that occurred in 2006 and 2015 respectively.

It was discovered that the critical t value (tc =1.96) for human wildlife incidents in 2006 and 2015 was lower than the observed t value (to =2.12) for the distance to the oil well/ drill sites hence there was a significant difference (Appendix.12).

For distance to houses, the human wildlife incidents of 2006 and 2015, had their critical t value (tc=1.96) lower than the observed t values (to=2.49). This meant that there was significant difference among the human wildlife incidents in 2006 and 2015 (Appendix.12).

The null hypothesis (H0) stated: there is no significant difference between the means for human wildlife incidents in 2006 and 2015. However, the critical t values for human wildlife incidents in 2006 and 2015 are lower than their observed t values, hence there is a significant difference, and the null hypothesis is rejected. This shows that obtaining any of the values of human wildlife incidents in 2006 and 2015 with distances to the park, houses, and drill sites was not by chance.

Therefore, there is a relationship between the human wildlife incidents in 2006 and 2015 and the distance from the oil well/drill sites and local people's houses/ settlements.

5.8 Human wildlife zones

Based on the data of human wildlife incidents, maps showing hot spots for conflicts, and areas susceptible to conflicts were made. The maps presented show zone of conflict and distance of spread to represent the level of susceptibility. The information represented for hotspots for human wildlife incidents is based on the incidents that happened in 2006 compared with those that happened in 2015 in all the villages. For the case of places susceptible to the incidents in the future, we considered areas where respondents had seen animals in their backyard, a term used to refer to the environment surrounding the households.

They are more human wildlife incidents facilitated by wild pig, baboons, and buffaloes in 2015 compared to 2006. In addition, the human wildlife incidents are occurring closer to the houses and away from the park boundary compared to the incidents in 2006 (Figure.18). Therefore, if the factors influencing the human wildlife interaction are not dealt with as soon as possible the trend in human wildlife incidents will keep increasing way beyond the 31 human wildlife incidents experienced by local people in 2017.

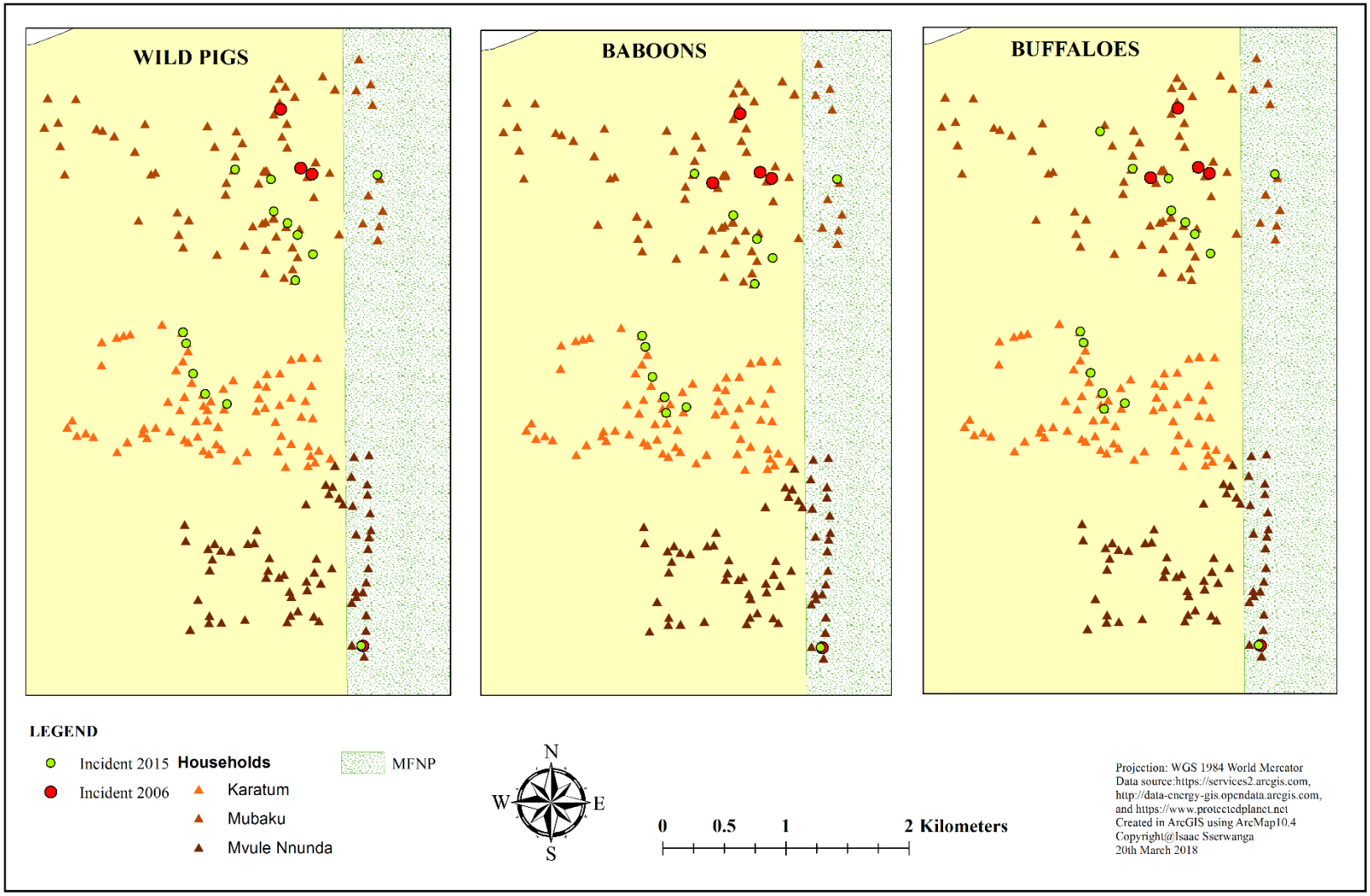

Figure 18: A comparative representation of human wildlife incidents by wild animal in respective villages

Using the incidents in 2015, a buffer zone of 500 meters from the incident was used to indicate susceptibility of households with in the conflict buffer zone to human wildlife interaction (Figure.19). This was established based on the response on the question to the respondent if they had experienced human wildlife incidents in their community and where it happened. The buffer zones for human wildlife incidents in 2015 clearly show that more households are susceptible to human wildlife interaction (Figure.19). This may later breed human wildlife conflicts between the local people and the PA management if they fail to address the underlying factors to the challenges leading to human wildlife incidents.

