ECONOMIC IMPLICATION OF HUMAN WILDLIFECONFLICT IN LUPANDE GAME MANAGEMENT AREA – MAMBWE DISTRICT EASTERN PROVINCE.

By

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DECLARATION

I, Chilembo Robert Morgan (20019027), hereby declare that this dissertation is my own work, and that it has not been previously submitted to The University of Zambia or any other university for the award of any academic qualification. All published work or material from other sources incorporated in this dissertation have been acknowledged and adequate reference thereby given.

Signature: …… Date: …..……

CERTIFICATE OF APPROVAL

This dissertation by Chilembo Robert Morgan has been approved as a fulfilment of the requirements of the award of the degree of Master of Science in Environmental and Natural Resources Management by The University of Zambia.

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Chairperson Board of examiners	Signature	Date
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Supervisor	**signature**	**date**

DEDICATION

This work is dedicated to my family mostly my lovely wife (Alice Nhowani Chilembo) and children (Mercy, Janet, Robert, Nelson, and Alice) for supporting me throughout my career, the people of Lupande Game Management Area (Mambwe District) and Department of National Parks and Wildlife.

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Thank you so much once again.

ABSTRACT

Conflicts between humans and wildlife have occurred in the world since the dawn of humanity. These conflicts can cause damage or economic challenges due to both incidences of crop damage and the deaths of domestic animals, as well as human deaths and poaching. Therefore, the aim of the study was to estimate the economic loss to small-scale farmers and the government. Four objectives were used for the study: to estimate the economic value of damage in agriculture; to estimate the economic value related to problematic animals controlled by the state; to estimate direct costs associated with human-wildlife conflict management response strategies; and to assess the effectiveness of response strategies on human-wildlife conflict in Lupande Game Management Area. The following specific research questions formed the basis of this study to inaugurate the economic consequence: what is the estimated household annual economic value of damage in agriculture caused by wildlife?, what is the estimated economic value of the problematic animals controlled?, what are the associated direct costs involved in responding to human-wildlife conflict management strategies?, and how can the measures taken in responding to human-wildlife conflict be improved? Relevant literature was discussed in this research with the aim of establishing the gap between this study and other previous related studies. The research was based on pragmatism, where both ontological and epistemological orientations were used. Convenient sampling was used with key informants by administering a semi-structured interview guide. Purposive sampling was used in focus group discussions using the focus group discussion guide. The secondary raw data sets used were from the Department of National Parks and Wildlife. The analysis used descriptive statistics, using averages, percentages, and totals to analyze quantitative data, while qualitative data was analyzed using content and thematic analysis.

In the findings on damage in agriculture, it was established that economic loss was quite enormous, affecting farmers, with K180, 317.00 being the highest in the damage range of 25–50 percent. Regarding the estimation of economic value related to problematic animal control by killing, the government incurred revenue losses amounting to K 4,318,049.86. The findings show that more expenses on the direct costs associated with human-wildlife conflict management response strategies were incurred on the procurement of a vehicle, a Land Cruiser, in 2021 for easy transportation, which increased the fuel cost, as well as volunteers who were employed to aid in proficiency, which doubled the expense from the previous years, which stood at K771, 262.00 in 2019, K 558,228 in 2020, and K1, 225,655. On the other hand, it was established that other costs, such as erecting solar fences and chilli bombs, received less investment in direct costs in 2021, a situation that may have triggered an increase in human-wildlife conflict cases compared to the previous years of 2019 and 2020, when they received much attention. In order to effectively respond to human-wildlife conflict in the area, the findings showed that controlling conflict by killing problematic animals, using chilli bombs to scare away animals, and erecting solar fences in conflict hotspot areas was effective. Other measures established include enhanced education through sensitization, avoiding cultivation in animal corridors, improved construction of watch tower vantage points, and enhancement of the newly introduced smelly fences. In conclusion, it was established that the economic implications for small-scale farmers and revenue loss to the government through control by killing problematic animals were huge. Thus, there is a need for the government to enhance the construction of solar fences around field settlements and consider formulating a policy towards the revenue recovery from controlled animal trophies. For future research, it is recommended that a similar study be undertaken in all 36 game management areas in Zambia.

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LIST OF ABBREVIATIONS AND ACRONYMS

BCP	BioCarbon Partners
CBNRM	Community Based Natural Resources Management
CITES	Convention on International Trade of Endangered Species of Flora and Fauna
CBU	Copper belt University
COMACO	Community Markets for Conservation
CRB	Community Resources Board
CSL	Conservation South Luangwa
DMMU	Disaster Management and Mitigation Unit
DNPW	Department of National Parks and Wildlife
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EMP	Environmental Management Plan
EPB	Environmental Project Brief
ERB	Energy Regulation Board
EWSCO	Eastern Water and Sewerage Company
GDP	Gross Domestic Product
GPS	Global Positioning System
GMA	Game Management Area
GRZ	Government of the Republic of Zambia
Ha	Hectare
HWC	Human Wildlife Conflict
Km	Kilometre
LGMA	Lupande Game Management Area
PPE	Personal Protective Equipment
SI	Statutory Instrument
SLNP	South Luangwa National Park
SNDP	Sixth National Development Plan
UNZA	University of Zambia
UTM	Universal Transverse Mercator
WPO	Wildlife Police Officer
TCA	Tourism Concession Agreement
ZEMA	Zambia Environmental Management Agency
ZESCO	ZESCO Limited
ZCP	Zambia Carnivore Project
ZICTA	Zambia Information and Communication Technology Authority

CHAPTER 1: INTRODUCTION

1.1 Introduction

Chapter one primarily focused on the background, problem statement, objectives, and research questions. The significance of the study and the structure of the dissertation were also considered.

1.2 Background.

Conflicts between humans and wildlife currently rank among the main threats to conservation. This has been coupled with rapid expansion of the human population, extensive habitat loss, and fragmentation, increasing the potential for people and animals to come into contact, often with devastating consequences for all involved (Nyirenda *et al.,* 2011). Human lives and livelihoods can be significantly impacted by wildlife through the predation of livestock and game (Loveridge *et al.,* 2017), damage to crops and property, and direct attacks resulting in human injury or even death (Amarasinghe *et al.,* 2015). This situation may also affect some individuals who may experience psychological trauma, including fear, extreme stress, and diminished mental well-being (Barua, Bhagwat, and Jadhav, 2013). On the other hand, the consequences for wildlife can also be extensive and severe through retaliatory killing, poaching, and habitat destruction (Torres, Oliveira, and Alves, 2018).

Crop-riding by wild animals is one of the major effects of human-wildlife conflict (Dickman, 2010). Elephants are considered one of the top crop-raiding wildlife in many African countries like Gabon, Ghana, Malawi, Uganda, and Zimbabwe (Patience, 2015). This is evident in the case of Uganda, where in 1996 only 21% of the crop from the smallholder farmers was lost, resulting in a huge economic loss for the farmers and creating poverty and hunger (WWF, 2006). Similarly, the percentage of crops lost by elephants in Zimbabwe and Mozambique is also significant, which affects food security and escalates human-elephant conflicts (Mashapa *et al.,* 2014). This phenomenon is not restricted to a particular geographical area or climatic region but is common to all areas where wildlife and humans share limited resources.

In Lupande GMA, increased human population has led to the expansion of human settlements, leading to encroachment in protected areas (PAs), which has led to the constriction of species

in wildlife habitats (Nyirenda *et al.*, 2013). The animal population has increased, which has resulted in many animals straying out on people's field crops and big cats killing livestock, a situation that has led to increasing poverty by affecting households' income (Mambwe District Council, 2020). The government of the Republic of Zambia and other stakeholders have always put concern into policy on how human-wildlife conflict cases can be managed (Zambia Wildlife Act No. 14, 2015). The intervention measures put in place by conservationists range from the use of solar electric fences, chili fencing, and the control of problematic animals by killing and translocations (Patience, 2015). Therefore, this study will attempt to gain insights into human-wildlife conflict and its associated economic implications arising from crop raiding, livestock depredation, and the killing of problematic animals. The study also suggested options for addressing the problem.

1.3 Problem Statement

Increasing densities of humans (Nyirenda *et al.*, 2013) and increasing populations of large wild animals in protected areas (DNPW, 2020), coupled with encroachment, poaching, climate change-induced habitat loss, and deepening poverty in the Zambian ecological systems where livelihoods are predominantly agro-based, result in human-wildlife conflict as humans and wild animals share resources. Human-wildlife conflict cases are a national concern in countries where human and wildlife requirements overlap and are intense and increasing (FAO, 2008). This problem is growing in today's crowded world and can have significant impacts on both human and wildlife populations (Sekhar, 1998). Lupande GMA is no exception to this trend.

Species most exposed to conflict are shown to be more prone to extinction because of injury and death caused by humans; these can be either poaching, control of problem animals by killing, retaliatory killing of problem animals by some affected community members, poisoning and poaching. Such human-induced mortality affects not only the population sustainability of some of the most endangered species but also has broader environmental impacts on ecosystems and results in revenue loss to the government.

Human-wildlife conflicts undermine human welfare, health, and safety and have economic and social costs. Interactions with animals, exposure to physical injury, or even death, humans can be economically affected through destruction and damage to property and infrastructure (e.g.,

agricultural crops, grain stores, water-installed facilities, and fencing), livestock depredation, and the transmission of domestic animal diseases, such as African yellow fever. However, studies conducted by Patience (2015) failed to estimate the economic loss farmers faced despite the presentation of results showing crop damage and the loss of domestic animals. Nyirenda (2013) also failed to establish the revenue loss the government of Zambia suffered despite revealing that some wild animals were killed by the state to save people's lives and crops in Lupande GMA. Further, after reviewing the literature (Umar and Kapembwa, 2020), human-wildlife conflicts induced by wild animals towards crop raiding, property destruction, and loss of human life, which were perceived economic losses, prohibited the development of conservation among residents of Lupande GMA. As a result, the literature did not highlight the estimated economic impact of killing problematic animals on farmers and government.

Notwithstanding the application of different management practices ranging from solar electric fences, control by killing of problematic animals, chili bombs, planting of early maturing varieties, and translocation of problematic animals far away from near human settlements to the national parks, the problem still exists both globally and locally. This calls for methods and groundbreaking approaches that could make a meaningful contribution to resolving such a long-term problem. The study therefore collected data from the affected farmers on crop damage, livestock depredation, and control of animals by killing and investigated the direct costs associated with human-wildlife conflict management response strategies for Lupande GMA. The results of the study provided information on economic implication for both farmers and the government of Zambia, which contributed to the knowledge gap identified.

1.4 Aim

The aim of the study was to estimate the economic loss caused by Human - wildlife conflict amongst small scale farmers and the Government of the Republic of Zambia in Lupande Management Area.

1.5 Research objectives

1. To estimate the economic value of damage in agriculture from Human - Wildlife Conflict in Lupande Game Management Area.
2. To estimate the economic value related to problematic animals controlled by the state as a result of Human - Wildlife Conflict.
3. To estimate direct costs associated with Human – Wildlife Conflict management response strategies.
4. To assess the effectiveness of response strategies on Human - Wildlife Conflict in Lupande GMA.

1.6 Research questions

The following specific research questions formed the basis of this study to inaugurate the economic consequence by Human - Wildlife Conflict in Lupande GMA:

1. What is the estimated household annual economic value of damage in Agriculture caused by wildlife?
2. What is the estimated economic value of the problematic animals controlled?
3. What are the associated direct costs involved in responding to Human – Wildlife Conflict management strategies?
4. How can the measures taken in responding to Human - wildlife conflict be improved?

1.7 Significance of the study

Pragmatic studies often fail to grasp the economic implications of human-wildlife conflict, and perceptions of this conflict often deviate from actual incidences. Thus, the present study attempts to gain insights into current smallholder farming and the perceived effects of damage to agriculture caused by wildlife, control by killing problematic animals, direct costs associated with human-wildlife conflict management response strategies, and an assessment of the effectiveness of current strategies adopted. The study therefore aims to advise more economically and ecologically appropriate mitigation efforts in light of livelihood and food insecurity concerns and wildlife conservation objectives. This may be able to estimate the value

lost from agriculture damaged by wildlife and how much revenue the state loses from the controlled killing of wildlife in the study area.

The study findings could therefore influence the formulation of appropriate mitigation measures and policies for wildlife conservation and management to enhance problem animal control efforts, as they may provide evidence on the severity of human-wildlife conflict in relation to poverty. The information gathered from the study could be useful to the office of the vice president under the Disaster Management and Mitigation Unit (DMMU) on planning for aid, the Central Statistics Office on economic census, and policymakers in the Ministry of Agriculture and Ministry of Tourism.

The extent of the economic implications for smallholder farmers and how much revenue the government of the Republic of Zambia is losing through the killing of problematic animals in Lupande GMA are less documented in the literature. Therefore, the study findings may be part of the academic literature on wildlife conservation and set a benchmark for future researchers who would want to carry out similar research in all 36 game management areas in Zambia in trying to estimate the economic implications caused by human-wildlife conflict.

1.8 Dissertation Structure

The dissertation is broken down into seven independent but connected chapters. Each chapter deals with arguments that are logically presented from section to section. The links and logic among the seven chapters are given due consideration while being dealt with. Here is the outline of the chapters of this dissertation.

Chapter one has a primary focus on the background and purpose statement of the research, objectives and research questions, significance of the study, study site and operational definitions, and the outline of the thesis.

The **second chapter** deliberates on the literature review employed in the research. Most of the literature reviewed confirms the existence of human-animal conflict the world over and describes different management and preventive measures carried out in other parts of the world concerning human-animal conflict.

The **third chapter** gives a description of the study area. In this regard, a brief discussion is presented about Lupande GMA's geographic location and its biological and physical characteristics.

The **fourth chapter** is on research methodology.

The **fifth chapter** presents research findings (research results) gathered from the interviews, focus group discussions, and raw human-wildlife conflict data from the Department of National Parks and Wildlife. Each result table or figure is accompanied by a result interpretation.

The **sixth chapter** presents the discussion and interpretation of the results in chapter five.

Finally, the **seventh chapter** draws a conclusion and makes some recommendations. The seventh chapter provides the conclusion of the study in the context of research findings and a literature review. It further includes suggestions for future research.

GMA. The results of the study provided information on economic implications for both farmers and the government of Zambia. The next chapter reviews the literature.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter contains an experimental review of applicable literature on the economic implications and response strategies of human-wildlife conflict. This review will help in the identification of gaps in the empirical studies.

2.2 General Concept of Human-Wildlife Conflict

Human-wildlife conflict (HWC) has become one of the fundamental characteristics of wildlife management as it signifies the most widespread and complex challenge currently faced by conservationists around the world. This phenomenon of human-wildlife interaction arises mainly because of the loss, degradation, and fragmentation of habitats through anthropogenic activities (human activities) such as logging, animal husbandry, agricultural expansion, and developmental projects (Ngoma, 2011). As habitat gets fragmented, the boundary for the interface between humans and wildlife increases, while animal populations become compressed, resulting in thin protection (Nyirenda *et al.*, 2013).

2.3 The Economic Implications of Human-Wildlife Conflict on Damaged Agriculture

In the mountain area of Simao, an area closer to the Xishuang Banna Natural Reserve in China, a group of 19–24 Asian elephants was responsible for large-scale crop and property damage (Zang and Wang, 2003). The conflict arises from the degradation and fragmentation of the habitat around the area that can sustain the feeding of elephants. During natural food shortages, the elephants forage on food crops such as wheat, rice, bananas, and bamboo, which become food alternatives. Studies conducted by Zang and Wang (2003) reviled that "in 2000 only, rural inhabitants claimed that elephant damage accounted for 28% to 48% of the community's annual income, and the total economic losses between 1996 and 1999 amounted to US$ 314,600".

The most visible consequences of human-wildlife interactions concern the economic costs incurred through depredation of livestock and damage to crops and property (Dickman and Hazzah, 2016). Livelihoods can be substantially impacted, and costs can be severe, especially in less developed countries where high percentages of the population are in poverty and often live in close proximity to wildlife protected areas (Loveridge et al., 2017). In Zimbabwe, for

example, livestock loss due to predation reduced the annual income of agricultural communities by up to 20% (Butler, 2000), and those living in the Bhadra Tiger Reserve, India, were found to lose 11% of total crops to elephant damage and 12% of livestock to big cats per annum (Madhusadan, 2003). Industries, such as fisheries, commercial farms, and sporting interests, can also be significantly affected by predation and other wildlife damage. A highly common strategy to manage conflicts is therefore to lessen this economic burden by compensating for incurred losses, and effectiveness is generally measured as an apparent improvement in tolerance (Loveridge *et al.*, 2017).

Patience (2015) reveals that human-wildlife conflict is escalating and illustrates a worldwide issue. The most visible consequences of human-wildlife interactions concern the economic implications incurred through despoliation of livestock, damage to crops and property, lost income by the state through lethal control of wildlife, and frustration by the community (Gandiwa, 2013). Crop-raiding and livestock depredation by wild animals occur all over the world, with different wild animal perpetrators in Zimbabwe. Most studies conducted on a variety of wildlife species causing crop destruction and livestock depredation have investigated factors, determined patterns, and influenced parameters that may help in predicting cases of human-wildlife conflict (Gandiwa, 2013).

Human-wildlife conflict is a growing problem in Zambia as wild animals destroy people's crops and livestock and kill or threaten their lives. This problem is not restricted to a particular geographical area or climatic region but is common to all areas where wildlife and humans share limited resources (Nyirenda *et al.*, 2011). In Lupande GMA, for example, increased human population has led to the expansion of human settlements in protected wildlife habitats, which has led to the constriction of species in wildlife habitats, leading to high incidences of crop damage (Nyirenda *et al.*, 2013). Still in Lupande GMA, it was reported that human-wildlife conflicts are increasing where animals damage people's crops and are a threat to their lives. Further, there were 2304 human-wildlife cases in Eastern Province affecting communities (DNPW, 2021). These cases ranged from affecting agricultural fields to depredation of domestic animals, property damage including houses, human injury, and human death.

A study conducted by Umar and Kapembwa (2020) examined views on economic benefits, local participation in wildlife management, and conservation principles among residents of three chiefdoms in Mambwe district, Eastern Zambia. The study outcome showed that 68% of the residents who live in the Lupande GMA are not in any way involved in community wildlife management. The reasons attributed were that only a few individuals or a few residents' benefited from the wildlife revenues. After reviewing the literature, this motivates the human-wildlife conflicts induced by wild animals towards crop raiding, property destruction, and loss of human life, which are perceived economic losses that prohibit the development of conservation among residents of Lupande GMA (Umar and Kapembwa, 2020). The literature did not highlight the estimated economic implication on farmers and the government of controlling problematic animals by killing them.

2.4 The economic value related to problematic animals controlled by the state.

According to WWF (2008), the report indicated that there was a growing number of human lives lost as well as captures and deaths of elephants due to human-wildlife conflict in Indonesia. The report further indicated that the vast majority of human and elephant deaths occurred in or around elephant pouch areas, which have lost significant amounts of forest. Looking from a different perspective, the lack of effective land-use planning at an appropriate scale in Riau has resulted not only in high levels of human-wildlife conflict and the near decimation of elephant populations (a decline of 80% in less than 25 years), but will also likely result in the province being unable to capitalize on possibly its most important and valuable resource: its carbon-rich peat swamp forests. If current trends continue, Riau will be left with just 6% of forest cover by 2015 and will thus have relinquished an enormous opportunity to generate economic benefits and development opportunities for its rural communities through globally exchanged carbon credits, while simultaneously stabilizing the global environment and conserving its unique and spectacular biodiversity.

