A COMPARATIVE ANALYSIS OF OPPORTUNITY, TRANSACTION AND HEALTH COSTS OF HUMAN-WILDLIFE CONFLICT IN AMBOSELI AND MT. KENYA ECOSYSTEMS, KENYA

MANOA DAVID OWINO

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DECLARATION

This thesis is my original work and has not been presented for examination in any other university.

16th December 2022

Manoa David Owino **Date**

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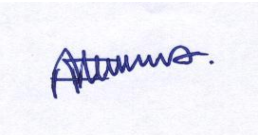
This thesis has been submitted for examination with our approval as university supervisors.



16th December 2022

Prof. Francis Mwaura **Date**

Department of Geography, Population & Environmental Studies,

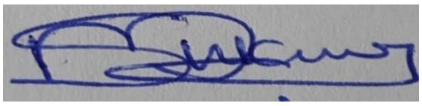
University of Nairobi

16th December 2022

Dr. Thuita Thenya **Date**

Wangari Maathai Institute of Peace and Environmental Studies,

University of Nairobi



16th December 2022

Dr. Mikalitsa S. Mukhovi **Date**

Department of Geography, Population & Environmental Studies,

University of Nairobi

DEDICATION

This work is dedicated to my late father-Timothy Kisore and my elder brother Japheth Angogo, who passed on during my study. They would have loved to see me finalize my PhD journey. The two men left fingerprints of handwork and determination in my life.

My wife-Lilian Vihenda, who has tirelessly encouraged me to continue with my PhD work and for standing strong with me when life seemed to be meaningless.

"You cannot protect the environment unless you empower people, you inform them, and you help them understand that these resources are their own, that they must protect them"

-Prof. Wangari Maathai-

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ABSTRACT

Conventionally, the cost of Human-wildlife conflict (HWC) has largely dwelled on visible costs (VC), ignoring the hidden costs (HC). The HC of HWC are losses that are uncompensated, temporarily delayed, or of psychosocial in nature, and are often excluded from economic assessments, policy formulation and scientific research. This study was conducted in the Amboseli Ecosystem (AE) and Mt. Kenya Ecosystem (MKE) with the aim of comparing the HC economic losses of HWC and demonstrating the importance of considering HC in wildlife conservation. The two ecosystems are HWC hot spot areas, yet the main sources of livelihoods, culture, climatic conditions and level of development are different, hence providing a chance to compare HWC across the forementioned variables. The objectives of this study were to; a) quantify the economic magnitude of the opportunity, transaction and health costs of HWC and its impacts on human wellbeing; b) compare the visible and hidden costs of HWC in AE and MKE; c) identify methods used by the communities to reduce the hidden costs of HWC; and d) explore strategies and mechanisms for appropriate and sustainable financial compensation. Data was collected from 408 households using a muti-stage sampling technique. Results indicates that crop and livestock guarding costs were the most common HC in AE and MKE. Other HC included loss of school time, time lost escorting children to school, money spent on guarding, disease contraction during guarding, sleepless nights, anxiety and fear. However, the hours spent guarding livestock ($t= 3.820$, $d.f=110$, $p=0.000$) and crops ($t=3.571$, $d.f=130$, $p=0.00$) at night in AE and MKE were significantly different. Conversely, daytime hours spent guarding livestock and crops in AE and MKE were similar ($P>0.05$). School children in AE lost more time in the morning (1.28 ± 0.053 hours; $n=98$) and in the evening (1.22 ± 0.044 hours; $n=93$) than those in MKE. Similarly, the time adults lost escorting children to school ($t=8.166$, $d.f=284$, $p=0.000$) were significantly different in the two ecosystems. On average, AE households spent KES 208,540 guarding livestock and crops compared to MKE households who incurred KES 131,309. While guarding, 75.5 % ($n=154$) of the households in AE and 38.7% ($n=79$) in MKE contracted diseases such as malaria and pneumonia. In addition, most households in AE, 78.9% ($n=161$) and in MKE, 61.3% ($n=125$) experienced anxiety and fear, while 68.1% ($n=139$) and 51% ($n=104$) in AE and MKE respectively, had sleepless nights. Transaction costs analysed as the losses incurred due to delayed payment of HWC claims over a period of 1 year, revealed that human fatalities resulted to the highest loss in both MKE (KES 228,763.89) and AE (KES 152,462.33). Households in both ecosystems used a range of techniques to deal with the HC of HWC, including rescheduling activities, physical structures, and guarding. Overall, HC were more in AE than MKE, suggesting HC varies with wildlife species, human population, land use practices, mitigation measures and ecosystems. A review of the wildlife compensation policy and law to include HC can help deter resentments resulting from uncompensated HWC costs.

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LIST OF ACRONYMS AND ABBREVIATIONS

AE	Amboseli Ecosystem
BFF	Born Free Foundation
BLF	Big Life Foundation
CGK	County Government of Kajiado
CGL	County Government of Laikipia
CGM	County Government of Meru
CVM	Contingent Valuation Method
CWCCC	County Wildlife Conservation and Compensation Committee
FAA	Federal Aviation Administration
FAO	Food and Agriculture Organization of the United Nations
FV	Future Value
GoK	Government of Kenya
GPS	Global Positioning System
Ha	Hectare
HHC	Human-Human Conflicts
HWC	Human-Wildlife Conflict
IRA	Insurance Regulatory Authority
IUCN	International Union for the Conservation of Nature
KES	Kenya Shillings
KFS	Kenya Forest Service
KLIP	Kenya Livestock Insurance Program
KNBS	Kenya National Bureau of Statistics
KWS	Kenya Wildlife Service
MEA	Millennium Ecosystem Assessment
MKE	Mount Kenya Ecosystem
MV	Money Value
NACOSTI	National Commission for Science Technology and Innovation
NEMA	National Environmental Management Authority
PPP	Public and Private Partnership

SARPO	World Wide Fund for Nature-Southern Africa Region Programme Office
TVM	Time Value for Money
TVM	Time Value for Money
UNEP	United Nation Environmental Programme
USDA	United States Department of Agriculture
USIP	United State Institute of Peace
WCMA	Wildlife Conservation and Management Act
WCMC	UNEP World Conservation Monitoring Centre
WHO	World Health Organization
WTA	Willingness to Accept
WTP	Willingness to Pay
WWF	World Wide Fund for Nature

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND TO THE STUDY

It is estimated that 14.8 % of the world's terrestrial surface and 12.7% of marine areas comprises of wildlife-protected areas (United Nation Environmental Programmes [UNEP], 2016). For wildlife species to continue maintaining their genetic viability, shift their ranges, and establish new territories, among other live supporting needs, protected areas need to be geo-spatially linked. Unfortunately, wildlife species are becoming increasingly isolated in patches of habitats, surrounded by landscapes dominated by people (Ament et al., 2014). As a result, interaction between people and wildlife has intensified. The interaction between people and wildlife sometimes results to human-wildlife conflict (HWC). HWC is a reciprocal complex process that affects both human and wildlife negatively (Frank et al., 2019), thus destabilising the coexistence between humans and wildlife (Manfredo, 2008). HWC problem is a key issue that is discussed in different social, political, and economic forums across the globe.

HWC can be considered a twofold problem, between those defending conservation objectives and those defending other objectives, mainly livelihood (Redpath et al., 2015). As such, two dimensions of wildlife conservation conflicts emerges, namely, the human-wildlife conflict (HWC) and the human-human conflicts (HHC). The HWC dwells on the impacts of wildlife on humans and their respective activities, while HHC refers to the antagonism between those defending pro-wildlife positions and those defending other positions (Young et al., 2010). Therefore, wildlife conservation largely depends on the divergent interpretation of conflicts in conservation, and how the HHC and HWC are managed.

Conventionally, HWC has over the years been documented to manifest itself in form of crop raiding, livestock predation, property damage, attack on humans, and diseases transmission (Thirgood et al., 2005). For example, the United States Department of Agriculture (USDA, 2012) documented crop raiding by white-tailed deer (*Odeocoileus virginianus*); Hudson et al. (2002) reported the spread of tuberculosis vectors (*Mycobacterium bovis*) by badgers (*Meles meles*) in United Kingdom since 1950s; several studies revealed livestock predation around Serengeti National Park in Tanzania (for example Holmern et al. 2007) and in ranches adjacent to Tsavo (Patterson et al., 2004) and Amboseli (for example Manoa & Mwaura, 2016; Manoa et al., 2020b) National parks in Kenya. The HWC has been conceptualized in the context of addressing the direct costs, ignoring the hidden costs such as opportunity, transaction, and health costs. This approach has been cited by different scholars (see for example Redpath et al., 2014; Madden & McQuinn, 2014; Massé, 2016) to be a hindrance to finding effective solutions to HWC. It is for these reasons, that HWC remains a major problem around the world especially in Africa where people and wildlife still coexist.

The hidden costs of HWC are costs that are uncompensated, temporally delayed, or psychosocial in nature (Ogra, 2008), and are often excluded from economic assessments associated with living with wildlife (Hunter et al., 1990). Yet, some studies have shown that hidden costs have more impacts on people than the visible costs. For example, back in 1979, the hidden costs (amount used to deter or control coyotes attacks) associated with sheep depredation was US$1.2 million compared to direct economic cost of US$ 419,000 in South Utah USA (Taylor et al., 1979*)*. In Botswana, farmers spent US$ 30 to employ 3.5 herders to prevent livestock predation and Manoa' (2015) indicated that pastoralists in the Amboseli region of Southern Kenya spent an average of KES 40,530 per predator-proof enclosures. The Botswana and Kenya examples, captures the hidden costs that farmers incur, and which are never compensated. In such cases, the money spent on mitigation measures and employee wages could have been used for other social and economic needs. This definitely presents hidden costs to the farmers.

The aim of this study is to bring out the hidden impacts of HWC in Kenya, using Amboseli Ecosystem (AE) and Mt. Kenya Ecosystem (MKE) as case studies. The AE and MKE have a diverse wildlife species including lions, elephants, buffaloes, baboons among others that are associated with HWC. The two ecosystems are linked to other conservation areas through wildlife corridors and dispersal areas. For much of the year, wildlife moves between these ecosystems and other conservation areas following migration routes, searching for food, and seeking calving grounds. In the process of movement, it is envisaged the wildlife species yield both visible and hidden costs of HWC to people.

The researcher adapted the 2005 Millennium Ecosystem Assessment (MEA) human well-being framework modified by Barua et al. (2013) to include the HWC, for a comparative study to analyse the opportunity, transaction, and health costs in AE and MKE. The study also explored mechanisms and strategies for sustainable financial compensation for HWC damages.

1.2 STATEMENT OF THE PROBLEM

Kenya's core conservation areas are small and highly disjointed. The wildlife species therefore rely on both the protected areas and surrounding community land for survival (Watson et al., 2010), as a result, there is a close proximity between people and wildlife in migratory and dispersal areas. In Amboseli and Mt. Kenya ecosystems, different wildlife species migrate between the core protected areas and community group ranches and farms. With the increasing human population and the widespread demarcation of wildlife habitats, it was predicted that both the visible and hidden costs of HWC in dispersal areas would be significant. As such, this study analysed the hidden costs namely, opportunity, transaction, and health costs of HWC in villages around the AE and MKE. The hidden costs of HWC are not recognised in the Wildlife Conservation and Management Act (WCMA) 2013 and are scantly researched to inform policy decisions; yet people in AE and MKE incur these hidden costs. Deutsch and Coleman (2012) warn that "if attention is not given to the history of how previous decisions were made and implemented and the influence of deeper-rooted social and psychological factors in conflicts, the overall conflict may move further toward intractability despite interventions that address the immediate or material issues at hand"

Various informative studies on HWC have been undertaken in Kenya. However, a content analysis did not yield studies that have been done to quantify and compare the hidden costs of two different communities such as AE and MKE with distinct main sources of livelihoods-pastoralism and crop farming (Manoa et al., 2020a). Yet, Barua et al. (2013) asserts that studies examining transaction and opportunity costs should be implemented across a range of HWC contexts. Barua et al. (2013) assertions supports Gusset et al. (2008) who claimed that little is known how people have come up with coping-mechanism to deal with hidden cost of HWC. Similarly, Sukumar (1990) asserted that for an effective long-term conservation of wildlife, HWC must be viewed from the economic, social, and ecological aspects.

The two ecosystems-AE and MKE, together with their surroundings were selected because of their central location and connection with other conservation areas through wildlife migratory corridors. The targeted households were located in the wildlife dispersal areas and corridors where wildlife movements are frequent.

This study answered the following questions:

i. What is the economic magnitude of the opportunity, transaction, and health costs of human-wildlife conflict in Amboseli and Mt. Kenya Ecosystems?
ii. Is there a significant difference between visible and hidden costs of human-wildlife conflict in Amboseli and in Mt. Kenya ecosystems?
iii. What methods are used by communities in Amboseli and Mt. Kenya ecosystems to minimise the hidden costs of human-wildlife conflict?
iv. What are the appropriate strategies and mechanisms for sustainable financial compensation?

1.3 OBJECTIVES

The overall goal of the study was to compare the hidden impacts of HWC in Amboseli and Mt. Kenya Ecosystem. The specific objective were:

i. To quantify the economic magnitude of the opportunity, transaction and health costs of human-wildlife conflict and its impacts on human wellbeing constituents in Amboseli ecosystem and Mt. Kenya ecosystem.
ii. To compare the visible and hidden costs of human-wildlife conflict in Amboseli ecosystem and Mt. Kenya ecosystem.
iii. To identify suitable methods used by the communities to reduce the hidden costs of human-wildlife conflict in Amboseli ecosystem and Mt. Kenya ecosystem.
iv. To explore strategies and mechanisms for appropriate and sustainable financial compensation.

1.4 RESEARCH HYPOTHESES

H_O: There is no significant difference in the economic magnitude of opportunity, transaction and health costs in Amboseli and Mt. Kenya ecosystems.

H_A: There is a significant difference in the economic magnitude of opportunity, transaction and health costs in Amboseli and Mt. Kenya ecosystems.

H_O: There is no significant difference in the economic magnitude of visible and hidden costs within Amboseli and Mt. Kenya ecosystems.

H_A :There is a significant difference in the economic magnitude of visible and hidden costs within Amboseli and Mt. Kenya ecosystems.

H_O: There is no relationship between the household characteristics and the magnitude of hidden costs of human-wildlife conflict.

H$_A$: There is a relationship between the household characteristics and the magnitude of hidden costs of human-wildlife conflict.

All the hypotheses were tested at 95% confident level.

1.5 JUSTIFICATION AND SIGNIFICANCE OF THE STUDY

The HWC hidden costs in terms of transaction, opportunity, and health costs are poorly documented (Ogra, 2008; Dixon et al., 2009). Treves et al. (2006) and Woodroffe et al. (2005a) claim that hidden impacts of HWC have more destructive impacts than direct threats from wildlife. Yet, studies, policies and efforts to address the HWC lean toward visible impacts, compared to hidden impacts (Barua et al., 2013).

Currently, the WCMA 2013 specifies and puts a value for the HWC direct costs as crop damage, livestock loss, human death and injuries, and property damage. This study attempts to quantify the hidden costs of HWC in two different ecosystems-AE and MKE. The results of this study are important to wildlife practitioners and policy makers in reviewing the wildlife management and conservation policy on how best to deal with the ever-increasing compensation claims from January 2014. Since the claims are huge, and cases of HWC continues to be reported across the country, it becomes important to look into other long sustainable solutions. This study provides appropriate mechanisms and strategies for financial compensations.

Since the enactment of the Constitution of Kenya in 2010, wildlife compensation was devolved to the County governments. The County Wildlife Conservation and Compensation Committee (CWCCC) under the WCMA 2013 is mandated with verifying claims related to HWC and making recommendations to the Cabinet Secretary in the Ministry of Tourism and Wildlife. Previously, under WCMA 1976, compensation was characterised with delays and corruptions that led to the abolishment of the scheme in 1989 (Thouless, 1994).

It is envisaged that the current compensation scheme may face similar challenges. With cases worth over KES 4.65 billion still pending, it is clear that there is need to look into more effective and sustainable options. This study aims at proposing alternative compensation strategies for communities in direct interaction with wildlife. In addition, the study results reveal whether the bureaucracy that characterised compensation during the WCMA 1976 are being addressed by the CWCCC with the WCMA 2013. The study is relevant for the Kenya vision 2030, which advocates for the securing of wildlife corridors and migratory routes. HWC is one of the impediments to the survival of the key wildlife corridors. As such, this study contributes to the improvement of the wildlife corridors by suggesting some solutions to HWC.

The study also highlights the shortcoming of the current approach to the wildlife conservation in Kenya and suggest alternatives to addressing the HWC problem. As pointed out by Peterson et al. (2010), depicting of wildlife as conscious human antagonists and combatants against people is problematic as it hides the underlying human dimension and limits the possibilities of finding the effective solutions to the conservation conflicts. Lastly, the findings of this study contributes to the pool of wildlife conservation knowledge and serve as an important reference for more studies to document other dimensions of the hidden costs of HWC and the controversies in protected area management.