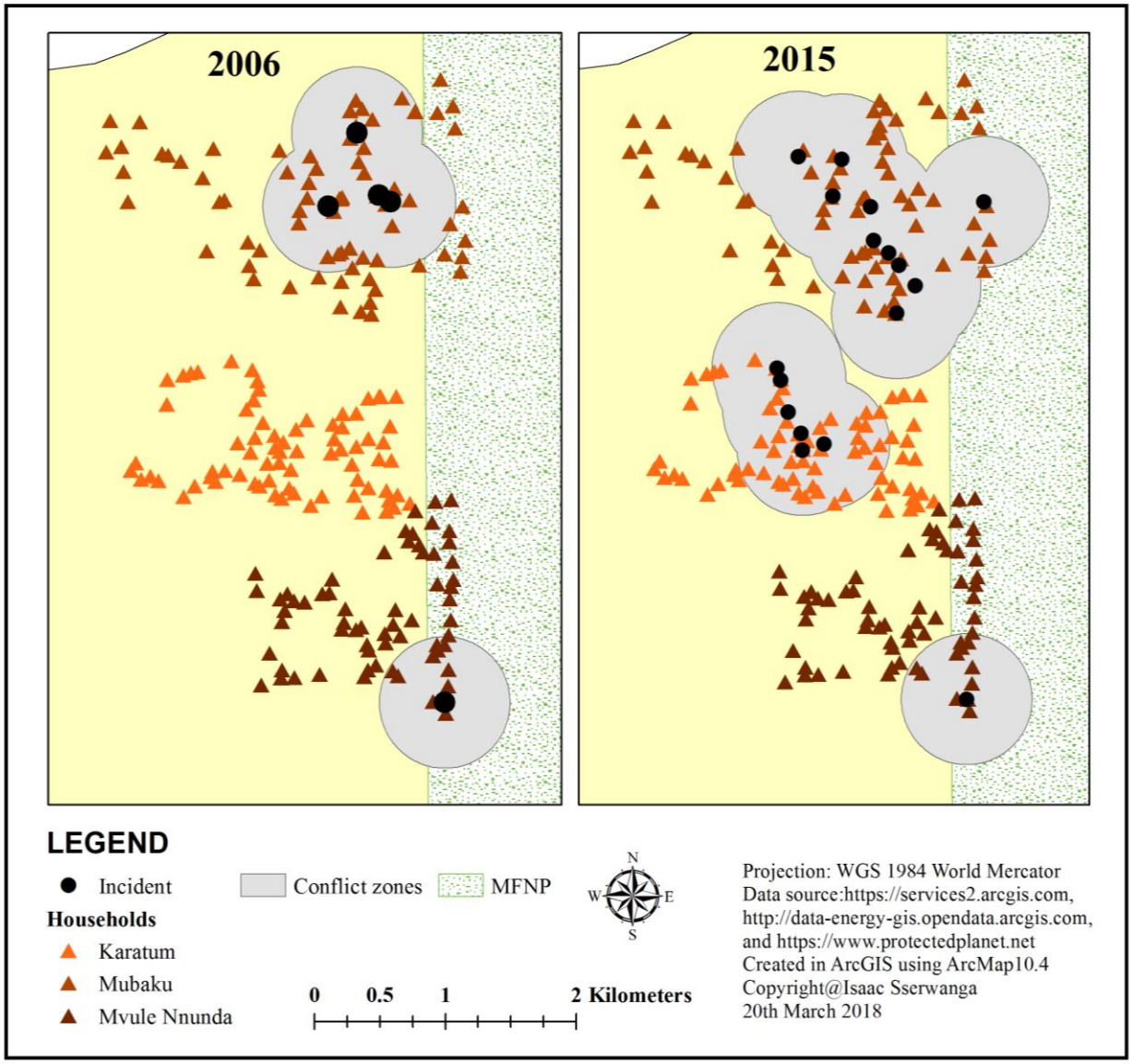

Figure 19:The conflict zones at a 500m buffer zone from the incidents in 2006 and 2015

5.9 Chapter summary

The chapter shows the association of oil exploration activities with the patterns of human wildlife interaction presented as human wildlife incidents occurring overtime in relation to distance from houses, park, and drill sites. It also shows data processed and visual out outputs inform of maps for households and human wildlife incidents. The chapter examines the results of mean distances to houses, park boundary, and oil wells/drill sites. A student t-test is used to show the relationship between human wildlife incidents with distance from the houses and oil drill sites for 2006 and 2015.

In 2015 the mean distance between the human wildlife incidents and oil well/ drill sites was higher than in 2006 which meant that more incidents occurred further away from the park boundary towards households. The chapter closes with the establishment of human wildlife conflict zones based on hot spots where human wildlife incidents occurred, and susceptible areas represented by 500m buffer around the human wildlife incidents.

CHAPTER SIX

6.0 CHALLENGES, REMEDIES, AND RECOMMENDATIONS

6.1 Introduction

This chapter introduces some challenges to overcoming human wildlife conflicts and interactions and others specific challenges to MFPA. Further, the remedies to meet these challenges are elaborated on. Initiatives taken by park management to mitigate the impact of damage to the areas adjacent to the park are also presented. The chapter closes with several recommendations to the government, NGOs, and local leaders from the different respondents from Mubaku, Karatum, and Mvule Nunda.

