MAKERERE UNIVERSITY

THE IMPACT OF CROP RAIDING BY WILD ANIMALS FROM BUGOMA FOREST RESERVE ON FARMERS' LIVELIHOODS.

BY:

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Msc:(ENR)

A Research thesis submitted to Makerere University Institute of Environment and Natural Resources (MUIENR) in partial fulfillment of the requirements for the award of the degree of Master of Science in Environment and Natural Resource of Makerere University.

August 2010

Declaration

I, *Nyangoma Joseline* do declare that the work presented in this thesis is original unless otherwise stated and has never been submitted to any other university or institution for the award of Master of Science or its equivalent.

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Dedication

Dedicated to my Mother, Sisters, Brothers, Children Nalubega , Kasozi and Husband

Acknowledgement

I am highly indebted to all those who in one way or another helped me during the Research work.

Many thanks are due to all people who assisted me in carrying out this study. I am particularly indebted to Professor John. M. Kasenene and Jeremiah .S Lwanga Ph.D for supervising my work and the immeasurable advice and encouragement they rendered.

I am very grateful to individual respondents from around Bugoma Forest Reserve, Igwanjura parish for their patience and time they sacrificed, without them this thesis would have been short of what it contains.

Special indebtedness to my mother Mrs. Ruth Kabasindi for her personal interest, continued support and encouragement throughout my educational career. She willingly met my expenses for research.

May God reward you all, Amen.

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Acronyms

CFR	Central Forest Reserve
NEMA	National Environment Management Authority
BINP	Bwindi Impenetrable National Park
KNP	Kidepo National Park
UWA	Uganda Wildlife Authority
NP	National Park
PNV	Park Nationale des Vulcan's
IUCN	International Union for the Conservation of Nature and Natural Resources: The World Conservation Union
WWF	World Wide Fund for Nature
UBOS	Uganda Bureau of Statistics
NEAP	National Environment Action plan

Abstract

This research dealt with the impact of crop raiding by wild animals from Bugoma Forest Reserve on farmers' livelihoods. The research was carried out with the objectives of finding out the animal species most involved in crop raiding, type of crops most affected, extent of damage by wild animals, the causes and effects of crop raiding on the livelihoods of the people surrounding the forest reserve.

The research conducted was both qualitative and quantitative in nature whereby descriptive cross sectional methods were used. Data were collected using questionnaires, one to one interviews, direct assessments/observations, reviewing of literature, and was later analyzed using statistical package for social scientists (SPSS).

The results of the study indicate that animal species most involved in crop raiding/damage from Bugoma Forest Reserve are baboons, vervet monkeys, wild pigs, several species of birds, squirrels, edible rats, porcupines and chimpanzees . Most raided crops were sweet potatoes, cassava, maize, and sugar cane by wild animals both vermin and non vermin animals. The least raided crops include: rice, millet, beans and peas. These are mainly raided by avian species. However there are some crop species which are not eaten by wild animals but vandalized. Some of the vandalized crops include tobacco, onion, pepper, cabbage, and simsim. Over 96% of the population of Igwanjura parish adjacent to the forest reserve was affected by crop raiders. Therefore palatable and nutritive crops should not be grown within the fringes of the forest reserve, conservation education is paramount, coherent land use plans should be emphasized to determine where certain crops can be grown.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Crop raiding can be simply defined as wild animals moving from their natural habitat into agricultural land to feed on the crops that humans grow for their own consumption and trade (Sillero –Zubiri and Switzer, 2001). Some of the more dramatic cases like the swarms of locusts that devastate large swaths of crops in many parts of the world, tend to receive wide coverage in the media. However, crop raiding by vertebrates such as birds and mammals is also becoming a major issue (Sillero –Zubiri and Switzer 2001). Human wildlife conflict is of increasing concern in several or many parts of the world and has been the focus of recent conservation efforts (Else and Lee, 1986; Naughton Treves, 1998). With increasing human populations especially in the developing world more human and wildlife populations are coming into direct competition for resources (Strum ,1987).

Agriculture forms the baseline to Uganda's economy, contributing over 40% of the GDP while generating 90% of the foreign exchange earnings (NEMA, 1996). Apart from providing food security and farm incomes, agriculture supports the agro-industrial base and employs about 86.6% of Uganda's population (NEMA, 1998). Farmers in rural Uganda mainly practice subsistence agriculture, while surplus from a given agricultural season may be sold off to supplement farmers' income. The practices thus guarantee

food security and income for the particular communities.

However, much as agriculture is important to the farmer and the country's economy in general, it is threatened by a number of factors which include; soil degradation, land tenure, misuse of agrochemicals, low technological inputs, low yields, and poor agricultural produce marketing.

At household level, subsistence farming is threatened by erratic climatic patterns, civil unrest, cattle rustling, pre and post harvest losses (NEMA, 2000) and crop raiding by animals.

Crop raiding by wildlife is neither a new phenomenon nor a rare one. In many parts of rural Africa and Asia, it is perceived to be an increasingly serious issue by farmers, conservationists and developers (Damiba and Ables, 1993; Thouless, 1994; Sukumar ,1990). Until recently, there has been little attention given to vertebrate species that damage crops with exception of elephants and rodents. Wildlife that has become agricultural pests present a wide spread problem throughout the world (Else, 1991). As human populations expand, particularly in the biologically rich developing world, the conflict between wild animals and people over crops poses a major threat to wildlife in general and primates in particular (Strum, 1994).

The increase in the human population and the expansion of agricultural land has forced wildlife into modified habitats. Some primate species find crops palatable and these are ones that become pests (Forthman Quick and Demment, 1988).

For so long Olive baboons were not considered as friendly wildlife particularly outside

national parks. Their legal status was changed from vermin to wildlife only recently (Strum, 1984). According to the Uganda Wildlife Act 2000, baboons are considered vermin once they are outside the gazetted National Parks and Wildlife Reserves.

In Uganda there are several incidences of direct baboon/ human conflict involving loss of lives or severe injuries to humans (Kingdon, 1971). Here the olive baboons (*Papio anubis*) occur throughout the country in both savanna, forest, woodland, arid and human modified habitats (Kingdon, 1971).

Human wildlife conflict is one of the major threats to conservation, house hold food security and rural incomes. In Africa, the great dependence of a large proportion of the human population for their survival on land, coupled with the presence of many species of large mammals leads to many sources of conflict between people and wildlife. This in turn creates friction between protected area managers and local communities living in the regions that border these protected areas. (Hill, 1999).

According to NEAP (1995) high population pressure areas in the country like Kabale and Mbale have people who own numerous fragmented pieces of land near protected areas; most of these pieces are too tiny to be environmentally and economically viable, and pose challenges for conservation. In most cases , these small landholdings share a common boundary with protected area thus making them vulnerable to crop raiding by wildlife. Due to increasing pressure on land, coupled with poor land use practices, the people , together with their livestock in many parts of the country like the districts of Mbarara, Kabale, Masindi, Mukono, Bundibugyo and Karamoja have already invaded

areas gazetted for nature conservation as well as land considered marginal for agriculture. In the process of doing so, the people have destroyed habitats to the detriment of certain important wildlife/ species.

Crop raiding is one of the major problems encountered in Hoima district. The animals often involved in crop raiding include primates, ungulates, rodents, bush pigs, porcupines and birds among others. These animals destroy a variety of crops including maize (*Zea mays*), sweet potatoes (*Ipomea batatas*), rice (*Oryza sativa*), tobacco (*Nicotiana tabacum*), cassava (*Manihot esculenta*), beans (*Phaseolus vulgalis*), ground nuts (*Arachis hypogaea*), cocoa (*Theobroma cacao*), and sugar cane (*Saccarum africanum*) (Sentayi, 2002).

Primates are among the pests that damage crops particularly in African and Asian reserves, accounting for over 70% of the crop damage and 50% of the area damaged (Naughton-Treves, 1998). Because of their intelligence, opportunism, adaptability and manipulative abilities, some species can easily turn to crop foraging and make formidable crop raiders. The human and non human primate niches overlap extensively making competition much higher between the two posing quite a number of management problems (Strum, 1987).

Crop raiding around Bwindi Impenetrable National Park (BINP) presents a major problem towards improving the park community relations. While the predation of crops by wildlife serves as a contributing factor to the generation of local community hostility

towards the park, it warrants consideration as a pervasive problem to the park management in its own right due to the magnitude and complexity of the problem (BINP Management Plan,1995)

A study around the Budongo Forest Reserve in Masindi District found that the cost of crop raiding and guarding varied from US$96 to 519 per household per year. This is a huge amount o f money if one considers average local incomes in this area which are at only US$25 to 30 per month (Sillero-Zubiri and Switzer, 2001).

Bugoma Forest Reserve is situated in Hoima district in the western part of Uganda. This forest reserve was first gazetted by Legal Notice No.87 of 1932 as undemarcated forest reserve of 35,840 ha. Under Legal Notice 251 of 1944, the area was increased to 43,520 ha. According to the Biodiversity report on Bugoma Forest Reserve, Bugoma is an exceptionally rich forest in terms of vertebrate fauna. Two notable bird species are nahan's francolin and the black eared ground thrush which are known from only one other forest in Uganda, Kibale forest. Sizeable populations of chimpanzees and small numbers of elephants have been recorded in Bugoma Forest in recent years (National Forestry Authority, (2001).

The surrounding communities practice mainly subsistence agriculture. The types of crops grown are mainly cereals which attract all sorts of forest animals that keep attacking the farmers' crops. The increased frequency of attacks from these animals has posed a serious challenge to both the neighbouring farmers and the conservationists and

managers of Bugoma Forest Reserve.