The study conducted by Patience (2015) in Zimbabwe aimed at understanding measures to manage human-wwildlife conflicts. Data collection was done using semi-structured questionnaires administered to a stratified and randomly selected group of 300 households and 20 key informants. The study found that 86% of households were smallholder agricultural

farmers who had incurred economic loss and perceived both the frequency and level of crop and livestock damage to have increased over the last two years. Elephants, buffaloes, and lions were key problem wild animals in the study area. Annual household economic costs of human-wildlife conflicts were enormous (USD 18.61 to USD 1 174.60), though the perceived and actual losses differed by 63.2% for mono-specific stands of crops and livestock. The study by concluded that the main sources of human-wildlife conflicts are the damage inflicted by selected wild animals on agricultural crops and livestock produce, injuring and/or causing death to human life, all of which caused household economic loss in the study area.

In Kenya, farms that had been raided in the past and were larger and bordered by fences were more likely to be raided by elephants, while farms with greater guarding efforts were less likely to be raided (Graham *et al.*, 2010). A study found that the occurrence of crop raiding was predicted by settlement density, distance from daytime elephant refuges, and percentage of cultivation Patterns and effects of wildlife crop raiding and livestock predation are complex, determined by multiple factors acting at more than one scale with obvious causes of agricultural losses (Graham *et al.*, 2010). Human-wildlife conflict is a spatial phenomenon, and it is therefore important to investigate the effects of spatially explicit factors on its distribution. For example, a variety of factors have been identified in studies in east and west Africa that may influence spatial patterns of crop-raiding by African elephants (*Loxodonta africana*) (Okemwa, 2018).

Nyirenda (2013) examined the nature of human-wildlife conflict and its subsequent hidden costs for the affected communities living in the game management area in Zambia. The study area was divided into three clusters, where a sample of 124 households was conveniently sampled for the household survey. Three focus group meetings (FGDs) were conducted, one in each cluster, and three key informant interviews were conducted in each cluster. Furthermore, key informant interviews and focus group discussions were conducted in each cluster. The study shows that the expansion of agricultural activities has led to an increase in humans encountering wildlife, leading to human-wildlife conflict. Elephants, bush pigs, and monkeys are the most problematic animals. Crop raiding was found to be the most common form of conflict, largely because farming is widely practiced and is the major economic activity in the Lupande GMA. The hidden costs of conflict identified were increased exposure to mosquitoes,

reduced incomes, food insecurity, school dropouts, and opportunity costs. (Nyirenda *et al.*, 2013)

2.5 The direct costs associated with human-wildlife conflict management strategies.

According to (Zang and Wang, 2003), 5,196 households live near 11 wildlife reserves in India, and self-reported annual costs include crop and livestock losses and human casualties (injuries and deaths). By employing conservative estimates from the literature on the value of a statistical life (VSL), we find that costs from human casualties overwhelm crop and livestock damages for all species associated with fatalities. Farmers experiencing a negative interaction with an elephant over the last year incur damages on average that are 600 and 900 times those incurred by farmers with negative interactions with the next most costly herbivores: the pig and the nilgai. Similarly, farmers experiencing a negative interaction with a tiger over the last year incur damage that is on average three times that inflicted by a leopard and 100 times that from a wolf. These cost differences are largely driven by differences in the incidence of human death and casualties. Our estimate of costs fluctuates across reserves, mostly due to variations in human casualties. Understanding the drivers of human casualties and reducing their incidence are crucial to reducing the costs of human-wildlife conflict.

These costs are frequently additional to visible or direct costs, particularly crop damage by wildlife. Ogra (2008) describes hidden costs as those characterised as uncompensated, temporally delayed, and psychological or social in nature. Hidden costs manifest as decreased returns from livelihoods, reduced food security, poor health, increased opportunity costs, and diminished wellbeing (Barua *et al.*, 2013). Madden (2008) describes the costs emanating from human conflicts with gorillas in Bwindi Impenetrable National Park, Uganda, as having a great impact on the livelihoods of affected households. Community participation in the management of conflict becomes especially important because affected communities are major stakeholders. As a result, co-management of human-wildlife conflict as an approach to finding a solution is vital.

A study by (Nimmi, 2016) looked at conflict in farming both small scale and commercial in South Africa. The study was conducted in South African game reserves and interviewed 15

participants who worked and owned the reserves. The study found that the protection of wild life has become more expensive because new investments are coming up to ensure parks and animals are protected all year round. He argued that South African safari operators have invested in drones and security cameras that are motion-sensitive to ensure that any human figure is captured and censored, whether it is dangerous or not. The study under review did not directly address the topic that this study explored in the Zambian Game Management Areas. This was done to outline the research gap in the Lupande GMA.

A study on strategies to avoid human-animal conflict in Kenya during the pandemic was conducted by Nguni (2020) in two parks. Data was collected from 10 participants, and cost-related books were analyzed. The study found that the protection of animals in the private game areas of Kenya is now expensive because they have been forced to install solar fences and employ more game scouts, which resulted in an increase in camp sites, rations, and Protective Personal Equipment (PPE) during the pandemic. The study proved that it was becoming an expensive venture to completely avoid human-animal conflicts because they happen at different times and places that are not known by the game owners.

In Malawi, (Brandon 2009) also looked at investment in human-animal conflict resolution practices. The study found that safeguarding animals in areas that are closer to people has become an expensive venture because the direct costs of transport, fuel, guards, and general management have been doubling to a certain extent every year. He stated that the animal population is increasing just like the human population, and classes regarding farm land and grazing land have become common, hence raising human-wildlife conflict. Therefore, increased direct costs for patrols and high-tech facilities have become a source of relief from the escalation in game management areas.

The costs associated with human-wildlife conflict management response strategies are the investment measures and are usually identified by noticeable effects and therefore are referred to as visible or direct costs (Barua, 2013). These are most commonly crop or property damage, but they also include physical injuries or death. Food security has been compromised in many areas that are vulnerable to crop losses, particularly elephants in the Zambian case; costs are often uncompensated, and impacts are increased by limited infrastructure, shortages of

agricultural inputs, and a lack of access to affordable credit (Richardson *et al.*, 2012). On the other hand, hidden costs also exist. These are costs that are not readily noticeable but are still experienced and borne by affected communities. According to Fernandez (2010) hidden costs are poorly addressed in the human-wildlife conflict literature, and most research attention has focused on visible or direct costs. Hidden costs may include loss of sleep hours, increased workload, family breakups, foregone opportunities, reduced school attendance by children, fear, and in some cases, mental health problems (Hill et al., 2002; Barua et al., 2013).

2.6 Strategies for human-wildlife conflict management

Governments employ regulated methods of lethal control as a tool to alleviate unwanted human-wildlife impacts, such as depredation (McManus *et al.*, 2015). Forms of lethal control include harvesting, culling, legalized hunting, and selective or targeted killing of 'problem' animal individuals. The latter method is often used in instances where animals pose a direct threat to human safety or property, such as African elephants (Hoare, 2015); leopards (Holland, Larson, and Powell, 2018); and several species of shark (McCagh, Sneddon, and Blache, 2015). Lethal control is often considered a cheap and cost-effective method of reducing negative human-wildlife impacts, potentially explaining its popularity with governments (Naughton-Treves, Holland, and Brandon, 2005). This strategy applies in the present study area and is highly supported by the Zambia Wildlife Act, 2015.

Deterrents provide another non-lethal conflict strategy for human-wildlife management, commonly used to dissuade species from entering human settlements and accessing resources. Types of deterrents are many and varied, ranging from olfactory repellents, such as the use of chili to deter elephants (Hoare, 2015), to chemicals to repel sharks from popular swimming areas (Guerra, 2019). Acoustic devices are largely used in the marine environment, with the most obvious examples being acoustic harassment devices that are employed to discourage marine mammals from approaching fishing fleets (Guerra, 2019). Finally, biological deterrents such as beehive fences are increasingly being applied as a way to combine conflict management with additional revenue for local communities. An example includes the Elephants and Bees project, implemented and supported by the charity Save the Elephants. The effectiveness of deterrents is often evaluated by changes in the rate of predation or crop raiding events before

and after application. In the case of African elephants, several studies claim that olfactory and biological deterrents have decreased incidences of crop raiding (Hoare, 2015). Several scholars agree that, while the use of deterrents like chili and bee-hive fences is effective to a point, alone they are not sufficient as a conflict management tool and are therefore most successful when used in conjunction with other measures, such as guarding (Okemwa et al., 2018).

According to Conover (2002), translocation has been used to remove individual animals responsible for depredations and, in some cases, to reduce populations in specific areas by removing relatively large numbers of animals. Mostly, this has been an appealing method to the general public, especially those who are particularly concerned about animal welfare, as they perceive that it gives the affected animal a second chance at a new site. Unfortunately, reality is often not so positive, and translocation can be a controversial means of resolving human-wildlife conflicts, associated with a number of problems. It is quite common for translocated animals to return to the site where they were originally captured. This method is also a risky procedure, and it is normal for a proportion of translocated animals to die either due to the stress of capture or soon after release (Stander, 1990).

Physical exclusion methods such as electric fences and trenches are commonly used to deter elephants from entering farmland and human settlements. Substantial costs of construction and long-term maintenance confer challenges for the larger-scale application of these physical barriers, especially in fragmented landscapes with high forest or farm frontage (Wijayagunawardane *et al.*, 2016). Long-term effectiveness may be further hindered by design, responses to reports of fence breaks and fence-breaking animals, and overall PA enforcement and management (Massey *et al.*, 2014). Studies show that once African elephants learn that their tusks do not conduct electricity, they may use their tusks to break an enclosing electric fence, resulting in costly damage to the fence (Mutinda *et al.*, 2014). Physical barriers also negatively affect long-term survival by further isolating already fragmented elephant populations, disrupting movement and access to seasonal food and water resources, and impeding gene flow between herds. Fencing effectiveness remains largely unexplored in Asia.

Farmers guard crops and scare away crop-raiding elephants by yelling, setting off firecrackers or carbide cannons, hitting metal objects, and throwing stones (Gunaryadi *et al.*, 2017). These

techniques are effective in keeping elephants away from crops, but they disrupt the psychosocial well-being and livelihood activities of farmers (Barua *et al.,* 2013). High-tech acoustic deterrents remain problematic too. Audio playbacks of threatening sounds like wild cat growls, human shouts, and vocalizations from elephant matriarchal groups have only been tested as short-term and short-distance elephant repellents (Wijayagunawardane *et al.*, 2016). Some studies show that elephants quickly learn to tolerate these sounds and return to raiding crops. Moreover, the installation, regular monitoring, and maintenance of these playback systems present logistical challenges in remote areas. Although reportedly 65–100% effective in the tests performed (Thuppil and Coss, 2016), the potentially negative feedback of audio playbacks on other species merits further assessment before wider adoption (Gamage and Wijesundara, 2014; Zeppelzauer *et al.,* 2015). Recent studies in Africa show promising results using bio-acoustic methods such as beehive fences to deter elephants, which have the added benefit of providing pollinators and honey (Swanepoel et, al., 2015).

Farmers may light bonfires and use flaming torches or flashlights to guard ripening crops and deter raiding elephants (Shaffer, 2010; Davies et al., 2011). Solar spotlights, which are shone in elephants' eyes to drive them away from agricultural fields, have been tested on a limited basis for communal fields; however, initial purchase costs prevent widespread adoption by low-income rural households and communities (Gunaryadi *et al.*, 2017). Like the acoustic methods, light-based deterrents are short-term solutions that lose effectiveness over time as elephants adapt to the deterrent or move to a different location.

In comparison to exclusion, acoustic, and light methods, agriculture-based deterrents like chili-grease-covered fences and chili dung have had limited testing and use (Chang'a *et al.*, 2016). Existing field tests show wide variation in the effectiveness of chili deterrents, from no effect to some reduction in crop-raiding. Furthermore, high costs for application and maintenance make this technique economically prohibitive for many communities (Baishya *et al.*, 2012). Another agriculture-based deterrent involves the spatial strategy of interspersing commonly raided crops with crops that are less attractive or palatable to elephants (Gross *et al.*, 2016; 2017). In addition to serving as repellents, these alternative crops, including chamomile, coriander, mint, ginger, onion, garlic, lemongrass, and citrus trees, can economically benefit farmers by compensating for reduced cultivation of main crops. While fences smeared with

chili powder and small-scale cultivation of elephant-unfriendly, unpalatable crops to buffer out crop raiding elephants from main crops are commonly reported forms of agriculture-based deterrents (Chang'a *et al.*, 2016), commercial cultivations of chilis and other less attractive crops on a large scale do not appear to have been tested yet.

Translocation involves the drugging, immobilization, and transportation of problematic elephants from human settlements or farms to PAs for release (Fernando et al., 2012). Although the efficacy and long-term feedback of elephant translocation have not been extensively tested, initial results suggest that translocated elephants often return to their original territory and tend to propagate conflict around the release area while returning toward their original home range (Fernando *et al.*, 2012). Moreover, translocation often undermines conservation goals because of increased elephant mortality during capture and transportation and sometimes deliberate killing in the release area (Fernando and Pastorini, 2011; Fernando *et al.*, 2012).

More market-based strategies for mitigating human-elephant conflict provide financial compensation to those affected (Treves and Karanth 2003). The perceptions and attitudes of people who inhabit conflict-prone areas are crucial to the management of human-elephant conflicts (Adams and Hutton, 2007; Treves and Bruskotter, 2014), and offsetting economic losses plays a major role in building positive attitudes toward wildlife and fostering tolerance toward elephants (Hartter *et al.*, 2014; Snyman, 2014). Requesting compensation involves reporting the property damage and/or loss to park officials or an authorized local body, followed by a visual assessment of the damage by the authorities. The lack of standardized assessment guidelines and compensation approaches creates opportunities for conflict and corruption (Ogra and Badola, 2008). Compensation schemes often target the market price for victims' crops and livestock losses without recognition of the opportunity costs of conflict mitigation, the transaction costs of getting compensation, or the hidden costs of declining psychosocial and social well-being (Ogra, 2008). Difficulties also exist in placing economic value on and providing adequate compensation for humans injured or killed by elephants.

Guarding crops and livestock is another way of managing human-wildlife conflict in communities (CSL, 2020). Watchtowers that provide good vantage points, built around fields of crops, increase the farmers' chances of being alerted to the presence of potentially harmful

wildlife before damage has occurred. Simple alarm systems, using string and cowbells or tins, can also be effective and avoid the farmer having to be alert all night (ZCP, 2020). Dogs can be effective in protecting homesteads and livestock from attack by predators. To date, there has been comparatively little systematic research carried out to investigate patterns of crop raiding activity by wildlife and its potential impact on farmers' food and household economic security. Therefore, this research will take an in-depth look at the economic implications the small-scale farmers faced from crop raiding, livestock lost by wildlife, how much the state lost by lethal control of wildlife, and the response strategies to human-wildlife conflict being implemented in Lupande.

While studies have provided sufficient evidence that human-wildlife conflict affects people's livelihoods and frustrates conservation efforts in Zambia and the world at large, none of the studies have attempted to establish the economic losses farmers experience through damage in agriculture or how much revenue the government is losing from the control of problematic animals by killing. Therefore, this research will attempt to fill the gaps by exploring the financial losses affecting small-scale farmers and how much revenue the government of the Republic of Zambia lost from human-wildlife conflict during the study period. The research will further contribute to the finding of long-term management strategies that will help in policy formulation targeting to reduce human-wildlife conflict in Lupande Game Management Area.

2.7 Theoretical framework

This study is therefore augmented by Nevitt Sanford's (1962) development theory of challenge and support. Sanford's theory is premised on two fundamental concepts associated with development: cycles of differentiation and integration and readiness, challenge, and support in a college environment. The first foundational concept of Sanford's Community Development Theory (1962) involves the cycles of differentiation and integration. Differentiation occurs when people understand themselves as unique individuals, while integration happens when people recognize themselves as members of various groups (Pratto *et al.*, 1994). Through this process, community members protect the community environment to ensure they get the most value out of the community investment. To achieve this, the community members ensure that they protect the economic value that they have invested in their communities, and this brings

conflict with the other stakeholders. Therefore, this should be a game changer for the communities to develop.

Gardener (2006) noted that the second fundamental concept of Sanford's Development Theory examines three evolving conditions: readiness, challenge, and support. Readiness refers to the maturity and preparedness of the community to deal with the costs of the actions they are taking in the environment. Challenge refers to circumstances where the community does not have the necessary skills to cope with the situation, and support focuses on providing an environment that is encouraging and allows the community to explore the conditions of their identity in a safe setting. In such a manner, the cost of engagement is reduced as the community develops early alerts on the perceived dangers in the community. With such a situation, the wildlife officers and community members gain as the animals do not reach the farms to graze and destroy crops. When a challenge is presented to a community, it requires them to change their behavior and further grow in their development (Sanford, 1962). Support is a direct component in that it helps with the community's ability to be successful with the challenge (Sanford, 1967).

In addition, Bowman (2016) argued that for development to happen, there should be a balanced amount of challenge and support that is appropriate to the situation. According to Sanford (1966), the amount of challenge a community can handle should be dependent on the support available from its stakeholders. The cost of handling the challenge should be proportionate to the cost the parties will incur, so that neither party should be bound to lose in the process. If there is too much challenge and not enough support, community members may degenerate to less adaptive behaviors, ignore the challenge, or try to escape the challenge so that the cost can be reduced in one way or another so that lives are saved. The wildlife officers in this case should work together to ensure the associated direct costs involved in responding to human-wildlife conflict management are reduced before they are incurred. Preventive measures are what they have to engage in.

Sanford (1966) further argued that a community environment should be considered a developmental community where members' abilities ought to be nurtured to enhance their agricultural progress from the local resources. The ultimate outcome is to find the range of optimal dissonance in a person's environment. The environment should not present too many

challenges for an individual, as this may lead to regression and allow for less adaptive modes of behavior. If the environment seems too challenging, individuals may want to escape or ignore the situation, which brings conflict with the surrounding stakeholders. On the other hand, if the environment seems less challenging or easy, an individual may feel safe and satisfied with the situation but not develop in that atmosphere (Evans et al., 2010).

2.8 Definition of Terms

Boma: A "boma" for this study will be used to describe a housing where livestock is kept**.**

Biodiversity: The term 'biodiversity' will be used in this study to describe the number, variety, and variability of living organisms.

Bidder: This terminology for this study will be used for the people who are eligible to buy animals or animal trophies.

Communities: All the people found around Lupande game management area, including members of the Department of National Parks and Wildlife (DNPW), Conservation South Luangwa (CSL), BioCarbon Partners (BCP), Zambia Carnivore Program (ZCP), Chipembele Education Trust (CET), Community Markets for Conservation (COMACO), members of the Community Resource Boards (CRB), pastoralists and agro-pastoralists, chiefs, and so on, who experience and have in-depth knowledge of human-animal conflict in the area.

Control: authorized killing of problematic animals

Conservation: preservation, protection, or restoration of the natural environment, natural ecosystems, vegetation, and wildlife.