6.2 Challenges

The respondents were asked what challenges prevented or hindered control of human wildlife conflicts in their communities. These were the responses to a multichoice question where the alternatives were; lack of knowledge to formulate solutions, Lack of resources to formulate solutions, People's perception of animal intrusion or threat of intrusion and Poor implementation of set guidelines like control of wildlife beyond borders of reserves

The results showed that 172 of respondents considered poor implementation of set guidelines like control of wildlife beyond borders of reserves as the main challenge, followed with 118 who stated lack of resources to formulate solutions and others specific to MFPA (Figure.20).

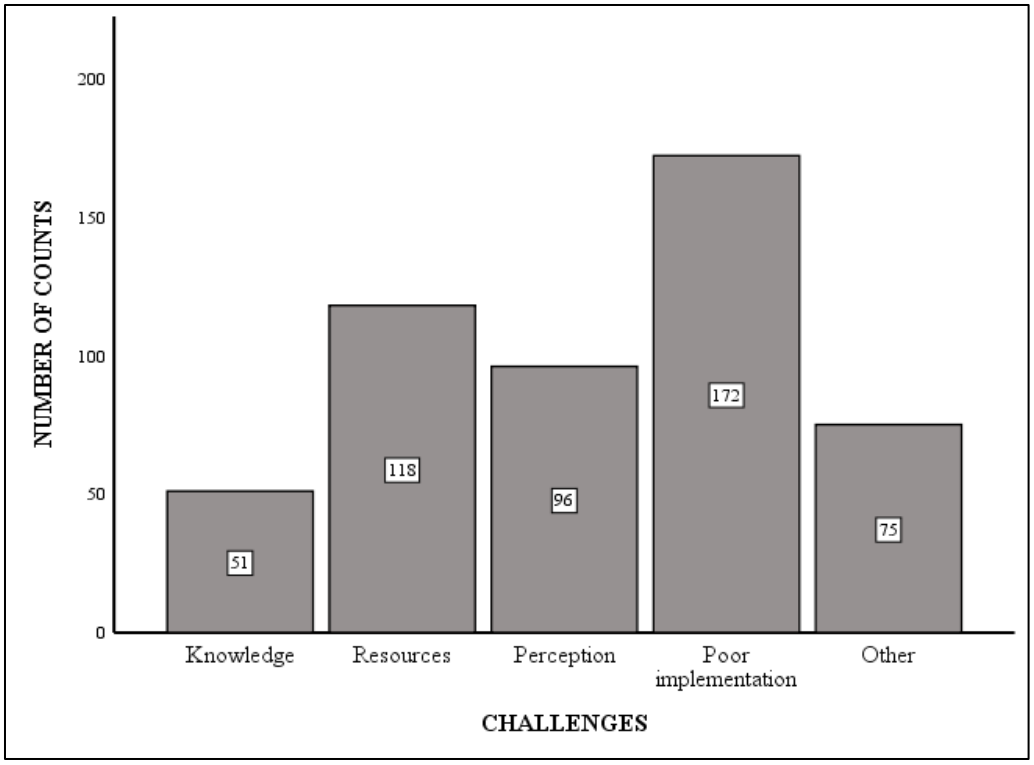

Figure 20:Representation of challenges to control of human wildlife conflicts in the community

Besides the multichoice options people were able to provide open ended answers and, the other challenges raised by local people included, lack of direct compensation to losses accrued due to foraging of crops by vermin and problem animals which cost farmers money and time invested in farming. Furthermore, life threatening incidences by problem animals, and sometimes loss of life of residents has led to retaliation by killing problem animals responsible for the loss.

UWA's 20% revenue sharing scheme from park collection fees has supported communities close to the Murchison Falls National Park and a community project has been established. However, the bureaucratic means through which the money reaches the affected communities, and the amount received is too little to account for the losses caused by vermin and problem animals.
This has made it less popular, and its review remains the closest response to worthwhile account for the losses incurred. In addition, the compensation bill awaits approval by the parliament of Uganda, which seeks to see victims to losses compensated after verification of losses.

6.3 Remedies

Respondent were asked what steps they had taken to control human wildlife conflicts in their villages. The responses to the question are presented to show the difference in preference for control strategy overtime by the respondents (Table.5).

Table 5: Responses to control measures for human wildlife conflicts and interaction in 2015 (multichoice)

Control measures for human wildlife conflicts and interactions	Responses	
	N	Percent
Erecting fences around gardens	110	21.2
Involving responsible authorities like UWA	172	33.1
killing of animals by shooting with arrows and spears	75	14.5
Use of traps like ditches, snares, tripwires	94	18.1
Other	68	13.1

The responses from the interviewees on what steps they had taken to control human wildlife conflicts and interactions included; Involving the park authority as the major way of controlling human wildlife incidents, followed by erecting fences around garden, use of traps like ditches, snares, and trip wires, killing of animals by shooting with arrows, spears, and any other way possible to deal with the issue (Table.5).

Other ways used to control the conflicts included; educating community members on the importance of game reserves and how to live close to them, drumming around game reserves to chase animals, involving local leader and game rangers in case an animal escaped, putting thorns and thorny plants around plantations, continuous inspection of gardens, discouraging poaching in the community, communal alerts like drumming, and pruning and cutting long crop to discourage animals from eating them.

6.3.1 Stakeholder initiatives

The respondents gave their response based on the question; which of the following initiatives have been used by different stakeholders to prevent human wildlife conflicts in your area? It was a multichoice type of question with the following options; compensation schemes with community participation, compensation schemes with good livestock husbandry, fostering communication and

trust, demonstrating effort and willingness to address issue, training programs at all level to address human wildlife conflicts, and other ways used by stake holders from the local people.