1.6. SCOPE AND LIMTATION OF THE STUDY

This study compares the magnitudes of opportunity, transaction and health costs of HWC for 408 respondents in AE and MKE wildlife dispersal areas at household level. The influence of household's characteristics on the quantities of opportunity, transaction and health costs are critically discussed. The estimation of the hidden costs was based on all wildlife species and not just those listed in the Third Schedule of WCMA 2013. The study also deliberates on the local approaches used by the communities in AE and MKE to minimise the hidden costs of HWC. In addition, the study considered possible sustainable ways of dealing with the ever-growing HWC including the pending compensation claims. On health costs of HWC, this study did not address the psychological/mental costs because of its complex nature. It only dwelled on the physical injuries costs. This is because of the incapacity to the researcher to deal with the psychological and mental costs. Although, HWC may be happening in other parts of the AE and MKE, the study focused on the wildlife corridors and dispersal areas with human settlements, where HWC had been anticipated to be high. In AE, the study was conducted in the following areas: Kitenden-Kilimanjaro corridor, Amboseli-Chyulu corridor, Amboseli-Tsavo corridor, and Amboseli-Namanga corridor**.** In MKE, the study focused on Mt. Kenya forest-Ngara Ndare-Lewa corridor and the dispersal areas namely: Kisima, Timau and Ethi locations.

1.7 OPERATIONAL DEFINITIONS

Ecosystem disservices: A variety of goods and services produced and delivered by ecosystem that undermines human well-being (Shackleton et al., 2016). In this study, "ecosystem disservices" means all kinds of conflicts that arises from the conservation of wildlife.

Health costs: Health cost entails mental and physical health injuries, malnutrition, exposure to diseases vectors and loss of sleep (Barua et al., 2013). In this study "health costs" means physical injuries sustained from wildlife, time and money spent on medical treatment due wildlife.

Hidden costs: costs of HWC that are uncompensated, temporally delayed, or psychosocial in nature (Ogra, 2008). In this study, "Hidden costs" refers to opportunity, transaction and health costs.

Human-wildlife conflict: interaction between people and wildlife that impacts negatively on the goals of humans or the needs of wildlife (IUCN, 2003). In this study, "Human-wildlife conflict" means the negative impacts of wildlife to people and their activities.

Opportunity costs: The loss or expenses sustained by making a choice to take one action instead of another (Fauna and Flora International[FFI], 2014). In this study, "opportunity costs" means loss of time and money from other alternatives when one is safeguarding their livestock, crop, and other properties from wildlife attacks. Opportunity costs are not recognized in the WCMA 2013.

Transaction costs: Costs incurred through bureaucratic, and delays associated with compensation (Barua et al., 2013). In this study, "transaction costs" means amount lost due to delayed compensation for wildlife damages.

Visible costs: human injuries and deaths, crop and property damages and livestock predation that occurs as result of human-wildlife conflict (Barua et al., 2013) and can be compensated as outlined in WCMA 2013

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

The literature review looks at the global problem of human-wildlife conflict with a key focus on the types of conflicts. The chapter differentiates the visible and hidden costs of HWC and discusses the various approaches used to mitigate the conflict. In addition, the chapter identifies the research gaps and links them to the study theoretical and conceptual frameworks.

2.2 THE WORLDWIDE CONTEXT OF HWC PROBLEM

The HWC is an ancient problem that has existed for many years. However, HWC cases are becoming more often and intense world-wide, and it is projected that it will continue to upsurge in future (Madden, 2004). HWC occurs in all continents and countries, whether developed or not, and the impacts may vary from one area to another. For example, between 1990 and 2012, vehicular wildlife strikes resulted to an economic loss of $957 to individuals annually in the United State of America (USDA, 2012). In Africa, where wildlife and people still share space, the intensity and severity of HWC is diverse. For instance, in Tanzania, around Lake Rukwa and Momba River, crocodiles attacked 51 people between 2003 and 2012 (Zakayo, 2014)). In the same period, 52 cattle, 10 dogs, and 23 goats were killed by the crocodiles (Zakayo, 2014). Around Kibale National Park in Uganda, each farmer was reported to have experienced an average loss of US$ 74 within a period of six-month due crop raiding by elephants (Mackenzie & Ahabyona, 2012). And in Kenya, the studies by Ngene and Omondi (2009) around the Marsabit National Park and Reserve indicated that the adjacent community lost KES 15,034,610 (US$ 208,814) due to crop raiding by elephants between August 2004 and July 2005. The study depicts a significant loss to farmers, which could even be higher if the hidden costs in terms of time and money incurred on preventive measures was considered.

HWC is problematic in African countries such as Kenya because the affected populations are mostly the rural poor with no adequate food, health care, education, infrastructure, and social institutions (USIP, 2011). The HWC impacts further deepens when poor people lose their main sources of livelihood such as livestock and crops and are not compensated by the government. And if they are compensated, the hidden costs such as time and money used to pursue compensation are not considered. Considering both the visible and hidden cost of HWC can greatly improve the well-being of people living adjacent to wildlife areas, particularly areas where majority of the population are rated as poor.

2.3 COSTS OF HWC TO HUMANS

2.3.1 Visible costs

According to Barua et al. (2013), the visible costs of HWC are well documented. Scientific literature is quite rich on the visible costs of HWC, including the African region. Visible costs, mainly occurs as wildlife damage to crops, as well as attack livestock and people.

2.3.1.1 Crop raiding

Wild animals, especially herbivores, can damage crops by either feeding on or trampling them. The extent of crop damage varies depending upon the location and the type of wildlife species involved (Muluken, 2014). A range of wildlife species such as primates, buffalos, hippopotamuses, bush pigs and elephants damage crops at different levels (Lamarque et al., 2009). However, smaller wildlife species such as baboons can be more damaging to crops compared to the mega-fauna on long-term basis (Naughton-Treves & Treves, 2005). For example, in 2005, the Red-billed Quelea birds were driven south by the drought in Niger, where they destroyed tens of thousands of hectares of rice fields (Ahemba, 2005). Such a magnitude of damage may take a relatively longer period for larger mammals. For example, in Kenya, crop raiding by elephants in 414 farms around Marsabit National Park and Reserve took 9 months resulting to a loss of USD 208,814 (Ngene & Omondi, 2008). Crop raiding also varies within the same locality, and Sitati et al. (2005) attribute the difference to geographical factors and the mitigation measures used by the farmers. Most of the documented mitigation measures address the visible impacts of crop raiding, and therefore, identifying and highlighting the local approaches used by the famers to minimise the hidden costs is essential.

2.3.1.2. Livestock predation

Livestock predation is considered as one of the most frequent causes of conflict between humans and wildlife throughout the world and can result in significant economic losses (Woodroffe et al., 2005a). According to Jackson and Wangchuk (2001), livestock predation depends largely on the breed type, farmer's stock management skills, livestock previous experience with the carnivores, the density and abundance of the carnivores. On the other hand, Naughton –Treves (1998) argued that the total economic damage by smaller predator species such as coyote and jackal is greater than that of the more conspicuous predators such as lions and jaguars. However, the sentiments by Naughton-Treves (1998) are contrary to other studies. For example, in northern Guatemala, the jaguar accounted for 78.9% of all livestock attacks compared to the puma-15.4% and coyote-5.8% (Soto-Shoender & Giuliano, 2011). In China, the government spent US$ 66,700 in 2006 on compensation claims for bear related damages in Nyima County (Lu et al., 2012). In Peru, hawks (*Accipiter spp.*, *Leucopternis spp.*), jaguars (*Panthera onca*) and pumas (*Puma concolor*) in the Amazon Province of Tambopata were blamed for causing most of the depredation to community's livestock (Naughton-Treves *et al.* 2003). Similarly, Bauer *et al.* (2001) established that lions in Cameroon around Waza National Park, were singularly responsible for losses of cattle herds worth about US$370 per stock-breeder. Elsewhere, Okello et al. (2014) in their study in Amboseli revealed that about US$ 272,000 was used to compensate livestock loss to predators in homesteads between 2008 and 2012.

Other than the direct economic losses of livestock predation, Thirgood et al. (2005) reveals that people incur hidden costs by investing more in mitigation measures such as herding, guarding and predator control methods. The huge economic losses that arises from livestock predation, could also be the reason as to why in areas where there is no government compensation schemes, private schemes have been initiated to deal with the problem. The private schemes in most cases are meant to cater for damages arising from predators of high conservation status, such lions and tigers.

2.3.1.3 Human deaths and injuries

HWC can result to human deaths and injuries and such incidences can intensify negative attitude toward wildlife. At the same time, putting a value on a human life is both difficult and, according to some people, immoral (Zhang & Wang, 2003). Human deaths and injuries are considered as the most severe manifestations of HWC, although less common than livestock predation and crop raiding (FAO, 2009). Several nations have experienced loss of human life due to HWC. For example, in the United States and Namibia, vehicle collisions with wildlife species are frequent. In Namibia, the collisions have been cited to be a serious problem responsible for more human deaths and injuries than mortalities associated with crocodiles and elephants (Lamarque et al., 2009). The analysis by Packer et al. (2005) indicated that at least 563 people were killed and 308 injured by lions in Tanzania between 1990 and 2004; in Zimbabwe, 21 people were killed by elephants while guarding their farms in 2001; and in Kenya, WWF (2007) reported that elephants killed more than 200 people between 2000 and 2007, while Western and Waithaka (2005) claimed that 250 people were killed over the same time period by various predators. Putting a value on human death is subjective. For instance, the government of Kenya can pay up to KES 5 million for human death due to HWC. This is regardless of the age, gender, profession, and the role of the person in the society.

2.3.2 Hidden costs

HWC has a wide-ranging of negative social impacts which Hoare (1999) outlines as labour costs, loss of sleep, fear, and restriction of travel. The hidden costs of HWC are usually categorized into opportunity, transaction, or health costs. Taylor et al. (1979) have claimed that the overall indirect financial costs (hidden costs) from wildlife can be equal to or more than the direct costs. Scientific studies on opportunity, transaction, and health cost of HWC are scarce, both internationally and in African region.

2.3.2.1 Opportunity costs

Opportunity costs concept is associated with economic science. The concept was originated by Australian economists and popularised by Frank Knight. According to Alchian (1968), people are forced to make a choice between two alternatives based on the subjective values of the goods presented to them. As such, Alchian argues that "both supply and demand have their foundation in the concept of opportunity cost, because consumers must also evaluate their alternatives, make a choice, and sustain a cost in terms of their most highly valued option foregone."

Buchanan (1987), in his essay on "Opportunity cost" describes the characteristics of opportunity costs as follows: (i) opportunity cost is the value that exists in the mind of the decision maker; (ii) opportunity cost set at the moment of choice and cannot be realized thereafter; and (iii) opportunity cost is subjective in nature and cannot be measured by an outside observer. Fauna and Flora International (2014) defines opportunity cost as "the loss or expense sustained by making a choice to take one action instead of another action".

Over the years, there has been advancement in the methods of estimating opportunity costs. For instance, Philips (1998) in his guideline to protected area managers, explains that in the case of environmental loss such as HWC, people can reveal the values of opportunity costs by stating their willingness to pay to prevent HWC and their willingness to accept compensation to tolerate the HWC.

Opportunity cost analysis provide potential benefits and risks associated with taking one action rather than other alternative actions (Fauna & Flora International, 2014). Wildlife conservation can impose opportunity costs such as preventing people from using resources inside protected areas or the wild animals for cultural beliefs or financial gains (Goldman *et al.*, 2010). Dickman (2008) asserts that "management strategies to reduce HWC take time to implement, time which would have been otherwise spent on other aspects of property management, work or leisure". For example, in areas where livestock predation occurs, communities invest in predator-proof bomas to mitigate the conflict (Manoa & Mwaura, 2016). This is an additional cost in terms of time, money and labour (Dickman, 2008). Although the predator-proof bomas minimises the livestock loss at night, Ogada et al. (2003) associates such enclosures with the retarded growth of calves and upsurge of diseases which leads to a decrease in livestock production and hence financial losses.

Destruction of infrastructure can also result to hidden opportunity costs. Wildlife species such as elephants can destroy water pipes forcing people to walk longer distances to fetch water (Mariki, 2016). As a result, more time is spent on fetching water at the expense of other chores. For example, a study by Ogra (2008) indicated that elephants were linked to increased labour among the communities around protected areas in India, due to repair work on the destroyed fences. Crop raiding by elephants also increases field-guarding time thereby leading to reduced sleep and increased stress levels. Similarly, crocodiles have been reported to damage fishing nets in Lake Kariba in Zimbabwe which reduces fish off-takes and increases labour, time and effort to repair the nets (McGregor, 2004).

HWC opportunity costs are not just experienced by the adults, but also children of different age groups. For example, in Transmara County, Sitati et al., (2003) established that children aged between 6 and 15 years reported late to school in the morning (8:00-10:00am) and left early (3:00-4:00pm) due to the fear of being attacked by elephants. As a result, teachers were not able to complete the syllabus resulting to the risk of poor performance in national exams. Similar findings were documented by Mwangi et al. (2016) in Nthongoni-an area bordering Tsavo and Chyulu National Parks. Although some of the cases presented here depicts opportunity costs, most of them are not quantified, which is necessary in order to make meaningful compensation policy decisions on hidden costs of HWC which requires tangible statistics.

2.3.2.2 Transaction costs

The transaction costs concept was devised by Coase (1937), and subsequently developed by other scholars such as Alchian and Demsetz (1972) and Williamson (1985) among others. According to North (1990), the costs of production can be "transformation costs" (for example costs of inputs on land, labour, and capital) involved in converting the physical attributes of a good, and "transaction costs", the cost in defining, protecting, and enforcing the property rights to goods. Zhang (2001) points out that "transaction cost economics provides a very useful tool to understanding several seemingly unrelated and non-economic issues such as the law, ethics, organization, governments, family, and state". Zhang claims that the concept has only been applied in limited numbers of conservation initiatives, mostly in forestry (see for example: Geodecke & Ortmann, 1993; Wang & van Kooten, 1999; and Zhang, 2000).

Barua et al. (2013) defines transaction costs as "those costs incurred through bureaucratic inadequacies and delays associated with compensation for HWC damages". Across the globe, compensations schemes are meant to refund people the financial losses incurred through human injuries, death, crop loss, damage to properties, and so on in order to enhance the coexistence people and wildlife (Treves et al., 2009). Yet, in reality those affected by HWC experience difficult in accessing compensation as expected. Consequently, scholars such as Ogra and Badola (2008), DeMotts and Hoon (2012), and Barua et al. (2013), have pointed out corruption, lack of education and awareness, and inability of the wildlife authority to attend to claims in a quick way as hindrances to compensation schemes. The compensation process requires victims to get documents such as death certificates and title deeds, proof of travel expenses to report and get progress on the compensation claims, all which adds up to the transaction costs (Madhusudan, 2003). Jadhav and Barua (2012), therefore claims that pursuing compensation can expose people to new spaces of institutional inequality.

2.3.2.3 Health costs

Health and quality of life can greatly be shaped by the stress and anxiety of living within wildlife ranges. People have been found to be sensitive to financial costs and their freedom of movement, which can be compromised by wildlife (Bowie, 2009). FAO (2009) argues that crop damage results to reduced cash income and has repercussions on human health, nutrition, education and eventually on development. When crop damage occurs, people divert the finances reserved for healthcare towards the purchase of food items. In Indian Sundarban, Chowdhury et al. (2008), for example, observed that about half of the women who lost their husbands to tiger and crocodile attacks had psychological problems due to the inability of recovering the bodies of their loved ones for decent burials. Many had high rates of suicidal tendencies and depression. Another study by Jadhav and Barua (2012) established that injuries, fatality or physical threats from elephants worsened pre-existing illnesses such as alcoholism and contributed to new ones such as post-traumatic stress disorder.

2.4 APPROACHES FOR MITIGATING HWC

HWC has a negative implication on both conservation and people. Therefore, different approaches have been devised to mitigate it, but this is a challenge, because an array of wildlife species are involved. According to Treves (2007), HWC mitigation measures can either be direct or indirect. The direct methods are applied in order to reduce the impacts of HWC through construction of physical structures such as fences (Ogada et al., 2003, Muruthi, 2005; Manoa & Mwaura, 2016), property guarding by humans or animals (Potgieter, 2011), use of repellents such as chilli (Parker & Osborn, 2006) and removal of wildlife by killing or translocation (Lekolool, 2012). The indirect methods include environmental education and awareness, community involvement and participation in conservation initiatives, incentives and compensation for property damage, loss of lives, livestock and injuries. Such methods are aimed at persuading victims of HWC to be tolerant to conflict and wildlife (Treves, 2007).

Compensation schemes have also been used as a tool to mitigate HWC (Schwerdtner & Gruber, 2007), by ensuring that those who benefit and lose from wildlife share the costs (Fourli, 1999). According to Schwerdtner and Gruber (2007) compensation can either be *ex-post* compensation, where damages are paid after they have occurred, or *ex-ante* advance compensation which is based on estimating the likely damage and paying regardless of actual damage occurrence.

Kenya has adopted the ex-post compensation approach. The visible damages resulting from wildlife can be compensated as per the Third Schedule of the WCMA 2013. For example, human death caused by wildlife is compensated with KES 5 million, while bodily injuries attract KES 2-3 million. However, since January 2014, most of the victims of HWC were yet to be compensated (Mutai, 2017). To contain the ever-increasing compensation claims, Kenyan law makers proposed that injuries or death arising from wildlife conflicts be limited to national reserves or game parks where the KWS oversees the operations.

During the crafting of WCMA 2013, the hidden costs of HWC such as time spent guarding properties against wildlife attacks, transaction and health costs were omitted. Section 25(5) of the Act dictates that people living within the wildlife areas must use their resources to protect their property including, crops, livestock, and human lives; and that their land use practice must be compatible to the ecosystem management plan of the area. This may be a challenge to the HWC victims which also complicates their claims for compensation. The WCMA 2013 also restricts compensation for livestock, crops, properties, injuries and death by specifying the wildlife species whose damages can be paid for. A large number of risky wildlife species are not listed in Third Schedule of the WCMA 2013, yet they are likely to cause significant loss to people. For instance, porcupine, baboons, squirrels and birds such as Quelea as well as locust can destroy crops at various levels thereby compromising the farmers yield both in quantity and in quality. This kind of policy that focuses on conservation of wildlife at the expense of people is destined to fail. Wildlife conservation policies must be proactive and must address people's concerns and at the same time protect wildlife.