Citizen: These are residents of the Lupande game management area and are eligible to buy animals on the sustainable quota. One can only buy an animal from the Department of National Parks and Wildlife with a consent letter from the Area Chief.

Drivers or determinants of conflict: agents, factors, or simply causes of conflict.

Ecosystem: An ecosystem is made up of plants, animals, microorganisms, soil, rocks, minerals, water sources, and the local atmosphere interacting with one another.

Endangered species: a native species that faces a significant risk of extinction in the near future throughout all or a significant portion of its range. Such species may be declining in number due to threats such as habitat destruction, climate change, or pressure from invasive species.

Environment: An interaction between the physical surroundings and the social, political, and economic forces that organize people in the context of these surroundings

Environmental education is a process that allows individuals to explore environmental issues, engage in problem solving, and take action to improve the environment. As a result, individuals develop a deeper understanding of environmental issues and have the skills to make informed and responsible decisions.

Established: These are Zambian nationals from different parts of the country who are eligible to buy animals allocated under the sustainable quota. The Department of National Parks and Wildlife's Chilanga office is the only place where established people can buy animals.

Human-wildlife conflict: a range of direct and indirect negative interactions between humans and wildlife

Mitigate: To moderate, lessen the problem. In the case of lessening the human-wildlife conflict.

Non-Resident: These are the people who come from outside Zambia and are rich and buy animals through the company allocated a hunting block. These companies sign a concession agreement with the government and community for their authority to be allocated a hunting area. The sale of animals under non-resident or safari is always higher compared to establishments and citizens. They also buy animals allocated to the sustainable quota.

Problematic animals: animal species terrorizing communities

Perception: the feelings and understandings of the people of the Lupande game management area concerning human-animal conflict

Quota: These are animals allocated by the government to be sold to buyers in a particular year. It is also called a sustainable quota. This helps with population balance, considering many factors.

Species: A class of individuals having some common characteristics or qualities; a distinct sort or kind.

Sustainable: conserving an ecological balance by avoiding the depletion of natural resources

Wildlife traditionally refers to non-domesticated vertebrates but has come to broadly refer to all wild plants, animals, and other organisms; for this study, it will only refer to wild animals.

CHAPTER 3: STUDY AREA

3.1 Introduction.

This chapter describes the physical and socio-economic characteristics of the study area. It describes the location, physical characteristics, social and economic activities, and what made the researcher choose the study area.

3.2 Location

Lupande GMA is located in Mambwe District, Eastern Province. The GMA forms a buffer zone for the South Luangwa National Park, located at the tail end of the Great Rift Valley in Zambia. It covers a total of 4,840 km^2 and lies between Latitude 13º 30' North South and Longitude 14º 45 South East, with altitudes ranging from 350 m to 640 m above sea level, and the escarpment rises to 1,200 m above sea level (ZAWA, 2013). The GMA is divided into two (Lower Lupande and Upper Lupande) and accommodates both consumptive and non-consumptive tourism because of its richness in wildlife resources.

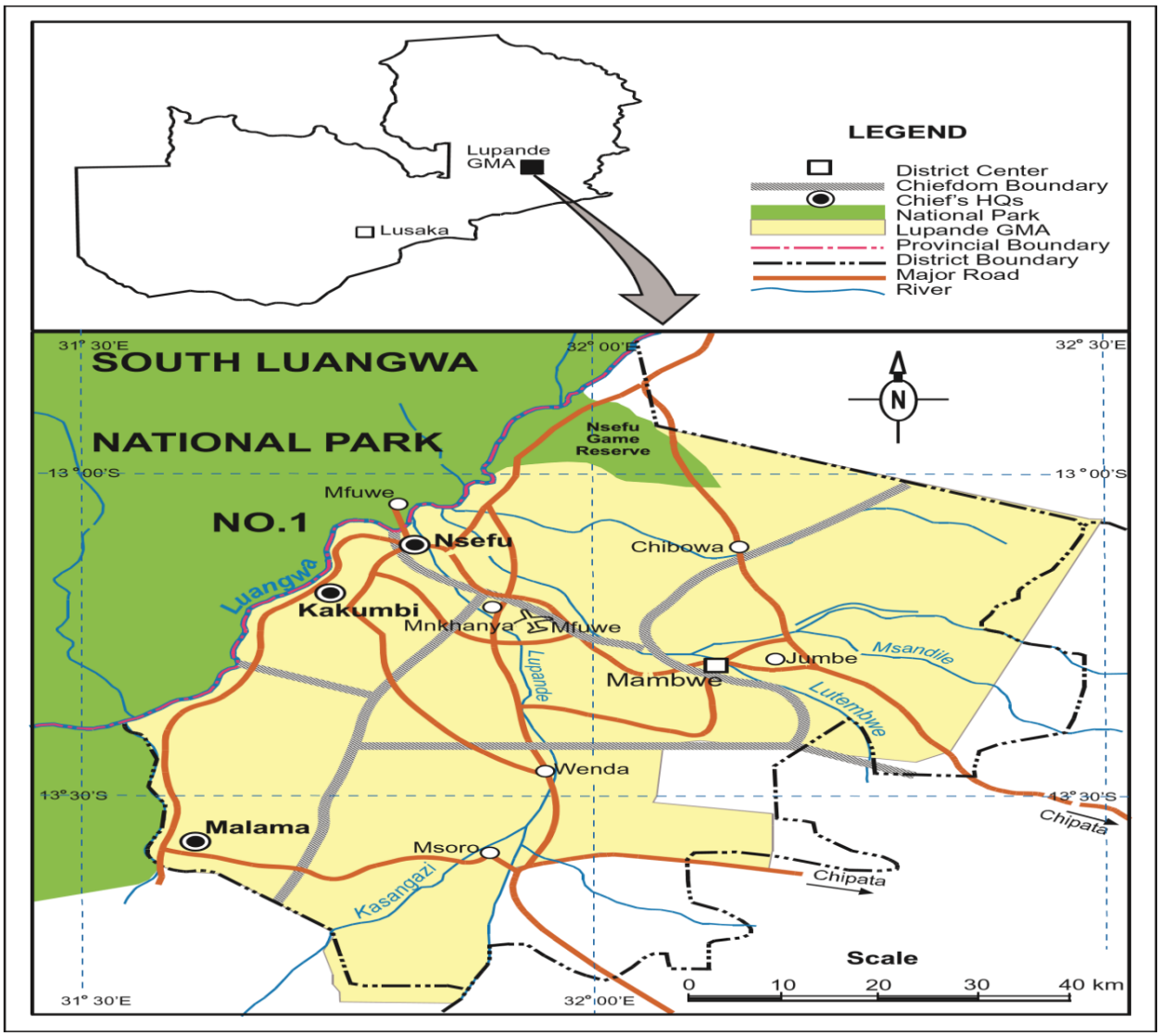


Figure 1: Shows the location of Lupande Game Management Area.

Source: Umar and Kapembwa, 2020

3.3 Physical Characteristics

3.3.1 Climate

The study area lies on the Central African Plateau, whose rainfall pattern is controlled by the movements of the Inter-Tropical Convergence Zone and increases from south to north (ZAWA, 2013). According to ZAWA (2013), "a tropical continental type of climate with three distinct seasons characterizes it, i.e., a hot rainy season from late November to April; a cool-dry season from May to August; and a hot-dry season from September to early November". It further states

that "the study area normally experiences a hot climate with mean daily maximum temperatures in the range of 32–36 °C." Further, the mean annual rainfall is in the range of 400 mm–800 mm, whereas records of up to 1,000 mm have been noted in the northern sector of the valley (Simute et al., 1998).

3.3.2 Geology and soils

The study area lies in the Rift of the Luangwa Valley, which is similar in origin to the East African Rift Valley system. It contains Paleozoic and Mesozoic strata rather than the more recent sediments of the rocks that form the dominant strata of the valley floor and has been laid down over a period of approximately 125 million years, starting 300 million years ago (ZAWA, 2011). Lying at low elevations and next to the Luangwa, the soils are classified as fluvisols. This type of soil is imperfectly to poorly drained, very deep, dark yellowish brown to dark brown in color, friable to firm, stratified, fine loamy to clayey in places, and coarse loamy (ZAWA, 2013).

3.3.3 Relief and drainage

The landscape is generally one of gentle to moderate hill slopes. There are two distinct zones: the plateau, which lies at an attitude of 900–1200 m above sea level, and the lower parts of the plateau (dambos), which have a reliable supply of water even during the dry season but become flooded during the rainy season (ZAWA, 2013). The Luangwa Valley is 300–600 m above sea level, and most of the rivers in the province are seasonal and flow from December to August (Simute *et al.*, 1998). The largest river in the province is the Luangwa River, which flows from the northern parts of Eastern Province to join the Zambezi River in the southern parts of Lusaka Province. The Luangwa River Basin covers approximately 140 000 km^2 of land, the majority of which comprises national parks. The Lupande GMA is part of the drainage basin of the Luangwa River. There are several main rivers draining the area, and they are all tributaries of the Luangwa River. These rivers include Musandire, Lupande, Lusangazi, and Matizye, and are mainly the source of water for both people and animals that have been attracted to the area.

3.4 Socio-Economic Characteristics

3.4.1 Population

According to the MDC (2020), the population in 2020 was projected at **99,981** and to be **143,914** in 2030. This GMA covers the whole of Mambwe district, which is dominated mainly by two tribes, namely the Kunda and Chewa.

3.4.2 Community structures

The study area comprises six traditional rulers or chiefs, namely His Royal Highness (HRH) Senior Chief Nsefu, HRH Chief Malama, HRH Chief Mnkhanya, HRH Chief Jumbe, HRH Msoro, and HRH Chief Kakumbi. The traditional administrative system involves the chiefs themselves, the indunas, and the headmen, which is complimented by formal political authority vested in the area councilors and the area member of parliament. The traditional administrative system in the GMA is mainly involved in obtaining local consensus regarding developmental projects, managing access to land, and undertaking conflict resolution in civil cases. The local land tenure system is through family inheritance by the female parent, commonly known as matrilineal (MOCTA, 2021).

3.4.3 Economic activities

The main economic activities in Mambwe district consist of subsistence farming, trading, and providing tourism and hospitality services (Umar and Kapembwa, 2020). The high incidence of poverty leading to limited food security for most households prevails in Lupande GMA, with most of the people dependent on their environment for survival. One of the reasons leading to a shortage of food in the study area was due to the high incidences of human-wildlife conflict, as most crops are destroyed and damaged by wildlife, and their livestock is killed by wildlife (Ngoma, 2011). However, the people of Lupande Game Management Area (LGMA) have adopted a variety of livelihood strategies in order to cope with the harsh environmental conditions of the area.

There are a number of tourism facilities, including lodges, bush camps, and safari camps, in Lupande GMA and South Luangwa National Park. These facilities employ a good number of local people from the area who provide a service and, in return, get paid. Most of the workers in these facilities come from all six chiefdoms, while others come from outside and bring expertise to the tourism facilities (ZAWA, 2013).

There is traditional subsistence agriculture being practiced in the study. The major purpose is primarily intended to provide food at the household level, but the surplus produce is often sold to raise money to meet other immediate needs. On a larger scale, farming is practiced in Msoro as the area has less wildlife prevalence to damage people's fields. According to Mambwe District Council (2020), the area is relatively undeveloped, primarily due to poor road access, and is relatively drought-prone. Areas like Chief Kakumbi, Malama, and Nsefu experience food shortages because of the high numbers of crop damage, and normally most households run out of food before the next harvest (ZAWA, 2005). According to Umar and Kapembwa (2020), "the main food crops grown are maize (*Zea mays*), sorghum (*Sorghum bicolor*), rice (*Oryza sativa*), groundnuts (*Arachis hypogaea*), sweet potatoes (*Ipomoea batatas*), cowpeas (*Vigna unguiculata*), cassava (*Manihot esculenta*), common beans (*Phaseolus vulgaris),* and pumpkins".

The Luangwa River is a source and provides fish for the local communities and urban areas in Eastern Province. The community indeed treasures fish as a major source of protein and currently cannot afford legally obtained game meat due to the governing laws on wildlife. This prompts a number of people in the area to earn a living from fishing activities, both in the Luangwa River and lagoons. The fishing activity, however, in both lower and upper Lupande has been sighted to be in conflict with the consumptive tourism with operators, which is safari hunting, as fishing camps are located along the river where spot hunting for big cuts normally takes place (Hachileka *et al*., 1999).

Lupande GMA has big forest areas, which include the Lupande National Forest and Machenje Forest Reserve (GRZ, 2021). The local people are privileged to have access to the forest products, which include fuel wood and building materials that they sell to the tour operators for lodge construction. Hardwood timber is also harvested and is used for carpentry and construction work on the developments prevailing in the area. Without forgetting other products like traditional medicines, mushrooms, fruits, and honey.

Another category of economic activity in the study area includes conducting business by owning small shops that supply groceries and other daily necessities for the local community. This enables shop owners to earn some income and provide service to the community, as they do not need to travel to faraway towns like Chipata. Local beer brewing and prostitution in the area are rampant sources of livelihood. This encompasses tourism activities pronounced in the area, mostly done in the cropping or Mfuwe area, which is closer to the tourism facilities (Mambwe District Council, 2020).

3.5 Reasons for Choosing the Area

Lupande GMA is one among the regions in Zambia with the highest prevalence of human-wildlife conflict, according to DNPW (2021). In the Game Management Areas, the expanding human population, encroachment, and clearing of land for development and cultivation have led to the loss of wildlife habitat and pushed wild animals into close proximity to people. This strengthened the rationale behind picking the field of research.

CHAPTER 4: METHODOLOGY

4.1 Introduction

The term "methodology" describes the procedures used to carry out research. It outlines the data collection techniques and how the data will be evaluated in order to meet the goals of the study (Kumar, 2011). The philosophical underpinnings of the research's methodologies and the justifications for using them are discussed in this chapter. The research approach, sample methodologies, data gathering procedures, and data analysis procedures are described. The demographic details of the respondents and the restrictions of the study are given. The smart data from the Department of National Parks and Wildlife was used for four (4) years, from 2018, to 2019, to 2020, and to 2021. Between April 14 and September 10, 2022, the primary data was gathered.

4.2 Philosophical basis of the study

The ontological and epistemological orientations of research influence the researcher's methodology. Therefore, the philosophical assumption used for this research was pragmatism. This philosophical concept focuses on reconciling objectivism and subjectivism by applying different accurate knowledge and experiences in considering theories, concepts, ideas, and hypotheses from the research findings (Kelemen and Rumens, 2008).

According to Bryman (2012: 32), describe ontology as "being concerned with the nature of reality and its characteristics". In the case of ontology, it relates to whether social entities are viewed as objective entities or subjective entities. Therefore, the ontological position helped the researcher in the self-motivated process of setting suggestions for empirical experimentation to test these hypotheses, of deep analysis to measure the results, and then of codifying the results in a set of laws and predictions of the study (Marsh and Smith, 2005).

What constitutes "acceptable knowledge in a discipline" is the core topic of epistemological considerations, according to Bryman (2012). In order to reconcile objectivism and subjectivism, the epistemological perspective used throughout this study was to apply various accurate knowledge and experience while taking into account theories, concepts, ideas, and hypotheses based on the research findings (Kelemen and Rumens, 2008). When it comes to human-wildlife conflict, this recognized numerous realities that are amenable to empirical investigation and presented their particular belief that there is an objective reality that exists separate from human experience (Creswell and Clark, 2011). This was employed in the study to comprehend human experience variables and how the community views wildlife conservation in light of its significant economic effects on both households and the community as a whole.

4.3 Research design

Research design is the procedure for collecting, analyzing, interpreting, and reporting data in research studies' (Creswell & Plano Clark 2007, p. 58). In other words, the research design sets the procedure for the required data, the methods to be applied to collect and analyze this data, and how all of this is going to answer the research question (Creswell & Plano Clark 2007, p. 58). Therefore, this study was centered on the mixed method. The mixed method provided a more complete picture by noting trends and generalizations as well as in-depth knowledge of participants' perspectives on human-wildlife conflict. Therefore, an embedded research design was used for this study.

The embedded design is a mixed-methods design in which one data set plays a supportive, secondary role in a study based primarily on the other data type (Creswell, Plano Clark, et al., 2003). The premises of this design are that a single data set is not sufficient, that different questions need to be answered, and that each type of question requires different types of data. Researchers use this design when they need to include qualitative or quantitative data to answer a research question within a largely quantitative or qualitative study (McKim, 2017). This design was particularly useful as

the researcher embedded the primary data from the key informants and focus group discussion meetings into the quantitative secondary human-wildlife conflict data set. This design helped the researcher gain a complete understanding of the results, in which two data sets were combined to get a complete picture of the issues being explored and to validate one set of research findings with the other (Creswell and Plano Clark, 2018).

4.4 Sampling

Sampling is a technique employed by a researcher to scientifically select a comparatively smaller number of representative items or individuals from a pre-defined population to serve as subjects for observation or experimentation in line with the objectives of the study (Bryman, 2012). On quantitative data, the study used simple random sampling of the Department of National Parks and Wildlife Smart raw data sets of the affected households. By using this technique, each member of the population had an equal chance of being selected as a subject.

Purposive sampling was considered for this study to collect qualitative data. A purposeful form of sampling is when respondents in a study are strategically selected so that those sampled are relevant to the research questions (Creswell, 2003). The two purposive sampling methods used involved expert and homogenous purposive sampling, respectively.

Expert sampling is a type of purposive sampling technique that is used when your research needs to glean knowledge from individuals that have particular expertise (Patton, 2002). Therefore, the experts from organizations or stakeholders working in conservation who were identified through the Department of National Parks and Wildlife were used. The stakeholders include; Department of National Parks and Wildlife (DNPW) itself, Community Resources Boards (CRBs), Community Market for Conservation (COMACO), Chipembele Wildlife Education Trust, BioCarban Partners (BCP), Conservation South Luangwa (CSL), and Zambian Carnivore Programme (ZCP).

The selection of these key informants by using a semi-structured interview guide was based on their knowledge of wildlife conservation management in general (Kumar, 2011). During the exploratory phase of qualitative research, the experts highlighted potential areas of interest to understand the scope of human-wildlife conflict by acquiring focused, specific expertise, which included the mitigation efforts that formed the basis of the study objectives.

Homogenous sampling is a type of purposive sampling that aims to produce a homogenous solution, or one in which all of the components have the same traits or properties (Patton, 2002). A homogeneous sample is often chosen when the **research question** that is being addressed is specific to the characteristics of the particular group of interest, which is subsequently examined in detail. Therefore, this sampling was used in focus group discussion meetings because the people of Lupande GMA share the same challenges of human-wildlife conflict and have similar gender, background, and occupation. In this study, community resource boards helped the researcher identify human-wildlife conflict hotspot areas for focus group discussions with communities. Twelve (12) focus group discussion meetings were held in the most affected areas, which helped to discuss various issues of human-wildlife conflict in line with the objectives. This sampling helped the researcher obtain the essential data to form a conclusion on the general human-wildlife conflict perspective in Lupande Game Management Area.

4.4.1 Population sampling

According to Mambwe District Council (2020), the projected population for Mambwe District, which is also Lupande GMA, in 2020 was 99,981 and was to be 143,914 in 2030. The affected households in this study represented the 2020 projected population for the district. Therefore, the researcher used seventy percent (70%) of the total affected households from the raw data from the Department of National Parks and Wildlife.