Earlier research focused on the issues related to crop damage by elephants and rodents (Hill and Plumptre, 2002), yet other animals such as primates and ungulates are also important pests in agricultural areas. Unfortunately, much of the information that is available is "hidden" within reports and papers (Hill and Plumptre, 2002)

1.2 Problem statement:

There have been several complaints from the people of Igwanjura parish to the district environment office on issues of vermin/problem animals attacking and destroying crops and property of people living in close proximity to Bugoma Central Forest Reserve. The increasing population within areas surrounding Bugoma Forest Reserve has increased the search for free land mainly for settlement, agriculture and grazing. People from neighbouring reserve come to harvest forest resources that include but are not limited to timber, charcoal, building poles, rattan canes, forest sticks, medicine, honey, bush meat, bush sticks, white ants, mushrooms, and beer brewing, among others. Some of these people end up getting settled within the proximity of the forest reserve.

The people within and around the reserve are small scale farmers who entirely depend on subsistence agriculture for their livelihoods but the crops they grow are destroyed by vermins and other crop raiders. These people have tried to grow cash crops that are presumably not attractive to vermins, for example tobacco but are also destroyed by trampling.

Farmers have increasingly lost crops to vermin/problem animals, hence increased human wildlife conflicts. This has increased competition for forest resources by both humans and wild animals, due to destruction of wildlife habitats which leads to competition for

food, water, among other forest resources, and increased the food shortage problem within the area. It is against this background that the researcher was prompted to carry out this research, to assess the impact of crop raiding by wild animals on people's livelihood around Bugoma Forest Reserve.

1.3 Objectives of the study

1.3.1 Overall objective

The overall objective of the study was to assess the impact of crop raiding by wild animals on people's livelihoods around Bugoma Forest Reserve, Hoima District.

1.3.2 Specific Objectives :

i. Identify animal species most involved in crop raiding from Bugoma Forest Reserve
ii. Identify the types of crops most affected and measure the extent of damage by wild animals
iii. To find out the underlying causes of crop raiding by wild animals.
iv. Assess the effects of crop raiding on the livelihoods of the people surrounding the forest reserve.

1.4 Research questions:

i. What are the animals species most involved in crop raiding from Bugoma Forest Reserve ?
ii. What crops are most affected and to what extent ?
iii. What are the underlying causes of the problem of crop raiding in the study area?
iv. How has crop raiding impacted on the livelihoods of the community around the forest reserve?

1.6 Justification

A wide variety of mammalian and avian species are involved in crop raiding and the impact they cause to neighbouring communities, is significant. This research therefore was intended to offer solutions to the problem of crop raiding within the surrounding areas of Bugoma Forest Reserve to improve on the livelihoods of the surrounding communities. The study also lead to suggest strategies for living in harmony with wild animals. Information generated by this study is intended or will help improve the knowledge and understanding of protected area managers and the people on how to reduce the impacts resulting from crop raiding by wild animals.

1.7 Scope of the study

In view of the stated problem, the impact of crop raiding by wild animals on people's livelihoods is quite a big challenge. As Bugoma Forest Reserve is quite big, only a small sector covering the western part of it was studied in greater details. The research therefore concentrated on the most common crop raiding animals, identified the type of

crops raided and the impacts that arise out of crop raiding and how these impacts can be mitigated to harmonize community wildlife relationships. The study was purposely carried out in Igwanjura parish that harbours a bigger number of the human communities around Bugoma Forest Reserve. Igwanjura parish was taken as a representative sample of other parishes within Kabwoya Sub County as it is the parish with several complaints of vermin and crop raiding animals.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Conservationists view human wildlife conflict as a critical new problem created by growing rural populations settling in or near wildlife habitats .Historically experts realized that agriculturalists have lost crops and livestock to wild animals for centuries. (Vansina ,1990; Sukumar,1994).

People have coexisted with wildlife since the early age when they lived a simple hunter-gatherers lifestyle supplementing his diet with fruits and leaves. Man has been and is still a threat to wild plants and animals. The interaction between wild animals from National Parks, Wildlife reserves and forest reserves with man has been studied in many different areas of the world.(Uganda National parks,1995;Thouless,1994) A lot of studies have been done on the impact of wild animals on agricultural crops in eastern and central Africa (Thomption , 1966; Bere,1962)

Human wildlife conflicts is not a new problem in Africa. The contemporary conflict between farmers and wildlife at the edge of Uganda's National parks, wildlife reserves and forests echoes the traditional pattern of conflict on African agricultural frontiers, in historical times, agricultural frontiers were dynamic. At some sites, shift in animal distribution forced farmers to abandon cultivation due to heavy crop losses (Osmaston ,1959; Vansina, 1990). More recently, as human population continues to increase, human

– wildlife conflicts have intensified and this demands careful management plans.

Crop raiding by wildlife is a problem of most rural Africa which has led to incidences of loss of human life, injury to humans, destruction of crops and farm infrastructure (Hill, 1997; Naughton-Treves, 2001). A common, ancient and global example of human wildlife conflict is crop raiding (Hill , 1997; Naughton – Treves ,2001) whereby a range of mammals, birds and insects utilize cultivated crops as their food resources.

The problem of crop raiding is thus a national and an international problem for which no perfect long term solutions have yet been found. In other National Parks and forest reserves , quite a number of measures to minimize crop raiding have been implemented ranging from the establishment of a stone wall in Bwindi Impenetrable and Mgahinga Gorrilla National Parks , to creating long ditches in Kibale National park. (Uganda National Parks ,1996)

2.1 Common animals involved in crop raiding

When crop raiders cross into a farm to raid crops, they are typically viewed as "pests", "weeds" or "ecological" dislocates (Sawarkar, 1994). Crop raiding is seldom incorporated into theoretical studies of primates feeding ecology or behavior because of an emphasis on evolved plant –animal interactions (Richard ,1985)

In Uganda , crop raiding by wild animals has persisted as a problem in most of the areas surrounding Protected Areas to the detriment of surrounding communities' livelihoods. In Kibale National Park (KNP), the problem animals (bush pigs, baboons, redtail monkeys, elephants and buffalos) cause significant crop damages outside the park and this jeopardizes the park community relations (UWA, 2003). Though often demanded, compensation for damage caused by wild animals, the law does not allow for compensation. Uganda Wildlife Authority (UWA, 2003)

From Africa to the Arabian Peninsula up to south East Asia and Japan, primates come into conflict with humans due to the renowned crop raiding behaviour of many species. Omnivorous species like the baboons will take a whole range and diversity of foods, including many crop species, and often utilize several different parts of these plants rendering the plants vulnerable throughout their life cycle (Sillero-Zibiri, 2001).

From the animals' perspective, fields of ripe maize may be analogous to the mast fruiting of forest trees that bearded pigs (Susbardatus) raided crops less heavily during mast fruiting events in the forests of West Kilimantan. Similarly shifting agriculturalists in the Ituri forest of Zaire ascertained a decline in crop raiding by primates and bush pigs when fruits were abundant in the forest (Mubalama 1996). These anecdotes suggest that the timing of crop raiding is influenced by the availability of fruits in the forest. Others attribute temporal peaks in raiding behaviour to crop availability, which is in turn driven by seasonal patterns of rainfall (Osborn ,1998)

Among the 17 wildlife species recorded damaging crops around Kibale National Park during a 2year period, primates accounted for 71% of damage and 48% for the area for crop damage (Naughton -Treves, 1998). Redtail monkeys were by far the most frequent raiders, while baboons damaged the greatest area of crops. Chimpanzees ranked third but caused less than one-third the crop damaged by baboons, and one-half the damage by red tails. Black and white colobus (*Colobus guereza*), Vervet and I'hoests monkeys were also occasionally observed foraging on crops.

Considering the crop raiding animals that inflict the greatest damage, big animals such as elephants, and buffaloes, receive disproportionately large amounts of the blame for the damage caused. On the other hand, smaller animals such as wild pigs, baboons, rodents and birds which cause the greatest cumulative damage overtime are less frequently complained about. Similarly, domestic animals may cause considerable damage to crops yet the damage does not elicit high community resentment (Graham, 1973).

Primates are particularly serious crop raiders especially due to their intelligence, adaptable and sometimes intimidating behaviour (Else, 1991; Strum, 1994). In addition, several species are protected by the law, which can aggravate and even generate conflict (Knight, 1999). By protecting wildlife species and restricting traditional crop protection methods Hill,(1999) communities begin to have a different view of the problem Naughton – Treves,(2001).

It is important to conduct research that examines conflict mitigation strategies for crop

raiders, making rural farmers less vulnerable to crop loss while protecting important wildlife species.

In a study conducted around Mgahinga Gorilla National Park, Andama (1999), noted that, assigning blame to particular crop raiders corresponded to the perceived origin of raiding animal rather than the amount of crop lost or frequency of raiding incidences. Andama (1999) noted that, porcupines were perceived as causing more crop damage yet the study findings indicated that birds caused more damage. Secondly, porcupines cause intensive damage to crops and mainly raid Irish potatoes, which is a major crop grown in the area for both domestic use and sale.

People's perception matters a lot when comparing different crop raiders. Weaver birds frequent gardens but pose no threat according to communities. People claim birds only come early in the morning and late in the afternoon when children are around and can chase them. On the other hand, baboons are considered unpredictable and cause more damage because people cannot predict when or whether they will visit an individual farm and that the protection methods available are not considered adequate Hill, (2000).

Naughton-Treves, (1998) also assert that around Kibale National Park, crop raiding frequency on maize peaked approximately eight weeks after the onset of rains and was strongly corresponds with the three primate species. Abundant forest fruit did not diminish primates' appetite for maize. Raiding frequency on bananas varied considerably despite continuous availability of fruit and pith in the forest. Peaks in banana

consumption or destruction by primates were unrelated to maize damage but were associated with forest fruit shortages, especially *Mimusops bagshawei*. Chimpanzee and baboons consumed banana pith and banana fruit respectively. Banana pith consumption by chimpanzees supports the suggestion that energy-rich pith is crucial to chimpanzees during fruit scarcity in the forest(Naughton-Treves, 1998)

2.2 Type of crops most affected and extent of damage by wild animals.

An important consideration is how crop damage is distributed. The damage occurs seasonally or year round? Baboons are likely to visit fields all year round, Thus farmers, whose farms are located close to the forest boundary, are potentially at risk of losing staple crops year round. A point to note is that crop raiding activity, especially by wild pigs occurs at night, so fields have to be protected at night (Hill, 2000).