Given the challenges of current wildlife compensation scheme in Kenya and in many places around the world, there is a need to trial some other interventions such as insurance schemes. For example, the government of China operates an insurance scheme to protect Yunnan Province farmers against elephants that raid the rubber plantations. Although the China insurance scheme faces challenges such as underfunding, undervaluation of plantations and limited community participation, such challenges can be used to improve the compensation scheme. For instance, Chen et al. (2013) suggests for such insurance model to be effective and sustainable, multiple stakeholders (e.g., government , farmers and tourists) should buy in and cost share the premiums. In addition, it is imperative for the scheme to timely assess the damage and incentivise community to invest in preventive measures to lower the premiums. Based on the lesson learned from existing insurance schemes in countries like Italy, Pakistan, India, Greece, Canada and Namibia, there is a need to explore insurance scheme as an additional finance compensation for HWC in Kenya.

2.5 RESEARCH GAPS

There have been a number of valuable studies (for example Makau, 2016; Musyoki, 2014; Manoa & Mwaura, 2016; Lesilau, et al., 2018) on HWC and resolution mechanism in AE and MKE. However, these studies dwell on immediate and visible costs without serious consideration of the indirect or hidden costs. Yet, ignoring hidden costs of HWC is problematic in wildlife conservation because, in most cases the hidden costs are repetitive in nature and can override the visible costs. The provisions for HWC compensation in WCMA 2013 are provided in Sections 24(2), 25(3), 25(4) and (5), only to the visible cost of HWC in form of death, injury, crop loss and properties damaged by wildlife. The goal of this study is to address the existing gaps by analysing and comparing the hidden costs of HWC in AE and MKE.

2.6 THEORETICAL AND CONCEPTUAL FRAMEWORK

This study is grounded in two theories namely, political ecology and human dimension in wildlife management (HDWM). The political ecology is used in this study to bring out the complexities surrounding HWC because of governance issues in AE and MKE, while the HDWM reflects on people's struggle to attain their livelihoods in the presence of wildlife that is protected by the state.

2.6.1 Political ecology

Muldavin (1996) defines political ecology as "an informed attempt to understand the role of the state, the social relations within which land users are entwined, and resulting environmental changes", while Robbins (2004) claims that "political ecology, explains the connections in the condition and change of social/environmental systems, with clear attentions of relations on power". The theory considers the environment as an arena with various social actors and unbalanced political power. The social actors therefore compete for access to, and control of natural resources as exemplified by the formation and implementation of conservation policies as a form of environmental control (Bryant & Bailey, 1997). Neumann (1992) phrases this scenario as a struggle by different actors with different ability and power to dominate, define and dictate the protected areas legal frame work.

The Amboseli National Park in AE and Mt. Kenya National Park in MKE were established and are managed using the fortress conservation model. The fortress conservation or fences and fines approach, exclude people from wildlife areas and prevent them from using resources from these areas, but give wildlife priority. The approach treats local as intruders who can cause land degradation and species extinction (Nelson, 2003). The fortress system of protected area, which dictates the use of nature by people (Adams & Hutton, 2007), has dominated African countries, including Kenya. This paradigm has existed since the colonial period and has failed to withstand the test of time. Mbaria and Ogada (2016) ask, "how are local Kenyans expected to accept and nurture wildlife that institutions and agents have worked so hard to alienate them from for over a century?" Therefore, HWC and its associated negative impacts are reflections of the fortress conservation model (Massé, 2016). Adams and McShane (1992) claim that the fortress model of conservation has disrupted the harmony between people and wildlife in Africa. Such kind of management has no interest in people's wellbeing, and that could be a reason as to why visible costs are given little attention and the hidden costs completely ignored in policy levels in Kenya. This study uses political ecology to demonstrate how formation of the WCMA 2013 and the related policy is skewed, and does not serve the intended purposes of conservation, people wellbeing, and reducing the HWC.

2.6.2 Human dimension of wildlife management

Understanding how individual, groups, and institutions respond to change and how their actions enable or constrain management has been documented to be effective in natural resources management (Manfredo et al., 1995). The human dimension of wildlife management (HDWM) theory provides an understanding of how people think about and interact with the natural environment to improve natural resources stewardship (Fulton, et al., 1996). Bath (1998) claims that wildlife managers are challenged on how best to involve the public in policy and programs implementation. Bath (1998), therefore insists that wildlife managers must understand public opinions before, during, and after implementing wildlife management decisions for identifying public concerns before and over time. Addressing people's concern promptly is essential in handling people aspect in wildlife management.

Therefore, wildlife management must move away from the traditional approach of giving attention to wildlife only and involve people. However, Paxis (1988) warns that "people's involvement in wildlife management should however not compromise the biological basis for implementing certain policies, and that the public should not dictate wildlife policy, and wildlife management should not be a popularity contest". Generally, policies have been found to be effective when their formulation takes into consideration the people's perspectives such as different sources of livelihoods (Owuor, 2011). The constitution of Kenya 2010 provides for public participation in decision-making. The WCMA 2013 also gives a provision for people to participate in the formulation of wildlife policies and law. However, people receive little capacity building and are not able to engage in the process from an informed and meaningful way (Mariru, 2015). The policies and laws end up not addressing people's needs and welfare as anticipated. The same policies and laws have been used to force people to change their source of livelihood, culture, and settlements for conserving wildlife (Adams & McShane, 1992). In this study, the HDWM theory is relevant in demonstrating how omission of people's needs and rights can fuel HWC in AE and MKE. Currently, the compensation policy in Kenya, specify that damages arising from HWC can be compensated by the state. However, the hidden costs of HWC incurred by communities preventing wildlife attacks has not been incorporated into the compensation policy. Although, public participation exercises were held to capture the people's opinions on compensation policy, the failure to respond to peoples complains on time and not rewarding those who have lost their loved ones and properties to wildlife, results to further conflicts. As noted in early 1940 by Aldo Leopold, the problem of wildlife management is not about how to handle the wildlife species, but rather the people (Flader, 1994).

2.6.3 Conceptual framework

This study adapted the MEA (2005) Ecosystems and Human Well-being conceptual framework, as partially modified by Barua et al. (2013) to include the HWC dimension. The framework portrays how people can change ecosystems, and how changes in ecosystem services can affect human well-being (MEA, 2005). In this study, the changes resulting from human activities is associated with HWC, which has both visible and hidden impacts on people's well-being components. More attention was given to the hidden impacts of HWC on well-being of people (**Figure 2.1**).

A change in the ecosystem can results to "ecosystem disservices" such as wildlife conservation conflicts. Such conflicts are shaped by the interaction between people and wildlife. The intensity and type of wildlife conservation conflicts largely depends on several root causes, namely: ecosystem type, protected area management regimes, conservation policy and law, historical displacement of people from landscapes to create protected areas, the type of wildlife species and their population in the ecosystem, people's perceptions and attitude toward conservation, and land use for people's livelihood.

When conflict resolution mechanisms fail to address the root causes of wildlife conflict, two dimension of conflict emerges: human-human conflicts (HHC) and the human-wildlife conflict. Peterson *et. al*. (2010), Knight (2000), and Hill (2004) affirms that "the underlying causes of the HWC are the HHC or human-state conflict". The human-human conflicts result to two kinds of HWC- visible costs (crop, livestock, human death and injuries, and property damage) and hidden costs. The hidden costs depend on the type and magnitudes of the visible costs. To prevent the visible and hidden costs on people's wellbeing, appropriate, effective and sustainable compensation is required.

The independent variables in the conceptual framework are ecosystem type, wildlife law and policy, wildlife species and population, land use and people's livelihood sources; while the dependent variable are costs arising from hidden impacts: opportunity, transaction and health costs; as well as the kind of visible costs namely: livestock, human death and injuries, and property damage.

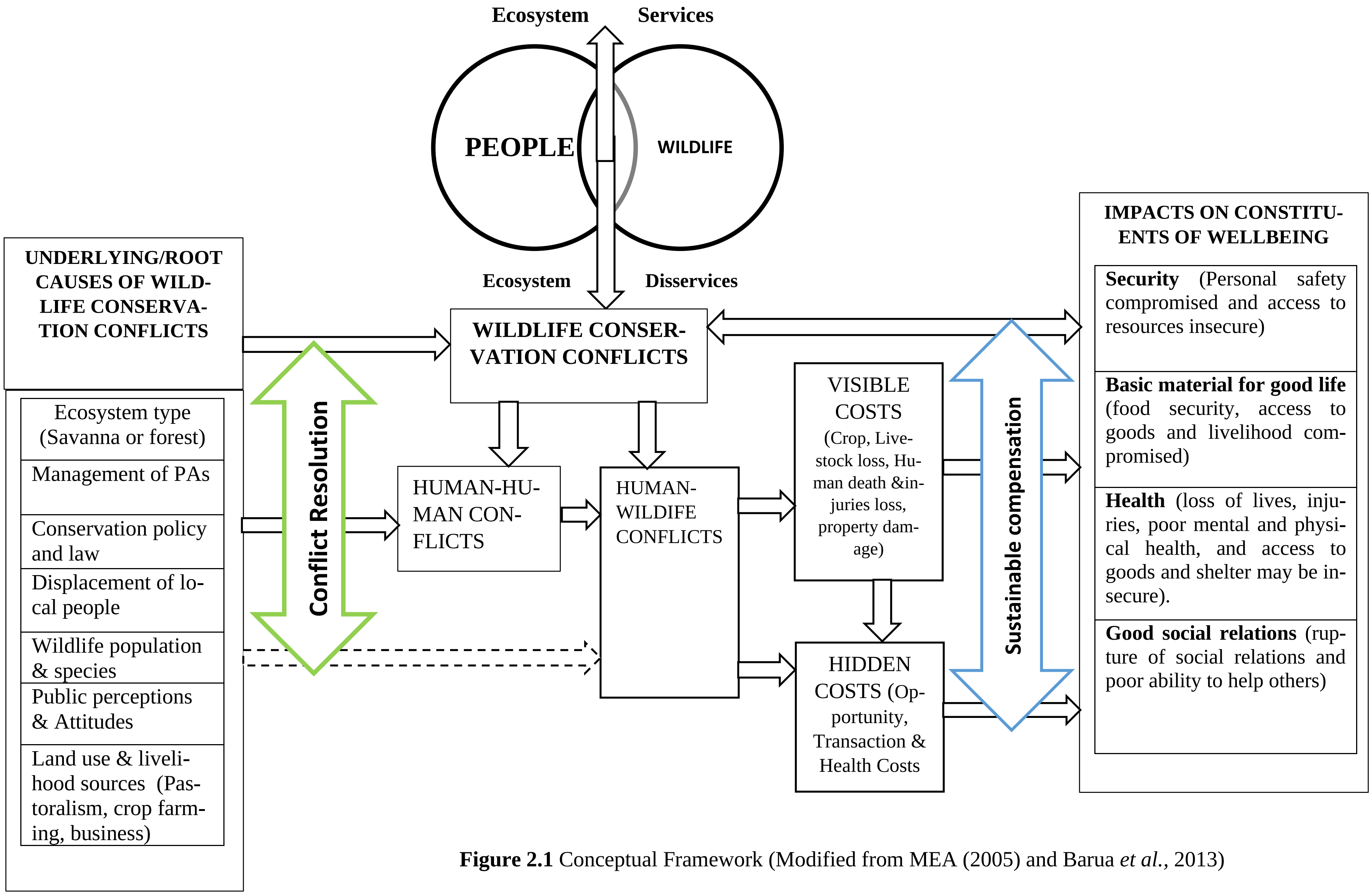

Figure 2.1 Conceptual Framework (Modified from MEA (2005) and Barua *et al.*, 2013)

CHAPTER THREE: THE STUDY AREAS

3.1 INTRODUCTION

This chapter describe the location, climate, demographic characteristics, fauna and flora, geology and soils characteristics of the Amboseli Ecosystem (AE) and the Mt. Kenya Ecosystem (MKE). The study sites in AE were Imbirikani/Eselenkei, Kimana, and Entonet/Lenkisem locations in Kajiado County. On the other hand, the study sites in MKE were Timau and Kisima locations in Meru County, and Ethi location in Laikipia County.

3.2 SITE SELECTION CRITERIA

The study areas were selected because they are connected to other different conservation areas with wildlife corridors, where human settlements exist (**Figure 3.1 & 3.2)**. AE is connected to Kilimanjaro National Park in Tanzania through the Kitenden corridor; linked to Chyulu National Park by Kaputei dispersal area and connected to Tsavo West National Park through the Kimana-Tikondo dispersal area. MKE is connected to Lewa Conservancy and Ngare Ndare forest. The culture, economic status, main sources of livelihoods, climatic conditions and level of development are different. Pastoralism is the prevailing source of livelihood for the Maasai community in AE, while crop farming and business activities are the core activities in MKE.

The population densities of the two-study site are also very different, for example, Meru, which is in MKE, has an average population density of 318 people per square kilometre, while Kajiado County in AE has a mean population density of 51 people per square kilometre. In addition, the two areas have distinct poverty levels, with Meru having about 31% and Kajiado 47% of people living below the poverty line (GoK, 2016). Yet, the two ecosystems experience intense human-wildlife conflict. As such, this study compared visible and hidden costs of HWC for two different climatic areas, with people of different social and economic background.

3.3 AMBOSELI ECOSYSTEM

3.3.1 Location

Amboseli Ecosystem is located in southern part of Kenya and is dominated by Kajiado County, which lies along the boundary of Kenya and Tanzania boarder. Kajiado County (21,292.7 km^2) is situated between longitude 36˚, 5' and 37˚, 55' East and between latitude 1˚ 10' and 3˚, 10 (CGK, 2018).The AE (5,700km^2) has a core conservation area - Amboseli National Park that is linked to six community group ranches: Ol gulului/Olorashi, Imbirikani, Kuku, Rombo, Eselenkei, Kimana/Tikondo that form the buffer zone (Amboseli Ecosystem Trust, AET, 2020) as shown in **Figure 3.1**.

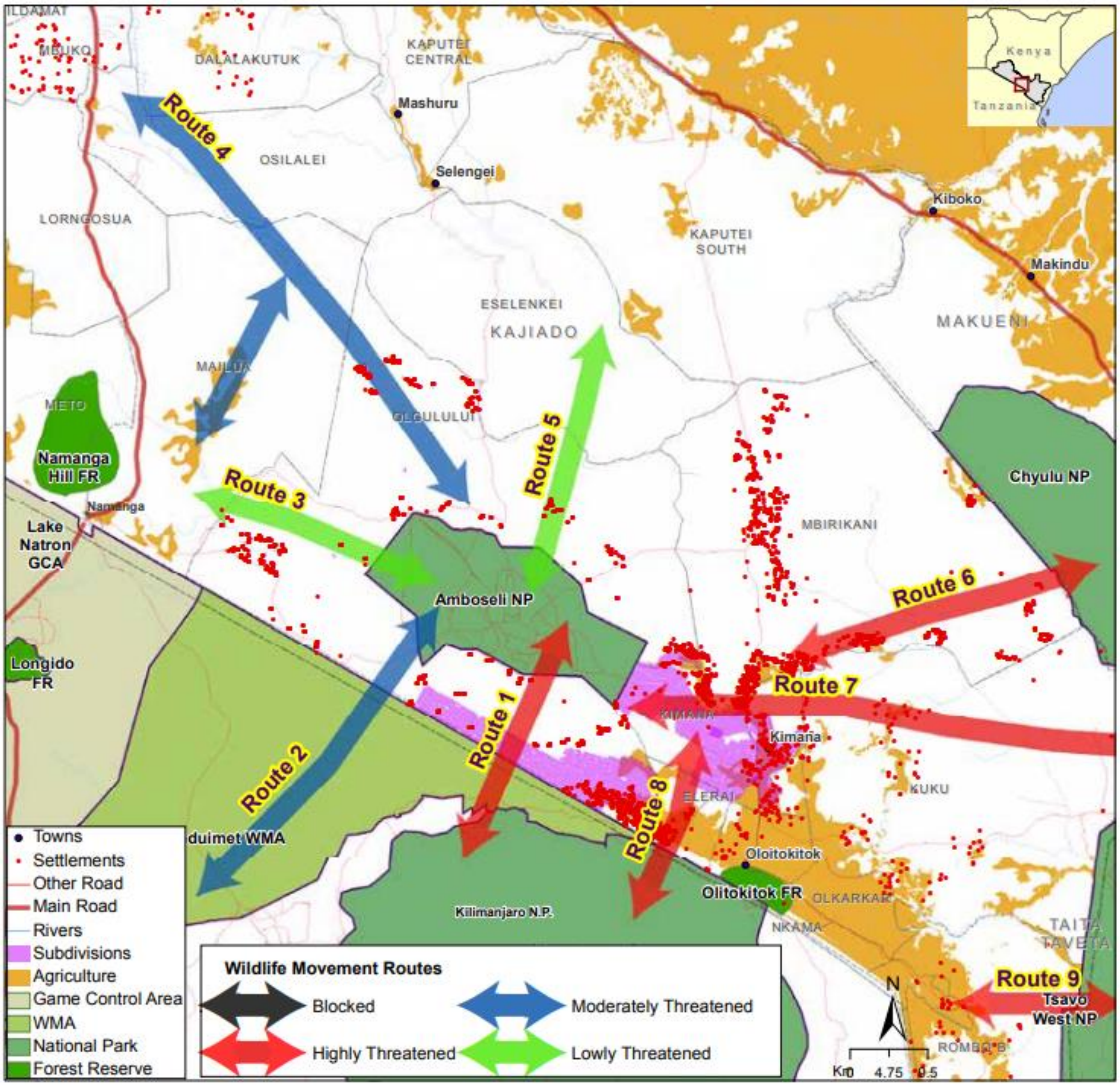

Figure 3.1 Map of Amboseli Ecosystem showing the human settlements within the wildlife migratory and dispersal areas. The arrows indicate the wildlife movement routes and the level of threats to each routes by human activities. The wildlife routes are: 1). Kitenden-Kilimanjaro 2). Kitirua-West Kilimanjaro 3). Amboseli-Mailua-Namanga 4). Amboseli-Magadi-Shompole 5). Amboseli-Eselenkei-Imbirikani 6). Amboseli-Chyulu-Tsavo 7). Amboseli-Kimana-Tsavo 8). Kimana-Elerai-Kilimanjaro.