4.5 Data collection methods

Kumar (2011) defines data collection as a process of gathering and measuring information on entities of interest following a systematic procedure that enables the researcher to answer research questions or evaluate outcomes. Both primary and secondary data collection tools were used for the study.

4.5.1 Secondary Data

Secondary data can be literally defined as "second-hand" data or already existing data; this could be from reports, articles, books, etc. (Cnossen, 1997). For this study, the researcher used the human-wildlife conflict SMART raw data from the Department of National Parks and Wildlife.

4.5.2 Primary Data

According to Bryman (2012), primary data is original information collected for the first time. The primary method of data collection is the most original and authentic method of data collection. Therefore, primary data was used for additional information and verification purposes in relation to the secondary data, as this increased the reliability and authenticity of the study. To collect the primary data, the researcher used a semi-structured interview guide and a focus group discussion guide.

4.5.2.1 Semi-Structured Interviews

This involves the collection of data from the respondent; interviews are conducted either face-to-face or by telephone (Creswell *et, al.,* 2003). The semi-structured interview guide was administered only to the key informants identified for the study. These included all six (6) Community Resources Boards (CRBs) around Lupande Game Management Area, Conservation South Luangwa (CSL), the Department of National Parks and Wildlife (DNPW), BioCarbon Partners (BCP), Community Markets for Conservation (COMACO), Chipembele Wildlife Education Trust, and the Zambian

Carnivore Programme (ZCP). The interviews helped the researcher understand the latitude of human-wildlife conflict in the area in relation to the research objectives. After the interviews, the participants were given the chance to ask questions of their choice.

4.5.2.2 Focus Group Discussion

In the focus group discussions, the researcher is just a facilitator, and the respondents provide information (Bless and Achola, 1990). Focus groups, therefore, provided an opportunity for the researcher to interact with the local community and gain relevant information and knowledge. Therefore, the study used twelve (12) focus group discussion meetings, that is, two meetings per chiefdom, by using focus group guides in different wildlife conflict hotspot areas in the study area. The selection of hot spot areas was guided by the community resource boards, the Department of National Parks, and data from Conservation South Luangwa. This helped the researcher interact with the local community and gain relevant information about their knowledge, direct costs involved, opinions, attitudes towards human-wildlife conflict, and strategies.

4.6 Data analysis methods

Data analysis is the systematic organization and synthesis of research data and the testing of research hypotheses (Creswell, 1994). It also entails categorizing, ordering, manipulating, and summarizing the data and describing themes in meaningful terms (Bliss *et al.,* 1983). Descriptive statistics, comprising averages, totals, and percentages, were used to analyze quantitative data.

The qualitative data was analyzed using content and thematic analyses (Bryman, 2012). Content analysis is a systematic search for patterns to gain the full descriptions necessary for shedding light on the research questions to be answered (Creswell, 2003). Both secondary and primary data collected from key informants were checked for errors such as unclear and incomplete responses. The data inputted into the spread sheet was processed using Microsoft Excel 2010. Then, the data was coded by highlighting the

most relevant words, phrases, sentences, and actions. The relevance of the words, phrases, sentences, and actions was informed by the research questions and ultimately by the study objectives. Using the themes created during processing, insights into the data were gained by comparing responses to key questions from different data sources and relationships between different actors. Thereafter, graphical representations of the data were made necessary using tables and graphs.

4.7 Ethical obligations

This involves the rules for distinguishing between right and wrong or a code of professional conduct for the study. The researcher obtained a research permit from the Department of National Parks and Wildlife to carry out the research and use already-collected data for the quantitative part of the study. Also, ethical clearance from the University of Zambia was obtained. Thereafter, the researcher wrote a transmittal letter informing the respondents that the research was purely for academic purposes and assuring them of the confidentiality of their identities. Informed consent was also obtained from the respondents before data collection was done, and only those who agreed will participate in the research.

4.8 Quality Assurance

The quality assurance measure used for this study involved credibility. This is defined as the confidence placed in research findings to establish the truth about whether participants represent reasonable information drawn from the original data and have a correct interpretation of their original views (Monette, Sullivan & Dejong 2005). Since the findings will not only be based on the secondary data, the primary data from the key informants and focus group discussion will make corrections for quality research.

The credibility quality assurance process had the following steps: the adoption of research methods should be well established, which provided both information from secondary and primary data collected (Hancock, 1998). The affected households were

randomly sampled using Excel. On questions for the key informants and focus group discussions, the researcher avoided questions that could make the respondent upset, as the research itself is sensitive. Thereafter, the researcher ensured honesty in informants during data collection, which made the researcher evaluate the study. The qualifications and experience of the investigator and constant checking of the description and scrutiny of the study were considered for the examination of previous research findings.

4.9 Validity and Reliability

Matters of validity and reliability were adequately addressed for this study. Validity determines the trustworthiness of the research with a focus on whether the research has addressed the intended objectives (Golafshani, 2003; Welman *et al.*, 2005), while reliability deals with the consistency and accuracy of the research evidence and the representativeness of the determined sample (Welman *et al.*, 2005).

The reliability of the instrument was guaranteed by clearly wording the questions included in the interview schedule. A pre-test was done to determine whether the respondents understood the questions correctly, and where the questions did not seem clear enough, the essential adjustments were made before the schedule was finalized. To ensure that the participants understood the questions correctly, the researcher translated the questions into 'Kunda, the language best understood by the participants.

Content validity was also tested: the researcher, experts in the field, and the supervisor scrutinized the questions of the interview schedule and associated them with each dimension of the objectives of the study. Furthermore, methodological triangulations were employed. To be specific, *between-method* triangulation, which involves the use of different methods, was used (Denzin, 1970). Among the tools the researcher used to gather primary data were semi-structured interviews and focus group discussions.

4.10 Delimitation of the study

Geographical scope: the study was limited to Lupande GMA environs as a case study, but the findings can be generalized to the whole Luangwa ecosystem.

Sample size: the whole Lupande GMA population consisting of six (6) chiefdoms was considered, but with a focus on hot spots with high cases of human-wildlife conflict during focus group discussion.

Methodological scope: the prime aim of the study was to estimate the economic loss caused by human-wildlife conflict amongst small-scale farmers and the Government of the Republic of Zambia in Lupande GMA.

Value scope: The study attempted to establish how the rise in human-wildlife conflict cases affects the economic value of damage in agriculture, revenue loss to the government by the control or killing of problematic animals, and how management strategies effectively help to mitigate the human-wildlife conflict in Lupande GMA. The wildlife species responsible for conflict and the type of conflict were also investigated as a preferred model for wildlife conflict resolution.

Academic scope: the study was also limited to fulfilling the requirement for the degree of Master of Science in Environmental and Natural Resources Management.

4.11 Limitations of the Study

The Department of National Parks and Wildlife did not adequately capture some of the data on the direct expenses related to mitigation efforts for 2018. This allowed the researcher to use the direct cost data for only 2019, 2020, and 2021. There were tendencies among the respondents to conceal information due to the sensitivity of the research; others had a lack of full knowledge about the subject under study, which led them to give unreliable and incorrect information.

The constraints were therefore overcome by adopting a research methodology and sample procedure focused on a specific sample population targeting key players and stakeholders to ensure accuracy and effectiveness of data collection.

The study's conclusions might not apply to all of Zambia's thirty-six (36) game management areas (GMAs) because it was only one of those areas' case studies.

CHAPTER 5: FINDINGS OF THE STUDY

5.1 Introduction

This chapter presents the findings of the study on the economic loss caused by human-wildlife conflict amongst small-scale farmers and the government in Lupande GMA from 2018 to 2021 in Mambwe District. Data was collected from the respondents using a semi-structured interview guide from key informants, a focused group discussion guide from focus group discussion meetings, and human-wildlife conflict data sets from the Department of National Parks and Wildlife. Demographic data is presented first, followed by the findings according to the research questions of the study.

5.2 Demographic data

This section presents the demographic characteristics of the participants and the research area of the study.

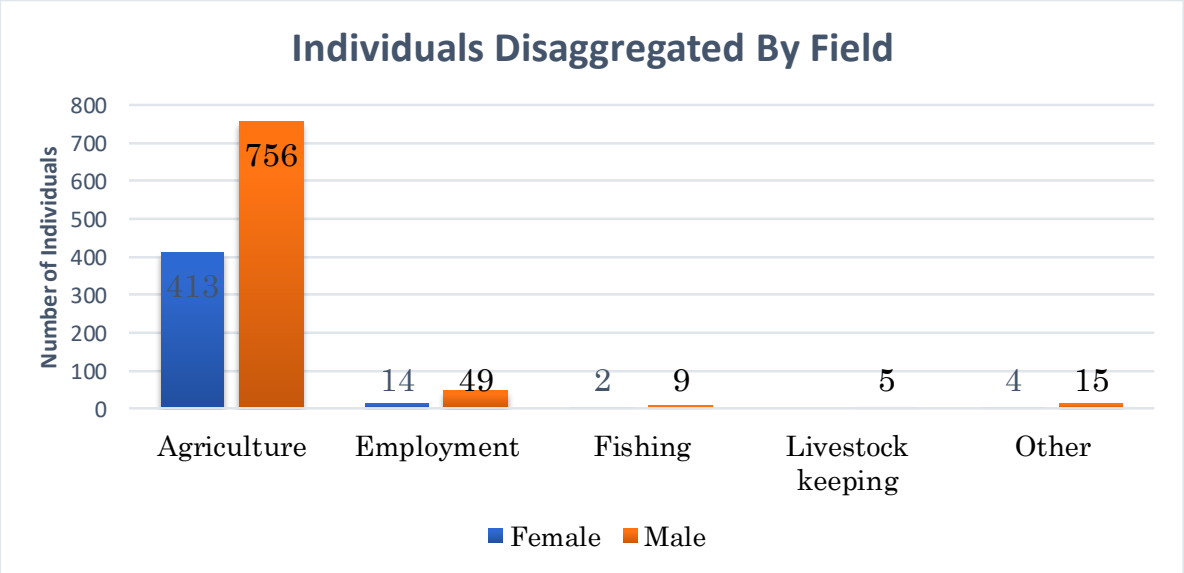


Figure 2: Individuals affected by human animal conflict by field and gender.

Source: Field Data, 2022

Results in figure 2 show that 756 males and 413 females of those that logged complaints worked in the agricultural sector as small-scale farmers; 49 males and 14 females were

in employment; 9 males and 2 females were in the fishing industry as fishermen; 5 males were in livestock keeping; and others represented 15 males and 4 females. From the graph, it can be concluded that most of the people who logged complaints to the Department of National Parks and Wildlife authorities were in the agriculture sector.

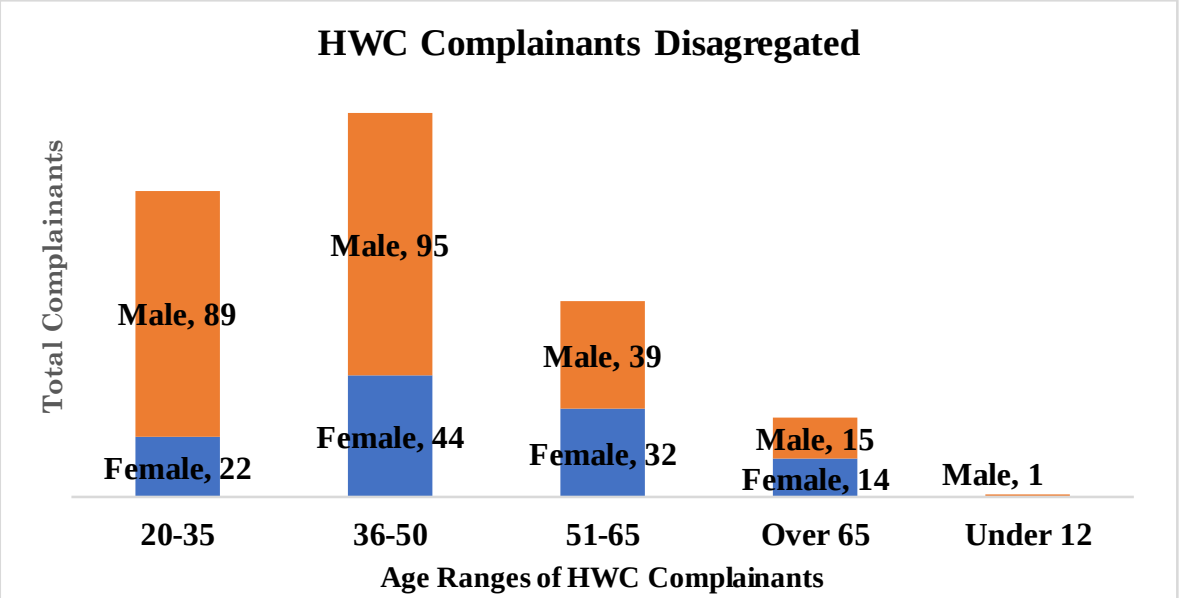


Figure 3: Showing complaints of affected individuals by age.

Source: Field Data, 2022

Results in Figure 3 show the disaggregation of all the complaints into male and female in the different age ranges. The 36–50-year age group had the most complaints, followed by 20–35 years, 51–65 years, those over 65 years, and those below 12 years. The majority of the people who complained were between 36 and 50 years old.

Table 1: Showing the occupation of groups of affected by human animal conflict.

Type of Animal	Occupation of Complainants								Grand Total
	Businessperson	Employed	Farmer	Fisherman	Self employed	Tourism worker	Unemployed	No Response	
Buffalo		1	3	1			2		7
Bushpig		1	7						8
Carnivores			3						3
Crocodile			10	3	1			1	15
Elephant	11	28	877	1	3	6	12	15	953
Genet		1	9						10
Hippopotamus	2	6	39	1		1		1	50
Honey Badger			22			1	1		24
Hyaena	1	1	41						43
Leopard			5						5
Lion	1	9	90	1					89
Other Animal			4						4
Panthera		1							1
Snake		1	3			1			5
Velvet Monkey		1	11						12
Yellow Baboon			34		1	3			38
Grand Total	**15**	**50**	**1158**	**7**	**5**	**12**	**15**	**17**	**1267**

Source: Field Data, 2022

Table 1 shows that most of the complainants were farmers (1158) (95 percent), with the highest damage caused by elephants at 877, lions at 90, hyenas at 41, hippopotamus at 39, yellow baboons at 34, velvet monkeys at 11, crocodiles at 10, and the rest of the animals' damage being less than 10 for farmers. From the table, most of the complaints on HWC were against elephants (953; 75 percent).

5.3 The economic value of damage in agriculture.

The first research question sought to establish damage in agriculture. Data for this research was collected from respondents, and data from human-wildlife conflict (HWC SMART) data for the selected years was analyzed and presented in the table below.

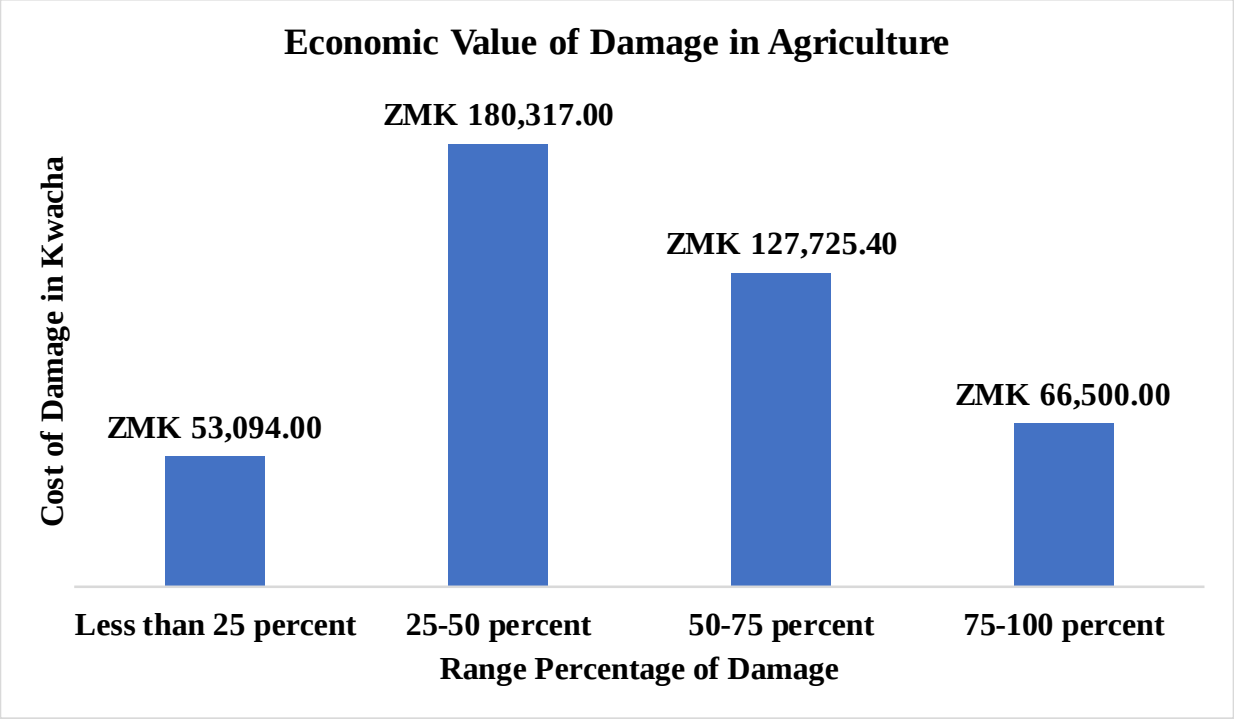


Figure 4: Showing the economic value of damage in agriculture.

Source: Field Data, 2022

Results in figure 4 show the cost relating to the percentage of damage to agriculture, with K180, 317.00 being the highest in the damage range of 25–50 percent, followed by damage of K127, 725.40 representing a damage range of 50–75 percent; third was K66, 500.00 with a range of 75–100 percent; and K53, 094.00 being the lowest at less than 25 percent. The highest cost relating to

the percentage of damage to agriculture was K180, with 317.00 being in the range of 25–50 percent. From the findings, it can be deduced that the economic loss as a result of human-wildlife conflict was huge in the sampled area.

5.4 Economic value related to problematic animals controlled by the state.

The second research question sought to establish economic value in relation to problematic animals controlled by killing as a result of human-aanimal conflict damage in agriculture. The data is presented in the figures below. Figure 5 presents the cost percentage range for wildlife police officers when responding to animal control by killing the problem animal. Figure 6 presents animal species and the number of animals controlled by the killing of problem animals, while Figure 7 presents the category of revenue loss in the sampled years. Lastly, figure 8 presents the summary of revenue loss for the study period.