Crop raiding is not a new phenomenon; it has most likely been occurring since humans started practicing agriculture. Many different crops are targeted by animals, these include cereals, fruits, and vegetables and trees (Sillero-Zubiri, 2001).

Naughton- Treves (1997) analyzed the incidence of socio-economic variables on local perception of the conflict around Kibale National Park, where 54% of the land is within 200 m from the edge of the park. The farmers lost on average 4-7% of their crop per season and reported the use of defensive strategies (mainly guarding and to a lesser extent fencing and trenches). Farms that are located close to the forest boundary are likely to

suffer much more from crop damage. In Bundibugyo and around Kibale National Park, crop raiding by large mammals was found to generally be limited to within a few hundred meters of the forest edge, with fields further away receiving little or no damage (Naughton-Treves, 1998).

Hill, (1999) asserts that, where chimpanzees raid cash crops, there is great friction between the local communities and the protected areas' authorities. This is particularly true around Bugoma Forest Reserve where cocoa is being grown and around Budongo Forest Reserve where sugar cane is being grown Plumptre, (1997) observed that chimpanzees raid mango and pawpaw trees but people do not regard these as important crops. Around Budongo Forest, fruit trees are considered as food for children ,the fruit is not considered important and people can disregard losses to chimpanzees.

In Budongo area (Masindi District), maize, cassava, finger millet and sweet potatoes are the four most commonly grown carbohydrate sources. Of these, cassava, maize and sweet potatoes are at most risk of being raided by wildlife (Sillero-Zubiri, 2001).

The Budongo survey found average crop losses of 25% for cassava (range 4.5-61%) and 19% for maize (range 7.7-53%) (Sillero-Zubiri, 2001). Crop raiding may be greatest during harvest season, but it does occur throughout the year. In particular maize seems to be targeted and damaged throughout its growing cycle, from the newly sown seed to the time the cobs are mature. Damage sustained at any stage can cause severe crop losses, but these are most serious when crops are mature (Sillero-Zubiri, 2001).

Elephants have been observed to show preference for certain crops (Naughton-Treves, 1998). It was observed that bananas and sweet potatoes were the most preferred crop species by elephants in areas around Kibale National Park (Naughton-Treves, 1998). However, there is lack of information whether the abundance and distribution of preferred crop species determine the intensity and patterns of crop predation.

There is increasing cultivation of cash crops in the country, particularly where land was relatively undisturbed, especially in Hoima, Kibaale, and Masindi districts. There are increasing problems of human-animal conflict in these areas. (Uganda Wildlife Authority, 2007).

However, problems occur when all endangered species are protected, such as chimpanzees and elephants raid crops. As a signatory to CITES and the Convention on Biodiversity, Uganda has committed to protect these species of conservation concern. crop raiding by chimpanzees is a problem around Budongo where they raid sugarcane (in Kinyara plantation and out growers fields). Around Bugoma Forest Reserve cocoa crops have been affected and around Kibale National Park the most raided crops are bananas. (Plumptre,2002).

In another study carried out around Parc Nationale des Vulcan's (PNV) in North West Rwanda, Plumptre, (1997) it was found that 91.2% of the respondents faced problems from crop damage caused by wild animals. The vast majority of respondents (71.3%) claimed that the buffalo was the worst offender, followed by the bushbuck (40.3%). The

effect is directly proportional to distance from the park boundary. Buffalo, bushbuck, duikers, and porcupines (those animals that raid most frequently) all showed strong negative correlations between crop raiding frequency and distance from the park boundary. Sweet potatoes and wheat were consumed by buffalo and bushbuck while, sorghum tended not to be consumed except by cane rats. Whether animals perceived to be the worst crop raiders actually cause the most damage needs further study. Buffalos are large and can be dangerous, and may be considered to be 'bad' because people are afraid of them rather than because they cause more crop damage (Hill, 1997).

Twenty three months of data from 4 villages around Kibale National Park, Uganda, revealed that primates including redtailed monkeys (*Cercopithecus ascanius),* Olive baboons (*Papio anubis)* and chimpanzees (*Pan troglodytes)* selected different crops or plant parts even if bananas or maize figured the most preferred crops. Even when animals selected the same crops, there were variations in the specific plant part eaten or the age of the crop when attacked. Baboons took root tuber crops that the other primates ignored, and also fed on the greatest variety of crops, averaging 15 types. They forage on maize throughout its lifecycle (seedlings, inflorescence, pith and fruit), while redtailed ate only banana fruit, baboons ate banana fruit frequently than pith, and chimpanzees raided pith and fruit in equal proportions (Hill ,1997).

2.3 Causes of crop raiding by wild animals

2.3.1 Increasing human populations.

Rapid population growth with a national average growth rate of 2.5%-3.5% in Uganda and the changing life styles have resulted into destruction of habitats through

encroachment for agriculture and human settlement. This has resulted in human-chimpanzee conflicts around major National Parks and forest reserves in Uganda (Oloya, 2002).

Chimpanzees once inhabited the entire equatorial zone now occupied by 25 African countries, and their number are decreasing at an accelerated rate as human population increases throughout the region (Goodall, 2001). Chimpanzees are now found in only 21 of these countries and their populations have become fragmented and isolated due to human encroachment on their habitats. Currently the major threats to survival of these species are illegal poaching for 'bush meat' and the pet trade, as well as deforestation through agriculture and logging. Chimpanzees are now on the endangered species list and are protected in all countries (Goodall, 2001).

As a result of increasing human population and migration into Bunyoro, there is increasing encroachment on forest reserves for crop production. Tobacco production is increasing very fast in the district because of the incentives given to farmers by tobacco companies. People are opening up new or virgin land for crop production resulting into forest clearance. This has in turn led to human settlements and cultivation getting closer to the wildlife habitats. The wildlife which are of great concern to us in Hoima district, include baboons, pigs and chimpanzees. Chimpanzees are very destructive in places where they exist, especially in Kyabigambire, Kitoba, Kabwoya, Kyangwali, and Bugambe sub counties in Hoima district (Ssentayi, 2002).

2.3.2 Lack of a buffer zone.

Elements of Kibale National Park's remarkable biodiversity create conflict between the

park and adjoining human communities (Chetri, 2004). In the absence of a buffer zone between the park and the surrounding public lands, wild animals move freely between park and farm lands destroying crops (Chetri, 2004).

2.3.3 Local increase in wildlife populations.

Strong opposition by international stakeholders to wild population reduction through culling and bans on hunting means that wild animal populations are increasing locally. This, coupled with increased protection, has resulted in a tremendous increase in the wild -life populations as well as changes in animal behaviours. Due to restrictions in culling, populations of large mammal species such as elephants increase, resulting in high densities within the protected areas (Naughton -Treves, 1996), thus leading to incursions outside the park.

Elephants which are locked in parks at high densities are reported to raid surrounding farms very frequently. Tchamba (1995), states that the increases in abundance and such factors as war and other disturbances can displace animals resulting into occupying buffer zones and increased contacts with humans. Some displaced animals may turn to crop raiding to survive in resource-poor habitats (Tchamba, 1995).

2.3.4 Wildlife ownership changes.

Ownership and control over wildlife areas and resources is contested in all wildlife rich areas (Naughton-Treves, (1996). While states have taken over vast areas for conservation purposes, indigenous residents have not given up claims for rights to benefit economically from these areas. In some situations, local communities have been evicted

to establish protected areas. Under such circumstances, traditional rights over wildlife resources are lost and become an issue of contention to the local community (Naughton-Treves, (1996).

2.3.5 Changes in agricultural methods and techniques

In recent decades there has been a significant shift towards the intensification of agriculture, and the resulting large monoculture can be very attractive to animals. Some animals are naturally pre-adapted to take advantage of these opportunities, for instance cereal crops are a target for birds that are primarily seed eaters , and root vegetables are prime target for species of pigs that are able to dig the ground. Omnivorous species like baboons will take a wide range and diversity of foods, including many crop species, and often utilize several different parts of these plants, rendering them vulnerable throughout their life cycle (Sillero -Zubiri, and Switzer, 2001).

2.3.6 Increase in agriculture and encroachment

Through high population pressures, the rise in demand for land for cultivation means that in many areas much of the suitable arable land is already cultivated. More marginal land is therefore tilled and farming goes right up to boundary of wilderness and protected areas. Pest species are likely to flourish along the edges of natural habitat and agricultural lands, where they can eat both the food available in undisturbed habitats and the crops growing in the adjoining farmland (Sillero -Zubiri, and Switzer, 2001).

2.3.7 Competition for resources between people and wildlife

Crop raiding is on the increase and people are competing with wildlife for resources. The

development of small scale farming in areas that have historically been known to be prime wildlife habitats, or migration corridors. . In Kenya for instance, the remarkable transition from semi nomadism to semi agricultural and settlement. Most natural wildlife buffer zones have led to competition for food, water, habitats, and space for both humans and wildlife hence resulting in a conflict for survival (Kagiri, 2000)

2.4 Effects of crop raiding on peoples livelihoods

Crop raiding and hunting may be closely linked. People interviewed around Parc Nationale desVulcan's in Rwanda admitted to hunting crop raiding animals and expressed dissatisfaction with the park authorities for not doing anything to prevent crop raiding. People who admitted to hunting in the park have small farms located near the park edge and are consequently likely to be most affected economically by crop raiding animals Plumptre, (1997). Crop raiding can reduce farmers' tolerance towards wildlife. Despite high human population densities in rural areas and more rapid conversion of forest to farm land, much less is known about crop raiding in Asia and Africa (Linkie, 2007).