In 2015, the percentage response to training programs at all levels to address conflicts and the other options to control human wildlife conflicts and interaction known to local people were slightly low with 33 % and 24 % respectively. However, the response to the compensation schemes, community participation and good livestock husbandry had an increase in the percentage response in 2015.
The other initiatives by stakeholders included; giving status report about animals by the PA management, control of access to PAs to prevent human wildlife interaction, informing people of park boundaries and farming areas, sensitization on the impacts of poaching and its consequences, painting boundaries between PA and community, donating seeds and cuttings to communities prone to conflicts, funding community projects like the repair of boreholes, and creating community conservation areas.

6.4 Recommendations to government and other stakeholders

The respondents had an opportunity to recommend possible solution to the recurring human wildlife conflicts in their community. Again, a multichoice question was asked, and probable recommendations were provided for the respondents to agree to it or suggest something better under the other.
The question was; what recommendation would you give to government, Non-government organizations (NGOs), and local leaders to control human wildlife conflicts?

Table 6: Responses to recommendations to control human wildlife incidents (multichoice).

Recommendations to stakeholders	Responses	
	N	Percent
Build up and tap into a formal global network that will foster the exchange of ideas and information	11	1.8
Create resource linkages and partnerships with relevant agencies and individuals	61	10.1
Establish, update, and share the current state of knowledge on HWC	56	9.3
Empower local practitioners and affected stakeholders with needed resources, skills, and information	64	10.6
Gather, disseminate, test, and improve best practices	44	7.3
Identify additional gaps, needs, and lessons learned in the field	41	6.8
Quick response to human wildlife conflicts and interactions	208	34.4
Other recommendations	120	19.8

Based on the options provided, quick response to human wildlife conflicts and interactions was the most desired recommendation, followed by Other, and empower local practitioners and affected stakeholders with needed resources, skills, and information (Table.6).

The other options for recommendation included, create resource linkages and partnerships with relevant agencies and individuals, Establish, update, and share the current state of knowledge on human wildlife conflicts, Gather, disseminate, test, and improve best practices, identify additional gaps, needs, and lessons learned in the field, and Build up and tap into a formal global network that will foster the exchange of ideas and information.

Lastly, the Other option of the multichoice question had the following recommendations to the stakeholder in conservation especially government, local leaders, NGOs, and PA management. Provide communities with barbed wires to make fences, a law should be clearly made to allow killing of vermin like baboons, demarcate PA boundaries from people's land, set up fences on the boundaries of the PAs, Government should build schools and health centers near people to avoid far movements to look for these services especially those established in the PA, resettling people close to park boundaries with a resettlement package like money to start over, deploying park rangers at the boundaries of the park, sufficient and timely compensation to the people who have lost their crops, livestock, as well as life, and extension of the park to create more land for settlement.

Based on the responses, fencing of park boundaries, creating a clear boundary, compensation of affected households, deploying park rangers at the boundaries, and regulation to kill vermin like wild pigs and baboons received the most responses for other recommendations.

6.5 Chapter summary

The chapter presents the challenges, remedies, and recommendations. The major challenges according to the interview were poor implementation of set guidelines and lack of resources to design solutions. Concerns like lack of compensation for accrued damages, and bureaucratic nature of the revenue sharing scheme were considered as other challenges. The chapter also examines the remedies used by communities to control human wildlife conflicts and interactions based on study fencing was the most preferred solution. Further presents the stakeholder initiatives to the cause and closes with recommendations by households to government and other stakeholders on how to prevent and control the recurring human wildlife incidents in their communities.

CHAPTER SEVEN

7.0 CONCLUSION

This study explores the relationship between oil exploration and development activities with human wildlife conflicts and interactions in Buliisa. This has been done through assessment of people ‘s perceptions living in proximity to the PAs, and areas of oil exploration. Further, mapping human wildlife incidents in areas proximate and away from the PAs was done to establish conflict zones based on human wildlife incidents experienced by local people in the different communities.

It was argued by Hill (2004), that lack of effective ways to handle interaction between wildlife and humans at local level breeds conflicts and makes conservation initiatives almost impossible. Further, Gillingham and Lee (1999) noted that local people have negative conservation attitudes even when they receive substantive benefits. It was identified that also lack of participation in decision making for resource management shapes conservation attitudes. Through review of literature, I was able to make a directed assumption that human wildlife conflicts and interactions decrease further away from the exploratory drill site.

The oil and gas industry cycle adopted by Uganda was used to align the different stages of the cycle with different processes, and their impacts. These were used to investigate the association of different activities for a given stage of the cycle like exploratory surveying and drilling since their inception. So, attention was given to detrimental impacts to wildlife like noise and vibrations that lead to change in wildlife utilization zones and the associated human wildlife incidents.

Role of political ecology in the study

The nature and consideration of human environment interaction and the influence of unequal balance of power made political ecology important for the study. And overtime the power relations between local people and state actors sustains underlying factors that change the environment and this comes along with resistance (Bryant, 1998; L & Sinead, 1997). For example, limiting access to wildlife resources leads to poaching in PAs. Further Robbins (2011) acknowledged that the cost and benefits of the environmental change are not equally shared, and this enhances or reduces socioeconomic inequalities due to unequal power relations between actors.

The study considered the history of wildlife conservation of Uganda to examine the impacts of unequal power relations to the interaction between different actors and its influence on human wildlife conflicts. Through the different socioeconomic processes and structures of different actors a series of causalities exist that help to explain different conflicts and deterioration of resources (Akama et al., 1996). In Uganda, exploratory drilling of oil led to displacement of people in Kakindo village where Kasemene 1 oil well is located further into marginalized areas (NRO, 2016). And they could hardly support their livelihoods hence putting more pressure on natural resources.

In my assessment, before colonization local people had power vested in their cultural leaders under Kingdoms with clear intentions to use resources sustainably. This was evident with communal ownership, and free access to resources as well as making some wild animals taboos to people as a conservation tact embedded in culture (Baker et al., 2013). This signified coexistence between local people and wildlife with occasional hunting to keep them in check.