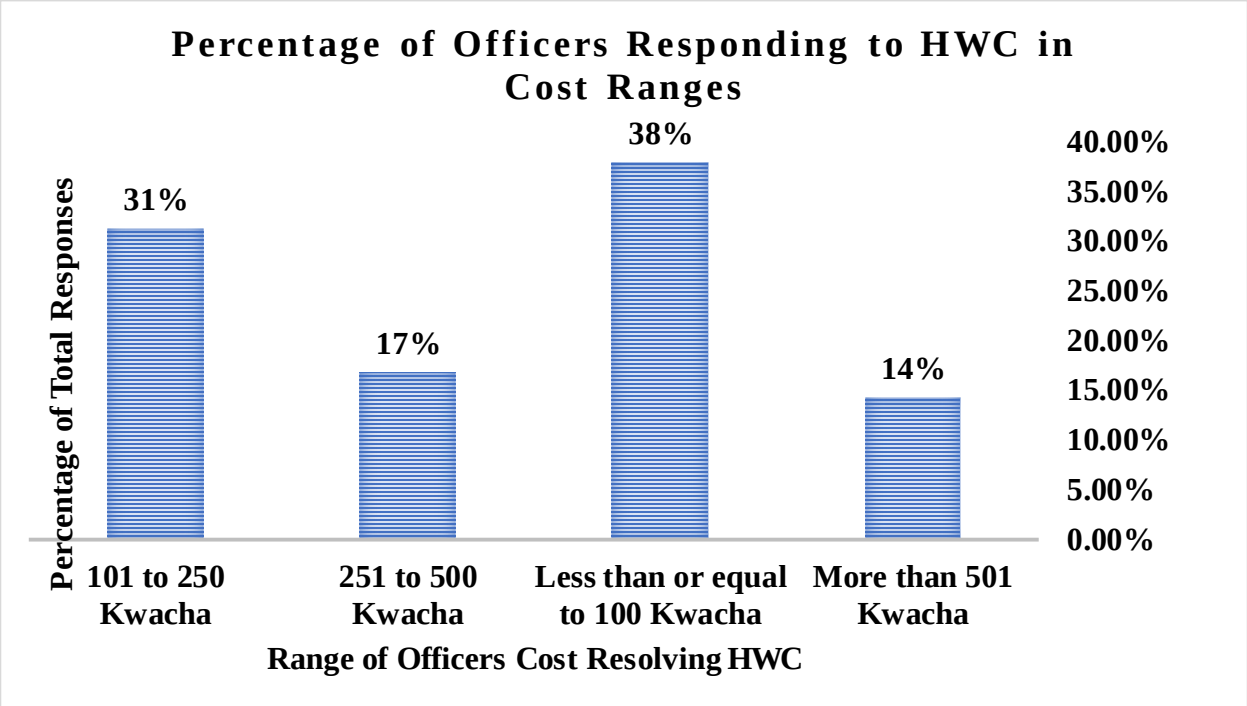
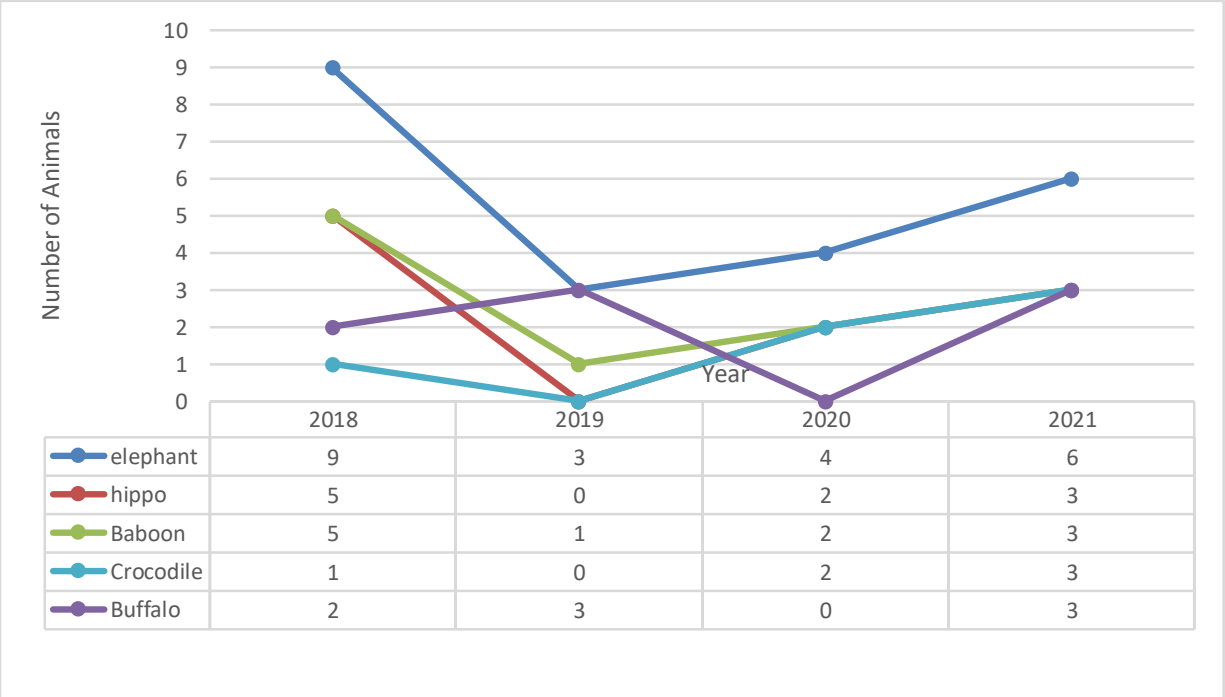


Figure 5: showing cost percentage range for officers when responding to control by killing of problem animal.

Source: Field Data, 2022

Results in figure 5 show that 38 percent of the officer's cost less than or equal to K100 when responding to human-wildlife conflict cases, followed by 31 percent, which cost between K101 and K250; next was 17 percent, which cost K251 to K500; and 14 percent of the officers costs when responding to human-wildlife conflict were more than K501. From the graph, the highest percentage range was 38 percent, which costs less than or equal to K100.

From the control of the killing of wild animals by the wildlife police officers, the researcher further established the numbers of animals killed during the study period, and the data is presented in figure 6.



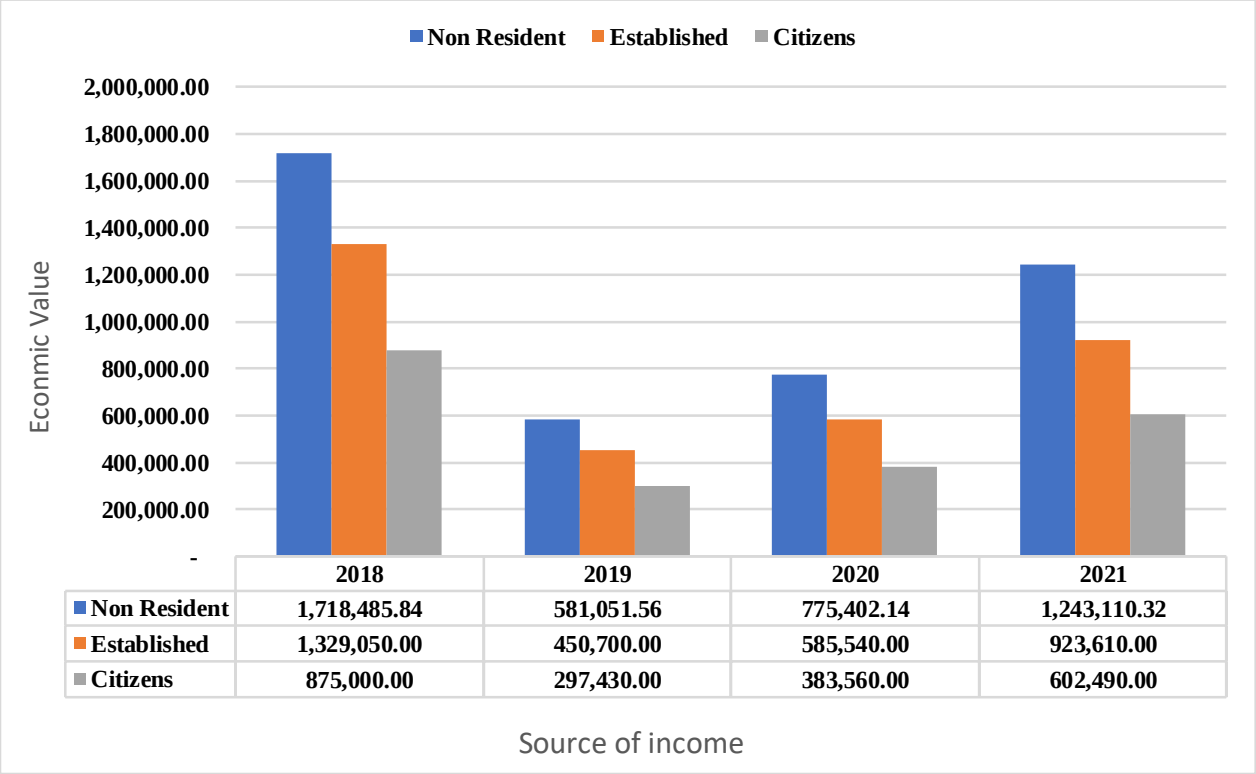
	2018	2019	2020	2021
elephant	9	3	4	6
hippo	5	0	2	3
Baboon	5	1	2	3
Crocodile	1	0	2	3
Buffalo	2	3	0	3

Figure 6: Showing the number of controlled by killing of wild animals by the state.

Source: Field Data 2022

Results in Figure 6 show that the highest number of animal species controlled by killing for the study period was that of the elephants with twenty-two (22) and was followed by that of baboons with eleven (11). Others include hippopotami with ten (10), buffalo with eight (8), and crocodiles with six (6). Therefore, 2018 represents the highest controlled killing of problematic animals with twenty-two (22), followed by 2021 with eighteen (18).

From the data presentation in Figure 6, the researcher went further to establish the economic value of the controlled killing of wild animals by state wildlife police officers. This was sought to establish how much the state is losing in revenue if the controlled animals are sold to interested parties. Therefore, the data in Figure 7 presents the revenue loss to the state by indicating categories of wildlife sold to bidders.



	2018	2019	2020	2021
Non Resident	1,718,485.84	581,051.56	775,402.14	1,243,110.32
Established	1,329,050.00	450,700.00	585,540.00	923,610.00
Citizens	875,000.00	297,430.00	383,560.00	602,490.00

Figure 7: Showing the revenue loss from control by killing of problem animals in ZWK.

Source: Field Data 2022

Figure 7 presents results of the revenue lost from the control of problematic animals by killing them. The results established that the highest amount representing the economic loss or revenue lost by the government from control by killing problematic animals occurred in 2018 with K 1,718,485.85. Therefore, the summary data of the lost revenue during the study period is presented in figure 8.

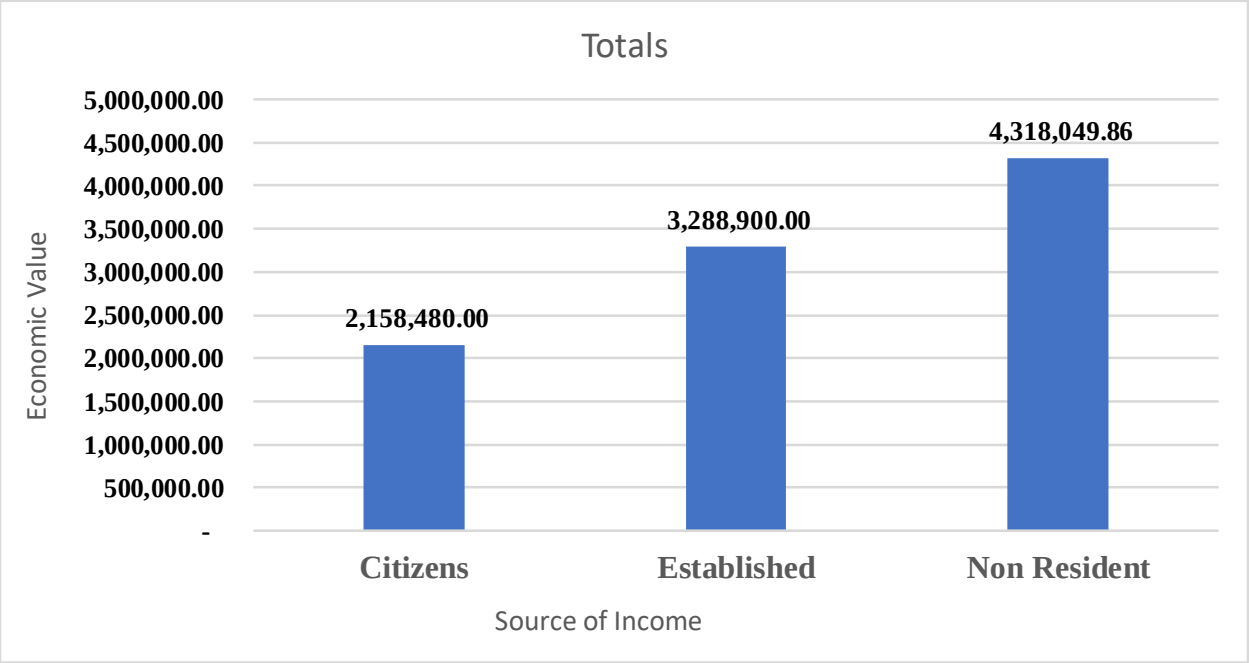


Figure 8: Showing the summary of economic value of the controlled animals by the state.

Source: Field Data, 2022

Figure 8 presents the summary results of the revenue lost from controlled animal species by the government due to human-wildlife conflict from 2018 to 2021. Findings from Figure 8 show that the highest economic loss or revenue loss by the government of Zambia was K 4,318.49.86 in the category of non-residents if the controlled animals were sold to interested buyers or bidders.

5.5 Direct costs associated with human-wildlife conflict management response strategies

The third research question was to establish the direct costs associated with human-wildlife conflict. Management response strategies The data collected from the respondents was represented in two categories. Category one was presented in percentage form using the pie charts, with interpretation from the key below. The second category presents results with amounts invested in the particular year and an interpretation of the investment trend on cost towards management strategies during the study period. The percentages presented in category one reflect the investment amount presented in category two. The data for 2018 was not captured, hence it was not reliable enough to be used for the study.

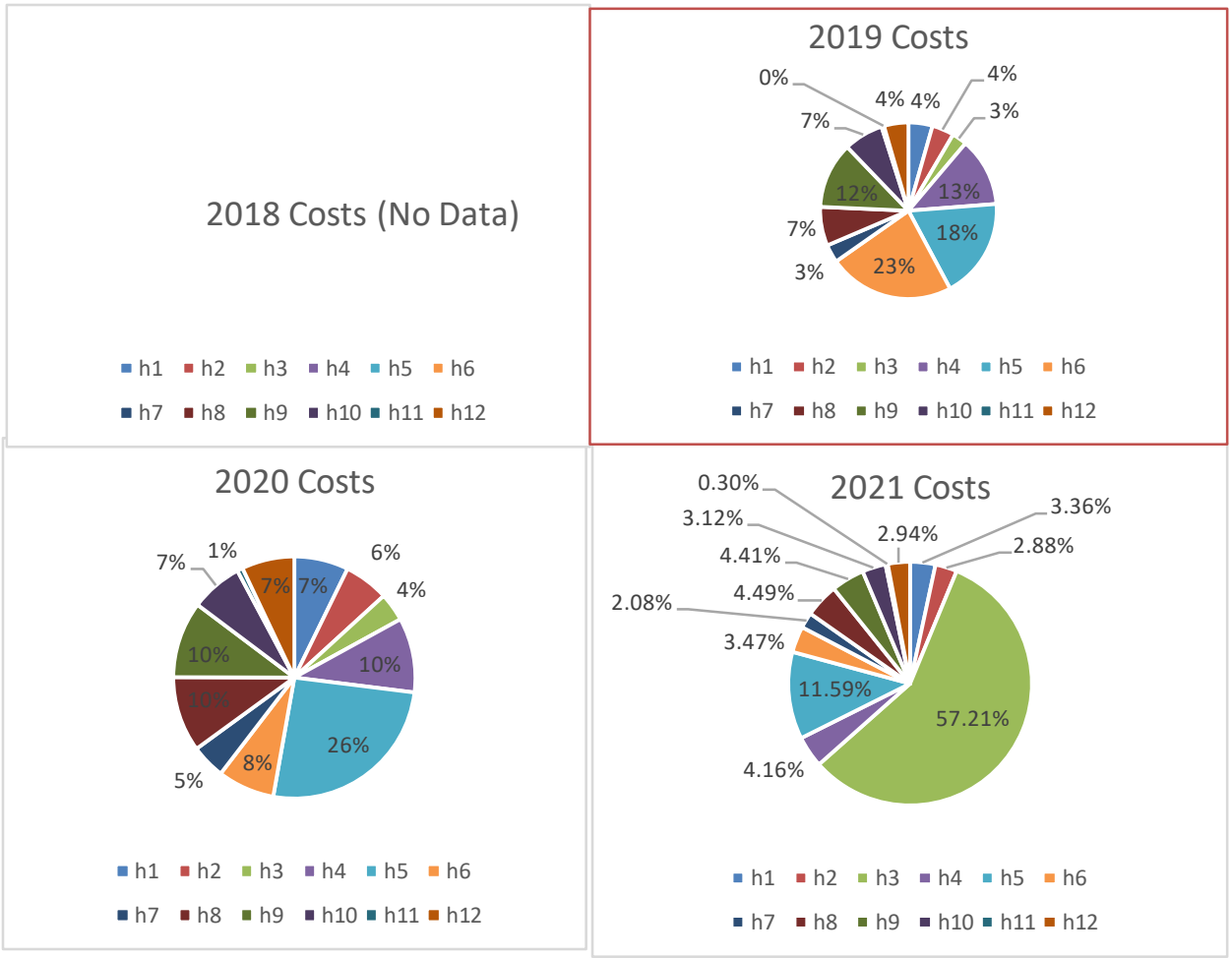


Figure 9: Representing HWC investment percentage cost according to the year:

Source: Field Data, 2022

Table 2: Key representing costs attached to management strategies on the pie charts above.

Table 8: Key representing costs attached to management strategies on the pie charts above	
Volunteer stipends	h1
HWC Fuel	h2
HWC Transport	h3
Field Equipment (GPS, Cameras, Camping kit, Uniforms, PPE)	h4
Mitigation costs - Chilli Patrollers (Supplies, rations, allowances, equipment)	h5
Mitigation costs - Solar Fences	h6
Mitigation costs - Smelly Fences	h7
Mitigation costs - Elect Safe grain stores	h8
Sensitisation Trips - Expenses & drama performances	h9
SMART HWC database/devices	h10
Alternative crop scheme (Ginger, Chilli, Lemongrass, Turmeric)	h11
HWC Office Overheads (Internet / Zesco)	h12

Source: Field Data, 2022

Results in Figure 9 in 2019 show that the highest direct cost relating to management strategies in responding to human-wildlife conflict was investment in solar fencing with 23 percent, followed by chilli patrollers (supplies, rations, allowances, equipment), while transport in responding to human - wildlife conflict cases and alternative crop schemes (ginger, chilli, lemongrass, and turmeric) represented the least with 3 percent.

Results in Figure 9 in 2020 present that the highest direct cost relating to management strategies in responding to human-wildlife conflict was investment in Chilli Patrollers (supplies, rations, allowances, equipment) with 26 percent, followed by provision of field equipment (GPS, cameras, camping kit, uniforms), while fuel allocation in responding to human-wildlife conflict cases became the least with 1 percent, followed by transport with 3 percent.

Results in Figure 9 in 2021 show that the highest direct cost relating to management strategies in responding to human-wildlife conflict was invested in procuring transport (a land cruiser) with 57.21 percent, followed by chilli patrollers (supplies, rations, allowances, equipment) with 11.59 percent, whereas construction of safe grain stores represented the least with 0.30 percent, followed by smelly fences with 2.08 percent. Therefore, it can be concluded that transport, being one of the least improved in 2019 and 2020, will improve in 2021 to enhance the operations of the Human-Wildlife Conflict Rapid Response Unit Team in order to respond to cases of human-wildlife

conflict. The second category of data presentation was to show the trend of direct costs invested in human-wildlife conflict management strategies.