Human-wildlife conflict is recognized as a significant threat to the success of conservation initiatives (Strum, 1994).

Crop raiding is a major problem in Uganda currently because it leads to a very negative attitude towards protected areas and their managers. There is therefore a great need to find ways of reducing this friction by either reducing the level of crop loss or by raising the tolerance of local people so that they are prepared to accept a certain amount of loss. Crop raiding is a very emotive issue and finding effective solutions is difficult. (Hill,

2002)

Despite the extent of human-animal conflict has not been adequately monitored systematically or assessed quantitatively (Hoare, 1995). The damage caused by problem animals range from 10% to 90% depending on location and crop types. Naughton – Treves (1997) observed that crop loss caused by park animals along Kibale National Park boundary is between 4-7% which equals to nearlyUS$6 per farmer or US$100 per kilometer of boundary per year.

Damiba and Ables (1993), noted that production of highly palatable and nutritious seasonal crops such as maize, which attracts primates and other wild animals involve heavy losses and therefore high guarding investments. In some instances farmers lose a whole garden particularly in areas highly infested with baboons, vervet monkeys, bush pigs and porcupines, which inflict heavy and potentially catastrophic losses.

Nchanji (1998), reported that crop raiding is a serious problem as crop raiding animals can have a devastating impact on the standard of living of peasants whose entire survival is dependent on subsistence agriculture. He estimated that in situations where farmers guarded their crops, the loss incurred was 30% and where there was no guarding at all, it was 90%.

Chambers (1992), also noted that in some cases, there was severe food shortages, high food prices, malnutrition and morbidity increased besides the rural agricultural society

becoming poorer and poorer, majority of children not going to school and in situations where farmers guarded their crops, children were forced to abscond from school to guard crops.

Nchanji (1998) reported that the vermin problem generates negative attitudes towards wildlife and that threatens their future survival. The wildlife being a state property causes considerable resentment and the anti-poaching by-laws further prevent people from eliminating problem animals to protect their crops, livestock and themselves. This implies that despite bearing the significant cost of living with wildlife, rural people in Uganda and other countries collaborate resource management has been embraced. They therefore regard wildlife as a source of trouble rather than a potential natural resource for their benefit.

Crop raiding will continue to increase in Africa in the foreseeable future as the human population continues to grow. In the year 2000 the population of sub – Saharan Africa was estimated at 657 million. By 2025 this is expected to have grown to 1,053 million and by 2050 to 1,556 million. The rise in human populations will undoubtedly lead to the expansion of agriculture into areas currently unused (Sillero-Zubiri and Switzer, 2000)

2.5 Identified gap to be filled

Researched information will update web-based portal including conflict databases, remedial technologies, good management practises, as a fulfilment of one of the five recommendations of the IUCN World Park Congress (2003) which recommended an

establishment of international forum that acts as a global network for sharing information and expertise in addressing Human Wildlife Conflict. Furthermore, the development of an innovative solutions and their outcomes, Good management practises, workable and competitive measures that could be replicated across a wider spectrum

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the location of the study area around Bugoma Forest Reserve. It highlights the design, target population, sample size, sampling procedure instruments and data analysis techniques used.

3.2 Study area

3.2.1 Location

The study was carried out in Igwanjura Parish, (Figure 3.1) one of the 4 parishes in Kabwoya subcounty, Buhaguzi County, Hoima District. It is bordered by Bobogo parish in the north, River Nguse in the south, Bubogo parish in the east and Bugoma Forest Reserve in the west. The study was conducted in five villages of Igwanjura parish which include: Kiburara, Nyangabi, Bwijongoro, Kyabayanja, and Kimbugu. I worked with local community members in the parish to identify villages within a distance of 1.5 kilometers from Bugoma Forest Reserve.

3.2.2 Population

Igwanjura has a population of 10,723 people according to the National census of 2002 of which 5,591 are male and 5,132 female (UBOS, 2002). The population is mostly along Hoima Fort Portal road.

3.2.3 Ethnic composition

Igwanjura parish has a heterogeneous population with the indigenous Banyoro being the dominant tribe followed by the Bakiga, Lendu, Lugbara and Bafumbira. Trailing behind are Bahima, and Bakonjo.(Hoima District Development plan 2004).

3.3 Geographical features:

3.3.1 Land

The land for settlement and cultivation in Igwanjura parish covers the largest part followed by patchy forested areas and plains (wet lands) along major rivers like Nguse. The terraine of Igwanjura is a fairly flat with undulating ridges like hills that run parallel to valleys that have rivers and streams in between.

3.3.2 Climate

The area generally has a pleasant climate with little variation in temperature, humidity and winds throughout the year. It receives a total rainfall of about 700-1000mm per annum. Wetter months are April and May and September/October, with two dry spells occurring in June/July and December/January. This type of climate and the good loamy soils favours the growth of a variety of both food and cash crops. Western areas bordering the rift valley are the driest and hottest. Mean annual temperature average 28^{o}C. Temperatures are generally high ranging between 15^{o}-32^{o}C.

3.3.3 Water bodies

It has a high network of streams, rivers and marshy areas that are evenly distributed in the whole parish. Rivers Nyakaralike, Nyakibumba, Kadiki, Nguse, and Kabatobato form the main systems

3.3.4 Communication

Road net work communication is still being developed as the area. Radio stations of Hoima and Kagadi and MTN mobile phone network cover all the parts of the parish.

3.4 Economic activities:

The recent influx of people into the parish has brought about economic development in the area with the following representation:

Wild lands that were once full of wild animals like baboons, buffaloes, elephants and forests have been cleared for human settlement and cultivation. Some growing point settlements are turning into trading centers. The areas that are arid , plains and wetlands along rivers have turned into grazing lands. There is an increased road network to tap the agricultural produce in the most remote areas.

3.4.1 Economic importance

The Bugoma Forest Reserve has some potential for tourism and recreation. Karwata Fort, a historic Bachwezi defence and the relatively undisturbed forest around it is ideal for nature tourism, a potential not yet exploited. Bugoma Forest Reserve is between Murchison Falls National Park and Kibale National Park and would be an ideal stop over along the western tourist circuit.

3.3.2 Socio-economic problems:

The study area is also affected by certain socio economic problems that have affected its development including inter alia: High demand for social services and social infrastructure. Gross encroachment on the once natural environment for the last 10 years and conversion into arable and grazing land.

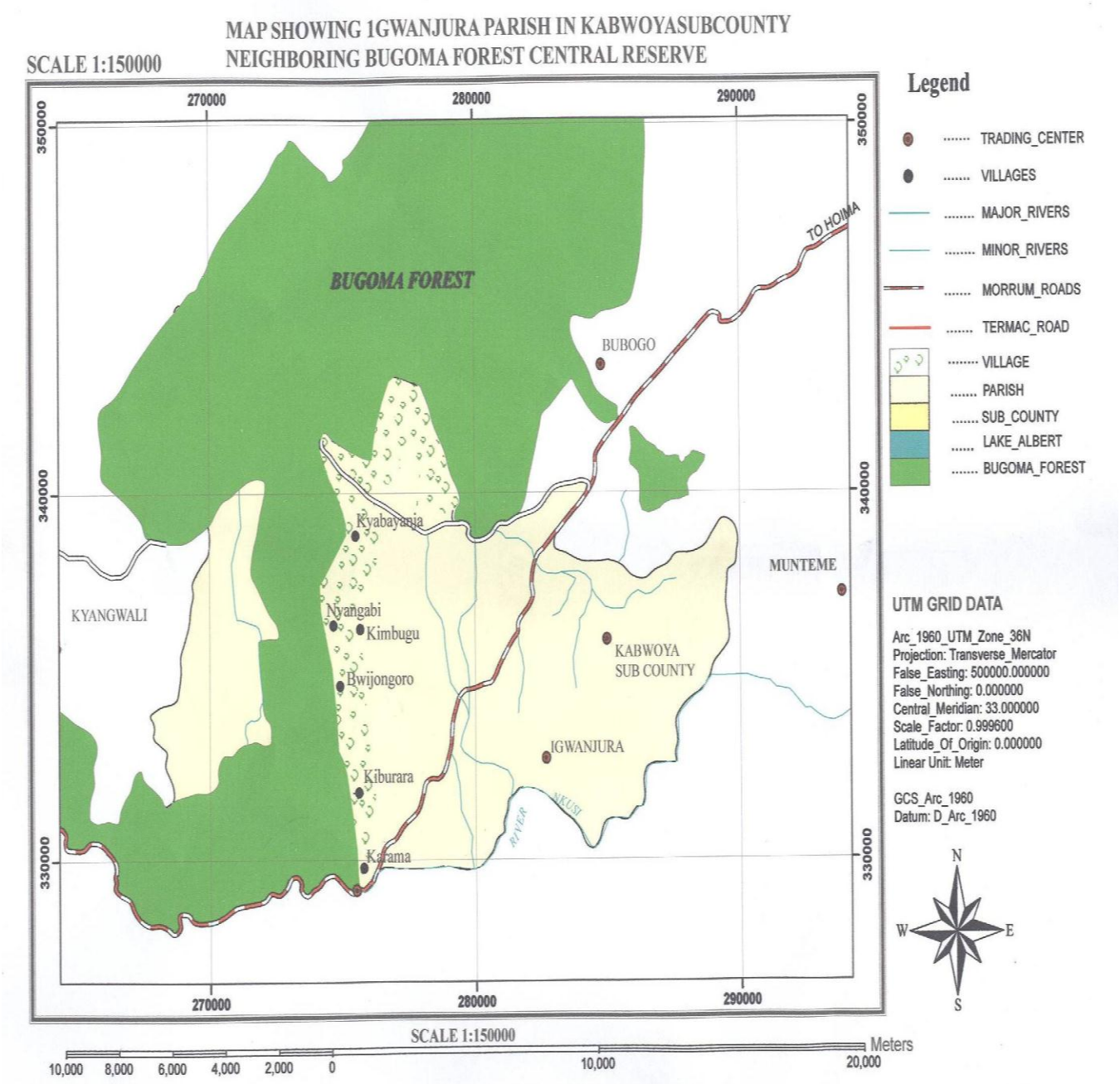

Figure 3.1 Map Showing Igwanjura Parish in Kabwoya Sub county Neighboring Bugoma Central Forest Reserve.