However, the coming of colonial powers led to a shift in power with introduction of land tenure rights that limited access to resources. This pushed the local people away from their traditional hunting areas and settlements, changed their survival behavior, and eventually relocated to marginalized areas that negatively impacted their livelihoods. In these areas, they interacted more often with wildlife and killed wild animals especially elephants. Continuity showed failure to meet people's need of protection from crop foraging by wild animals' conflicts arose (Madden, 2004). At this moment it was evident that resistance was due to the failures of the state body. Enhancing the state body to quell conflicts led to tourism with a conservationist agenda. This was initiated to share benefits to offset costs from wildlife conservation (MacKenzie et al., 2017). However, the benefits are not equal to the cost of damage by wild animals from the protected areas and this has led to more human wildlife conflicts in places close to the park. Since the state is a beneficiary to revenue from tourism and the local people face the cost of wildlife conservation due to human wildlife interactions. Therefore, the state continues to foster its preservationist and a quasi-conservationists agenda. Nonetheless, most of the local people emerge losers because of the recurring challenge of aligning benefits with costs incurred due to wildlife conservation.

The study sets out to answer three questions derived from the objectives and these are;

1. What is the perceptions of people on human wildlife conflicts and interactions in proximity and away from the oil wells/ drill sites.

People's perception are inherent on relations with social issues especially those that are negative and these force wild animals to adjust to changes in a limited time (Sanchez-Vazquez et al., 2016). This eventually exerts pressure on their habitats and lead to spatial interaction with humans. It's argued that the distribution of geographical range of animals is not only about habitat preference but also disturbance exerted on their habitats (Pedrana, Bernad, Maceira, & Isacch, 2014). People's connectedness to their immediate surrounding determines the preferred method to control and prevent conflicts. This justifies the preference of certain methods, and not others.

Understanding that people's experiences in response to human wildlife conflicts and interactions is key to uptake and sustainability of technical initiatives to mitigate the conflicts. Therefore it's quite important to know their priority and their view on risks as result of wildlife engagement (Hill, 2015). The study considered people's perception on land use cover changes because of multiple processes sustained by continuous exploitation of oil resources. For example, exploratory drilling that leads to vibrations and noise and road construction which fragments habitats and increase edge effect.

In 2006 local people experienced more human wildlife conflicts than in 2015. This was attributed to rampant foraging of crop, loss of life by domestic animals to wildlife, people lost their lives too, and delayed response by PA management to deal with wild animal escapees. However, delayed response led to redirection of anger and frustration to wildlife. This was because of the failure of UWA to control movement of animals beyond PA boundaries, and people's fear to direct their anger to those responsible for the conflicts (Distefano, 2005; Hill, 2015).

Nonetheless, in 2015, the local people had experienced a decline in the human wildlife conflicts compared to 2006. This was attributed to people migrating to areas with less human wildlife incidents and protecting their gardens by using natural fences. Also, engagement with PA management when problem animals were involved in human wildlife interaction. Further, creation of community conservation areas and groups to benefit from the 20% revenue sharing scheme to offset cost of wildlife conservation to local people. It was argued that the scheme encourages collective management of conservation areas through exposing the economic benefit of protecting

biodiversity, which eventually contributes to poverty alleviation in communities adjacent to PAs (Tumusiime & Vedeld, 2015).

Though 87% of the respondents had seen human wildlife incidents, 88.3% had experienced these incidents in other years besides 2006 and 2015. In 2015, local people experienced 43 human wildlife incidents. This was attributed to factors like agricultural production especially crops and livestock besides oil exploration in Murchison Falls National Park that communities claimed to have pushed animals in neighboring farming communities.

In 2015, people reported crop damage by wildlife, and threats to people by wildlife. The wildlife responsible for crop damages included wild pigs, baboons, buffaloes, and monkeys in order of their visibility in respondents' crop plantation, and those that threaten people's lives included, buffaloes, elephants, lions, and hippos.

Lastly, people did not experience any increase in employment opportunities. This was due to employability of people in available slots, and their priorities towards income generating activities in the study area. The local people preferred farming to doing casual labor.

2. What are the spatial patterns for human wildlife conflicts and interactions in Ngwedo Sub county, Buliisa

Spatial analysis of the human wildlife conflicts and interaction patterns were represented as human wildlife incidents. These were used to visualize the incidents that happened in 2006 and 2015 with help of maps and through a comparison of the arithmetic means of the distances like, distance to houses and drill sites/oil wells in the Murchison Falls National Park. In addition, a student t-test was used to define the tendency of occurrence of human wildlife incidents in relation to distances from households and drill sites. This was key to affirming the assumption that human wildlife incidents decrease away from the oil well/ drill sites.

Based on the results from comparison of arithmetic means, the distance of human wildlife incidents occurred close to the park boundary in 2006 before exploratory drilling in the park, and far away in 2015 after establishing drill sites (Table. 4). Contrary to the distance to the reference location of drill sites and drill sites for 2006 and 2015 respectively, the average distance to houses from human wildlife incidents was shorter in 2015 compared to 2006. In 2006 oil companies had not started exploratory drilling in Murchison Falls National Park. However, by 2015 the exploratory drilling

had been done in the Murchison Falls National Park. So, the human wildlife incidents shifted far away from the park boundaries towards the households (Figure.19).

To further examine the relationship between distance to houses and the oil wells/ drill sites, a student t-test was used (Appendix.12). The results showed significance difference for the distance to houses and drill sites. Therefore, the null hypothesis was rejected, since it stated that there was no significant difference between the means representing the distances. So, there was a tendency of human wildlife incidents occurring close to park in 2006, and further away in 2015. The shift defined occurrence of human wildlife incidents closer to houses from the park, in relation to the established exploratory wells/ drill sites in Murchison Falls National Park.

The maps provide a clear position for priority areas to deal with human wildlife incidents in Mubaku, Karatum, and Mvule Nunda. In addition, due to limited resources and knowledge on spatial and temporal patterns of human wildlife incidents it's vital for planning so that resources are well allocated in implementing future initiatives like fencing the boundary of protected area (Kumar, Bargali, David, & Edgaonkar, 2017).