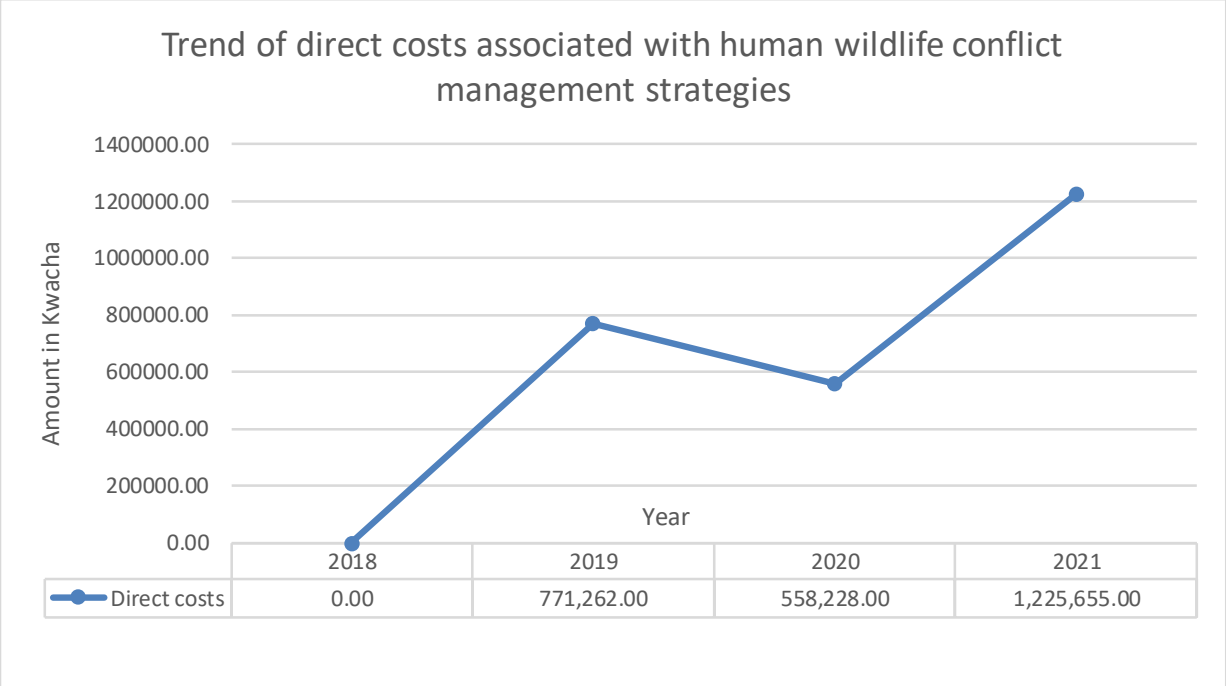


Figure 10: Showing trend in direct costs associated with HWC management strategies.

Source: Field Data, 2022

Figure 10 presents the direct costs associated with human-wildlife conflict management response strategies that have been employed during the study period in Lupande Game Management Area. From the figure above, it was established that there was an increase in direct investment towards human wildlife management strategies in 2021 with K1, 225,655.00.

5.6 Effectiveness of response strategies for human-wwildlife conflict in Lupande GMA

The fourth research question sought the effectiveness of response strategies on human-wildlife conflict data. For this research, data was collected from respondents, and data from SMART was analyzed and presented in the figure below.

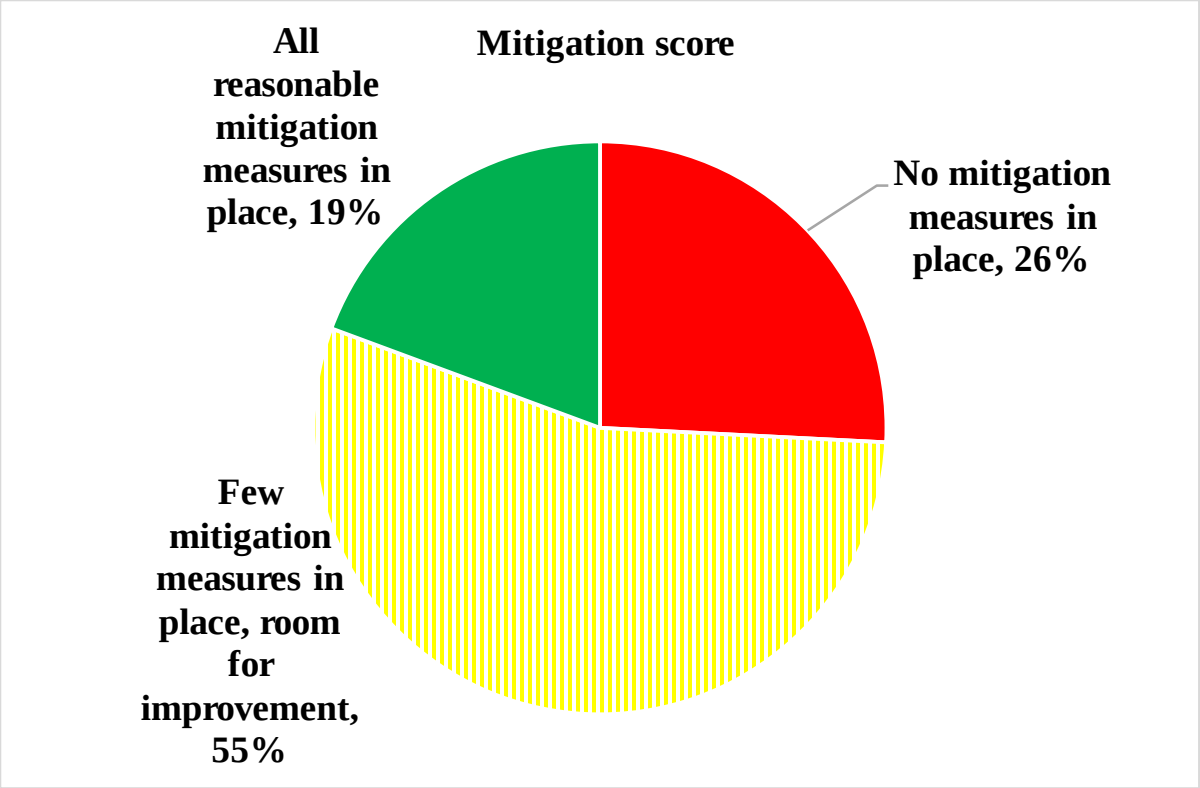


Figure 11: Results showing the mitigation efforts by percentage.

Source: Field Data, 2022

Results in Figure 11 show the mitigation efforts taken when HWC occurs. The graph illustrates that 55 percent of the responses had few mitigation measures in place, 19 percent had all reasonable mitigation measures in place, and 26 percent had no mitigation measures in place. The majority of the participants stated that few measures were put in place to solve human-animal conflict.

5.6.1 Measures taken in responding to human-wilflife conflict should be improved.

The fourth and last question was on how human-wildlife conflict measures could be improved. Data from respondents was collected through interviews and analyzed through themes. The respondents were asked about the measures that had been undertaken to control human-animal HWC in Lupande Game Management Area. They disclosed a number of measures that have been put in place to control human-animal conflict. Nine themes emerged: control by killing wild animals; chilli bombs; solar electric fences; planting of early maturing varieties; enhancing education through sensitization; avoiding cultivation in animal corridors; improved construction

of watch tower vantage points; introduction of smell fences; and increasing the community blaster on HWC.

5.6.1.1 Control by killing.

The respondents revealed that one measure to control human-animal conflict in Lupande Game Management Area has been the killing of animals, which mostly terrorize villagers.

R1 respondent that: -

> *As a wildlife Police Officer, we have always killed animals such as lions, elephants, buffalos, hyenas, baboons, and others that mostly terrorise villages around the game management areas. It may not be the best solution, but it is helpful when situation gets worse.*

R2 respondent postulated that:

> *In some instances, we have resorted to cropping the animals, which have been causing problems for the community around them. A number of animals have been killed, and the practice has been quite helpful over the years, although it depletes the animals in the Game Management Area.*

5.6.1.2 Chili Bomb

Respondents revealed that one of the ways to control the practice is by using chili bombs, which chock and scare away the animals around the fields.

The R1 respondent stated that:

> *In some instances, chili bombs have been used and have been successful in protecting the fields from animals. The animals get chocked and run away, and they rarely return to that field after the bad experience for fear of being bombed again. For this method to be effective, there is a need for consistency so that every group of animals that visits the field is targeted, hence the field will be secured.*

The R2 respondent indicated that:

> *There is a method that the villagers are using. I'm told it's called a chili bomb; the bomb is made of chili, and it is thrown on the animals. The targeted animals get choked, and in the process, they run away. It's a very effective method and is used consistently.*

5.6.1.3 Solar electric fence

The respondents revealed that a sure way of protecting the field from the animals is by fencing the field with an electric solar fence.

The respondents said that:

> *To protect the fields, some farmers with money have put up electric solar fences to keep the animals out. This is very effective but difficult for small-scale farmers to implement in the communities where they live. It takes good capital to put up such infrastructure; however, Conservation South Luangwa has erected more than five (5) solar electric fences in Lupande Game Management Area, which have helped the beneficiaries from human-wildlife conflict.*

5.6.1.4 Planting of early-maturing varieties

Respondents revealed that planting early-maturing crop varieties helps prevent encroachment.

R1 explained that:

> *The other is by planting early-maturing crop varieties. This strategy works well in that the crops will grow and mature early, hence the period of the crop being in the field will be shortened, thereby reducing the chances of the crop being eaten up by the animals.*

The R2 respondent indicated that:

> *Some farmers have resorted to planting early-maturing varieties as a way of preventing their crops from being eaten up by animals. The way this system works*

is that by the time the animals realize that the crops are ripe in the fields, the farmer will have harvested all the crops because it was an early-maturing crop.

R3 respondent noted that:

I can only advise farmers to plant early-maturing varieties of crops. It is helpful in that crops are not in the field for a long period of time, which in the end helps a farmer harvest.

5.6.1.5 Education through sensitization

Respondents revealed that farmers have been sensitized on the best methods of planting their crops to avoid their crops being eaten up. The R1 respondent stated that:

A number of sensitization meetings have been conducted with the farmers around Lupande Game Management Area. The meetings have been successful and well attended by the villagers. The farmers have told us the best ways of protecting their fields from around Lupande Game Management Area. The meetings have been successful and well attended by the villagers. The farmers have told us the best ways of protecting their fields from animals, the best farming methods, areas to plant, and ways of chasing away animals from the fields without necessarily killing the animals.

R2 respondent postulated that:

We have done a lot of sensitization among the communities around us, and our meetings have been very interactive. They have also explained their challenges and problems; we have also explained our mandate, and together we have found some solutions. In areas where we have failed to reach consensus, we have consulted our bosses and the royal highnesses.

R3 respondent added that:

> *What has helped us is the meeting we have had with the community around Lupande Game Management Area. The sensitization meetings have had a positive impact in addressing many issues, such as protecting the crops, preventing big cats, and the best farming methods around the game management area.*

5.6.1.6 Avoiding cultivation along the animal corridors

The respondents revealed that communities around the game management area had been told not to plant their crops around the game management area. One respondent noted that:

> *The challenge we have is that some of our farmers want to plant their crops along the animal corridor areas when there are areas that are rarely reached by animals. Hence, every now and then, we urge our villagers to plant their crops far away from the animal corridors; this will help them get a good harvest without problems.*

5.6.1.7: Improved construction of watchtower vintage points

The respondents revealed that a number of watchtower-vintage points have been constructed around Lupande Game Management Area. R1 respondent noted that:

> *There are a number of watchtower-vintage points that have been constructed or are yet to be constructed around the area. These have helped us to observe and monitor the movement of the animals in the area; therefore, we are able to warn and caution the farmers about the possible destruction of their fields, and the farmers are able to guard their fields or find ways of making sure that their fields are safe.*

R2 respondent said that:

> *The vintage towers have also been helpful in monitoring the movement of the animals around the area. The only challenge is that they are few; I hope many more can be constructed.*

5.6.1.8 Food storage and preservation methods

The respondents were asked about preventive strategies for food storage against wildlife destruction and attack. Three themes emerged: construction of improved granaries; education through sensitization on the safe storage of farm produce; and solar electric fences.

5.6.1.9 Construction of improved granaries

The respondents revealed that their communities had embarked on the construction of improved granaries, which make it difficult for animals to access the crop. One community member indicated that:

> *We have been made to spend a lot to build granaries with blocks so that the animals do not access the food that we store. If the granaries are not strong, animals like baboons are able to break them and eat the stored crop. Like I said earlier, this has come at a huge cost for us as the villagers of this community.*

Similarly, one official from the department of wildlife stated that:

> *As a department, we have encouraged the community to come up with strong granaries that cannot be easily damaged by animals. A good number of the community members have adhered to our advice, but others have not. At least this has helped.*

5.6.1.10 Education through sensitization on the safe storage of forms

The respondents revealed that there is a need to conduct sensitization on the safe storage of farm produce. One community member postulated that:

> *We appeal to the officials in the park to ensure that they educate our members on the best way to store our food, especially during the time of drying our food before storing it. It will help because we lack knowledge and skills on how to do it. But with the help of the workers from the park who have the expertise, we know it can be done.*

Another community member indicated that*:*

> *The challenge is that the officials from the park do not visit us regularly to give us ideas on how we can store our grain. We really need the officials to be sensitized on a number of things; this will greatly help us.*

5.6.1.11 Solar electric fences

Respondents revealed that there is a need to encourage people to resort to putting up electric fences as a way of protecting the grain. One official said that:

> *For people who can manage electric fences, they have been very helpful not only in controlling grain and other food stuffs from being eaten up by animals but also in preventing animals from reaching homes and farmland. So, we encourage community members to use electric fences as a long-term measure.*

5.6.1.12: Controlling animals from reaching homes and farming land

The respondents were asked how they prevented animals from reaching their homes and farming land. They revealed a number of preventive measures. Three subthemes emerged: preservation of forests, avoidance of encroachment in animal corridors, and avoidance of poaching, which results in the wounding of wild animals.

5.6.1.13.1 Preservation of forests

The respondents revealed that there was a need to ensure that forests are preserved, which will provide shelter and adequate forage for the animals. One official from the wildlife department stated:

> *As a department, we have encouraged the communities to leave a forest near their homes so that it is not very open. This prevents the animals from encroaching directly on the homes. But some communities have found it very difficult to follow this measurement method as they use the nearby forests for firewood and charcoal burning.*

A second official from the wildlife department postulated that:

> *The other method we have encouraged the people around the park to use is to preserve enough forest near their homes as a way of preventing the animals. It may not be the best method, but in some ways it works.*

5.6.1.13.2 Avoid encroachment in animal corridors.

The respondents also revealed that communities should avoid settling along the animal corridors as a way of preventing the animals. One community member noted that:

> *It has been rough, and what we have resorted to is to run away from areas that have a lot of animals to areas that are less visited by animals. Some areas are liked by animals; for instance, the east of the park has so many animals. This area where we are settled is quite isolated from the animals.*

A second community member said that:

> *The only way is to look for an alternative place to settle where there are fewer animals so that one can have peace.*

Similarly, one park official indicated that:

> *In the meetings I have conducted with the community members, I have always encouraged them to settle in areas away from animal corridor areas. Some communities have adhered to our advice, but others are still hesitant to move to alternative places. However, this is a long-term measure; others will listen; others become stubborn; but when they become victims, they are the first to complain.*

5.6.1.13.3 Avoid poaching, which results in to wounding of wild animals.

The respondents revealed to the researcher that poaching results in the wounding of animals. One wildlife official stated that:

The other way is to ensure that communities avoid poaching because when animals like buffalo are wounded, they become very violent and attack villagers, so the best way is to do away with poaching completely and allow animals to live safely in their habitat.

Respondents were asked how the communities preserved their domestic animals. Three themes emerged: construction of strong predator-proof bomas; construction of mat-reinforced bomas (ideal for cattle); noise-making trumpets (vuvuzelas); and solar lights.

5.6.1.14 Construction of strong predator-proof bomas

The respondents revealed that some residents with domestic animals living in and near the park have constructed strong predator-proof bomas. One Park official indicated that:

It has been difficult, but we have now and again insisted that the communities construct strong predator bomas, which will make it difficult for predators such as lions to catch the animals. Some have been very cooperative, and they have since done that to ensure that their animals are protected.

Similarly, one community member noted that:

It has not been easy, but I have constructed very strong predator bomas just to make sure that my animals are safe.

A second community member stated that I have reinforced my bomas with a mat so that the predators cannot pounce on the animals.

5.6.1.15 noise-making trumpets (vuvuzelas) and solar lights.

The respondents revealed that communities in the park produce noise using various instruments such as vuvuzelas and solar lights to scare away animals. One community member stated that:

One way is to make noise by using instruments such as whistles, vuvuzelas, drums, and other instruments to scare away animals that are near our communities. Most animals don't like the noise; hence, they get scared.

A second community member postulated that:

Normally, in the night, apart from solar lights, we also use noise objects as a way of scaring away predators.

5.6.1.16 Preserving wild animal lives

The respondents were asked how they preserve animals in the park for future generations. Three themes emerged: stop poaching, avoid encroachment, and recruit more wildlife police officers.

5.6.1.17 Stop poaching

The respondents revealed that communities around Lupande Game Reserve have been urged to stop poaching in order to preserve animals for future generations. One officer indicated that:

As a way of preserving the animals, we have sensitized the community to avoid poaching so that animals can continue to multiply and also made them understand that animals in the park do not belong to the park but to every citizen, hence the need to preserve them.

5.6.1.18: Avoiding Encroachment

Respondents revealed that communities have been told to avoid encroachment. The second officer said that:

It is important that the community does not encroach inside the Game Reserve; this will reduce HWC in the long run.

5.6.1.19 Recruitment of Wildlife Police Officers

The respondents revealed that it was important to have more wildlife police officers employed to curb poaching in the Lupande Game Management Area. The third officer stated that:

> *There is a need for the government to recruit so that there is compliance among the community to stop poaching. Although many have been prosecuted, due to understaffing, the officers are not everywhere, so poaching still goes on unnoticed in many areas of the Game Management Area.*

CHAPTER 6. DISCUSSION OF FINDINGS

6.1 Introduction

The previous chapter presented the findings of the study. This chapter discusses the findings of the study in light of the main purpose of the study and the specific research objectives. These findings have been linked to the presented literature review in Chapter 2 and the theory guiding the study.

6.2 The economic value of damaged agriculture from human-wildlife conflict.

The study established that there has been a lot of damage caused by human-wildlife conflict in the Lupande Game Management Area. The highest cost relating to the percentage of damage to agriculture was K180, 317.00, being in the range of 25–50 percent according to figure 4. This finding was in line with Butler (2000) in Zimbabwe, who established that livestock loss due to predation reduced the annual income of agricultural communities by up to 20%. Further, Madhusadan (2003) notes that in Bhadra, the tiger reserve was found to lose 11% of total crops to elephant damage and 12% of livestock to big cats per annum. This demonstrates that human-wildlife conflict comes from the damages that the animals cause in settlements. Despite arguments on who provokes the other, it is clear that humans have gotten closer to the animals' boundaries; hence, their grazing land has been turned into farms, which is why they graze there (Ngoma, 2011).