3.4.3 Soils

The soils of Igwanjura and the surroundings are mainly red, black loamy and sedimentary beds which occupy parts of Bugahya and Buhaguzi counties. There are 8 soil units which include two soil catenas, three soil series, two soil complexes and one papyrus peat. The soil types have been identified and mapped based on 1:250000 reconnaissance soil map sheets, NA36-15(1971)

3.4.4 Agriculture

Agriculture is still the major economic activity in the parishes near and around Bugoma forest, engaging about 63% of the working population. Production is carried out on a myriad of small farms scattered all over the district with average holdings about 2 hectares. Agriculture in the district is highly dependent on the traditional methods and natural environment. Major crops grown include coffee (robusta), tobacco, cocoa, millet, cassava, maize, beans, cotton, ground nuts, rice, tea, among others. Except for tea and tobacco all other crops are attractive and commonly raided by wildlife from the forest reserve

3.4.5 Village residential patterns:

The settlement pattern in the villages around the forest reserve is clustered around main trading centers and linear settlements along main routes.

3.4 Research design.

The research conducted was both quantitative and qualitative in nature where descriptive

or cross-sectional methods were used. Systematic data collection was used to isolate important variables within a highly varying agro ecosystem.

3.5.1 The study target population

The investigations were made on paired fields from 90 households in Igwanjura parish in Kabwoya Sub-county. The LC.III chairperson of the sub-county and the five LCI chairpersons of the five villages where the study was carried out were also consulted and included in the study.

3.5. 2 Sampling Frame

The main objective of the study was to ascertain the impact of the crop raiding of wild animals on the livelihoods of the people around Bugoma Forest Reserve. The sampling unit was a household and the 2002 census population of household was used to determine the sample size. The sampling frame was the village mapping for the 2002 population and housing census conducted by Uganda Bureau of Statistics (UBOS 2002). From the mapping the selected households were easily identified.

The subjects of the study were agriculturalists, hunters, craft makers and administrators. The administrators selected were at district level, sub-county and local council LCI chairpersons of the selected villages. Selection of agriculturalists, hunters and craftsmen was random.

In a farming system with numerous variables, the matched pair sampling design helps control the variability in the agro-ecosystem which otherwise might confound the analysis. Within each village surrounding the reserve, pairs of fields were selected that matched in age, type of crops and size but differed in one factor, distance and direction

from the forest edge. The field selection depended on distance from the forest edge (500 m-1.5 km).

3.5.3 Sample size

Multistage sampling was done to determine the sample size of the study where 90 households from five villages of Kiburara, Nyangabi Bwijongoro, Kimbugu and Kyabayanja were selected, as they are found to be adjacent to the Bugoma Forest Reserve. Then household number of households in the village were selected to give a fair representation of the samples under study.(Table 3.1)

Table 3. 1: Distribution of sample households per village

Village	**Number of households using household mapping per village**	**Sample proportion**	**No. of Respondents**
Kiburara	106	106/624*90	15
Nyangabi	151	151/624*90	22
Bwijongoro	108	108/624*90	16
Kimbugu	115	115/624*90	17
Kyabayanja	144	144/624*90	21
Total	624		90

3.5.4 Data collection techniques (instruments)

3.5.4.1 Questionnaire

Questionnaire suvey were used to acquire information on the various aspects of the study about the different variables with the questions being both open and close ended. The questionnaire survey was carried out between July and August among local community and strictly in all five villages of Igwanjura parish in Kabwoya sub-county (see Table 3.1). Interviews were held with administrators, agriculturalists, hunters, carpenters, craft makers and civil servants were conducted to establish in depth information about crop raiding problem and its consequences on farmers' livelihoods. This approach mainly collected primary data.

3.5.4.2 Observation / Direct assessment.

Field visits and observations were mainly used to confirm the respondents' responses so that accurate and reliable information would be collected since most farmers have a tendency of exaggerating the problem in anticipation of possible financial help. Observation was also important in identifying the particular problem animal species responsible for the damage through assessing the teeth marks left on the damaged plants and foot marks of the animals.

3.5.4.3 Review of literature.

Information gathered from secondary sources of data, were related to literature written about the problem in question by different authors while comparing and contrasting the

issues raised on the subject of the research. This approach generated secondary data.

3.5.5 Administrative procedure

The researcher obtained an official letter /introductory letter from the Institute of Environment and Natural Resources, Makerere University which was presented to Hoima District Administrators for acceptance. These further recommended the statement to the respective sub county where the research was due to be carried out. The sub county officials acknowledged receipt of the letter and later directed chairperson's LC1's of sampled villages to help in guiding the researcher around villages to collect the necessary data.

3.5.6 Data analysis and presentation

The collected data from the field were analyzed using statistical package for social scientists (SPSS) as shown in the subsequent chapters. Treated data was summarized in Tables, Figures and Plates to enhance comprehension and interpretation

CHAPTER FOUR

RESULTS

4.1 Introduction

The Majority of the households in the parish are farm-households and 90% of the parish population depends entirely on agriculture. Basically, observed agriculture was subsistence but most of the surplus food crops are sold to generate household income. Due to the fast growing population at a rate of 4.7% (population and housing census 2002) of Igwanjura parish , the population is mounting high pressures on the land and increasingly land is getting scarce forcing the masses to resort to edge next to forest reserves for farming activities.

4.2 Background characteristics of the respondents in the area of study

Table 4.1 indicates gender of respondents where by 52% of the responses were received from males while 48% of the response were from females. This helped to avoid bias in data that were collected because they were so important to get views from both gender parties.

Table 4. 1: Sex of respondents

Sex	**Frequency**	**Percentage**
Male	47	52
Female	43	48
Total	90	100.0

Table 4.2 shows the age groups of respondents whose responses were mainly got from persons of ages between 18-24years with (42.2%), 25-29 years with(24.4%)and 45-49 years with (14.4%), as they are the majority living along the forest reserve and are energetic, looking for grazing land, hunting, collecting forest products, conducting agricultural activities, among others.

Table 4. 2: Age of respondents

Age (in years)	**Frequency**	**Percent**
18-24	38	42.2
25-29	22	24.4
30-34	6	6.7
35-39	6	6.7
40-44	1	1.1
45-49	13	14.4
50-54	1	1.1
55-60	3	3.3
	90	100

Responses were got from various categories of people of which 80% were married, suggesting that responses were from responsible and mature people (Table 4.3). A small fraction of 12.2% of the respondents were single. The bigger percentage of respondents were married, and therefore mature and are likely to require land for settlement and agriculture .

Table 4. 3: Marital status of respondents

Marital status	**Frequency**	**Percent**
Single	11	12.2
Married	72	80.0
Divorced	1	1.1
Widowed	6	6.7
Total	90	100.0

Table 4. 4: Education Background of respondents

Respondents	**Frequency**	**Percent**
None	43	47.8
Primary	17	18.9
Secondary	6	6.7
Vocational	8	8.9
Post secondary	16	17.9
Total	90	100

Table 4.4 shows that 47.8% of respondents interviewed were illiterate 18.9% attended primary level, and those who had attended secondary, vocational and post secondary

education were 6.7%, 8.9% and 17.9%, respectively. Therefore the study results have indicated high illiteracy of respondents meaning that the biggest percentage of population interviewed are involved in agriculture, hunting, craft making, and collecting forest products among others.

Table 4. 5: Main occupation of respondents

Main occupation	Frequency	Percent
Agriculturalists	55	62
Hunters	20	22
Craft makers	10	11
Carpenters	3	3
Civil servants	2	2
Total	90	100

Field data shows that 62% of the respondents were subsistence agricultural farmers other occupations included hunters (22%),craft makers (11%) carpenters (3%), and civil servants (2%) as shown in Table 4.5. These findings, show that crop raiding can affect the community most, since the majority of the respondents are engaged in farming(62%).

Table 4. 6: Size of land (acres) owned by respondents

Size (acres)	Frequency	Percentage
20+	54	60
1-4	18	20
10-14	18	20
15-19	0	0
5-9	0	0
Total	90	100

Table 4.6 shows that 60% owned at least twenty acres of land, 20% owned one to four acres and another 20% between 10- 14 acres of land. Of those respondents who owned land between 10-14 and 20+ acres, were comprised of agriculturalists, hunters and craft makers among others and the rest who owned land between 1-4 acres were civil servants and carpenters. This shows that most of the respondents are affected by crop raiding.

4.3 Animal species most involved in crop raiding.

In response to the first objective of the study; to identify animal species most involved in crop raiding/damage from Bugoma Forest Reserve to the people neighbouring the forest, respondents were asked through one to one interviews guided by questionnaires to identify the animals that mostly raid their gardens and destroy crops. These animals were

listed by the respondents and the results are presented in Table 4.7

Table 4. 7: Animal species involved in crop raiding indicating, frequency rank and the percentage of respondents that was affected by each crop raiding species.

Type animal	Scientific name	Frequency	% respondents	Rank
Baboons	Papio anubis	21	23.2	1
Vervet monkeys	Cercopithecus aethiops	18	20	2
Wild pigs	Potamochoerus porcus	17	18.8	3
Wild birds		10	11.1	4
Squirrels/edible rats	Funisciurus anerythrus/ crycetomys spp	9	10	5
Porcupine	Hystrix cristata	8	8.8	6
Chimpanzees	Pantroglodytes, schweinfurthii	5	5.5	7
Colobus monkeys		2	2.2	8
Total		90	100	

Table 4.7 shows that, baboons were ranked as the most rampant crop raiders in Igwanjura parish, followed by vervet monkeys , wild pigs, wild birds, squirrels/edible rats, porcupine, chimpanzees, colobus monkeys and livestock were ranked least.