Source: Ojwang *et al.* (2017)

3.3.2 Fauna and flora

The AE has diverse species of wildlife ranging from herbivores such elephants to carnivores such as lions and hyenas (GoK, 2009). The elephant population is about 1800 (AET, 2020) while the lion population is approximately 140 (KWS 2020a). Most of the wildlife migrate during the dry season to higher areas and swamps where forage is still available (GoK, 2009). The AE hydrology exhibits both temporal and spatial characteristics, with few permanent surface rivers. Most of existing springs and swamps are as result of the underground seepage from Mt. Kilimanjaro (Ojwang et al., 2017). Swamps located in the Amboseli National Park are critical in sustaining large populations and migrations .The high-quality grasslands found in community land form important connections between conservation areas in AE (Ojwang et al., 2017). The ecosystem has various xerophytes floras but the most common are *Commiphora spp*, *Balanites spp*, and *Acacia spp* (GoK, 2009). Elephants behaviour of falling trees and shrubs has over the years converted some of the shrubland to grassland.

3.3.3 Climate

The Amboseli ecosystem experiences warm and dry climate with a bimodal rainfall pattern, and the short rains occurring in October and December and the long rains between March-May. The rainfall fluctuates from 500mm to 600mm annually, while the mean yearly temperature is 18.9 ˚C (GoK, 2009). The AE falls under the eco-climatic zones IV and V hence categorised as semi-arid area (AET, 2020). Semi-arid lands such as AE experience recurrent drought in 10-15 years. In AE, the 2009 drought resulted to death of 95% wildebeest, 60% of the zebra and cattle within a period of six months (Amboseli Conservation Program, 2009). Some pastoralists have opted to diversify their livelihood by engaging in irrigated cropping in swamps and rivers outside the Amboseli National Park. The areas that are converted to crops farms are dry season grazing areas for herbivores, thus reducing wildlife habitats and increasing HWC.

3.3.4 Demography and livelihood systems

According to KNBS (2019b), the Loitokitok sub-county has 191,846 people, with a population density of 51 persons per km². More than 75% of AE residents depend on livestock for their income (GoK, 2009; Okello & Kioko, 2010). For hundreds of years, pastoralism has been a main land use in AE, with other emerging land use activities such crop production and wildlife-based enterprises having to compete economically and culturally with pastoralism (AET, 2020). The KWS (2008) has identified the key treats to the ecological connectivity in Amboseli

Ecosystem as expansion of crop farming and irrigation; human settlement, fencing and land subdivision in wildlife corridors. AET (2020), emphasise that the rapid expansion of irrigated agriculture is biggest threat to the wildlife movement in the AE.

3.4.5. Geology and soil characteristics

AE has three geological regions: Quaternary volcanic, Pleistocene and basement rock soils. On the river valleys and some plain areas, the basement system rocks which comprises of various gneisses, cists, quartzite and crystalline limestone, are found. Pleistocene soils are found in the inland drainage lake system around Lake Amboseli (CGK, 2018).

The soils in the AE are divided into two distinct parts of which the western half comprising of the deep, reddish-brown clay loams and a variety of poorly drained vertisols, while the eastern part, the geology changes abruptly to quaternary volcanics with deep, well-drained soils, many of which are very rocky (CGK, 2019).

3.4 MOUNT KENYA ECOSYSTEM

3.4.1 Location

Mt. Kenya Ecosystem (0˚25ʾS, 0˚10ʾN; 37˚00ʾE, 37˚45ʾE) is located in the central part of Kenya and consist of Mt Kenya National Park, Mt Kenya National Reserve, Ngare Ndare Forest, the Lewa Wildlife Conservancy and the adjacent human settlements (Rheker, 1992). The Mt. Kenya National Park and Mt. Kenya National Reserve are in Meru County, while Ngare Ndare forest and Lewa Wildlife Conservancy are in Laikipia County. The Mt. Kenya National Park covers an area of about 58870 ha (588km^2) and is under the management of KWS; Mt. Kenya National Reserve is under dual gazettement as a National Reserve under KWS and a Forest Reserve under KFS, is about 6361Ha. The Lewa Wildlife Conservancy is about 250km^2 and is connected to Mt. Kenya Forest by a narrow 9km wide corridor that crosses Ngare Ndare Forest and private land. The Ngare Ndare Forest is about 5554.3 ha and source of the Ngare Ndare River, along which human most human settlements are located (KWS, 2010).

3.4.2 Fauna and flora

The MKE has a range of wildlife species, but the species of special key concern include elephants whose population is estimated at 2000-3000 individuals and are documented to migrate between Mt. Kenya National Reserve and the Laikipia-Samburu ecosystem through the wildlife corridor connecting Lewa Conservancy and the forest. Other headline species include the

Black rhino with about 12% of the Kenya population being found in Lewa Conservancy, Grevy Zebra, Mountain Bongo (*Tragelaphus eurycerus isaaci*), Colobus monkey (*Colobus guereza*), Syke monkey (*Cercopithecus mitis*) and Olive baboons (*Papio Anubis*).

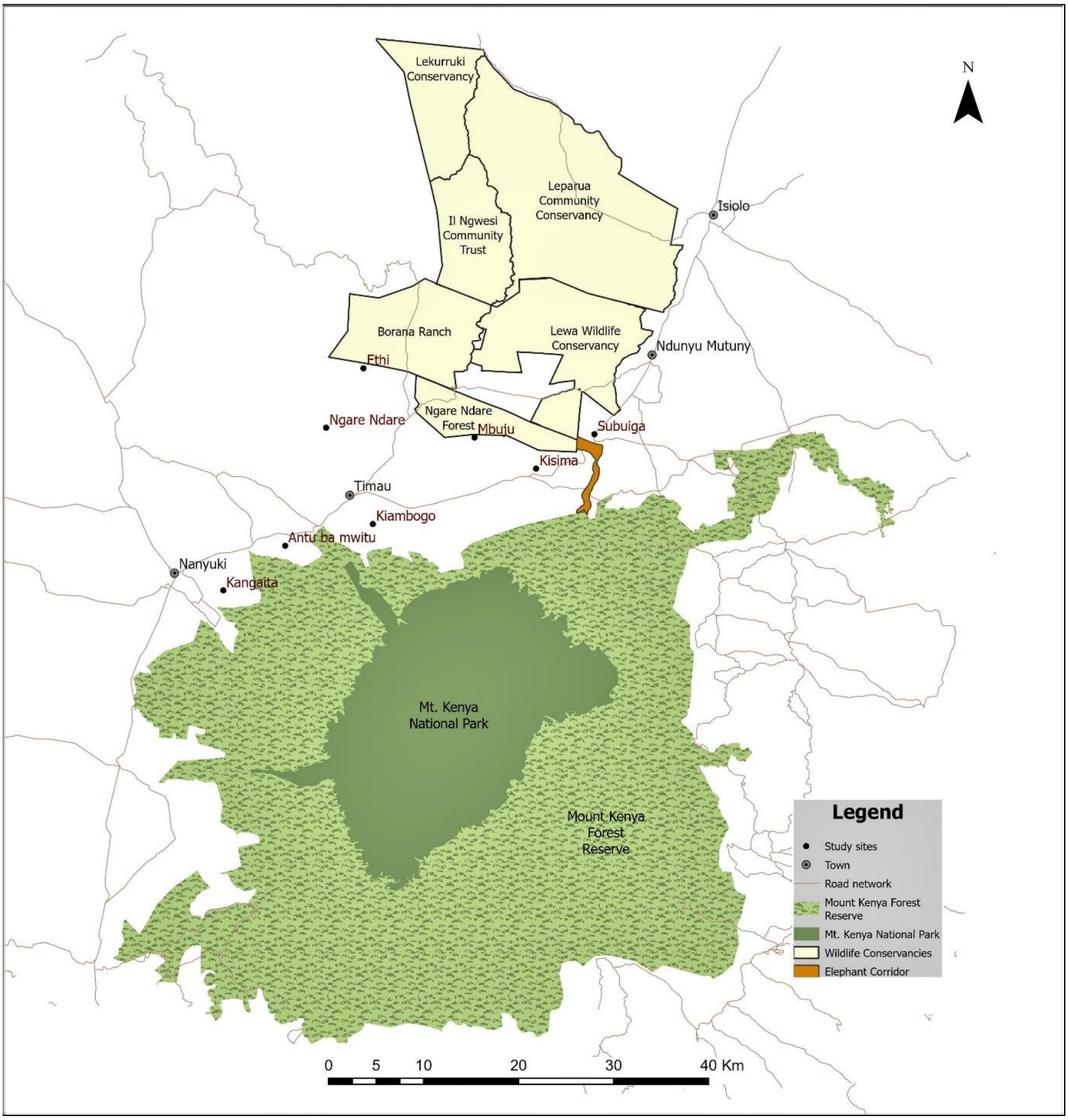

Figure 3.2 Map of Mt. Kenya Ecosystem, the areas has several electric fences to control wild-life movements **Source: (Author 2016)**

The Olive baboon, which is wide spread regardless of the forest conditions is in frequent conflict with the farming community in MKE. In addition, other wildlife species raid crops causing loss of produce, damage to infrastructure and injuries or death to people and their livestock. Most of the crop damage is caused by elephants with buffalo, primates, birds and wild pigs.

MKE is a continuum of habitats, which includes afromontane forest, moorland and grassland. The major land cover types include African pencil cider (*Juniperus procera*) and Pillar wood (*Cassipourea malosana*)in the lower zones, while bamboo (*Arundinaria alpine*) and a and East African yellow wood (*Podocarpus milanjianus*) dominate the higher altitude zones (UNESCO, 2020).

According to KWS (2010), the main threats to MKE are wildlife poaching for bush meat; illegal logging, which is prevalent in the lower elevations of the forest; forest fires; invasive species; illegal water abstraction; visitor related impacts such as poor waste management; and human-wildlife conflict.

3.4.3 Climate

Rainfall in the MKE ranges from 300mm to 2500 mm per annum, with high rainfall experienced in areas bordering the slopes of Mt. Kenya. The long rains occur from mid-March to May and the short rains from October to December. Temperatures during the cold season are as low as 8^0C with a high of 32^0C during the dry season (County Government of Meru [CGM], 2018; County Government of Laikipia [CGL], 2018).

3.4.3 Demography and livelihoods

Meru has a population density of 318 people per square kilometre (CGM, 2018) while Laikipia has 52 people per square kilometre (CGL, 2018). The Meru County population is projected to grow to 1,775,511 by 2022 (CGM, 2018), while Laikipia is projected to be 539,763 in the same year (CGL, 2018). The main economic activity in MKE is crop farming due to the high rainfall in most parts of the ecosystem. Parts of Laikipia are arid and semi-arid with the least population, dominated by wildlife ranches and pastoral livelihood patterns (CGL, 2018).

3.4.4 Geology and soil characteristics

The geology and soil type of MKE varies in characteristics from the Mt. Kenya National Reserve down to Ngare Ndare Forest and Lewa Conservancy. The higher altitude areas around Mt. Kenya have soils that are shallow, stony, and rich in organic matter. Andosols and peat soils are dominant on the upper slopes and the lower slopes are characterised by highly weathered, deep soils with argillic horizons. On the plain to the west and northwest of Mount Kenya, fine textured soils with dark top soils are common. They have developed on volcanic ash and pyroclastic rocks (Speck, 1982).

CHAPTER FOUR: RESEARCH METHODOLOGY

4.1 INTRODUCTION

This chapter describes the instruments and procedures used to collect data from the field and the subsequent analytical techniques. The chapter also discusses how the study hypotheses were tested and interpreted.

4.2 RESEARCH DESIGN

Parahoo (1997) defines a research design as "a plan that describes how, when and where data are to be collected and analysed". This study adopted a comparative study design by engaging the respondents through field surveys, interviews, and observations. Burns and Grove (2003) assert that "descriptive research is designed to provide a picture of a situation as it is naturally, and it can be used to explain current practice, make decisions and develop theories". As such, questions to key informants, pastoralists, and farmers on the various cost of HWC in AE and MKE was designed to get answers with the following terms: "who, how, when, where and what".

4.3 DATA COLLECTION

4.3.1 Reconnaissance study

A reconnaissance study was conducted in AE in July 2017 followed by pretesting ten questionnaires in October 2018 in Enkisanjani sub-location in Kuku group ranch, which is outside the selected sub-locations. In MKE, the reconnaissance study was conducted in September 2017 and eight questionnaires pretested in October 2018 in Kibirichia location .The reconnaissance study helped the researcher to determine the study sites, establish local contacts and recruit the research assistants, informing the local authority about the study and testing the data collection instruments to improve accuracy and consistency. From the reconnaissance study, the questionnaire was amended. First, the questions on human-wildlife deaths and injuries were moved toward the end of the questionnaire. This was because during the piloting, it was noted that respondents who are victims of human death and injuries got emotional, and the researcher had to switch the topic before embarking on the interview. It took the researcher some considerable time to get the respondents attention back. The adjustments therefore ensured that all other questions were answered with full attention of the respondents. Secondly, where the respondents were women in AE, it was difficult to get answers for some questions, especially on livestock numbers and the amount used for farming, time spent guarding, and estimated cost used for mitigation measures. The interviewed women said that such matters are men's responsibility, and culturally they are not required to keep such records or know the value of assets. The researcher established that most women in AE (predominantly Maasai) could only speak about such subjects if they are elderly or widows. Based on this, the researcher mainly focused on male respondents in AE.

4.3.2 Sampling

4.3.2.1 Sample size

For this study, the researcher set a desired Margin of Error or Level of Precision (e) of 95% confidence interval (CI) whose Z-score was 1.96 with Standard Deviation (S.D) of 0.5 (the conventional/maximum variance). The researcher adopted the simplified Yamane (1967) formula for calculating the sample size.

$$\boldsymbol{n} = \frac{\boldsymbol{N}}{1+\mathrm{N}(\mathrm{e})^2}$$, Where n= Sample size; N=Population size; e = Margin of error

Based on the population projection data of households in 2017 (KNBS, 2009) for AE sampling areas: Imbirikani and Eselenkei (100); Kimana and Inkoriak (135); and Entonet/Lenkisem (180), totalling to 415 households, the sample size for the ecosystem was calculated as follows.

$$\text{AE sample size} = \frac{415}{1+415(0.05)^2} = 204 \text{ (Rounded off)}$$

An equal sample size of 204 was proportionately distributed to the sampling areas in MKE, making the total sample size of 408 for the study (**Table 4.1**). Equal sample sizes for AE and MKE was used to strengthen the robustness of comparing the population means and testing the hypotheses of no significant differences in the economic magnitude of the HWC. AE was used as the basis for setting the sample sizes, as it had less households compared to MKE.

4.3.2.2 Sampling procedure

Extensive literature surveys and discussions with the key informants was done to help locate the sites with the highest incidences of HWC. Multi-stage sampling was used to cluster the population in each ecosystem into sub-locations. Rossi et al. (1983) emphasises that multi-stage sampling permits the selection of samples when explicit listing of sampling units are not available. As such, the sample of the sub-county was further expanded into locations, from which samples was drawn again. The location population samples were in turn expanded into sub-locations, from which the final household selection was made. Within the sub-location, the village sample size corresponded to the population size of the village.

Table 4.1 Sample Size

Ecosystem	County	Locations	Sampling areas	Sample size
MKE	Meru County	Kisima	Ngare Ndare, Mbuju, Subuiga, Manyagalo, & Kisima	**157**
		Timau	Kangaita, Antu Ba Mwitu, & Kiambogo	
MKE	Laikipia County	Ethi	Ngarendare Ethi	**47**
Total MKE				**204**
AE	Kajiado County	Imbirikani/Eselenkei	Imbirikani & Eselenkei	**204**
		Kimana	Inkoriak & Kimana	
		Entonet/Lenkisem	Entonet, Amboseli, Olchoro & Lenkisem	

To determine the sampling interval per village, the researcher divided the estimated number of households per village with the 2017 population projection of 4 persons per household in MKE and 5 persons in AE. Using the sampling interval and based on the common landmarks in the sub-location, such as schools, water points, dips, clinics and main junctions, households were picked for sampling. In each household, the researcher sought permission to interview an adult. The household heads were targeted for the interview, but where absent their spouses or any other adult (above 18 years) who had lived in the household for at least one year was interviewed. For participants to qualify as respondents in this research, they had to have resided within the wildlife rich areas and had recently (no more than 12 months ago) experienced HWC. The field data collection was conducted from March to October 2019. March to May are wet seasons while June up to October are dry seasons. This therefore captured the HWC during the wet and dry seasons in the two ecosystems.