Further findings of the study revealed that the economic value of the damaged agriculture products ranged from K180, 317.00, being the highest in the damage range of 25–50 percent, to K127, 725.40, representing the damage range of 50–75 percent. These values are too high for a farming community to be neglected. These findings are supported by (Okemwa, 2018) who also found that elephants in Kenya were the main cause of agricultural loss in the communities near the Serengeti National Park. He argued that year in and year out, animals scavenge in the fields of the local farmers because the farmers have encroached on the national park area where the animals were grazing. Therefore, animals know their territory, and what they graze on is within their boundaries. Such loss is a result of humans settling in the grazing land of the animals, and yet we have to count it as human loss.

The study also revealed that the economic loss that farmers encountered was K66,500.00 with a range of 75–100 percent, with K53,094.00 being the lowest at less than 25 percent. These findings

are supported by (Clara, 2019) who also found that elephants in the Mosi-Oa-Tunya National Park in Livingstone caused a lot of crop damage to the nearby farmers in the town, as the local farmers recorded a lot of losses when their land was grazed. They indicated that the minimum amount recorded from the farmers was about K3, 000, while the highest amount of loss was K24, 000. This showed that most of the communities in Livingstone Town were losing money as a result of animal-human conflict where grazing was concerned.

The finding also resonates with the study done by Gandiwa (2013), who established that crop-raiding and livestock depredation by wild animals occur all over the world, with different wild animal perpetrators in Zimbabwe. Most studies conducted on a variety of wildlife species causing crop destruction and livestock depredation have investigated factors, determined patterns, and determined influencing parameters that may help in predicting cases of human-wildlife conflict. Wildlife has caused a lot of crop damage in many parts of the world. It is therefore important that there be a concerted effort among all stakeholders for this vice to be eradicated.

The study also found that most of the complaints on human-wildlife conflict were against elephants (953, or 75%), according to Table 1. The finding resonates with the findings by Zang and Wang (2003), who found that in the mountain area of Simao, an area closer to the Xishuang Banna Natural Reserve in China, a group of 19–24 Asian elephants was responsible for large-scale crop and property damage. The conflict arises from the degradation and fragmentation of the habitat around the area that can sustain the feeding of elephants. During natural food shortages, the elephants forage on food crops such as wheat, rice, bananas, and bamboo, which become food alternatives. It has been shown that elephants have caused more damage to crops than any other animal. In addition, human-wildlife conflict is a growing problem in Zambia as wild animals destroy people's crops and livestock and kill or threaten their lives. This problem is not restricted to a particular geographical area or climatic region but is common to all areas where wildlife and humans share limited resources (Nyirenda *et al.,* 2013). It is therefore imperative that areas be fenced with solar electricity to prevent elephants from attacking crops.

The foregoing findings correspond to Sanford's community development theory. The first foundational concept of Sanford (1962) involves the cycles of differentiation and integration. Differentiation occurs when people understand themselves as unique individuals, while integration

happens when people recognize themselves as members of various groups (Pratto *et al.,* 1994). Through this process, community members protect the community environment to ensure they get the most value out of the community investment. To achieve this, the community members ensure that they protect the economic value that they have invested in their communities, and this brings conflict with the other stakeholders. Through this theory, the economic value has to be protected in the communities so that the animals and the agricultural land are of value to the communities.

6.3 The economic value related to problematic animals controlled by the state.

The study found in Figure 5 found that the highest percentage the officers used in responding to control problematic animals was 38 percent, which costs less than or equal to K100. The findings are in contrast with the findings of Patience (2015), who established that 86% of households were smallholder agricultural farmers who had incurred economic loss and perceived both the frequency and level of crop and livestock damage to have increased over the last two years. Elephants, buffaloes, and lions were key problem wild animals in the study area. Annual household economic costs of human-wildlife conflicts were enormous (USD 18.61 to USD 1 174.60), though the perceived and actual losses differed by 63.2% for mono-specific stands of crops and livestock. Patience (2015) concluded that the main sources of human-wildlife conflicts are the damage inflicted by selected wild animals on agricultural crops and livestock produce, which injure and/or kill human life. All of these caused household economic loss in the study area. Despite the figures being different in terms of the loss incurred in Lupande Game Management Area and Zimbabwe, it confirms that animals caused a huge loss to the government and surrounding communities.

The study further from Figure 5 established that the value of controlling problematic animals was very minimal; hence, this was the solution to ensure animals do not cross their boundaries and go into the farm land. Fernandez, A., (2010) agrees with these findings by stating that the expansion of agricultural activities has led to an increase in humans encountering wildlife, leading to human-wildlife conflict. Elephants, bush pigs, and monkeys are the most problematic animals. Crop raiding was found to be the most common form of conflict, largely because farming is widely practiced and is the major economic activity in the area. The hidden costs of conflict identified were increased exposure to mosquitoes, reduced incomes, food insecurity, school dropouts, and

opportunity costs (Brandon (2009). The study confirms that human-animal conflict has had a huge impact on communities and the government at large.

The study further found that it was cheaper to control animals without factoring in population decline and economic loss in the form of revenue loss from the controlled wildlife. For instance, results from figure 7 show that the economic loss from the control by killing of problematic animals was K 4,318.49.86 in the category of non-residents. The same controlled animal species if sold to the category of established lost revenue amounting to K 3,288,900, and lastly, the citizens with K 2,158,480.00. From figure 8, it can be seen that the government of Zambia, through controlled or killed problem animals, incurred revenue losses amounting to K 4,318,049.86, which would have created more investment if such animals were sold to the bidders for the study period. These findings are in line with WWF (2008), which indicated that there were losses of human lives as well as deaths of elephants due to human-wildlife conflict, indicating that the vast majority of human and elephant deaths occurred in or around elephant pouch areas, which have lost significant amounts of forest. Looking from a different perspective, the lack of effective land-use planning at an appropriate scale in Riau has resulted not only in high levels of human-wildlife conflict and the near decimation of elephant populations (a decline of 80% in less than 25 years), but will also likely result in the province being unable to capitalize on possibly its most important and valuable resource: its carbon-rich peat swamp forests.

The losses that are recorded by the farmers in this study area are huge and should not be neglected because the rural communities depend on the farms for their economic survival and for their daily income. Therefore, problematic animals have to be controlled by the Department of National Parks and Wildlife to save people's lives, but this should really be the last solution. The findings also resonate with (Hedges *et al.*, 2010) who found that agricultural losses in Kenyan farms were caused by the animals that raided the crops in the past. However, the farms that were larger and not fenced were more likely to be raided by elephants and other animals that grazed the local crops. It can be concluded that the occurrence of crop-raiding was predicted by settlement density, distance from daytime elephant refuges, and percentage of cultivation (Graham et al., 2010). Therefore, some problematic animals controlled by the state included elephants, buffalo, and hippos in most cases.

The foregoing findings are supported by Gardener (2006) with the principle of the theory, which states that readiness refers to the maturity and preparedness of the community to deal with the cost of the actions they are taking in the environment. Challenge refers to circumstances where the community does not have the necessary skills to cope with the situation, and support focuses on providing an environment that is encouraging and allows the community to explore the conditions of their identity in a safe setting. In such a manner, the cost of engagement is reduced as the community develops early alerts on the perceived dangers in the community. With such a situation at hand, the wild life officers and the community members gain as the animals do not reach the farms to graze and destroy crops.

6.4 The estimated direct costs associated with human-wildlife conflict management strategies

Results in Figure 9 represent the investments the government, through stakeholders (Conservation South Luangwa and Zambia Carnivore Program), and the community provided in human wildlife management response strategies during the study period. The management strategies ranged from solar fencing, chili bombs, smelly fencing, sensitization meetings, and control by killing problematic animals. In 2021, there will be an increase in the direct investment cost of human wildlife conflict management strategies. This attributed to more expenses on the procurement of a vehicle (a Land Cruiser) in 2021 to ease transportation, which, in return, together with the volunteer engagement, increased fuel costs, which doubled the expense from the previous years. Other expenses incurred were then channeled to community sensitization, which involved drama performances in the Lupande GMA. However, erecting solar fences and chilli bombs received little attention in 2021, and as a result, the situation triggered an increase in human-wildlife conflict cases compared to 2019 and 2020. Since the measures were becoming effective, more investment in such mitigation practices was encouraged.

The direct investment cost findings associated with human wildlife conflict were in line with Brandon (2009), who found that safeguarding animals in areas that are closer to people has become an expensive venture because the direct costs of transport, fuel, guards, and general management have been doubling to a certain extent every year. He further stated that the animal population is increasing just like the human population, and classes regarding farm land and grazing land have become common, hence raising human-wildlife conflict cases. Therefore, increased direct costs

for patrols, solar electric fences, and high-tech facilities have become a source of relief from the escalation in game management areas. The increase in direct costs in the Zambian game management areas in the quest to curb human-wildlife conflict is in line with the strategies other countries have been implementing in the same areas, and this should be encouraged. More funding is expected or needed to see a reduction in human-wildlife conflict in Zambian society.

The study findings in figure 10 further show that more expenses on the direct costs associated with human-wildlife conflict management response strategies were incurred on the procurement of a vehicle, a Land Cruiser, in 2021 for easy transportation, which increased fuel costs, as well as volunteers employed, which doubled the expense from the previous year, which stood at K 558,228 in 2020 and K 1,225,655. Other expenses incurred were now channeled to community sensitization, which involved drama performances in the game management areas. Other costs, for instance, erecting solar fences and chilli bombs, received less investment in 2021, a situation that could lead to an increase in human-wildlife conflict cases compared to the previous years, 2020 and 2019. Therefore, it can be concluded that transport was on the list in 2019 and 2020 and will be improved in 2021 to enhance the operations of the Human-Wildlife Conflict Rapid Response Unit Team in responding to cases of human-wildlife conflict. This trend corresponds with the findings in Figure 6, which presents the increase in the number of elephants controlled in 2021 compared to 3 elephants in 2019 and 4 elephants in 2020. Since these measures were becoming effective, more investment in such mitigation management practices was encouraged.

These findings are supported by (Nimmi, 2016) who found that the protection of wildlife has become more expensive because new investments are coming up to ensure the parks and animals are protected all year round. He argued that South African safari operators have invested in drones and security cameras that are motion-sensitive to ensure that any human figure is captured and censored, whether it is dangerous or not. Such increases have increased the budget allocation for internet connectivity, electricity, and rapid response methods. With similar methods being applied to the Zambian communities to prevent human-wildlife conflict, it was then true that the direct cost was increasing due to such investment.

Findings of the study in figure 9 further established that the direct costs associated with human-wildlife conflict management response strategies increased by more than one hundred percent,

including costs on global positioning systems (GPS), cameras, camping kits, uniforms, personal protective equipment (PPE), chilli patrollers, solar fences, and smelly fences in the physical year compared to 2018, which had no prober data documentation. These findings are supported by Nguni (2020), who found that the protection of animals in the private game areas of Kenya is now expensive because they have been forced to install solar fences and employ more game scouts, which resulted in an increase in camp sites, rations, and PPEs during the pandemic. This expense, however, resulted in preventing human-wildlife conflict since the strategies were better despite the high cost incurred. Even in Zambia, this has proven to be working; hence, the direct cost and investment have been increasing every year so that the human-wildlife conflict can be reduced to an acceptable level in the game management areas in Eastern Province.

These results are supported by Barua *et al.* (2013), who also found that hidden costs also exist in human-animal conflict and are not readily noticeable but are still experienced and borne by affected communities. Hill *et al.* (2002) add that hidden costs are poorly addressed in the HWC literature, and most research attention has focused on visible or direct costs. Hidden costs may include loss of sleep hours, increased workload, family breakups, foregone opportunities, reduced school attendance by children, fear, and, in some cases, mental health problems (Nimmi, 2016). This study then concludes that the direct costs of the damages animals cause are seen and recorded, while the effects and hidden costs are not addressed by the authorities, which leads to communities plunging into poverty.

The study findings revealed that the direct costs associated with the animal-human conflicts included loss of property, loss of labor on land preparation, and loss of the crop itself during that particular year. Galati (2020) concurred with the findings when they found that 5,196 households live near 11 wildlife reserves in India, and self-reported annual costs include crop and livestock losses and human casualties (injuries and deaths). By employing conservative estimates from the literature on the value of a statistical life (VSL), we find that costs from human casualties overwhelm crop and livestock damages for all species associated with fatalities. Farmers experiencing negative interactions with elephants over the past year incur damages on average 600 and 900 times greater than those incurred by farmers with negative interactions with costly herbivores: the pig and the nilgai. Similarly, farmers experiencing a negative interaction with a tiger over the last year incur damage that is on average three times that inflicted by a leopard and

100 times that from a wolf. These cost differences are largely driven by differences in the incidence of human death and casualties. Our estimate of costs fluctuates across reserves, mostly due to variations in human casualties. Understanding the drivers of human casualties and reducing their incidence are crucial to reducing the costs of human-wildlife conflict. In many ways, the findings of this objective resonate with the findings of this study. The direct costs involved in HWC pose a challenge to humanity and nature.

The foregoing discussion was in tandem with Sanford (1962), who argued that the amount of challenge a community can handle should be dependent on the support available from the stakeholders. The cost of handling the challenge should be proportionate to the cost the parties will incur, so that neither party should be bound to lose in the process. If there is too much challenge and not enough support, community members may regress to less adaptive behaviors, ignore the challenge, or try to escape the challenge so that the cost can be reduced in one way or another so that lives are saved. The communities should ensure that their agricultural practices are conducted away from the animal corridors so that conflicts are reduced at all costs.

6.5 To establish measures for responding to human-wildlife conflict

The study findings established a number of measures for responding to human-wildlife conflict in Lupande Game Management Area. It was found that to control human-wildlife conflict in Lupande Game Area, there was a need to kill animals, which mostly terrorize villagers. This finding is in line with the findings by McManus et al. (2015), who noted that there was a need for governments to employ regulated methods of lethal control as a tool to alleviate unwanted human-wildlife impacts, such as depredation. Forms of lethal control include harvesting, culling, legalized hunting, and selective or targeted killing of 'problem' animal individuals. These methods are common in the Zambian Game Management Areas to reduce human-wildlife conflict and the impact of the damage on agriculture.

The study found that lethal control was another common way of controlling animals in a more legal way in Zambia, especially the animals that caused problems for human communities. This method is often used in instances where animals pose a direct threat to human safety or property, such as African elephants (Hoare, 2015); leopards (Holland, Larson, and Powell, 2018); and several species of shark (McCagh, Sneddon, and Blache, 2015). Lethal control is often considered

a cheap and cost-effective method of reducing negative human-wildlife impacts, potentially explaining its popularity with governments (Naughton-Treves, Holland, and Brandon, 2005). This strategy applies in the present study area and is highly supported by the Zambia Wildlife Act, 2015. Therefore, this method ensures that animals that have been noted to be a threat to the community are killed so that there is safety for the local people. However, there is a need to be careful when using this method; there is a possibility that people may end up depleting wild animals in the name of killing a stray lion or elephant.

In addition, another control measure found in the study was the use of chili bombs. Respondents established that one of the ways to control the practice is by using chili bombs, which chock and scare away the animals around the fields. The finding is in resonance with Hoare (2015), who found that deterrents provide another non-lethal conflict human-wildlife management innervation strategy commonly used to dissuade species from entering human settlements and accessing resources. Types of deterrents are many and varied, ranging from olfactory repellents, such as the use of chili to deter elephants (Hoare, 2015), to chemicals to repel sharks from popular swimming areas (Guerra, 2019). Acoustic devices are largely used in the marine environment, with the most obvious examples being acoustic harassment devices that are employed to discourage marine mammals from approaching fishing fleets (Guerra, 2019). Though the method provided may be effective, it does not provide a sustainable solution as animals easily forget and may terrorize the area once more after some time.

Furthermore, the study also found that the use of solar electric fences also protects agricultural produce and household goods from attacks. The finding settles well with the findings of Hoare (2015), who established that biological deterrents such as beehive fences are increasingly being applied as a way to combine conflict management with additional revenue from local communities. An example includes the Elephants and Bees project, implemented and supported by the charity Save the Elephants. The effectiveness of deterrents is often evaluated by changes in the rate of predation or crop raiding events before and after application. In the case of African elephants, several studies claim that olfactory and biological deterrents have decreased incidences of crop raiding (Hoare, 2015). Okemwa et al. (2018) agree that while the use of deterrents like chili and bee-hive fences is effective to a point, alone they are not sufficient as a conflict management tool and are therefore most successful when used in conjunction with other measures, such as guarding.

Though electric solar fences may prove to be expensive for most communities, they are one of the best ways to protect communities from animals. There is a need for the government to work hand in hand with the community to ensure that this method is applied to prevent human-wildlife conflict in Lupande Game Management Area.

The study found that people need to settle and avoid planting crops along the corridor line, where animals can hardly reach them. However, this is in contrast with the findings of Conover (2002), who found that translocation has been used to remove individual animals responsible for depredations and, in some cases, to reduce populations in specific areas by removing relatively large numbers of animals. Mostly, this has been an appealing method to the general public, especially those who are particularly concerned about animal welfare, as they perceive that it gives the affected animal a second chance at a new site. Unfortunately, reality is often not so positive, and translocation can be a controversial means of resolving human-wildlife conflicts, associated with a number of problems. Stander (1990) argues that it is quite common for translocated animals to return to the site where they were originally captured. This method is also a risky procedure, and it is normal for a proportion of translocated animals to die either due to the stress of capture or soon after release. It is important that the two methods of planting along the corridor lines and translocation complement each other for effective results.

The study found that a watchtower and vintage point have been constructed around Lupande Game Management Area for the community to monitor the movement of animals. These have helped people observe and monitor the movement of the animals in the area and be able to warn and caution the farmers about the possible destruction of their fields. The finding is in line with the findings of CSL (2020) and ZCP (2020), who established that guarding crops and livestock is another way of managing human-wildlife conflict in communities. Watchtowers that provide good vantage points built around fields of crops increase the farmers' chances of being alerted to the presence of potentially harmful wildlife before damage has occurred. Simple alarm systems, using string and cowbells or tins, can also be effective and avoid the farmer having to be alert all night (ZCP, 2020). The method alerts the community to the movement of animals and allows them to carry out other intervention measures. Hence, the method works well with other measures such as chili bombs and making noise to chase away the animals.

The discussion was supported by Sanford (1962), who argued that a community environment should be considered a developmental community where members' abilities ought to be nurtured to enhance their agricultural progress from the local resources. The environment should not present too many challenges for an individual, as this may lead to regression and allow for less adaptive modes of behavior. The suppression of the animals in various ways is the best way of making people live in harmony with the animals in their communities. In addition, if the environment seems challenging, individuals may want to escape or ignore the situation, which brings conflict with the surrounding stakeholders. Communities should use the available measures to come up with collective ways of making animals not destroy their crops and livelihoods, even if they are near each other.

CHAPTER 7. CONCLUSION AND RECOMMENDATION

7.1 Introduction

The study's overall objective was to estimate the economic loss caused by human-wildlife conflict amongst small-scale farmers and the Government of the Republic of Zambia in Lupande Management Area. This chapter provides the conclusion and recommendations of the study based on the research findings.