4.4 Crops most affected and the extent of damage by wild animals from Bugoma forest reserve

Data were also sourced on crops mostly affected by wild animals. This was done in an attempt to answer the second research question and objective which was; to identify the type of crops affected most by the crop raiders and extent of damage. Respondents were asked to name the crop raiders and preferred crops they raid. It was noted that baboons feed on most types of crops and that is why they were ranked as the most prominent crop raiders by most farmers. The responses are presented in Table 4.8

Table 4. 8: Distribution and intensity (rank 1=top and 8 least)of crop raiding by wild animals in Igwanjura

	Crop raiding animals							
Type of Crops	**Wild pigs**	**Baboons and colobus monkeys**	**Porcupines**	**Rats and squirrels**	**Vervet monkeys**	**Wild birds**	**Domestic animals**	**No Crop raiders**
Cassava	1	2	2	3	-	-	5	5
Potatoes	2	1	1	2	-	-	1	5
Maize	3	3	4	4	1	5	3	7
Millet	4	-	-	-	-	3	6	3
Rice	5	8	-	-	-	1	2	4
Banana	6	6	-	-	4	6	7	5
Fruits crops	-	4	-	-	3	4	-	3
Tobacco	-	5	-	-	-	-	-	1
Beans	-	-	-	-	5	2	4	3
Peas	-	7	-	-	2	-	-	2
Ground nuts	-	-	3	1	-	-	-	2
No affected crops	6	8	4	4	5	6	7	

In Igwanjura parish a number of crops including both food and cash crops are grown by the communities surrounding Bugoma Forest Reserve. The study showed that food crops are the most raided by wild and domestic animals. For instance using pair wise ranking

method to this effect, this researchs show that each animal has got different taste and preference of a crop and this is indicated in the rank Table above where by 1 to 7(indicates highest to lowest ranked or preferred crop) as per a given animal and crop. Important to note is sweet potatoes, cassava, and maize are described as the most raided crops as per the intensity rank Table 4.8.

The results therefore significantly revealed that baboons and colobus monkeys have the highest number of crop varieties they raid (8 crop varieties),followed by domestic animals, wild pigs and wild birds(7,6,6 crop varieties respectively) although the magnitude of the damage varies from raiding animal and crops raided. The least was vervet monkey, porcupines, rats and squirrels

Though wild animals affect crops, there is a variation in the specific plant part eaten or the age of the crop when eaten. Baboons feed on maize throughout its life cycle i.e. seedlings, flowering, harvesting and fruiting while vervet monkeys eat maize fruit only close to harvest. Baboons damage banana fruit more frequently than the pith, monkeys consume only banana fruit while chimpanzees raid pith and sugar cane in equal proportions. Pigs usually raid root tuber crops such as cassava and sweet potatoes foraging behaviour is linked to different aspects in the forest and the agro- ecosystem. Food crops are produced on small gardens of 20x20 meters which are characterized by a high level of mixed crops (3-5 crop species) of no regular pattern.

Table 4. 9: Crops least raided by wild animals in igwanjura

Crop	Response	% age
onions	27	30
simsim,	23	25
orange	9	10
pepper	9	10
cabbages	4	5
Total	90	100

Table 4.9 show some of the crops not raided by wild animals, such as onions, simsim, tongolo, and pepper. The reason being that these crops are not palatable.

Table 4.10: Proportion of quantity lost from farmers' gardens indicating frequency and percentage in igwanjura.

Response	Frequency	%age
Lost full garden	45	50
Lost part of garden	40	45
No garden lost	5	5
Total	90	100

Table 4.10 shows that most farmers actually experience crop damage. The losses were substantial indeed, and obviously potentially devastating to individual households. A numbe of respondents (50%) reported that they had lost a full garden to crop raids while 45% had lost a portion of the garden, and a proportion of 5% had their gardens intact. More than half of the respondents claimed that wild animals were constantly raiding their crops thereby frustrating their expectations. They claim the increase in destruction to be

due to increased habitat destruction and the overall increase in wildlife population citing baboons and monkeys as the main raiders.

4.5 Causes of crop raiding by wild animals

Information was obtained by interviewing farmers, and administrators and technical staff from the district and later ranked and the results are presented in Table 4.11

Table 4.11: Factors influencing crop raiding by animals in igwanjura parish .

Local Farmers				**District Administrator and Technical Staff**		
Causes	**Frequency**	**% farmers Respondents**	**Rank of cause**	**Frequency**	**% Admin Respondents**	**Rank of cause**
Neighbouring the forest	25	28	1	2	20	2
Increased habitat destruction	20	22	2	6	60	1
High population	18	20	3	1	10	3
Not helped by government(ver min officer)	12	13	4	-	-	-
Poor guarding methods	10	11	5	1	10	3
Lack of gazing land	5	6	6	-	-	-
Total	90	100%		10	100%	

Farmers response (28%) in Igwanjura parish indicated proximity to the forest reserve as being the main reason as to why there is frequent crop raiding by wild animals, followed by increased habitat destruction (22%), due to increasing population (20%), inadequate help from government by the vermin control officers (13%) ,poor guarding methods (11%)and lack of grazing land for domestic stock (6%)(Table 4.12). The administrators and technical staff on the other hand cited destruction of habitats for wild animals as the main cause (60%) and this was substantiated by the rate at which these habitats are being cleared especially forests on private land. Because of massive clearance of forests, wild animals have resorted to raiding crops which are actually grown on land that was originally occupied by these forests. Increasing numbers of livestock have accelerated forest, and shrub clearance to create land for grazing domestic animals and this also paves way for wild animals to raiding gardens.

4.6 Effects of crop raiding on the livelihoods of the people surrounding Bugoma forest reserve

The researcher also gathered information on the effects of crop raiding on farmers' livelihoods. This was done in an attempt to answer the fourth research question and objective which was: to assess the effects of crop raiding on farmer's livelihoods in Igwanjura parish. Respondents' responses were documented and are presented in Table 4.12

Table 4.12: Respondents of farmers' in Igwanjura parish to whether their livelihoods are affected by crop raiders

Response of farmers' whose livelihood is affected by crop raiders	Frequency	Percentage
Yes	86	96
No	4	4
Total	90	100.0

It was found out that crop raiding was adversely affecting the livelihoods of the majority of people sampled. More than 96% of the population of Igwanjura parish adjacent to the forest reserve was found to have their livelihoods affected (Table 4.12). Livelihood was associated with food security, income of household, children not going to school, leisure time of individuals and the social relationships among neighbours.

The researcher was also interested in identifying the size of gardens prepared, average harvest consumption and sale. This has shown how wild animals contribute to the food security/insecurity problem which further determines the livelihoods of the local people.

Table 4.13: Acreage for crops grown, harvest, raided, showing frequency and, percentage consumed and sold

Acreage for crops grown	Frequency	% age	Raided (acre)	Average Harvest (kg)	Home consumption (kg)	Sold for income (kg)
¼	35	32	⅛	50	30	20
½	25	28	¼	400	100	300
1	15	17	⅓	300	150	150
≤ 2	10	11	⅔	1000		100
3 ≥	5	6	⅓	2000	1000	1000

Table 4.13 also affirms the fact that crop loss during raiding have contributed greatly towards inadequate income generation for the community hence affecting the socio-economic affairs of the community.

Table 4.14: Amount lost by respondents in Uganda Shillings by crop raiding animals

Amount lost	Frequency	Percentage
Tens of thousands	63	70
Hundreds of thousands	26	29
Millions	1	1

All respondents interviewed indicated that crop raiding has promoted poverty in the area. About 70% reported that they lost crops worth tens of thousands of shillings. Some 29% claimed to have lost hundreds of thousands of Uganda shilling while only 1% of the

respondents lost millions of Uganda shillings money as shown in Table 4.14.

Table 4.15: Socio economic factors affected by crop raiding and determining people's livelihoods around the forest reserve

	Food shortage		Low income		Children not in school		No time for meetings on gov't programs		Poor relationship with neighbours	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	89	98.9	43	47.8	6	6.7	6	6.7	40	44.4
No	1	1.1	47	52.2	84	93.3	84	93.3	50	55.6
Total	90	100.0	90	100.0	90	100.0	90	100.0	90	100.0

The most significant determinant of livelihood was availability of food for household consumption. More than 98% (Table 4.15) of the respondents mentioned that they face food shortages attributed to crop raiding by the wild animals from the reserve. Regarding the household incomes, 47.8% of the respondents experience low incomes from agricultural activities since a significant fraction of the crops grown are destroyed by the crop raiders (animal and birds).

Factor Analysis

Factor analysis is a data reduction technique that was aimed at reducing the number of variables to fewer factors. The variable livelihood was found to be influenced by five factors namely food for household consumption, household income, education of

children, leisure for households' members and the relationship between members. Factor analysis was used to identify the factors that were at the time significantly influencing the livelihoods of the respondents.

Using the principle component method as in table 4.16, the factors with Eigen values greater than one (total initial Eigen value[1]) were food shortage (food insecurity) and low income. The rest of the components (children not in school, no leisure time for the individuals, and poor relationship with neighbors') had less effect on livelihood or were not better than the variable itself.

Total Variance Explained

Table 4.16: Variance per factor influencing community livelihoods.