3. What is the relationship between oil exploration and development with human-wildlife conflicts?

The associative push factors like exploratory drilling linked to noise and vibrations arising from exploratory surveying and drilling of oil exerted pressure on wildlife and forced wild animals to change their utilization zone. In addition, as the major activity of the communities close to Murchison Falls National Park is subsistence farming this probably acted as a pull factor to interaction with wildlife

The push factors are responsible for the peaks in occurrence of human wildlife incidents in relation to the distances to houses, and oil wells/ drill sites. Therefore, defining human wildlife incident zones based on location, and wildlife involved in the incidents create a visual understanding of pattern assumed by wildlife. And according to the analysis in Chapter five, the wild pigs, baboons, and buffaloes were involved in human wildlife interaction more often than monkeys, elephants, hippos, lions, and others.

A trend of human wildlife incidents from 2006 to 2017 showed peaks in 2009 and 2015, with 30, 43 incidents respectively. The trend is closely linked to oil exploration and development activity stages. In 2009, the commercial threshold for oil development was exceeded with 750 million barrels through exploration (TullowOil, 2013). This was also evident after resuming exploratory drilling in 2017 especially in Murchison Falls National Park more human wildlife incidents occurred in areas close to the park. This consolidates the existence of an association between oil exploration and development with human wildlife incidents occurring in communities close to the Murchison Falls National Park.

Challenges like poor implementation of conservation laws, people's perception of animal intrusion and threats to intrusion, limited financial resources to develop solutions, and lack of a direct compensation scheme still exist. And this leaves the communities vulnerable to escalating human wildlife conflicts and interaction.

Therefore, there is profound need for quick response to human wildlife incidents by PA management. In addition to skilling local people and providing information to deal with dangerous wildlife species to foster behavioral change.

Further, to overcome unequal distribution of benefits to offset costs the Uganda Wildlife Bill 2017 must be passed to introduce direct compensation of costs incurred by people living close to protected areas after verification of human wild incidents.

To sustain initiatives to mitigate conflicts attention should be given to farmers' concerns and expectations with a clear distribution of responsibilities like implementation and maintenance of initiatives among stakeholder.

In addition, fencing and creating clear park boundaries, deploying park rangers, and a regulation to kill vermin were recommended to the stakeholders in conservation by local people. This was to control and prevent human wildlife conflicts and interaction in communities close to Murchison Falls National Park.

However, if recommendations in the study are not considered then the trend of human wildlife incidents will take its toll. Overall the study shows an association between oil exploration and development activities especially exploratory drilling and survey with human wildlife conflicts and interaction in Mubaku, Karatum, and Mvule Nunda in Ngwedo Subcounty.

In the future, a study that assesses the factors that determine movement of wildlife in relation to oil exploration and development in the Murchison Falls National Park should be carried out. This will help to consolidate the efforts of the studies that associate human wildlife conflicts and interactions with oil exploration and development in areas close to the protected area.

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8.1 Appendices

Appendix.1: Interview questionnaire

HUMAN WILDLIFE CONFLICTS AND LANDSCAPE CHANGE SURVEY QUESTIONNAIRE (WEBFORM)

I am working as an enumerator/research assistant for a researcher from Makerere University and Norwegian University of Science and technology, the survey aims at showing the relationship between landscape changes and human wildlife conflicts with oil exploration and development in Buliisa. The information provided will help in exposing and solving the challenges of protected area management, and decision making. In addition, information provided will be treated with utmost confidentially. *Quite important and should be clear to interviewee*

Are you willing to participate?

◉ Yes ○ No

SECTION A-Household information

Household number *Tabno.hhno (01.01)*

Which district is the household located

Which subcounty is the household located?

Which parish is the household located?

Which village is the household located?

Collect the GPS coordinates of this household

Allow the GPS to attain an accuracy of 5 meters. If the fix has not been established after 5 minutes, accept the coordinates provided and continue.

Take a picture of the front of the household

Stand far enough back to include the entire structure.

Respondent / Head of Household information

Is the respondent the head of the household?

○ Yes ○ No

Household demographic information

Which of the following ownerships does the household belong to?

☐ Owned ☐ Rented/Leased ☐ Other

Occupation of primary income earner in household

☐ Day / Unskilled laborer ☐ Farmer / Agriculturalist ☐ Business owner

☐ Government employee ☐ Private employee ☐ Other

Primary language spoken in the household

☐ English ☐ Lugungu ☐ Alur ☑ Lugbara ☐ Lukiga ☐ Swahili ☐ Other

Section C-Landscape Changes

Which income generating activities where you involved in before oil exploration in 2006?

☐ Subsistence farming ☐ Animal husbandry ☐ Vending ☐ Other

Which income generating activities where you involved in after oil exploration by 2015?

☐ Subsistence farming ☐ Animal husbandry ☐ Vending ☐ Other

What factors have influenced land use practices in your community?

☐ Income earned by a household ☐ Land ownership ☐ Strict implementation of laws

☐ Other

What is your perception on landscape changes and oil exploration and development?

☐ There has been more employment opportunities ☑ Improved infrastructure ☐ It has human wildlife conflicts ☐ It has led to migration influx ☐ Other

Section D-Distance

How far is it from the oil well to the household boundary? **Distance should be in Km (1 Mile= 1.6093 Km)*

How close were the human wildlife incidences from your household? **Distance should be in Km (1 Mile= 1.6093 Km)*

How close were the incidences to the wildlife reserves? **Distance should be in Km (1 Mile= 1.6093 Km)*

Section E-Human Wildlife Conflicts

Have you seen any wild animals in your backyard?

○ Yes ○ No

Have you seen any of these wild animals in your backyard?

☐ Monkey(s) ☐ Baboons ☐ Chimpanzees ☐ Elephants) ☐ Antelopes/kobs ☐ Buffalo(s)

☐ Wild pig ☐ Rodents; rats, squirrels ☐ Lion(s) ☐ Hippopotamus ☐ Other

How did you interact with wildlife before (2006) oil exploration and development?