4.4 SOURCES OF DATA

4.4.1 Primary data

4.4.1.1 Questionnaire

The questionnaire (**Appendix 1**) consisted of the general demographic characteristics of the household, questions on HWC impacts, households' wellbeing, and compensation. In each section of the questionnaire, there were open-end ended questions that gave the respondents an opportunity to express their views and closed ended with a list of possible answers. In addition, there were questions on HWC costs and compensation sections designed to capture the respondents Willingness to Accept (WTA) compensation, and respondents Willingness to Pay (WTP) to tolerate wildlife attacks. The use of WTA and WTP enabled the researcher to create a "theoretical market place in which no real transactions were made". Carson (1997) explains, "CVM method is used for commodities which cannot be traded in common markets, or where market transactions are difficult to observe under the anticipated situations", such as the opportunity, transaction and health cost of HWC".

Locally trained research assistants accompanied the researcher to help with the translation of the questions from English to Maasai/Kikuyu/Meru languages. In each household, the researcher sought permission from the head of the household and explained the general purpose of the study and assured them that the information they shared was specifically for this study and would be kept confidential without their details attached to it.

4.4.1.2 Interviews

Interviews with 20 key informants from conservation organisation, group ranch officials, political leaders, health and education experts, and ecologists was done using an interview guide (**Appendix 2**). Purposive sampling was used in order to get quality data from experienced key informants. Purposive sampling entails choosing respondents or subjects based on certain qualities and disregarding those without the specific characteristics(Tongco, 2007). Tongco (2007) further notes that purposive sampling enables the research to select the informants who are available, willing to participate, communicate experiences and opinions in an articulate, expressive, and reflective manner.

4.4.1.3 Observations

The household assets, damaged properties by wildlife and wildlife presence in the area were determined by observing. In addition, the researcher took photographs of the damaged crops and livestock killed by wildlife as well as methods used to prevent HWC. Based on the knowledge from the previous studies, respondents assertions and KWS data (2010-2018) on the most problematic species (elephants, baboon and hyena) and the typology of HWC in AE and MKE, the researcher ascribed the damage to specific wildlife species.

4.4.2 Secondary and grey data

This was obtained from the KWS data base, Ngare Ndare Forest Trust reports (MKE), Big Life (AE) compensation quarterly report, maps, past studies, university libraries, internet, and newsletters. Additional data from conference proceedings, NEMA environmental impact assessment (EIA) reports, government documents, annual reports, technical reports, working papers, and newspapers were used in this study.

4.4.3. Valuation of HWC economic losses

4.4.3.1 Hidden costs

Opportunity costs was calculated as the mean time and money spent on guarding livestock and crops to prevent wildlife attacks. Where a household employed human guards, the wages paid per day or month was used as an opportunity cost, but where individual households were engaged in guarding, the number of hours was used to calculate the amount spent. This was done based on the average daily wages of KES 400 in AE and KES 600 in MKE, on assumption that people work for on average 8 hours daily, translating to KES 50 and KES 75 per hour, respectively.

Transaction costs was calculated based on the crop, livestock and human fatalities caused by wildlife and the respective amount the respondents expected to be paid by the government as compensation. The delayed compensation was based on 1-year period, and in cases where the respondents had not been paid, the Time Value for Money (TVM) concept was used to calculate the Future Value (FV) of the delayed payments (Present Value). The researcher used the Central Bank of Kenya (CBK) commercial banks weighted average interest of 12.67% for years 2018 and 2019 (Central Bank of Kenya [CBK], 2020) to calculate Future Values as: $\mathbf{FV = PV \times [1 + (r / n)]^{(n \times t)}}$. Where, r= interest rate, n = number of compounding periods per year, t = number of years

The TVM was based on the idea that rational investors would prefer to receive money today rather than the same amount of money in the future, because of money's potential to grow in value over a given period. Equally, the victims of HWC would be better off if they were paid their losses within a short period, than being delayed.

Health costs applied to human deaths and injuries. The mean time used to take the victims to and from hospital, hospital bills paid, and transport amount used was treated as health costs. In addition, the mean, median and modes value of WTP/WTA for various opportunity, transaction and health costs identified by the respondents was further used to estimate the hidden costs. Where respondents gave their WTP in terms of crops and livestock, the quantities were converted to money using the market price obtained from Kajiado, Meru and Laikipia Counties. The mean WTP/WTP figures obtained from the open-ended questions were compared with the economic losses incurred by households. To determine the relationships between the levels of WTP/WTA (as dependent variables) and the household's social and economic characteristics (independent variables), a Pearson-product moment correlation analysis was done.

4.4.3.1 Visible costs

a). Crop losses

An indirect approach was used to calculate the economic losses from crops using the formula: **L= A x Y x %yl**; where:

L=crop loss in kilogrammes per year by a household

A= Area damaged by wildlife as reported by household

Y= Average yield in kilogrammes per year per unit area for a specified crop by the household

%yl=percentage yield lost

$$Y = \frac{\text{Total Crop Quantity produced per year+Quantity damaged}}{\text{Total areas planted}}$$

$$\%yl = \frac{\text{Crop Quantity damaged per year}}{\text{Total Crop Quantity produced per year}} \; x \; 100$$

To obtain the monetary value (MV) loss per a given crop in Kenya shillings/kg/household, the L was multiplied by the market price (MP) of the specified crops. Therefore, **MV=L X MP**

This indirect method helped to cater for the general tendency of respondents inflating the crop loss as explained by Nyhus et al. (2005).

b) Livestock loss

The economic loss to predators per household was estimated in accordance with prevalent average market values of livestock in AE and MKE markets between July 2017 and October 2019.

c) Property damage

The loss of properties was based on the figure from the respondents. This was cross-checked with the local area market value for the properties. Cases where the property were not in the market, the total material cost and the time spent making the property was computed to arrive at the loss sustained.

4.6 DATA ANALYSIS

The data on landholding size, livestock numbers, predation cases, crop raiding cases and household size was subjected to correlation analysis to test the relationship between the variables and the intensity of hidden costs of HWC. An independent student-test and Chi-square statistical analysis was used to test the hypothesis that there is no significant differences between economic magnitude in AE and MKE. To determine the relationship between household characteristics and economic magnitude of HWC, a Pearson product-moment correlation coefficient was applied. Data from key informants was analysed using content analysis. Interview transcripts and its sets of notes was hand-coded to create a list of the main themes for analysis (Denzin & Lincoln, 2000). This enabled the researcher to categorize the similar responses to questions and find description text for each questions. Based on the operational definition for hidden costs (Ogra 2008) the results were classified as visible or hidden costs and inferred accordingly. Questions with alternative answers on a Likert scale and ranking of statements was subjected to Chi square analysis to gauge the respondent's opinions. The Likert scale enabled the respondents to rate the degree to which they agreed or disagreed with provided statements on the effectiveness of monetary compensation on HWC. All the inferential statistics were tested at 95% confidence level.

CHAPTER FIVE: RESULTS

5.1 INTRODUCTION

In this chapter, the results of the study are presented as per the objectives and as set out in the methodology. The researcher compares the results of AE and MKE in terms of socio-economic characteristics, HWC economic losses, deterrent measures used for HWC, mechanisms and strategies for compensation.

5.2 HOUSEHOLDS SOCIO-ECONOMIC PROFILES

5.2.1 Age category

Respondents from all age categories were sampled, however, the majority (36.3%) were in the range of 40-49 years, with the least (4.1%) being above 70 years (**Table 5.1**). On average, the respondents had lived in their respective homes for 22.77±0.940 years in AE and 27.77±0.793 years in MKE.

Table 5.1 Summary of age categories

Age category	Frequency		Total Per-cent
	AE	MKE	
20-29yrs	3	18	5.1%
30-39yrs	41	35	18.6%
40-49yrs	75	73	36.3%
50-59yrs	55	47	25.0%
60-69yrs	22	22	10.8%
70-79yrs	5	9	3.4%
Above 80yrs	3	0	0.7%
Total	204	204	100.0%

Source: Researcher, 2019

5.2.2 Education level

Out of the 408 respondents, 33.3% and 33.6% had informal and primary level of education, respectively. AE had more people (52.0%, n=106) with no formal education compared to MKE with 14.7% (n=30). In total, MKE had 174 respondents with formal education compared to AE, with 98 respondents. The number of respondents with formal education decreased with age advancement in each level (**Table 5.2**).

Table 5.2 Education levels in AE and MKE

Education level	Ecosystem			
	AE		MKE	
	Frequency	Percent	Frequency	Percent
No formal education	106	52.0%	30	14.7%
Primary certificate	58	28.4%	79	38.7%
Secondary certificate	32	15.7%	78	38.2%
College certificate	7	3.4%	11	5.4%
College Diploma	0	0.0%	6	2.9%
Master's Degree	1	0.5%	0	0.0%
Total	204	100%	204	100%

Source: Researcher (2019)

5.2.3 Gender and household size

In AE, the respondents were predominantly male, 99.0% (n=202), while MKE had 52.5% (n=107), male and 47.5 % (n=97) female. Out of the 408 respondents, the male constituted 75.7% while the female constituted 24.3%. AE had a mean of 8.60±0.353 people while MKE had 5.45±0.137 persons per household. The largest household in AE had 34 people, while in MKE had 13 people. The minimum family size in AE had three people while MKE had one person.

5.2.4 Income levels

Income for respondents was based on the preceding year of the research. Majority of the households in AE (64.2%, n=131) and MKE (66.7%, n=136) earned a monthly income of less than KES 10,000. Only 4.9% and 3.5% of the households in AE and MKE, respectively, had monthly income of KES 41,000 and above (**Figure 5.1**).

The respondent's main sources of income were crops, livestock, employment, and business operations (**Table 5.3**). Households in MKE earned more from crops (KES 52,394.61±4272) than livestock (KES 11,810.34±1496). On the other hand, AE received more income from livestock (KES 65,738.51) than from crop farming (KES 30.671.08±4441).

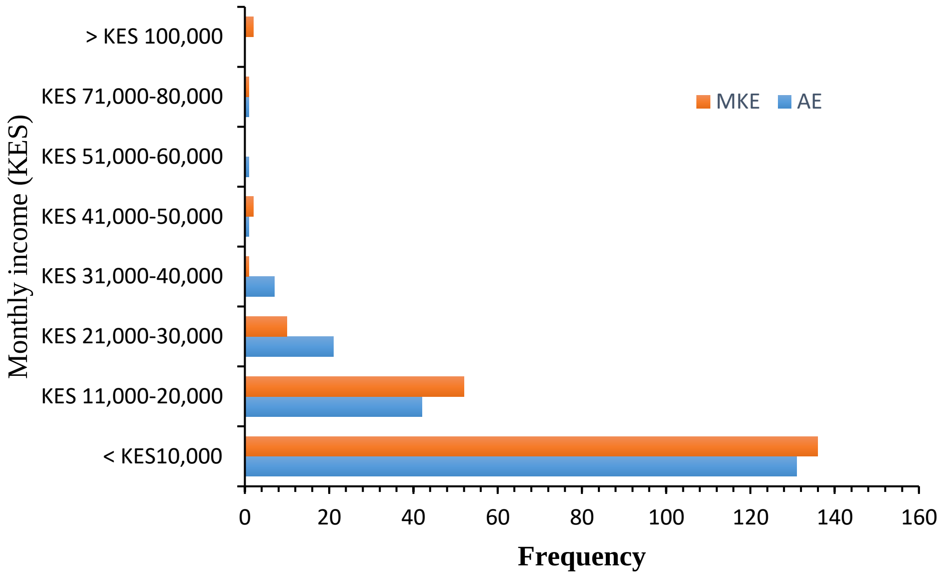

Figure 5.1 Monthly income per household in AE and MKE

Source: Researcher (2019)

The MKE households averagely generated more income from business (KES 33,215.35±4,575 than employment (KES10, 577.72± 2,185). Conversely, AE households earned more income from employment (KES 25,627.55±5,075) than from business operations (KES11, 306.53± 2,244).

Table 5.3 Mean annual main sources of income

Ecosystem		**Annual income in Kenya Shillings**			
		Crops	**Livestock**	**Employment**	**Business**
AE	Mean	30,671.08	65,738.51	25,627.55	11,306.53
	N	87	161	57	46
	S.E	4,441.05	4,799.05	5,075.53	2,244.06
MKE	Mean	52,394.61	11,810.34	10,577.72	33,215.35
	N	186	77	38	93
	S.E	4,272.98	1,495.66	2,185.05	4,575.48

Source: Researcher (2019)

In both ecosystems, most households practised mixed cropping, with the dominant crop combination being maize and beans (16%, n=43), wheat and potatoes (16%, n=43), maize and potatoes (12%, n=32) (**Figure 5.2**). The major single crops grown were wheat (13%, n=35), maize (11%, n=30) and potatoes (9%, n=24).

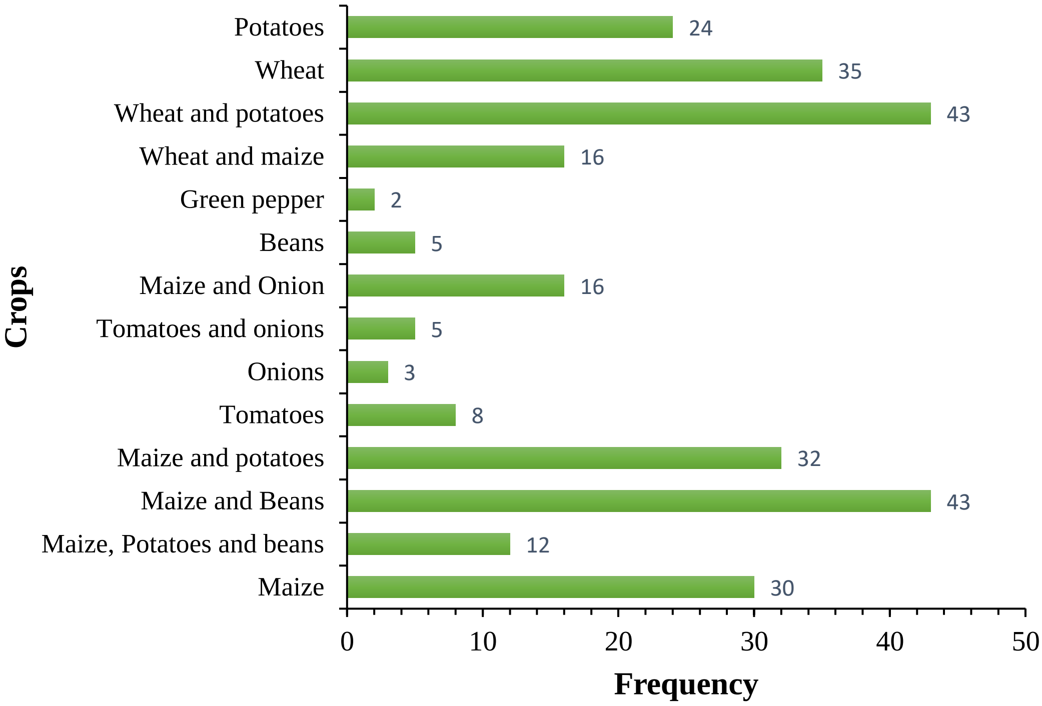

Figure 5.2 Main crops grown.

Source: Researcher (2019)

Households in AE had an average of 35.84±5.179 cattle, 40.81±4.19 sheep, 22.17±2.233 goats, and 1.12±0.207 donkey compared to MKE, which had less cattle (6.71±0.852), sheep (22.24±3.619), goat (9.73±1.759), and no donkeys. Most households also had poultry (chicken, ducks, and geese) which generally averaged to 10.56±1.412 in MKE and 6.71±1.254 in AE.

5.2.5 House characteristics

5.2.5.1 House type

There were three main types of dwellings in the study areas, namely, makeshift structures (MSS), semi-permanent houses (SPH) and permanent houses (PH). Majority of the houses in AE (65.7%, n=134) and MKE (74.5%, n=152) were SPH. However, AE had more MSS (31.9%, n=65) compared to MKE, with only 0.5%. PH were fewer in both study areas, but MKE had a higher percentage (25%, n=51) than AE (2.5%, n=5).

5.2.5.2 Walling

Majority of the respondents in AE (46.1%, n=94) had houses consisting of mud walls, while in MKE most of the house walls were made of timber (60.3%, n=123). The second most popular materials used for house walls were corrugated iron sheet in AE (27.9%, n=57) and stones in MKE (25%, n=51). The least used material in AE was stones (2.9%, n=6) compared to mud (10.8%, n=22) and iron sheet (3.9%, n=8) in MKE.

5.2.5.3 Floors

Most houses in AE (62.3%, n=127) had mud floors while in MKE majority (63.7%, n=130) had concreate floors. Mud floor houses were moderately common in MKE (31.9%, n=65) just like concrete floors in AE (37.7%, n=77). The least floor type had a combination of mud and cow dung, with 4.4 % (n=9) houses in MKE and none in AE.

5.2.5.2 Roofs

The most common type of roof-tops in AE (68.1%, n=139) and MKE (98.5%, n=201) were corrugated iron sheet. Grass roofs were second most popular in AE, comprising of 31.4% (n=64) of all the roof types. Only 1.5% (n=3) of the houses had grass tops in MKE. A combination of soil and cow dung was the least with only one house in AE and none in MKE.