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Food shortage (insecurity)	1.549	30.982	30.982	1.549	30.982	30.982
Low income	1.198	23.965	54.947	1.198	23.965	54.947
Children not in school	.906	18.120	73.067			
No time for meeting gov't programs	.785	15.693	88.760			
Poor relationship with neighbors'	.562	11.240	100.000			

Total Initial Eigen value [1] is the total variance explained by each factor

Table 4.17: Livelihoods affected and main occupation cross tabulation

			Main occupation					Total
			Agriculturalist	Hunters	Carpenters	Craft makers	Civil Servant	
Livelihood affected	Yes	Frequency	64	4	3	8	7	86
		% within Livelihood affected	74.4%	4.7%	3.5%	9.3%	8.1%	100.0%
	No	Frequency	1	0	1	2	0	4
		% within Livelihood affected	25.0%		25.0%	50.0%		100.0%
Total		Frequency	65	4	4	10	7	90
		% within Livelihood affected	72.2%	4.4%	4.4%	11.1%	7.8%	100.0%

The main occupation of the respondents was agriculture where more than 72% were engaged in farming activities. The remaining quarter was either hunters, carpenters, craft makers and civil servants. From Table 4.17, 74.4% of the respondents whose livelihoods were affected by the problem of crop raiding were mainly small scale subsistence farmers, followed by craft makers, civil servants, hunters, and carpenters with 11.1%, 7.8%, 4.4% and 4.4% respectively. Out of 90 respondents only 4 respondents had their livelihoods not affected by crop raiding.

Table 4.18: Farmers response to what measures should be introduced to reduce crop raiding.

Suggestions	**Percentage**
Eradication of vermin species	60
Community sensitisation	50
Intensive vermin control operations	45
Trans-location of vermin	30
Demarcation of forest to avoid encroachment.	3
Creation of buffer zone forest and farmland	1

From Table 4.18, eradication of vermin control operations, community sensitisation and vermin translocation were highly recommended in the area of study indicating their varied needs.

Table 4.19: Administrators response to what measures should be introduced to reduce crop raiding

Measures to be introduced	**Percentage**
Discourage forest encroachment	60%
Intensive mass sensitization	50%
Tree planting	45%
Produce crops which are not prone to vermin(tea, tobacco, coffee and pastures)	40%
Train vermin control personnel and deploy, at every sub county.	35%
Farmers should only scare off the vermin and not kill them	35%
Budgeting for vermin control programs.	30%
Patterned settlement.	15%
Shift from crop husbandry to animal husbandry.	10%

From Table 4.19, discouragement of forest encroachment, intensive sensitization, production of crops not palatable to vermins and tree planting were highly recommended in the area of study

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Discussion

Considering the increasing population growth rate of humans, demand for natural resources will continue. The human settlements in Igwanjura Parish, which result in destruction of wildlife habitats also reduced wildlife range and possibly their traditional migratory routes. Crop raiding will not easily be eradicated in the near future if the above factors are not controlled. These have forced wild animals to feed outside protected areas and raid agricultural crops. This implies that human-wildlife conflict will continue within areas of Bugoma Forest Reserve.

5.1.1Animal species most involved in crop raiding from Bugoma Forest Reserve

Results from this study in table 4.8 show that baboons, vervet monkeys, wild pigs, wild birds, porcupines, chimpanzees, among others, are the most notorious crop raiders within Igwangura village and these animals are typical forest dwellers and their survival depends on forest resources. According to this research, most farmers are said to be in the range between 500 m - 1.5km next to the reserve hence animals move from forest to gardens easily. And in presence of encroachment on their habitats, animals become notorious to planted crops.

Baboons damage banana fruit more frequently than the pith, most monkeys consume banana fruit, while chimpanzees eat pith and sugar cane in equal proportions. Pigs usually raid root tuber crops such as cassava and sweet potatoes .The foraging behaviour

is linked to different aspects in the forest and the agro- ecosystem. The findings of this study also came to the same conclusion with Sillero-Zibiri (2001).research that in Budongo area cassava, maize and sweet potatoes are at most risk of being raided by wildlife.

Many crops are damaged by crop raiders at specific stages of development, for example at germination, seedling, flowering, harvesting, and fruiting stages. Food crops are produced on small gardens of 20x20 meters which are characterized by a high level of mixed crops (3-5 crop species) of no regular pattern. The findings of this study also came to the same conclusion with Sillero-Zibiri (2001) research that across the globe, primates wherever they occur, are the most frequently identified crop raiding animals. From Africa to the Arabian Peninsula up to south East Asia and Japan, primates come into conflict with humans due to the renowned crop raiding behavior of many species. Omnivorous species like the baboons will take a whole range and diversity of foods, including many crop species, and often utilize several different parts of these plants rendering the plants vulnerable throughout their life cycle .The findings of this study also come to the same conclusions.

5.1.2 Type of crops most affected and extent of damage by animals.

Data on crops mostly affected by vermin were collected in an attempt to answer the second research question that identifies the type of crops affected most by the crop raiders and extent of damage. In Igwanjura Parish a number of crops are grown by the communities surrounding Bugoma Forest Reserve. They include both food and cash

crops. This research clearly shows in Table 4.9 that maize, cassava and sweat potatoes are the most raided crop by wild animals both vermin and non vermin animals. Among the least damaged crops are rice, millet, beans, and peas. These are mainly damaged by avian species. A number of crop species are not eaten by wild animals but they can be trampled on by the animals. The crops include tobacco, onion, pepper, cabbage, and simsim. Likewise the Budongo survey found average crop losses of 25% for cassava (range 4.5-61%) and 19% for maize (range 7.7-53%) Sillero-Zubiri (2001). Crop raiding is greatest during harvest season, but it does occur throughout the year. In particular maize seems to be targeted and damaged by vervet monkeys, baboons, and wild pigs

Throughout its growing cycle, from the newly sown seed to the time the cobs are mature. Damage sustained at any stage can cause severe crop losses, but these are most serious when crops are mature (Sillero and Switzer, 2001).

Damiba and Ables (1993) noted that production of highly palatable and nutritious seasonal crops such as maize, which attracts primates and other wild animals, involve heavy losses and therefore high guarding investments. In some instances farmers lose a whole garden particularly in areas highly infested with baboons, vervet monkeys, bush pigs and porcupines, which inflict heavy and potentially catastrophic losses. This therefore implies that community livelihoods adjacent to Forest Reserve are highly affected by crop raiders.

The distance from the forest to gardens is also an important factor influencing the level of crop raiding. Food crops are produced on small gardens of 20x20 meters which are characterized by a high level of mixed crops (3-5 crop species) of no regular pattern. More than half of the respondents claimed that wild animals were constantly raiding their

crops, 50% had lost a full garden to crop raids, there by threatening their livelihoods. A common, ancient and global example of human -wildlife conflict is crop raiding (Hill, 1997; Naugton-Treves, 2001) whereby a range of mammals, birds and insects utilise cultivated crops as their food resources. The findings of this study support their observations.

5.1.3 Underlying Causes of Crop Raiding

Research findings show that proximity to the forest reserve is the main reason leading to frequent crop raiding by wild animals, followed by increased habitat destruction, high population, lack of grazing land and poor guarding method, and inadequate help from government institutions are the most underlying causes of crop raiding within Igwanjura parish. In this parish the rapid population growth with a district average growth rate of 4.7% has changed the life style resulting into destruction of habitats through encroachment for agriculture and human settlement. Habitats destruction is also through fragmentation of natural habitats, killing of animal species, cultivation and settlement near chimpanzee habitat. This has resulted in human-chimpanzee conflicts around major national parks and forest reserves in Uganda as also observed by Oloya, (2002).

As a result of increasing human population and migration into Bunyoro, there is increasing encroachment on forest reserves for crop production. Tobacco production is increasing very fast in the district because of the incentives given to farmers by tobacco companies. People are opening up new or virgin land for crop production resulting into forest clearance for fertile soils. This has in turn led to human settlements and cultivation getting closer to the wildlife habitats. The wildlife species which are of great concern to us in Hoima district, include baboons, pigs and chimpanzees. Chimpanzees are very

destructive in places where they exist, especially in Kyabigambire, Kitoba, Kabwoya, Kyangwali, and Bugambe sub-counties in Hoima District (Ssentayi, 2002) where they grow their preferred crops.

Table 4.12 indicates that proximity to forest reserve is one of the key factors leading to crop raiding and the increased habitat destruction along the fringes of Bugoma Forest Reserve is also one of the main factors leading to crop raiding. In the absence of a buffer zone between forest reserve and the surrounding public lands, certain wild animals move easily destroying crops and sometimes attacking humans. This problem of wild animals needs urgent attention to prevent more serious problems in the future such as loss of human life to wild animals. Such incidences have been recorded in Kibale National Park where children were twice attacked by chimpanzees near, in one case fatally (Chetri ,2004).

5.4 Effects of crop raiding on the livelihoods of the people surrounding Bugoma Forest Reserve

Information on the effects of crop raiding on farmer's livelihoods was gathered in an attempt to answer the fourth research question which helped assess the effects of crop raiding on farmer's livelihoods in Igwanjura Parish. The data indicate that crop raiding has adversely affected the livelihoods of many people in Igwanjura parish. More than 96% of the population of Igwanjura parish adjacent to the forest reserve was found to have their livelihoods affected. This is associated with food security/insecurity and low income of households as indicated in table 4.17.

The researcher was also interested in identifying size of garden prepared, crop raiding, average harvest consumption and output sale. The findings of the study indicate that the destruction of crops in the gardens contribute significantly to the food insecurity problem which further determines the livelihoods of the local people. It also affirms the fact that crop loss to animals has contributed greatly towards low income generation within communities. Damiba and Ables (1993) confirms this view that production of highly palatable and nutritious seasonal crops such as maize, which attracts primates and other wild animals, involve heavy losses and therefore high guarding investments. In some instances farmers lose a whole garden particularly in areas highly infested with baboons, vervet monkeys, bush pigs and porcupines, which inflict heavy and potentially catastrophic losses.

Nchanji (1998) reported that crop raiding is a serious problem as crop raiding animals can have a devastating impact on the standard of living of peasants whose entire survival is dependent on subsistence agriculture. He estimated that in situations where farmers guarded their crops, the loss incurred was 30% and where there was no guarding at all, it was 98%.In a similar study, Chambers, (1992), noted that in some cases, there was severe food shortages, high food prices, malnutrition and morbidity increased besides the rural agricultural society becoming poorer and poorer, with the majority of children not going to school. In situations where farmers guarded their crops, the children were most often forced to abscond from school so as to guard the crops.