Probe to find out more on how people related with wildlife

How did you interact with wildlife after (2015) oil exploration and development?

Probe to find out more on how people related with wildlife

Have you ever seen a human wildlife incident in your community?

Yes No

When did the incident happen?

In 2006 In 2015 Other

Section-F: Perception on Human wildlife conflict

What is your perception on the occurrence of human wildlife conflicts in your community in 2006?

Before oil exploration and development in your community in nearby areas

Increased No change Decreased I don't know

What is your perception on the occurrence of human wildlife conflicts in your community in 2015?

After oil exploration and development; roads to ridges, oil wells, population pool and others

Increased No change Decreased I don't know

What are the effects of oil exploration and development on the employment of people in community?

Increased No change Decreased I don't know

What are the effects of oil exploration and development on the income of people in community?

Increased No change Decreased I don't know

What other factors have been influenced by oil development in your community?

Besides the ones mentioned above like resettlement, migration influx and others

Section-G: Challenges, Remedies, and Recommendations

What challenges prevented or hindered control of human wildlife conflicts in your community in 2006?

☐ Lack of knowledge to formulate solutions ☐ Lack of resources to formulate solutions ☐ People's perception of animal intrusion or threat of intrusion (animals protect vs animals unprotected by law)

☐ Other

What challenges prevented or hindered control of human wildlife conflicts in your community in 2015?

☐ Lack of knowledge to formulate solutions ☐ Lack of resources to formulate solutions ☐ People's perception of animal intrusion or threat of intrusion(animals protect vs animals unprotected by law) ☐ Poor implementation of set guidelines like control of wildlife beyond borders of reserves ☐ Other

What steps have you taken to control or prevent human-wildlife conflicts in your village in 2006?

☐ Erecting fences around gardens ☐ Involving responsible authorities like UWA ☐ Killing of animals by shooting with arrows and spears ☐ Use of traps like ditches, sneers, tripwires, etc. ☐ Other

What steps have you taken to control or prevent human-wildlife conflicts in your village in 2015?

☐ Erecting fences around gardens ☐ Involving responsible authorities like UWA ☐ Killing of animals by shooting with arrows and spears ☐ Use of traps like ditches, sneers, tripwires, etc. ☐ Other

Which of the following initiatives have been used by different stakeholders to prevent human wildlife conflicts in your area in 2006?

☐ Compensation schemes with community participation ☐ Compensation schemes with good livestock husbandry ☐ Fostering communication and trust ☐ Demonstrating effort and willingness to address issue ☐ Training programs at all level to address human wildlife conflicts ☐ Other

Which of the following initiatives have been used by different stakeholders to prevent human wildlife conflicts in your area in 2015?

☐ Compensation schemes with community participation ☐ Compensation schemes with good livestock husbandry ☐ Fostering communication and trust ☐ Demonstrating effort and willingness to address issue ☐ Training programs at all level to address human wildlife conflicts ☐ Other

What recommendation would you give to government, NGO's, and local leaders to control human wildlife conflicts?

☐ Build up and tap into a formal global network that will foster the exchange of ideas and information ☐ Create resource linkages and partnerships with relevant agencies and individuals ☐ Establish, update, and share the current state of knowledge on HWC ☐ Empower local practitioners and affected stakeholders with needed resources, skills, and information. ☐ Gather, disseminate, test, and improve best practices. ☐ Identify additional gaps, needs, and lessons learned in the field ☐ Quick response to HWCs ☐ Other

Do you have any inquiries about research project, special requests, and improvement(s) on the method used for research?

☐ Yes ☐ No ☐ I don't know

Do you have any requests based on the information gathered for research?

What improvements do you think should be made on the research method used?

Do you have any inquiries about research project?

Write down the household identification number

Tab number, date(mmdd), and time (01.06.14.09:47)

Time widget

Section-H: Follow-up

Is it okay to contact you for a follow up interview on the survey?

○ Yes ○ No

Thank you for taking part in this survey, the information you've provide will be used to assess oil exploration and development as a driver for land scape changes and human wildlife conflicts in Buliisa. The results will be used to show areas affected by conflicts, and recommendations on how they can be reduced. Thank you!

What is the status of the survey questionnaire?*50% plus is incomplete, and 30% done is terminated*

☐ Completed ☐ Incomplete ☐ Terminated

What is the name of the interviewer?

Save as Draft

Submit

Appendix 2: Primary language

Frequencies				
		Responses		Percent of Cases
		N	Percent	
[A] **Primary Language spoken in the household**	English	15	3.9	7.0
	Lugungu	158	40.8	73.5
	Alur	175	45.2	81.4
	Lugbara	1	0.3	0.5
	Lukiga	1	0.3	0.5
	Swahili	20	5.2	9.3
	Other	17	4.4	7.9

Appendix 3: Income generating activities

Frequencies				
		Responses		Percent of Cases
		N	Percent	
Which income generating activities where you involved before oil exploration in 2006?	Subsistence farming	214	97.3	99.5
	Livestock	1	0.5	0.5
	Market vending	1	0.5	0.5
	Other	4	1.8	1.9

Frequencies				
		Responses		Percent of Cases
		N	Percent	
Which income generating activities where you involved after oil exploration in 2015?	Subsistence farming	215	97.3	100.0
	Livestock	3	1.4	1.4
	Other	3	1.4	1.4

Appendix 4: Factors that influence land use

Frequencies				
		Responses		**Percent of Cases**
		N	**Percent**	
Factors influencing land use	Income	98	28.7	45.6
	Land ownership	129	37.7	60.0
	Laws	73	21.3	34.0
	Other	42	12.3	19.5

Appendix 5: Perception on land use changes and oil exploration

Frequencies				
		Responses		Percent of Cases
		N	Percent	
Perception on land use changes	Employment opportunities	85	21.5	39.5
	Infrastructural development	104	26.3	48.4
	Human wildlife conflicts	94	23.8	43.7
	Immigration	30	7.6	14.0
	Other	82	20.8	38.1