5.2.6 Households land size and tenure

On average, each household in AE had 7.64±1.098 acres of land, compared to 3.19±0.210 acres in MKE. The acres owned by individuals in AE ranged from none to a maximum of 60 acres, while in MKE, it ranged between 0.25 to 25 acres. Majority (95.6%, n=195) of the MKE respondents privately owned the land they lived on, with 84.3% (n=172) having tittle deeds, 13.2% (n=27) with no documents, and 2.5 % (n=5) had allotment letters. In AE, most respondents were private (49%, n=100) and communal (48%, n=98) land owners, with only 2.9% (n=6) living on leased land. Majority of the respondents had no formal documents (48.5%, n=99), while 46.6% (n=95) and 1.5% (n=3) had tittle deeds and allotment letters, respectively.

5.3 ECONOMIC MAGNITUDE OF HWC

The economic loss incurred by respondents from HWC in the two ecosystem was categorised into hidden and visible costs.

5.3.1 Hidden economic costs

Households in this study, incurred both time and monetary opportunity costs as results of HWC.

5.3.1.1 Time opportunity costs

a). Time spent guarding against wildlife

Guarding livestock and crops were common practices in both AE and MKE. **Table 5.4** indicates that households in AE spent more time guarding livestock during the day (4.16±0.185 hours) and during the night (3.63±0.126 hours) compared to their counterparts in MKE who spent 3.46±0.466 hours in daytime and 2.48±0.338 hours during the night. In addition, individuals in AE guarded their crops more during the day (4.57±0.249 hours) and night (3.88±0.180 hours) than those in MKE who used 4.39±0.178-hour daytime and 2.86±0.1957 hour during the night. The combined household time spent on both livestock and crops in AE and MKE during the day (16.58 hours) was more than the total time spent during the night (12.85 hours).

Based on the casual wages paid in AE (KES 50) and MKE (KES 75) per hour, the average combined time lost guarding livestock per household per day in AE is KES 389.0, while in MKE is KES 445.50. Equally, for crop guarding, a household in AE lost KES 422.50 per day while those in MKE lost KES 543.75 per day. This is a considerable amount to lose per day for people whose daily income is less than Kenya's gross per capita income of KES 483.60 and are largely dependent on natural resources for survival. Guarding against wildlife attacks severely reduces the chances of household to engage in other social and economic activities.

Table 5.4 Time in hours spent on livestock and crop guarding

	Ecosystem	N	Mean(hours)	S.E
Livestock day guarding hours	AE	88	4.16	0.185
	MKE	24	3.46	0.466
Livestock night guarding hours	AE	89	3.63	0.126
	MKE	23	2.48	0.338
Crop day guarding hours	AE	51	4.57	0.249
	MKE	98	4.39	0.178
Crop night guarding hours	AE	50	3.88	0.180
	MKE	82	2.86	0.1957

Source: Researcher (2019)

b). Loss of school time and adult delay in reporting to livelihood activities

Presence of wildlife resulted to children reporting to school late in the morning and leaving school early in the evening. The mean time children lost in the morning (1.28±0.053 hours;

n=98) and evening (1.22±0.044 hours; n=93) in AE was more than the time lost in MKE in the morning (0.79±0.026hours, n=115) and evening sessions (0.93±0.037 hours, n=125) as shown in **Table 5.5.** Majority of respondents in AE (51.5%, n=105) and MKE (43.6%, n=89) had their children reporting to school at 10:00am instead the required time of 6:00am which is necessary in order to do morning studies. In addition, 35.8% (n=73) of the respondents in AE and 19.1% (n=39) in AE had their children reporting to school at 8:00am instead of 7:00am. In the evening, most of respondents in both AE (53.9%, n=110) and MKE (38.7%, n=79) had their children leaving school at 3:00pm instead of 3:30pm. Another 19.6% (n=40) in AE had their children leaving school at 4:00pm instead of 5:00pm, while in MKE 23.5% (n=48) of the respondents had their children leaving school at 3.30pm instead of 4.30pm.

Table 5.5 School time lost and delayed reporting to livelihood activities

Session	**Ecosystem**	**N**	**Mean (hours)**	**S.E**
Time lost in the morning	AE	98	1.28	0.053
	MKE	115	0.79	0.026
Time lost in the evening	AE	93	1.22	0.044
	MKE	125	0.93	0.037
Time used to escort children to school	AE	107	0.55	0.015
	MKE	179	0.38	0.013
Time lost for delayed water and firewood fetching	AE	46	1.50	0.060
	MKE	8	2.25	0.412

Source: Researcher (2019)

In the cases where parents feared that their children could be attacked by wildlife, they escorted their children to school. The time used to escort children in morning in AE (0.55±0.02 hours; n=107) was higher than in MKE (0.38±0.04 hours; n=179). Adults also reported to their respective livelihood activities late because of wildlife loaming their localities (**Plate 1**). In MKE, 32.4 % (n=66) respondents and 5.9% (n=12) delayed their reporting to income related activities in the morning. In AE, seven out of every 12 people reported to work at 9:00am instead of the planned 8:00am. The remaining five people reported to work at 8:00am instead of the scheduled 6:00am to 7:00am. In MKE most respondents said they were required to report to livelihood activities at 7:00am (9.3%, n=19) and 6:00am (6.9%, n=14). However, most people delayed, and reported to work at 8:00am (17.6%, n=36) and 7:30am (4.9%, n=10).

Plate 1 An elephant blocking people travelling to Kimana market in AE.

Source: Researcher (2019)

c). Time spent on property repairs and crop replanting

Eleven (11) water storage tanks in AE and 21 in MKE were damaged by elephants within a period of one year. In addition, eight-farm fences in AE and 25 in MKE were damaged within the same period. On average, the time used to repair the damaged properties in AE (24.08±5.33-hour, n=12) was higher than in MKE (12=4.35±1.868 hours, n=43). After crop raiding by wild-life, households in AE spent an average of 124±47.88 hours for crop replanting, while those in MKE spent 60.03±8.13 hours.

5.3.1.2 Monetary opportunity cost

a). Money spent guarding against wildlife

Individual households in AE spent a total of KES 208,540.22 compared to MKE who used KES 131,309.75 guarding livestock per year (**Table 5.6**). Other households hired guards to keep off wildlife from their crops and livestock. The average amount spent per year on hired livestock guards by households in AE at KES 46,835.82±2115.35 (n=67) was higher than in MKE (KES 34,166.75±5976.98, n=12). Similarly, the amount used to hire guards to scare off wildlife from farms in AE (KES 31,888.89±6221.48, n=9) was higher than in MKE (KES 18,497.75±1545.25, n=89).

Table 5.6 Amount in KES spent on crop and livestock guarding

Expenditure	Ecosystem	N	Mean (KES)	S.E
Amount household spent on crop guarding	AE	50	70,970.00	6209.20
	MKE	93	47,298.39	3040.75
Amount spent on hired labourer to guard crops	AE	9	31,888.89	6221.48
	MKE	89	18,497.75	1545.25
Amount household spent on guarding livestock	AE	89	137,570.22	11794.88
	MKE	22	84,011.36	9610.17
Amount spent on hired labourer to guard livestock	AE	67	46,835.82	2115.35
	MKE	12	34,166.75	5976.98

Source: Researcher (2019)

b). Money spent on property repairs and crop replanting

The average amount used to repair damaged water tanks and farm fence by wildlife in AE (KES 12,686.67±4351.51, n=15) was almost equal to that used in MKE (KES 12,118.61±1186.39), with a slight difference of KES 568.06 per years per household.

Other than property repairs, respondents in both AE and MKE, indicated that they spent an average of KES 30,185±9989 and KES 21,005.59±3166.86 respectively replanting their crops after wildlife raids.

c). Money spent on other mitigation measures

Table 5.7 shows the other common mitigation measures used to protect crops from wildlife. They include the use of scarecrows (**Plate 2**), fencing, dogs, light emitting devices and noise emitting devices such as old magnetic tapes (**Table 5.7**). The fencing of farms using barbed wire and rolls of twisted chain-links was the most expensive method used in AE (KES 34,423.08±11720.41, n=13) compared to MKE (KES 23,833.33±1140, n=11402.97, n=6). Unlike in MKE, dogs and noise mitigation measures were not used to protect crops in AE.

Just like in crop raiding mitigation, enclosing livestock in a chain-link fence (**Plate 3**) was most expensive method used by households in AE (KES, 45,718.92) and MKE (KES 23,250) as shown in **Table 5.8**. The most common method used for livestock protection was hedge fencing, with 158 households using the method. On average, the hedge fence cost more in AE (KES 11,289.29±822.80, n=140) compared to MKE (KES 7,150.00±819.38, n=18). The average cost of lighting devices in AE (KES 17,017.44± 2134.50) was twice the cost in MKE (KES 8,375.00± 1434.33).

Table 5.7 Costs in KES for crop protection methods used in AE and MKE

Crop mitigation measures	Ecosystem	N	Mean (KES)	S.E
Scarecrows	AE	7	685.71	120.37
	MKE	55	1,068.18	74.92
Fencing	AE	13	34,423.08	11720.41
	MKE	6	23,833.33	11402.97
Dogs guarding	AE	-	-.	-.
	MKE	55	2,005.45	116.10
Lighting devices	AE	3	4,033.33	260.34
	MKE	19	4,063.16	407.69
Noise devices	AE	-	-.	-.
	MKE	26	1,234.62	206.21

Source: Researcher (2019)

Plate 2 Scarecrow in a beans field at Imurutot village in AE (**Source: Researcher (2019)**

Plate 3 Cattle entering predator-proof boma at Inkorienito village in AE

Source: Researcher (2019)

Table 5.8 Cost in KES for livestock protection measures used in AE and MKE

Livestock mitigation measures	Ecosystem	N	Mean(KES)	S.E
Hedge	AE	140	11,289.29	822.80
	MKE	18	7,150.00	819.38
Chain-link fence	AE	37	45,718.92	3798.49
	MKE	44	23,250.00	1735.75
Scarecrow	AE	12	808.33	83.90
	MKE	4	975.00	184.28
Dogs	AE	41	1,951.2195	584.12
	MKE	23	2,206.5217	261.20
Lighting devices	AE	39	17,017.44	2134.50
	MKE	4	8,375.00	1434.33

Source: Researcher (2019)

d). WTP and WTA for Hidden costs

Respondents in MKE were willing to pay and accept higher rates for various hidden costs than their counterparts in AE (**Table 5.9**). The highest mean WTA by respondents per day for time loss in income generating activities was KES 255.64±15.93 in AE and KES412.76±12.54 in MKE). Similarly, time loss for income-generating activities elicited the highest WTP in AE (KES102.44±7.99) and in MKE (KES 118.45±9.34). The lowest WTP and WTA was recorded in AE for restricted night travel of KES 43.13±3.19 and KES 84.22±5.78 respectively. Generally, the WTA for the various hidden costs was double the respective WTP values.

Table 5.9 WTP and WTA per day in KES for different hidden HWC

WTP/WTA	Ecosystem	N	Mean (KES)	S.E
WTP to mitigate diseases	AE	156	61.06	4.46
	MKE	80	67.50	6.59
WTA compensation for diseases	AE	156	126.67	9.82
	MKE	80	155.81	19.51
WTP for fear of attack	AE	164	65.88	12.75
	MKE	128	68.56	3.43
WTA compensation for fear of attack	AE	163	112.91	8.14
	MKE	129	143.02	8.62
WTP for restricted night time travel	AE	83	43.13	3.19
	MKE	122	69.06	3.28
WTA compensation for restricted night time travel	AE	83	84.22	5.78
	MKE	121	129.96	6.79
WTP for missing social gathering	AE	106	52.50	4.80
	MKE	95	63.90	3.47
WTA compensation for missing social gathering	AE	106	118.11	14.61
	MKE	97	124.02	6.77
WTP for school absenteeism	AE	84	66.25	5.55
	MKE	121	97.85	4.71
WTA compensation for school absenteeism	AE	84	128.57	10.96
	MKE	119	215.50	19.52
WTP for loss of sleep	AE	139	60.29	3.50
	MKE	105	81.38	3.97
WTA compensation for loss of sleep	AE	139	114.33	6.98
	MKE	105	177.33	10.37
WTP for missing income generating activity	AE	101	102.44	7.99
	MKE	116	118.45	9.34
WTA compensation for missing income generating activity	AE	101	255.64	15.93
	MKE	116	412.76	12.54

Source: Researcher (2019)

5.3.1.2 Transaction costs

Although majority of the respondents both in AE (58.82%, n=120) and MKE (53.43%, n=109) filed HWC claims to KWS, only three people had received compensation as stipulated in the WCMA 2013. This is despite 79.4% (n=162) and 27% (n=57) of the people surveyed in MKE and AE respectively, having experienced crop raiding; 50.49% of 408 respondents lost their livestock to predators; 46 people having lost their properties and 18 people attacked by wildlife (**Table 5.10**).The average delayed amount the respondents expected to receive for the HWC losses is shown in **Table 5.10**. However, the amount had not been paid by the time respondents were being interviewed. Based on the Kenya commercial banks average weighted interest rates of 12.67 % for the years 2018 and 2019 (Central Bank of Kenya[CBK], 2020), the real time value (Future Value) for the respective HWC cost for a period of 1 year is shown **Table 5.10**. Delayed payment to human fatalities resulted to the highest loss in both MKE (KES 228,763.89) and AE (KES 152,462.33). Generally, both AE and MKE lost an average total of KES 410,168.04 due to delayed payment of compensation claims for one year alone.

Table 5.10 Delayed expected payment of HWC costs in AE and MKE

Costs	Ecosystem	N	Mean expected compensation /Present Value (KES)	S.E	Future Value at 12.67% interest (KES)	FV-PV (KES)
Crop damage	AE	57	46,649.12	9249.01	52,559.56	5,910.44
	MKE	162	29,567.28	3342.77	33,313.45	3,746.17
Livestock loss	AE	147	64,326.00	6559.21	72,476.10	8,150.10
	MKE	59	47,883.05	7407.83	53,949.83	6,066.78
Human deaths and injuries	AE	9	1,203,333.33	560800.5	1,355,795.66	152,462.33
	MKE	9	1,805,555.56	798803.1	2,034,319.45	228,763.89
Property loss	AE	12	26,458.33	7757.07	29,810.60	3,352.27
	MKE	34	13,544.12	1508.8	15,260.16	1,716.04

Source: Researcher (2019)

5.3.1.3 Health costs

Respondents who had their family members attacked by wildlife in MKE used an average of 61.86 hours to find treatment for the victims (**Table 5.11**). This was almost ten times the average time used in AE (6.67 hours). In addition, the mean hospital bills in MKE were higher (KES 80,777.78 ±30419) than in AE (KES 59,000±19144.19). Similarly, the time taken for the wildlife victims to recover from injuries was higher in MKE (1614.40hours) than in AE (24 hours). In AE, four people and in MKE, two people were not able to perform their daily normal activities after being attacked by wildlife.

Table 5.11 Hidden health costs incurred due to wildlife attacks

Cost	Ecosystem	N	Mean	S.E
Hospital bill for injured person (KES)	AE	9	59,000.00	19144.19
	MKE	9	80,777.78	30419.19
Time in hours used to seek treatment for injured person	AE	9	6.67	1.24
	MKE	7	61.86	45.76
Transport cost for the injured person (KES)	AE	9	8,577.78	1722.14
	MKE	9	5,827.78	1997.66
Injured person time in hours lost while recuperating	AE	5	24.00	6.57
	MKE	5	1614.40	786.82

Source: Researcher (2019)

Other than injuries sustained from wildlife, respondents also indicated that they experienced fear and loss of sleep while guarding their livestock and crops against wildlife attacks. Most of the respondents in AE, 78.9% (n=161) and in MKE (61.3%, n=125) indicated that they experienced fear, while 68.1% (n=139) and 51% (n=104) in AE and MKE respectively had sleepless nights. Another 75.5 % (n=154) of the respondents in AE and 38.7% (n=79) in MKE stated that they had contracted diseases such as malaria and pneumonia while guarding. As a result, respondents were ready to pay daily rates of KES 61.06 in AE and KES 67.50 for engaging any measures that could prevent them contraction of diseases while guarding their property. Respondents were also ready to pay KES 65.88 in AE and KES 68.56 in MKE daily to deal with fear and anxiety for wildlife during guarding at night.

Out of the 408 respondents, 67.89% indicated that they had experienced food shortage. When asked to give the major reasons for food shortage at household levels, majority in AE (55.70%, n=83) cited drought, while majority in MKE attributed it to wildlife and drought (39.84%, n=51) as illustrated in **Figure 5.3.** Wildlife attacks alone were cited by 28.91% (n=37) in MKE and 7.38% (n=11) as the main reason for food shortage.

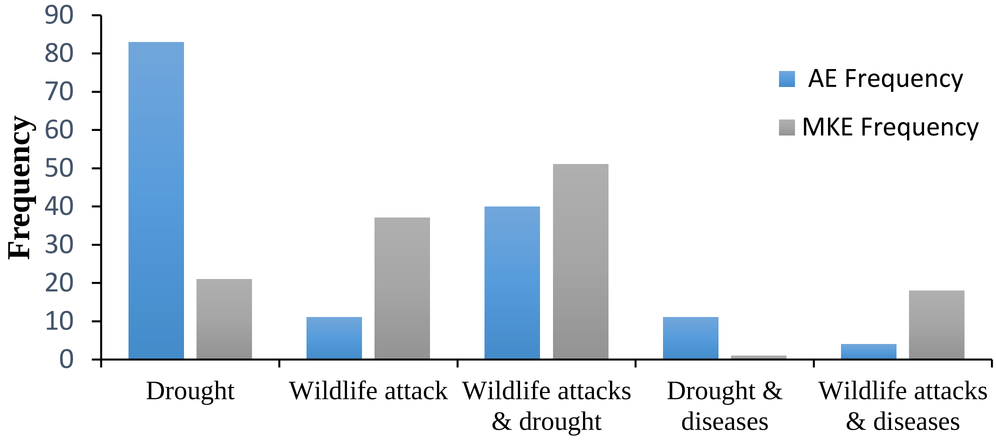

Figure 5.3 Main reasons for food shortage in households

Source: Researcher (2019)

5.3.1.4 Hypothesis testing: Opportunity, transaction, and health costs

a). Opportunity costs

i. Time spent guarding against wildlife

An independent student t-test indicated that night time hours spent guarding livestock (t= 3.820, d.f=110, p=0.000) and crops (t=3.571, d.f=130, p=0.00) in AE and MKE were significantly different, and hence the null hypothesis is rejected (**Table 5.12**). The AE respondents used 1.151 hours more at night guarding livestock and 1.026 hours more guarding crops than MKE respondents do. However, daytime hours spent guarding livestock and crops in AE and MKE were similar (P>0.05).