However, in table 4.17 using principle component factor reduction method, show that crop loss is not only limited to vermins. Other factors like neighbouring the forest, high population, lack of grazing land and increased habitat destruction in Table 4.12. has lead to the practice of shifting cultivation which promotes forest encroachment. Nchanji (1998), emphasized that crop raiding is a serious problem as wild animals can have a devastating impact on the standard of living of peasants whose entire survival is dependent on subsistence agriculture. He estimated that in situations where farmers guarded their crops, the loss incurred was 30% and where there was no guarding at all, it was 100%. Sillero-zubiri and Switzer (2001) observations show that omnivorous species like the baboons will take a whole range and diversity of foods including many crop species and often utilize several different parts of these plants rendering them vulnerable throughout their life cycle. So no wander, baboons are classified as the most destructive crop raiders wherever they occur.

5.2 Conclusions

This research indicates that baboons, vervet monkeys, wild pigs and wild birds were ranked the most destructive crop raiders in Igwanjura parish. They cause heavy crop losses while porcupines, chimpanzees, squirrels and rats were ranked least followed by livestock. Food crops are the most raided crops within Igwanjura parish compared to cash crops. Sweet potatoes are the most raided crops by animals from Bugoma Forest Reserve. Cassava and maize are also preferred. Rice, g/nuts, millet, fruits, bananas, beans, and sugar cane are liked by avian species. Among crops which are not vulnerable to crop raiding were found to be onions, simsim and pepper. There is a high incidence of

crop raiding attributed mostly to neighbouring the forest. Furthermore increased habitat destruction, high population, poor guarding methods and lack of grazing have also contributed to increased crop raiding.

Crop raiding is the main cause of poverty in Igwanjura, farmers loose a lot of income per season to crop raiders. Nonetheless, food shortages and loss of income caused by crop raiders were not the only factors affecting people's livelihoods other factors like High population growth, over dependence on subsistence farming among others. Livelihood was directly associated with food security, income of household, leisure time of individuals and poor social relationship among neighbours.

It is also important to note that crop raiding cannot easily be eradicated given the population pressure and the kind of human activities within and along the periphery of Bugoma Forest Reserve.

5.3 Recommendations

Wherever a forest neighbours agricultural farms, there will be some risk of crop loss. Ameliorating these losses and elevating local tolerance for wildlife incursion will require a sophisticated blend of technical, social and economic interventions.

Farmers have to accept a small amount of crop loss to wild animals. From the results of this study, the following recommendations were made to help reduce the effect of the crop raiding problem; however this is in two categories. Those to minimise crop loss to wildlife and those to conserve wildlife.

To minimize crop loss to wildlife

To avoid heavy losses or high guarding investments, highly palatable seasonal crops such as maize, ground nuts, and sweet potatoes should not be grown near the forest edge. This is because these crops seem more attractive to crop raiders than wild foods, thus making them more attractive to vermin.

Farmers should be encouraged to correctly time their crops when planting such that by the time the food is finished in the forest, the crops are already harvested since the seasonality of fruiting and ripening of both wild and domestic crops tend to occur at the same time. This is influenced by seasonal patterns of rainfall, which are similar for both wild and domestic plants. For the case of perennial crops there should be adequate safeguarding.

Farmers should also be encouraged to concentrate on crops which are not prone (non palatable) to wild animals such as hot chilli, Irish potato, onions, tea, tobacco, and

pastures as buffer crops. However, these crops are mainly cash crops, which can create food insecurity. This should be done carefully. In areas which are heavily infested with vermins, the farmers should be encouraged to practice cattle ranching, mixed farming, and crop production in that order as one moves away from forest edge or protected area. This will boost food crop production, as the ranches will buffer the intensity of crop raiding.

Education capacity building and training activities at different levels, for instance sensitisation on the rights of children to be in schools, farmers trained in buffer crops establishment and other crop protection methods should be encouraged in Igwanjura with the aim of disseminating information and building local capacity in conflict resolution. The increasing public understanding of human wildlife conflict as well as learning from demonstration sites and "new "approach of community integrated conservation share many basic principles and many of the complexities and problems.

There is need to open boundaries of Bugoma Forest Reserve so that encroachment on wild habitats is minimised. This will not only help to reduce encroachment but also minimise exploitation of forest resources by humans.

Environment and forest related laws should be enforced to minimise encroachment and forest habitat destruction. All the above interventions together, if implemented,

should help the protection of wild animals, as well as reduce incidences of crop raiding

Recommendation for future research

More research is needed on vermin repellant crops and methods of protecting crops with the aim of introducing the successful and cost effective ones to farmers.

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APPENDICES

APPENDIX 2: Questionnaire

Makerere University

Institute of Environment and Natural Resources

Crop Raiding Activity by Wild Animals around Bugoma Forest Reserve and Its Impact on Farmers' Livelihood

Am, _____, conducting an academic research as a requirement for the award of a master's degree of science in environment and natural resources. The research theme covers aspects of crop raiding by especially wild animals around Bugoma forest reserve and how farmers have been affected.

Research Questionnaire [Not Self Administered]

[For Farmers or Households Only]

For Official Use Only

Questionnaire No. _____

Date of Visit. _____

Result of Visit. _____

Parish. _____ Village. _____

Code

Results Code 1.Complete 2. Refused 3.Postponed 4.Incomplete

Section A: Demographic Background	
A1. Name	_____ *[Optional]*
A2.Sex	Male Female
A3.Age	_____ [Years] _____ [Months] *Use only One*
A4.Marital Status	Single Married Divorced Others _____ *[Specify]*

A5. Education	Primary Secondary Vocational Post Secondary *[Tick Highest]*
A6.Profession	_____ *[Probe Here]*
A7. occupation	_____[*Organization of Attachment]*

Section B: Crop Farming	
B1. Land Owned	_____ [*Probe to Estimate Quantity]*
B2.Form of Ownership	Purchase Inherited Others _____ *[Specify]*
B3.Land Occupants	Crops Animals [Farms] Homestead Others _____ *[Specify]*
B4.Types of Crops Grown <u>most</u>	Cash Crops Food Crops Others _____*[Specify]*
B5 What are the most common Animals involved in crop raiding?	_____ _____ _____ _____ ---------- ----------

Section C:

C1.Have you had or experienced [wild or domestic] invading farmers' gardens and in some cases threatening people's lives?

Yes [Go to C2] No [Go to C3]

C2.How often [number of times] do you experience these invasions?(TICK)

a) Daily------b)Monthly------- C) Annually------

C3. Which mammals invade farmers' crops [Garden] in this area? *[Tick as applicable]*

a) Primates b) Wild Animals c) Ungulates d) Birds e)Domestic Animals

C4. List down the names of mammals that invade and damage farmer's crops this area; [*R*

a. _____ c. _____

b. _____ d. _____

e. _____ f. _____

g. _____ h. _____

C5. Which crops are most raided by vermin and non vermin animals?

.....

.....

.....

C6. Which crops are not mostly raided by vermin and domestic animals?

.....

.....

C7. How much do you think is lost in the garden.....

C8. What do you think are causes of crop raiding?

.....

.....

.....

C9. What are the effects of crop raiding on people's livelihoods?

.....

.....

.....

.....

C10. Do you think people's livelihood in this community has been affected by crop raiding?

Yes..... No.....

If yes How?

.....

.....

.....

Section D: Crop Raiding and Extent of Practices

D1.Of the animals and birds that you mentioned in C4, which ones attack and destroy farmers' crops most? *Local names can be used in this case*

Animals [Wild, Domestic, Ungulates or Primates]

a. _____ b. _____

Birds

a. _____ b. _____

D2. What crops are mostly destroyed by the animals or birds mentioned above?

a. _____ c. _____

b. _____ d. _____

D3. At what stages in the growing cycle are crops mostly damaged? *[Tick as applicable]*

Germination Seedling Flowering Harvesting Fruiting/Rooting

D4. In what time of the year are the crops raided?

Beginning Middle End of the Year

D5. How often do these attacks happen monthly or annually? _____ [Probe]

D6. What time do animals or birds mostly raid and destroy crops

At dawn Afternoon Morning Evening Night

D7. How much damage is done to the crops

D8. Suggest possible ways how crop raiding should be controlled

.....

.....

.....

.....

.....

Makerere University

Institute of Environment and Natural Resources

Crop Raiding Activity by Wild Animals around Bugoma Forest Reserve and Its Impact on Farmers' Livelihood

Key Informant Guide

[Administrators in Government and Non Government Organizations Only]

Key Informant Title. _____

Date of Visit. _____

Result of Visit. _____

Code

Results Code 1.Complete 2. Refused 3.Postponed 4.Incomplete

Introduction

Section A: Awareness of Crop Raiding, Impact and Extent
A1.Have you heard of Crop Raiding Practices by Wild Animals or Rodents or Primates on Farmers crops?
A2.Are you able to identify areas in Hoima District where crop raiding has been Rampant
A3. Please, name some of these
A4. How often do animals invade farmers' crops in the above identified areas?
A5. What animals or birds invade farmers' gardens?
A6. Where do these animals come from
A7. What seems to be the cause of rampant crop raiding practices in these areas?
A8. How severe are crop raiding practices?
A9. How are farmers affected both in the short run or long run?

Section B: Control and Prevention of Crop Raiding
B1.Has local government improvised means of controlling and preventing crop raiding? Indirectly or Directly
B2.In your individual observation, how have they gone about this?
B3. Has this department or organization addressed indirectly or directly crop raiding?
B4. How have they addressed crop raid.
B5. In instances where farmers don't report crop raiding cases, have you bothered inquiring from farmers whether or not they are disturbed by wild animals or primates?
B6. How have farmers tried addressing crop raiding in the areas where they are common?
B7. In your opinion how else can crop raiding be addressed?