Appendix 6: Seen Wildlife

Frequencies				
		Responses		**Percent of Cases**
		N	**Percent**	
Have you seen any of the wild animals in your backyard?	Monkeys	91	10.8	45.3
	Baboons	175	20.8	87.1
	Elephants	82	9.8	40.8
	Antelopes	15	1.8	7.5
	Buffaloes	170	20.2	84.6
	Wild pigs	183	21.8	91.0
	Rodents	35	4.2	17.4
	Lions	50	6.0	24.9
	Hippos	36	4.3	17.9
	Other	3	0.4	1.5

Appendix 7: Human wildlife incident seen

Frequencies				
		Responses		Percent of Cases
		N	Percent	
What incidents did you see in 2006?	Crops damage by wildlife	4	25.0	80.0
	Injured domestic animals	3	18.8	60.0
	Threats to people by wildlife	4	25.0	80.0
	Kills by wildlife	1	6.3	20.0
	Kills by people	4	25.0	80.0

Frequencies				
		Responses		Percent of Cases
		N	Percent	
What incidents did you see in 2015?	Crops damage by wildlife	13	30.2	76.5
	Injured domestic animals	6	14.0	35.3
	Threats to people by wildlife	12	27.9	70.6
	Kills by wildlife	4	9.3	23.5
	Kills by people	8	18.6	47.1

Appendix 8(a): Perception on Occurrence

Frequencies				
		Responses		
		N	Percent	Percent of Cases
What is your perception of HWC in 2015?	Increased	71	33.0	33.0
	No change	26	12.1	12.1
	Decreased	118	54.9	54.9

Appendix 8(b): Perception on employment and Income

Frequencies				
		Responses		
		N	Percent	Percent of Cases
Effect of oil exploration on employment	Increased	96	44.7	44.7
	No change	97	45.1	45.1
	Decreased	14	6.5	6.5
	Don't know	8	3.7	3.7

Frequencies				
		Responses		
		N	Percent	Percent of Cases
Effect of oil exploration on Income	Increased	72	33.5	33.5
	No change	88	40.9	40.9
	Decreased	51	23.7	23.7
	Don't know	4	1.9	1.9

Appendix 9: Challenges to control of Human Wildlife Conflicts

Frequencies				
		Responses		
		N	Percent	Percent of Cases
What are challenges to control of Human Wildlife Conflicts in 2015?	Knowledge	51	10.0	23.7
	Resources	118	23.0	54.9
	Perception	96	18.8	44.7
	Implementation	172	33.6	80.0
	Other	75	14.6	34.9

Appendix 10: Initiatives by stakeholders

Frequencies				
		Responses		
		N	Percent	Percent of Cases
What initiatives were used by stakeholders to prevent Human Wildlife conflicts in your area in 2006?	Community	29	8.1	13.6
	Livestock	11	3.1	5.1
	Trust	67	18.7	31.3
	Issues	36	10.0	16.8
	Training	120	33.4	56.1
	Other	96	26.7	44.9

Frequencies				
		Responses		
		N	Percent	Percent of Cases
What initiatives were used by stakeholders to prevent Human Wildlife conflicts in your area in 2015?	Community	39	9.8	18.1
	Livestock	14	3.5	6.5
	Trust	70	17.6	32.6
	Issues	48	12.1	22.3
	Training	132	33.2	61.4
	Other	94	23.7	43.7

Appendix 11: Arithmetic means

1.Human Wildlife incidents 2006	2.Human Wildlife Incidents 2015
Distance to Boundary	**Distance to Boundary**
Count:5	Count:17
Minimum: 131.334	Minimum: 116.67
Maximum: 734.28	Maximum:1313.14
Sum: 1979.52	Sum: 12919.79
Mean: 395.90	Mean:759.99
Standard deviation: 233.96	Standard deviation:393.04
Nulls:0	Nulls:0
Distance to Oil well /Drill site (Reference point)	**Distance to Oil Well/ Drill site**
Count:5	Count:17
Minimum: 1776.56	Minimum: 1690.88
Maximum: 2748.27	Maximum:3371.12
Sum: 10762.4	Sum: 45075
Mean: 2152.48	Mean:2651.47
Standard deviation: 383.62	Standard deviation:480.463
Nulls:0	Nulls:0
Distance to House	**Distance to House**
Count:5	Count:17
Minimum:5.281394	Minimum:7.573626
Maximum:2514.935886	Maximum:1393.701432
Sum: 244487.614182	Sum:120877.273076
Mean:1131.887103	Mean:559.617005
Standard deviation:669.272161	Standard deviation:377.432635
Nulls:0	Nulls:0

Appendix 12: Student t-test

DISTANCE TO OILWELL	
Fill in the gray cells to calculate the observed t-values	
n for human wildlife incidents 2006	5
n for human wildlife incidents 2015	17
Df	4
Mean for human wildlife incidents 2006	2152.475038
Mean for human wildlife incidents 2015	2651.471165
Difference	499.00
Standard deviation for human wildlife incidents 2006	383.617029
Standard deviation for human wildlife incidents 2015	480.463176
Variation	235.41
Observed t value	2.12
Critical t value	1.96
Significant difference?	YES
DISTANCE TO HOUSES	
Fill in the yellow cells to calculate the observed t-values	
n for human wildlife incidents 2006	5
n for human wildlife incidents 2015	17
df	4
Mean for human wildlife incidents 2006	1131.887103
Mean for human wildlife incidents 2015	559.617005
Difference	572.27
Standard deviation for human wildlife incidents 2006	669.272161
Standard deviation for human wildlife incidents 2015	377.432635
Variation	229.53
Observed t value	2.49
Critical t value	1.96
Significant difference?	YES

Appendix.13: Pictorial

Photos: Author, 2017 October.