Table 5.12 Hypothesis testing: Time spent on livestock and crop guarding

Characteristics	t-test values	d.f	Sig. (2-tailed)	Mean Difference (Hours)	Remarks
Livestock day guarding hours	1.634	110	P=0.105	0.701	Similar
Livestock night guarding hours	3.820	110	P=0.000	1.151	Significant
Crop day guarding hours	0.592	147	P=0.555	0.181	Similar
Crop night guarding hours	3.571	130	P=0.000	1.026	Significant

Source: Researcher (2019)

ii. School time lost and adult delay to report activities

Table 5.13 show the t-values for time lost by children and adults due to presence of wildlife in AE and MKE. The time lost by children in the morning (t=8.669, d.f=211, p=0.000) and evening (t=5.101, d.f=216, p=0.000) was significantly different in AE and MKE, with the former losing 0.495 hour and 0.298 hour more, correspondingly. Similarly, the time adults used to escort children to school (t=8.166, d.f=284, p=0.000) and the time delayed to fetch water and gathering fire wood (t=3.424, d.f=52, p=0.001) were significantly different for the two ecosystems. Hence, the null hypothesis is rejected.

Table 5.13 Hypothesis testing: School and adult activity delayed time

Session	t-test values	d.f	Sig. (2-tailed)	Mean Difference(Hours)	Remarks
School time lost by children in the morning	8.669	211	P=0.000	0.495	Significant
School time lost by children in the evening	5.101	216	P=0.000	0.289	Significant
Time lost by parents in escorting children to school	8.166	284	P=0.000	0.164	Significant
Time lost for delayed water and firewood fetching	-3.424	52	P=0.001	-0.750	Significant

Source: Researcher (2019)

iii. Amount spent on livestock and crop guarding

The t-test for the amount spent by respondents on crop and livestock guarding in AE and MKE both for household members and hired labour was significantly different (**Table 5.14**), with the expenditure in AE being more than in MKE. The null hypothesis was therefore rejected for all the amounts spent on guarding (P<0.005).

Table 5.14: Hypothesis testing: Money (KES) spent on livestock and crop guarding

Expenditure	t-test values	d.f	Sig. (2-tailed)	Mean Difference (KES)	Remarks
Amount spent on crop guarding	3.847	141	P=0.000	23671.613	Significant
Amount spent on hired labourer to guard crops	2.559	96	P=0.012	13391.136	Significant
Amount household spent on guarding livestock	2.207	109	P=0.029	53558.861	Significant
Amount spent on hired labourer to guard livestock	2.266	77	P=0.026	12669.071	Significant

Source: Researcher (2019)

iv. Amount spent on other crop and livestock mitigation measures

As shown in **Table 5.15**, the money spent on scarecrows, fencing and lighting devices in AE and MKE were all similar (P>0.05).

Table 5.15 Hypothesis testing: Money in KES spent on other crop mitigation measures

Crop raiding mitigation measures	t-test values	d.f	Sig. (2-tailed)	Mean Difference (KES)	Remarks
Scarecrows	-1.776	60	0.081	-382.468	Similar
Fencing	0.556	17	0.586	10589.744	Similar
Lighting devices	-0.028	20	0.978	-29.825	Similar

Source: Researcher (2019)

On livestock protection against wildlife attacks, a t-test revealed that other than chain-link fence (t-5.672, d.f=79, p=0.000) being significantly different in the two ecosystem (**Table 5.16**), all other livestock protection measures were alike (p>0.05).

Table 5.16 Amount in KES spent on other livestock mitigation measures

Livestock protection measures	t-test values	d.f	Sig. (2-tailed)	Mean Difference (KES)	Remarks
Hedge	1.785	156	0.076	4139.286	Similar
Chain-link fence	5.672	79	0.000	22468.919	Significant
Scarecrow	-0.934	14	0.366	-166.667	Similar
Dogs	-0.317	62	0.753	-255.30223	Similar
Lighting devices	1.280	41	0.208	8642.436	Similar

Source: Researcher (2019)

v. Time and money spent on property repairs and replanting crops

The results of a student t- test indicated that there was a significant difference in the time (t=2.165; d.f=53; p=0.035) used to repair properties in AE and MKE. Respondents in AE spent 9.73 hours more on repairs, than those in MKE. Similarly, the time used to replant crops after wildlife raids was significantly different in the two ecosystems (t=2.200, d.f=42, p=0.03). Therefore, the null hypothesis was rejected for the crop repair and replant time used. However, a t-test revealed that there was no significant differences in the amount spent on property repair (t=0.176, d.f=56, p=0.861) and replanting crops (t=1.163, d.f=42, p=0.252) in the AE and MKE.

b) WTP and WPA

i. Comparison between daily WTP and WTA for various opportunity costs

WTP and WTA for various opportunity costs are summarised in **Table 5.17** with the last column indicating whether there is significant difference or similarity in AE and MKE.

Table 5.17 Comparison of WTP and WTA for various opportunity costs

WTP/WTA	t-values	d.f	Sig. (2-tailed)	Mean Difference(KES)	Remarks
WTP to mitigate diseases	-0.825	234	0.410	-6.44231	Similar
WTA compensation for diseases	-1.489	234	0.138	-29.14583	Similar
WTP for fear of attack	-0.181	290	0.856	-2.67054	Similar
WTA compensation for fear of attack	-2.522	290	0.012	-30.10915	Significant
WTP for restricted night time travel	-5.441	203	0.000	-25.92485	Significant
WTA compensation for restricted night time travel	-4.819	202	0.000	-45.74181	Significant
WTP for missing social gathering	-1.887	199	0.061	-11.39474	Similar
WTA compensation for missing social gathering	-0.356	201	0.722	-5.90741	Similar
WTP for school absenteeism	-4.327	203	0.000	-31.60124	Significant
WTA compensation for school absenteeism	-3.477	201	0.001	-86.93277	Significant
WTP for loss of sleep	-3.979	242	0.000	-21.09318	Significant
WTA compensation for loss of sleep	-5.220	242	0.000	-63.017	Significant
WTP for missing income generating activity	-1.283	215	0.201	-16.023	Similar
WTA compensation for missing income generating activity	-7.843	215	0.000	-157.115	Significant

Source: Researcher (2019)

c). Transaction costs

The compensation payments delayed and expected by respondents for crop damage (t=2.175, d.f=217, p=0.031) was significantly different in AE and MKE, with respondents in AE expecting KES 17,081.839 more compared to MKE (**Table 5.18**). Hence, the null hypothesis was rejected. However, livestock loss, human fatalities, and property loss compensation payments delayed for AE and MKE were similar (P>0.05).

Table 5.18 Hypothesis testing for transaction costs

Cost	t-values	d.f	Sig. (2-tailed)	Mean Difference(KES)	Remarks
Crop damage	2.175	217	0.031	17081.84	Significant
Livestock loss	1.436	207	0.153	16442.95	Similar
Human fatalities	-0.617	16	0.546	-602222.22	Similar
Property loss	1.634	11.842	0.128	12914.22	Similar

Source: Researcher (2019)

d). Health costs

The mean hospital bills, transport cost, time used for recuperating and to seek treatment were statistically similar in the two ecosystems (p>0.05) as shown in **Table 5.19**.

Table 5.19 Hypothesis testing for health costs

Health cost	t-test values	d.f	Sig. (2-tailed)	Mean Difference (KES)	Remarks
Hospital bill for injured person	-.606	16	0.553	-21777.78	Similar
Time used to seek treatment of injured person	-1.381	14	0.189	-55.19	Similar
Transport cost for the injured person	1.043	16	0.313	2750.00	Similar
Injured person time lost while recuperating	-2.041	8	0.076	-1605.60	Similar

Source: Researcher (2019)

5.3.1.5 Hypothesis testing: Relationship between household characteristics and hidden economic costs

a). Relationship between household characteristics and time opportunity cost

Pearson product-moment correlation coefficient was computed to determine the relationship between household characteristics and time used for guarding livestock and crops (**Table 5.20**). There was a weak positive correlation between time used to guard livestock at night and household size (r=0.195, n=112, p=0.040) and crop acreage (r=0.323, n=112, p=0.028). In addition, crop guarding time had a weak inverse correlation with households monthly income (r=-0.168, n=132, p=0.054). Generally, there was an insignificant relationship between the household characteristics and time as an opportunity cost.

Table 5.20 Correlation between household characteristics and time opportunity cost

		Household size	Duration of stay (Years)	Income per month(KES)	Main crops acreage grown
Time spent repairing on properties	Pearson Correlation	0.225	0.047	0.013	0.067
	Sig. (2-tailed)	0.099	0.735	0.926	0.674
	N	55	55	55	42
Time spent replanting crops	Pearson Correlation	0.047	-0.204	0.014	0.104
	Sig. (2-tailed)	0.760	0.185	0.930	0.500
	N	44	44	44	44
Livestock day guarding hours	Pearson Correlation	0.054	0.010	-0.167	0.083
	Sig. (2-tailed)	0.574	0.917	0.079	0.581
	N	112	112	112	47
Livestock night guarding hours	Pearson Correlation	0.195	-0.064	0.014	0.323
	Sig. (2-tailed)	0.040	0.501	0.880	0.028
	N	112	112	112	46
Crop day guarding hours	Pearson Correlation	-0.037	0.006	-0.035	0.002
	Sig. (2-tailed)	0.657	0.938	0.673	0.983
	N	149	149	149	149
Crop night guarding hours	Pearson Correlation	0.171	-0.099	-0.168	0.098
	Sig. (2-tailed)	0.049	0.260	0.054	0.262
	N	132	132	132	132

Source: Researcher (2019)

b). Relationship between household characteristics and money opportunity cost

The years household had lived in their respective localities had a weak inverse correlation with the amount of money spent (**Table 5.21**) guarding livestock (r=-0.201, n=111, p=0.034). A positive correlation was revealed between wages paid to guard livestock and the total production cost for main crops (r=0.523, n=24, p=0.009). In addition, the amount household spent on crop guarding had a positive relationship with household size (r=0.311, n=143, p=0.000). The amount spent on hired labourer to guard crops on farm showed a positive correlation with income per month (r=0.214, n=98, p=0.035), crop acreage (r=0.343, n=97, p=0.000) and main crops production cost per year (r=0.347, n=97, p=0.000).

c). **Relationship between household characteristics and WTP & WTA**

A few of WTA and WTP showed significant correlation with household characteristics (**Table 5.22**). Household total monthly income had a positive correlation with WTA for fears of wildlife attacks (r=0.247, n=292, p=0.000); Household land size had an inverse relationship with WTP for missing social gathering (r=-0.144, n=201, p=0.042) and WTA compensation for missing income a (r=-0.139, n=217, p=0.040) Household size had a negative relationship with

WTP for school absenteeism (r=-0.170, n=0.015, p=205) and WTA compensation for missing income generating activity (r=-0.134, n=217, p=0.049). The years respondents had lived in their villages positively correlated with WTA compensation for loss of sleep (r=0.134, n=244, p=0.036).

Table 5.21 Correlation between household characteristics and money opportunity cost

Opportunity cost		**Household size**	**Duration of stay (Years)**	**Income per month**	**Main crops acreage grown**	**Total production cost per year (KES) for all main crops**
Amount household spent on guarding livestock	Pearson Correlation	0.135	-0.201	-0.052	-0.057	-0.051
	Sig. (2-tailed)	0.158	0.034*	0.590	0.705	0.744
	N	111	111	111	46	44
Amount spent on hired labourer to guard livestock	Pearson Correlation	0.082	-0.208	0.188	0.255	0.523
	Sig. (2-tailed)	0.473	0.065	0.096	0.230	0.009*
	N	79	79	79	24	24
Amount household spent on crop guarding	Pearson Correlation	0.311	-0.095	-0.067	-0.005	0.014
	Sig. (2-tailed)	0.000*	0.257	0.426	0.955	0.874
	N	143	143	143	143	139
Amount spent on hired labourer to guard crops	Pearson Correlation	0.143	-0.082	0.214	0.343	0.347
	Sig. (2-tailed)	0.159	0.422	0.035*	0.001*	0.000*
	N	98	98	98	97	97

***=Significant** **Source: Researcher (2019)**

Table 5.22 Correlation between household's characteristics and WTA/WTP

		Household size	Duration of stay (Years)	Income in KES	Household land size in acres	Total production cost per year (KES) for all main crops
WTP to mitigate diseases	Pearson Correlation	0.081	-0.006	-0.045	-0.084	-0.133
	Sig. (2-tailed)	0.217	0.931	0.487	0.198	0.135
	N	236	236	236	236	128
WTA compensation for diseases	Pearson Correlation	0.016	-0.087	-0.056	-0.069	-0.047
	Sig. (2-tailed)	0.805	0.183	0.394	0.293	0.599
	N	236	236	236	236	128
WTP for fear of attack	Pearson Correlation	-0.054	0-.055	0.037	-0.062	-0.046
	Sig. (2-tailed)	0.356	0.348	0.532	0.288	0.539
	N	292	292	292	292	184
WTA compensation for fear of attack	Pearson Correlation	-0.069	-0.035	0.247	-0.078	0.074
	Sig. (2-tailed)	0.243	0.556	0.000*	0.184	0.319
	N	292	292	292	292	185
WTP for restricted night time travel	Pearson Correlation	-0.107	0.077	0.043	-0.146*	-.0142
	Sig. (2-tailed)	0.128	0.273	0.540	0.037*	0.087
	N	205	205	205	205	146
WTA compensation for restricted night time travel	Pearson Correlation	-0.038	0.109	0.008	-0.126	-0.045
	Sig. (2-tailed)	0.594	0.120	0.910	0.073	0.590
	N	204	204	204	204	145
WTP for missing social gathering	Pearson Correlation	-0.107	0.029	-0.016	-0.144	-.159
	Sig. (2-tailed)	0.131	0.682	0.820	0.042*	0.067
	N	201	201	201	201	134
WTA compensation for missing social gathering	Pearson Correlation	-0.085	-0.053	0.096	-0.087	-0.053
	Sig. (2-tailed)	0.231	0.449	0.172	0.216	0.542
	N	203	203	203	203	136
WTP for school absenteeism	Pearson Correlation	-0.170*	0.060	0.029	-0.106	-0.101
	Sig. (2-tailed)	0.015*	0.394	0.676	0.129	0.225
	N	205	205	205	205	146
WTA compensation for school absenteeism	Pearson Correlation	-0.098	0.121	-0.029	-0.090	-0.092
	Sig. (2-tailed)	0.164	0.085	0.686	0.199	0.274

	N	203	203	203	203	144
WTP for loss of sleep	Pearson Correlation	0.035	0.081	-0.038	-0.056	-0.154
	Sig. (2-tailed)	0.582	0.209	0.552	0.382	0.058
	N	244	244	244	244	152
WTA compensation for loss of sleep	Pearson Correlation	-0.001	0.134	-0.008	-0.099	-0.053
	Sig. (2-tailed)	0.985	0.036*	0.898	0.122	0.516
	N	244	244	244	244	152
WTP for missing income generating activity	Pearson Correlation	-0.036	-0.086	-0.020	-0.052	-0.094
	Sig. (2-tailed)	0.595	0.208	0.773	0.444	0.255
	N	217	217	217	217	147
WTA compensation for missing income generating activity	Pearson Correlation	-0.134	0.037	0.093	-0.139	-0.132
	Sig. (2-tailed)	0.049*	0.584	0.171	0.040*	0.111
	N	217	217	217	217	147

***=Significant Source: Researcher (2019)**

5.3.2 Visible economic costs

5.3.2.1 Crop and livestock economic losses

a). Extent of crop and livestock attacks

Crop raiding and livestock attacks occurred in both AE and MKE ecosystems. Majority of the respondents in AE (52.87%, n=46) and MKE (56.76%, n=105) described crop raiding as a "severe problem" while another 37.93% (n=33) in AE and 38.38% in MKE were of the opinion that it was a "moderate problem". Only 9.20% (n=8) and 4.86% (n=9) in AE and MKE respectively, considered crop raiding as "Not a problem". Similarly, livestock predation was considered to be a "severe problem" by 53.37% (n=103) of the respondents in AE, and 36.36% (n=28) in MKE. Majority of the respondents in MKE (50.65%, n=39) considered livestock attack as a "moderate problem" compared to 33.68% (n=65) in AE. On average, 13% (n=35) of the respondents in AE and MKE considered livestock attacks as "not a problem".

b). Crop economic loss

The most common crops grown in both AE and MKE were maize, beans, and tomatoes. Wheat and Irish potatoes were mainly grown in MKE (**Table 5.23**). In 2019, the average acreage of crops damaged by wildlife per household in AE were maize (0.72), beans (1.03), wheat (0.93), tomatoes (0.91), Irish potatoes (0.25). The market prices per kilogramme for cereals as provided by the Cereals Growers Association of Kenya (CGAK) in the Kajiado, Nanyuki and Meru towns markets, namely maize-KES 20; wheat-KES33; beans-KES 90) and the price of Irish potatoes (KES 60/kg) and tomatoes (KES 133/kg) was used in the estimation of economic loses as shown in Table 5.23.