7.2 Conclusion

The study found that the cost relates to the percentage of damage to agriculture, with K180, 317.00 being the highest in the damage range of 25–50 percent, followed by damage of K127, 725.40 representing a damage range of 50–75 percent; third was K66, 500.00 with a range of 75–100 percent; and K53, 094.00 being the lowest at less than 25 percent in Lupande Game Management Area. From the findings on damage in agriculture, it can be deduced that the economic loss as a result of human-wildlife conflict was huge, affecting farmers in the study area from 2018 to 2021.

Regarding the estimation of economic value related to problematic animal control by killing using state wildlife police officers as a result of human-wildlife onflict, the study established that 38 percent of the officers costs were less than or equal to K100 when responding to human-wildlife conflict, followed by 31 percent, which cost between K101 and K250, 17 percent, which cost K251 to K500, and 14 percent, which cost more than K501. From the findings, it was established that it was cheaper to control problematic animals through killing than translocation. Though it was cheaper to kill problem animals, results further showed that killing the animals would negatively affect their population growth and revenue loss to the government. Therefore, from these findings, it can be seen that the Government of Zambia, through controlled or killed problem animals, incurred revenue losses amounting to K4,318,049.86 from 2018 to 2021. This could have created more investment if such animals were sold to the bidders.

The findings show that more expenses on the direct costs associated with human-wildlife conflict management response strategies were incurred on the procurement of a Land Cruiser in 2021 to ease transportation, which in return, together with volunteer engagement, increased fuel costs, which doubled the expense from the previous years, which stood at K771, 262.00 in 2019, K

558,228 in 2020, and K1, 225,655. Other expenses incurred were now channeled to community sensitization, which involved drama performances in the game management area. On the other hand, erecting solar fences and chilli bombs received little attention in 2021, and as a result, the situation triggered an increase in human-wildlife conflict cases compared to the previous years, 2019 and 2020. Since the measures were becoming effective, there was a need for the government and stakeholders to provide more investment in solar electric fencing, sensitization, chilli bombs, and smelly fencing.

In order to effectively respond to human-wildlife conflict in Lupande GMA, the findings showed some response strategies, such as control by killing problematic animals, use of chilli bombs to scare away animals, erecting solar fences in conflict hotspot areas, and planting early maturing crop varieties. Other measures established include enhancement of education through sensitization, avoidance of cultivation in animal corridors, improved construction of watch tower vantage points, and the enhancement of the newly introduced smelly fences. The majority of participants were in support of enhancing solar electric fences as the most effective management strategy for controlling human-wildlife conflict.

7.3 Recommendations

Based on the conclusions of the study, the following recommendations are made:

1. Regarding the findings on damage in agriculture, it was established that the economic loss as a result of human-wildlife conflict was huge, affecting farmers in the study area. Therefore, there was a need for the government, through stakeholders, to enhance the construction of restraining solar-powered electric fences near human settlements and agricultural fields in Lupande GMA. This would enable massive reductions in damage to agriculture and retaliation against wildlife by the affected community.
2. Based on the findings from the control or killing of problematic animals, it was established that the government of Zambia incurred revenue loss, which could have created more investment if such animals were sold to the bidders. Therefore, the government, through stakeholders, needs to invest in infrastructure such as improved construction of watch tower vantage points to ease monitoring of problem animals, improved livestock

enclosures, and improved granaries. This would further help protect livestock from predation and elephants from damaging traditional granaries.

3. Due to the huge revenue loss from the control of problem animals causing damage to agriculture, there is a need for the government to consider formulating a policy towards the revenue recovery from controlled animal trophies. For this suggestion to be done properly, the controlled animal trophies should be well preserved by the Department of National Parks and Wildlife to add value and attract clients who are interested in buying them. The recovered revenue or money would not only increase the government's treasury but also recover the cost officers use to kill the problem animals.
4. The government of Zambia should consider increasing manpower (wildlife police officers). The increased manpower would enhance quick response to protect both wildlife and human life and property in the Lupande GMA.
5. Through increased wildlife conservation benefits, there is a need for capacity building among the local farmers through sensitization meetings to sufficiently protect their crops and livestock. Capacity building can be achieved through financial support from wildlife conservation payments and increased funding by the government for the Education Section of the Department of National Parks and Wildlife.
6. The government should consider employing a specialized ecologist in the area of human-wildlife conflict in the Luangwa Ecosystem. The move would help the government with strategic professional information on the larger spectrum of human-wildlife conflict. This information would enhance policy formulation for human-wildlife conflict.
7. On the basis of the results from the current study, the researcher recommends that similar studies be conducted in all 36 game management areas in Zambia that have similar human-wildlife conflict to correlate with these findings.

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APPENDIX 1: COMMUNITY MEMBERS - FOCUS GROUP DISCUSSION GUIDE

INTRODUCTION

My Name is Chilembo Robert, a student at the University of Zambia conducting a research on the Economic Implication of Human - Wildlife Conflict in Lupande Game Management Area. This will lead to my partial fulfilment for the award of a Master of Science Degree in Environmental and Natural Resources Management. Your group or community have been identified as a potential respondent to share and give valuable information. Be assured that all the information provided and collected during the study will be treated as private.

A. Identification

1. Names of participants
   ……
   ……
   ……
   ……
2. Date of the interviews
   ……
   ……...
3. GPS Coordinates ……&
   ……..
4. Village:
   …….....
5. VAG
   …….
6. Name of the
   CRB……..
7. Chiefdom
   …….
8. GMA……
   ……..
9. District
   ……
10. Province
    ……
11. Name of Facilitators
    …….

B. What is the estimated household annual economic value of crop damage caused by wildlife?

1. What agricultural property is destroyed by the wild animals in our area?
2. What kind of animals usually cause this destruction?
3. How many families have complained so far to have lost agricultural produce from animal?
4. From your experience, what can be the cost of the produce destroyed? Number of bags or kilograms.

C. What is the estimated household annual economic value of the killed livestock by wildlife?

5. With regards to the livestock, how many have been lost as a result of animal human conflict in this area?
6. Per household, which was affected, kindly state how many have been lost?
7. If possible, itemise even the cost of such animals at the time of losing them?

D. What is the estimated economic value of the problematic animals controlled?

8. From your experience in this community, which animals have been killed by the DNPW in the recent past?
9. According to them, how were these animals affecting the community?
10. After their killing, what was the effect on the community?
11. From the government point of view, what is the cost of this killing?

E. What are the associated direct costs involved in responding to Human – Wildlife Conflict management strategies?

12. From your budget, how much allocation is involved in resolving human animal conflicts?
13. What kind of compensation have you offered to the affected communities for far and its related costs?
14. How many animals have you lost in the process and what can be the estimated cost?
15. What have you done about the human life lost in the conflict and what costs are associated with such?
16. How does the DNPW help to mitigate human-wildlife conflict in your area?

F. What measures can be taken in responding to Human - Wildlife Conflict be improved?

17. In resolving this long standing problem, what can be done to resolve:-

    i. Agricultural lose for the communities,

ii. Food storage preservation
iii. Controlling animals from reaching homes and farming land
iv. Preserving animal lives
v. Preserving animal lives.
vi. Reducing hidden expenses in animal human conflict

THANK YOU VERY MUCH FOR YOUR TIME

APPENDIX 2: INTERVIEW GUIDE FOR KEY INFORMANTS

INTRODUCTION

My Name is Chilembo Robert, a student at the University of Zambia conducting a research on the Economic Implication of Human - Wildlife Conflict in Lupande Game Management Area. This will lead to my partial fulfilment for the award of a Master of Science Degree in Environmental and Natural Resources Management. Your institution has been identified as a potential respondent to share and give valuable information. Be assured that all the information provided and collected during the study will be treated as private. Be assured further that the final document will be shared to your institution as per guidelines stated and issued by the Department of National Parks and Wildlife.

SECTION A- BIO DATA

Name of the organization: ……

Position of respondent: ……

Date:

……..

SECTION B. What is the estimated household annual economic value of crop damage caused by wildlife?

1. What agricultural property is destroyed by the wild animals in our area?
2. What kind of animals usually cause this destruction?
3. How many families have complained so far to have lost agricultural produce from animal?
4. From your experience, what can be the cost of the produce destroyed? Number of bags or kilograms.

SECTION C. What is the estimated household annual economic value of the killed livestock by wildlife?

5. With regards to the livestock, how many have been lost as a result of animal human conflict in this area?
6. Per household, which was affected, kindly state how many have been lost?

7. If possible, itemise even the cost of such animals at the time of losing them?

SECTION D. What is the estimated economic value of the problematic animals controlled?

8. From your experience working with this community, which animals have been controlled by killing by the DNPW in the recent past?
9. According to them, how were these animals affecting the community?
10. After their killing, what was the effect on the community?
11. From the government point of view, what the cost of control by killing of problematic animals?

SECTION E. What are the associated direct costs involved in responding to Human – Wildlife Conflict management strategies?

12 From your budget, how much allocation is involved in resolving human animal conflicts?
13 What kind of compensation have you offered to the affected communities so far and its related costs?
14 How many animals have you lost in the process and what can be the estimated cost?
15 What have you done about the human life lost in the conflict and what costs are associated with such?

SECTION F. What measures can be taken in responding to Human - Wildlife Conflict be improved?

16. As a key stakeholder in conservation in the area, what can be done in resolving this long standing problem of HWC:

i. Agricultural lose for the communities,
ii. Food storage preservation
iii. Controlling animals from reaching homes and farming land
iv. Preserving of domestic animal lives
v. Preserving wild animal lives
vi. Reducing hidden expenses in animal human conflict

THANK YOU FOR YOUR TIME

APPENDIX 3: RESEARCH APPROVAL LETTER FROM UNIVERSITY OF ZAMBIA

THE UNIVERSITY OF ZAMBIA
DIRECTORATE OF RESEARCH AND GRADUATE STUDIES

Great East Road Campus | P.O. Box 32379 | Lusaka10101 | Tel: +260-211-290 258/291 777 **Fax**: (+260)-211-290 258/253 952 | E-**mail**: director.drgs@unza.zm | Website: www.unza.zm

APPROVAL OF STUDY

IORG No. 0005376
NASREC IRB No. 00006465

8th April 2022, 2022

REF NO. NASREC-2021-APR-003

Mr Robert M Chilembo

The University of Zambia

School of Natural Sciences

Department of Geography and Environmental Studies

P.O. Box 32379

LUSAKA

Dear Mr. Chilembo

RE: "ECONOMIC IMPLICATION OF HUMAN WILDLIFECONFLICT IN LUPANDE GAME MANAGEMENT AREA – MAMBWE DISTRICT EASTERN PROVINCE."

Reference is made to your protocol dated as captioned above. NASREC resolved to approve this study and your participation as Principal Investigator for a period of one year.

Review Type	**Ordinary Review**	**Approval No. NASREC-2021-APR-003**
Approval and Expiry Date	Approval Date: 8th April 2022, 2022	Expiry Date: 7th April 2023, 2023
Protocol Version and Date	Version - Nil.	8th April 2023, 2023
Information Sheet, Consent Forms and Dates	English.	To be provided
Consent form ID and Date	Version - Nil	To be provided
Recruitment Materials	Nil	Nil
Other Study Documents	Questionnaire.	

Specific conditions will apply to this approval. As Principal Investigator it is your responsibility to ensure that the contents of this letter are adhered to. If these are not adhered to, the approval may be suspended. Should the study be suspended, study sponsors and other regulatory authorities will be informed.

Conditions of Approval

- No participant may be involved in any study procedure prior to the study approval or after the expiration date.
- All unanticipated or Serious Adverse Events (SAEs) must be reported to NASREC within 5 days.
- All protocol modifications must be approved by NASREC prior to implementation unless they are intended to reduce risk (but must still be reported for approval). Modifications will include any change of investigator/s or site address.
- All protocol deviations must be reported to NASREC within 5 working days. All recruitment materials must be approved by NASREC prior to being used.
- Principal investigators are responsible for initiating Continuing Review proceedings. NASREC will only approve a study for a period of 12 months.
- It is the responsibility of the PI to renew his/her ethics approval through a renewal application to NASREC.
- Where the PI desires to extend the study after expiry of the study period, documents for study extension must be received by NASREC at least 30 days before the expiry date. This is for the purpose of facilitating the review process. Documents received within 30 days after expiry will be

labelled “late submissions” and will incur a penalty fee of K500.00. No study shall be renewed whose documents are submitted for renewal 30 days after expiry of the certificate.

- Every 6 (six) months a progress report form supplied by The University of Zambia Natural and Applied Sciences Research Ethics Committee as an IRB must be filled in and submitted to us. There is a penalty of K500.00 for failure to submit the report.

- When closing a project, the PI is responsible for notifying, in writing or using the Research Ethics and Management Online (REMO),both NASREC

- and the National Health Research Authority (NHRA) when ethics certification is no longer required for a project.

- In order to close an approved study, a Closing Report must be submitted in writing or through the REMO system. A Closing Report should be filed when data collection has ended and the study team will no longer be using human participants or animals or secondary data or have any direct or indirect contact with the research participants or animals for the study.

- Filing a closing report (rather than just letting your approval lapse) is important as it assists NASREC in efficiently tracking and reporting on projects. Note that some funding agencies and sponsors require a notice of closure from the IRB which had approved the study and can only be generated after the Closing Report has been filed.

- A reprint of this letter shall be done at a fee.

- All protocol modifications must be approved by NASREC by way of an application for an amendment prior to implementation unless they are intended to reduce risk (but must still be reported for approval). Modifications will include any change of investigator/s or site address or methodology and methods. Many modifications entail minimal risk adjustments to a protocol and/or consent form and can be made on an Expedited basis (via the IRB Chair). Some examples are: format changes, correcting spelling errors, adding key personnel, minor changes to questionnaires, recruiting and changes, and so forth. Other, more substantive changes, especially those that may alter the risk-benefit ratio, may require Full Board review. In all cases, except where noted above regarding subject safety, any changes to any protocol document or procedure must first be approved by NASREC before they can be implemented.

Should you have any questions regarding anything indicated in this letter, please do not hesitate to get in touch with us at the above indicated address.

On behalf of NASREC, we would like to wish you all the success as you carry out your study.

Yours faithfully,

Dr. E. M. Mwanaumo

CHAIRPERSON
THE UNIVERSITY OF ZAMBIA NATURAL AND APPLIED SCIENCES RESEARCH ETHICS COMMITTEE - IRB

CC: Director, Directorate of Research and Graduate Studies
Assistant Director (Research), Directorate of Research and Graduate Studies
Assistant Registrar (Research), Directorate of Research and Graduate Studies

APPENDIX 4: 2022 ANIMAL PRICES

DEPARTMENT OF NATIONAL PARKS & WILDLIFE *2022 RESIDENT & NON RESIDENT HUNTING* *LICENCE FEES*				
Category	***Citizens (ZMW)***	***Established (ZMW)***	***Non Residents (USD)***	
Application Fee	*16.80*	*16.80*	*N/A*	
Bird Hunting Licence	*416.70*	*583.50*	*100.00*	
Basic Fee	*166.80*	*333.60*	*N/A*	
GMA Permit	*83.40*	*104.40*	*150.00*	
Application Form to hunt in a GMA	*200.00*	*200.00*	*150.00*	
GAME ANIMALS				
Species	***Citizens (ZMW)***	***Established (ZMW)***	***Non Residents (USD)***	***Hunting Rights (USD)***
Baboon	*280.00*	*400.00*	*60.00*	*30*
Buffalo	*9,050.00*	*15,100.00*	*1,600.00*	*250*
Bushbuck	*703.00*	*1,950.00*	*380.00*	*100*
BushPig	*375.00*	*1,500.00*	*320.00*	*30*
Deer Axis	*2,000.00*	*4,000.00*	*800.00*	*100*
Duiker, Common	*469.00*	*1,200.00*	*350.00*	*80*
Eland	*13,000.00*	*19,950.00*	*2,500.00*	*350*
Grysbok	*500.00*	*1,350.00*	*250.00*	*50*
Hartebeest	*2,580.00*	*5,500.00*	*780.00*	*150*
Hyaena	*1,500.00*	*2,800.00*	*250.00*	*30*
Impala	*750.00*	*1,300.00*	*120.00*	*70*
Jackal	*500.00*	*1,200.00*	*260.00*	*100*
Kudu	*7,950.00*	*13,500.00*	*1,600.00*	*250*
Oribi	*550.00*	*1,350.00*	*250.00*	*60*
Otter	*480.00*	*1,350.00*	*190.00*	*100*
Puku	*1,160.00*	*2,700.00*	*420.00*	*80*
Reedbuck	*850.00*	*2,200.00*	*420.00*	*150*
Warthog	*800.00*	*1,875.00*	*360.00*	*80*
Waterbuck Common	*2,430.00*	*4,325.00*	*840.00*	*200*
Waterbuck Defassa	*2,750.00*	*5,500.00*	*1,200.00*	*200*
Wildbeest,Blue	*2,430.00*	*4,325.00*	*780.00*	*150*
Wildebeest,Cooksons	*3,000.00*	*6,370.00*	*1,350.00*	*250*
Zebra	*3,675.00*	*7,500.00*	*720.00*	*200*
PROTECTED ANIMALS				
Caracal	*1,200.00*	*2,750.00*	*680.00*	*150*
Civet	*1,200.00*	*2,750.00*	*680.00*	*150*
Crocodile	*3,000.00*	*7,500.00*	*1,600.00*	*150*
Duiker,Blue	*1,200.00*	*2,750.00*	*530.00*	*80*
Duiker,Yellow Backed	*1,200.00*	*2,750.00*	*500.00*	*80*
Elephant with Tusks	*90,000.00*	*135,000.00*	*10,000.00*	*3,500*
Elephant Tuskless	*70,000.00*	*100,000.00*	*6,500.00*	*1,500*
Hippopotamus	*8,500.00*	*14,870.00*	*1,600.00*	*350*
Honey Badger	*2,100.00*	*4,000.00*	*100.00*	
Klipspringer	*1,200.00*	*3,750.00*	*680.00*	*200*
Lechwe,Black	*2,300.00*	*4,800.00*	*1,700.00*	*300*

Lechwe,Kafue	*2,500.00*	*4,950.00*	*1,200.00*	*250*
Lechwe, Red	*2,600.00*	*5,000.00*	*1,200.00*	*400*
Leopard	*27,000.00*	*45,000.00*	*2,650.00*	*750*
Lion	*30,000.00*	*56,250.00*	*4,200.00*	*750*
Monkey Colobus	*938.00*	*1,950.00*	*310.00*	*0*
Monkey, Blue	*938.00*	*1,750.00*	*310.00*	*0*
Monkey Vervet	*850.00*	*1,750.00*	*50.00*	
Pangolin	*23,438.00*	*93,750.00*	*310.00*	*0*
Mongoose	*1,200.00*	*3,000.00*	*680.00*	
Roan Antelope	*13,900.00*	*24,250.00*	*4,000.00*	*750*
Sable Antelope	*15,000.00*	*26,000.00*	*3,000.00*	*750*
Sitatunga	*3,688.00*	*7,750.00*	*2,800.00*	*500*
Steinbok	*1,200.00*	*2,750.00*	*310.00*	*100*
Tsessebe	*4,200.00*	*7,750.00*	*1,550.00*	*280*
*** These prices are subject to change without notice**				