Table 5.23 Summary of estimated crop loss

Crop	Variables	Ecosystem	N	Mean	S.E
Maize	Acres damaged	AE	47	0.72	0.081
		MKE	60	0.28	0.029
	Quantity loss in kg	AE	47	572.83	69.05
		MKE	60	277.62	32.089
	Percent yield loss	AE	47	39.75	3.852
		MKE	60	41.24	3.559
	Economic loss (KES)	AE	47	11,456.60	1467.07
		MKE	60	5,552.40	636.90
Beans	Acres damaged	AE	10	1.03	0.364
		MKE	5	0.2	0.031
	Quantity loss in kg	AE	10	302.39	102.726
		MKE	5	144.16	45.747
	Percent yield loss	AE	10	38.35	10.167
		MKE	5	20.29	6.197
	Economic loss (KES)	AE	10	27,215.10	6434.488
		MKE	5	12,974.40	2951.203
Wheat	Acres damaged	MKE	89	0.93	0.242
	Quantity loss in kg	MKE	89	765.09	181.898
	Percent yield loss	MKE	89	42.2	12.482
	Economic loss (KES)	MKE	89	25,500.45	3774.91
Tomatoes	Acres damaged	AE	8	0.91	0.189
		MKE	5	0.18	0.031
	Quantity loss in kg	AE	8	2296.66	1250.356
		MKE	5	464.21	73.221
	Percent yield loss	AE	8	14.42	2.658
		MKE	5	14.04	4.077
	Economic loss (KES)	AE	8	305,455.78	56963.305
		MKE	5	61,739.93	6164.010
Irish potatoes	Acres damaged	MKE	54	0.25	0.026
	Quantity loss in kg		54	1378.522	1153.525
	Percent yield loss		54	97.107	58.149
	Economic loss (KES)		54	82,711.32	1246.732

Source: Researcher (2019)

Although tomatoes were grown by few people in AE and MKE, the negative impact of wildlife damage resulted to the highest economic loss amounting to KES 305,455.78 per household per acre. Potatoes registered the second highest loss of KES 82,711.32 per acre in AE, followed by wheat (KES 27,215.10) in MKE. Maize had the lowest economic loss per acre, with MKE registering and an average of KES 5,552.40 per household. In terms of percentage yield loss per acre, Irish potatoes had the highest (97.107%, n=54) followed by maize at 41.24% in MKE (**Plate 4**), while the lowest was 14.04% for tomatoes in MKE.

Plate 4 A maize field raided by zebras in Miarage village in MKE

Source: Researcher (2019)

The Zebra was associated with the heaviest crop economic loss in AE according to majority of the respondents (44.83%, n=39), followed by elephants (35.63%, n=31) as shown in **Figure 5.4**. In MKE, Elephants (30.11%, n=109) and Baboons (29.28%, n=106) contributed to most of the crop economic loss, followed by Quelea birds (21.82%, n=79).

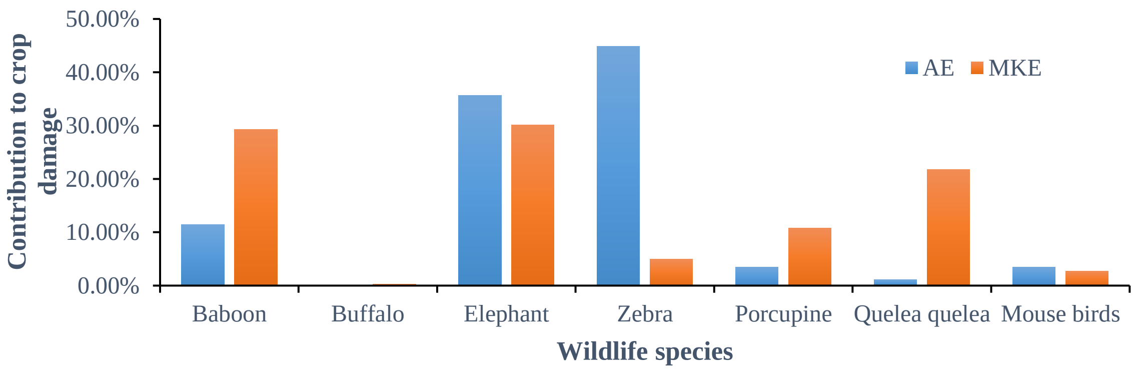

Figure 5.4 Wildlife species and their contribution to crop damage in AE and MKE.

Source: Researcher (2019)

As shown in **Table 5.24**, the Zebra and elephants accounted for most of the raids on maize with 32 and 23 incidents, respectively in AE, while in MKE, wheat was the most raided crop by *Quelea* (74 incidents), elephants (52 incidents) and baboons (34 incidents).

Table 5.24 Wildlife species and their contribution to main crops economic loss

Species	AE					MKE							AE+MKE incidents
	Maize	Beans	Tomatoes	Total	%	Maize	Wheat	Beans	Tomatoes	Potatoes	Total	%	
Baboon	8	1	1	10	11.49%	46	34	3	5	18	106	29.28%	116
Buffalo	0	0	0	0	0.00%	0	0	0	0	1	1	0.28%	1
Elephant	23	3	5	31	35.63%	22	52	2	3	30	109	30.11%	140
Zebra	32	6	1	39	44.83%	18	0	0	0	0	18	4.97%	57
Porcupine	2	1	0	3	3.45%	2	0	0	0	37	39	10.77%	42
Quelea quelea	0	0	1	1	1.15%	5	74	0	0	0	79	21.82%	80
Mouse birds	1	1	1	3	3.45%	3	0	4	2	1	10	2.76%	13
Total	66	12	9	87	100.00%	96	160	9	10	87	362	100.00%	449

Source: Researcher (2019)

c). Livestock economic loss

Majority (93.1%, n=190) of the households in AE reared livestock compared to 37% (n=77) in MKE. On average, households in AE lost more cattle (1.489±0.261), sheep (3.486±0.378), and goats (2.397±0.250) to wildlife predation compared to households in MKE, who incurred a mean loss of 0.672±0.146 cattle, 1.898±0.316 sheep, and 0.407±0.106 goats. Equally, households in AE had slightly more cattle (0.116) and goat (0.348) injured by wildlife than in MKE. To estimate the economic loss incurred by households, the average market price for livestock was obtained from the local markets in Kajiado (Kimana, Loitokiotok and Ilbisil) and Laikipia (Nanyuki, Rumuruti and Dol Dol) and Timau. The average price for cattle was KES 40,000, compared to KES 5,000, for sheep and goats. The average economic loss per household for cattle, sheep and goats are shown in **Table 5.25**. In total, AE households lost livestock worthy KES 88,975.00 per year compared to those in MKE, who averaged KES 38,405.00 annually.

Table 5.25 Livestock economic loss

Livestock	Ecosystem	N	Mean± S.E	Economic loss(KES)
Cattle killed	AE	139	1.489±0.261	59,560.00
	MKE	58	0.672±0.146	26,880.00
Goats killed	AE	146	2.397±0.250	11,985.00
	MKE	59	0.407±0.106	2,035.00
Sheep killed	AE	140	3.486±0.378	17,430.00
	MKE	59	1.898±0.316	9,490.00
Cattle injured	AE	126	0.151±0.053	-
	MKE	58	0.035±0.024	-
Goats injured	AE	130	0.400±0.084	-
	MKE	58	0.052±0.038	-

Source: Researcher (2019)

The lions were mainly associated with the killing of cattle in AE (72.6%, n=53) and MKE (75%, n=18) compared to goats (**Figure 5.5**). The Hyena accounted for the highest deaths of goats (45.1%, n=92) and sheep (46.6%, n=95) in AE (**Plate 5**). In addition, the hyena also contributed to the highest goat injuries (12.3%, n=25).

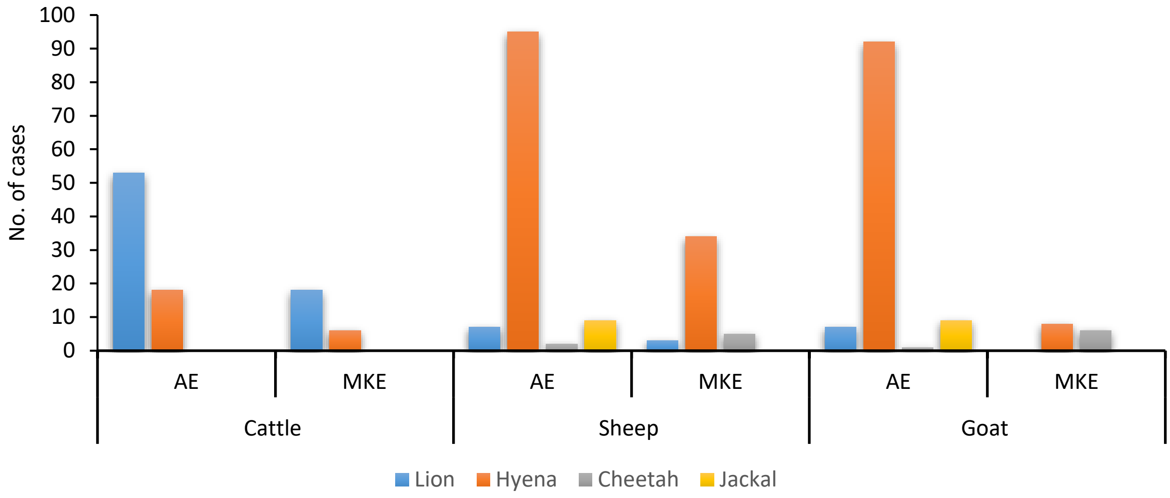

Figure 5.5 Livestock loss to various predators in AE and MKE

Source: Researcher (2019)

Plate 5 Sheep killed by hyena in a traditional kraal at Inkiito village in AE

Source: Researcher (2019)

Respondents were asked how much they were willing to pay (WTP) per year for mitigation measures in order to avoid both livestock and crops economic losses. AE respondents were ready to pay an average of KES 35,075±11244.05 for livestock loss and KES 33,301.08±1704.03 against crop loss. In MKE, respondents were willing to pay KES 33,794.52±3315.60 for livestock losses and KES 27,823.12±1993.84 to caution themselves against crop losses.

5.3.2.3 Human death, injuries, and property damage

Human death and injuries were recorded in both AE and MKE. Wildlife had killed three people in MKE and one person in AE within a period of one year. Elephants were responsible for the death of 3 people, while the hyena and snakes each accounted for the death of one person. Two people were killed during the day and another two during the night. The four people killed were aged 17, 28, 44 and 60 years, in the category of two females and two males.

In terms of injuries, a total of fourteen people aged between 12 and 65 years were injured by elephant (10 people), buffalo (3 people) and leopard (1 person) in the two ecosystems. Out of the 14 people injured, 8 were from AE and 6 from MKE. All the people were injured in day time while on their normal social and economic activities. Seven of the people got leg injuries while 5 had chest injuries and 2 had head injuries. In terms of gender, 12 of the victims were male and 2 females. Eleven out of the 14 people injured by wildlife were between 31 and 65 years.

Other than human deaths and injuries, wildlife also damaged properties. The common properties damaged in AE and MKE were water tanks, farm fence and houses. The water tank damage in AE was valued at KES 70,481.82±26621.20 (n=11) compared to KES 21,285.70±2068.06 (n=21) in MKE. The farm fence, which included the predator-proof livestock bomas were valued more in AE (KES 94,000±29585.23, n=8) than in MKE at KES 18,500±2183.65 (n=25). House damage was only recorded in MKE where the loss was valued at KES 17,000±1527.53 (n=3).

5.3.2.4 Testing Hypothesis: Economic magnitude of visible cost of HWC

H_O: There is no significant differences in the economic magnitude of visible costs within AE and MKE

H_A: Alternative

a). Crop economic costs hypothesis testing

A Student t-test analysis for the common crops grown in AE and MKE (maize, beans and tomatoes) showed that there was a significant difference in the quantity of maize loss (t=4.157, d.f=105, p=0.000), with households in AE losing 295.21 kg of maize more than their counter parts in MKE. The null hypothesis was therefore rejected. However, the quantity of beans lost (t=1.046, d.f=13, p=0.315) and tomatoes quantity (t=1.139, d.f=11, p=0.279) were similar in the two ecosystems.

b). Livestock economic costs hypothesis testing

An independent student t-test analysis to compare the livestock loss in terms of injuries and deaths (**Table 5.26**) revealed that the magnitude of cattle killing (t=1.967, d.f=195, p=0.05) and injuring (t=2.701, d.f=186, p=0.147) was similar in both AE and MKE (P>0.05). Therefore, the null hypothesis could not be rejected. However, the number of goats killed (t=4.990, d.f=203, p=0.000) and injured (t=2.701, d.f=186, p=0.008), as well as the number of sheep killed (t=2.572, d.f=197, p=0.011) by wildlife were significantly different in AE and MKE. The null hypothesis was therefore rejected.

Table 5.26 Hypothesis testing: magnitude of livestock loss

Livestock	t-values	d.f	Sig. (2-tailed)	Mean Difference	Remarks
No. of cattle killed	1.967	195	0.051	0.81679	Similar
No. of goats killed	4.990	203	0.000	1.99048	Significant
No. of sheep killed	2.572	197	0.011	1.58741	Significant
No. of cattle injured	1.457	182	0.147	0.11631	Similar
No. of goats injured	2.701	186	0.008	0.34828	Significant

Source: Researcher (2019)

c). Hypothesis testing on property economic loss

A t-test indicated that the cost of water tank damage (t=2.562, d.f=30, p=0.016) and the cost of fence destruction (t=4.544, d.f=31, p=0.000) were significantly different in AE and MKE**.** Therefore, the null hypothesis was rejected.

5.4 DETERRENT MEASURES FOR HIDDEN HWC

5.4.1 Category of hidden cost deterrent measures

Respondents used a range of techniques to minimise the hidden costs of HWC (**Table 5.27**). These included rescheduling activities, use of physical structures, human guardian, and deployment of dog to guards, among others. The use of hedge fence (15.42%, n=140) and escorting of children by adults to school (17.82%, n=178) were the most common methods used in AE and MKE, respectively. Escorting of children to school was the second most used method in AE (11.78%, n=107) while leaving school early was the second most used strategy in MKE (12.51%, n=125). Although, the mitigation measures were implemented with the intention of reducing the costs of HWC, they resulted in additional costs. For example, adults escorting children to school when wildlife were roaming their areas resulted to a delay in reporting to respective livelihood activities such as attending to livestock. Similarly, the purchase of dogs to guard livestock against wildlife attacks resulted to continuous dog feeding expenditure. To reduce additional hidden cost, households in both AE (9.25%, n=84) and MKE (9.51%, n=95) opted not to report the HWC cases to the KWS.

5.4.1.1 Hidden cost deterrent measures rating and target wildlife species

Construction of physical barriers, employment of casual guards and rearing of security dogs was mainly used to deter wildlife from attacking livestock and crops. Respondents were asked to rate the effectiveness of these methods using a Likert scale (**Figure 5.6**). Hired human guards was majorly rated as "Effective" by 61.58% (n=177) of the respondents. Hedge fence effectiveness in barring wildlife attacks ranged from moderate effective (37.34%, n=158) to "highly effective" (20.25%, n=158). The use of dogs was largely rated as being "moderately effective" (41.18%, n=119), while most respondents (37.04%, n=81) rated chain-link and barbed wire fence to be an "effective" as well as "highly effective" (34.57%, n=81) method. Scarecrows were majorly (45.16%, n=62) rated as "moderately effective" and "ineffective" (27.42%, n=62) in preventing livestock and crop attacks by wildlife. Light emitting devices such as solar flashing bulbs were rated as "moderately effective" and "effective" by 52.31% (n=65) and 43.08% (n=65) of respondents, respectively.

Table 5.27 Category of hidden costs deterrent measures

Deterrent measures category	Approaches	Purpose	Target hidden cost	No. of people using the preventive measures				Resultant cost
				AE		MKE		
				No.	%	No.	%	
Rescheduling activities	Delay reporting to work	Minimise attacks	Health cost	12	1.32 %	66	6.61%	Reduced income
	Delay reporting to school	Reduce fear and attacks	Health cost	98	10.79 %	115	11.51%	Learning time lost
	Leave school early	Reduce fear and attacks		93	10.24 %	125	12.51%	Learning time lost
	Water and fire wood fetching	Reduce attacks	Health cost	46	5.07 %	8	0.80%	Time-other chores delayed
	Escorting children to school	Reduce fear and attacks	Health cost	107	11.78 %	178	17.82%	Time-other chores delayed
	Not reporting HWC incidents	Reduce travel costs	Transaction cost	84	9.25 %	95	9.51%	Visible costs
	Replanting crops	Food security	Health cost	10	1.10 %	34	3.40%	Opportunity cost-time and money
Physical structures	Watch towers	Increase vigilance	Health cost	10	1.10 %	29	2.90%	Opportunity cost-time and money used
	Make-shift houses	Protection from weather effects and minimise attacks	Health cost	50	5.51 %	85	8.51%	
	Lighting devices	Reduce attacks	Opportunity cost	42	4.63 %	23	2.30%	
	Chain-link & barbed wire fence	Reduce sleep interruption		37	4.07 %	44	4.40%	
	Hedge fence	Reduce sleep interruption		140	15.42 %	18	1.80%	
	Scarecrows	Avoid attacks		7	0.77 %	55	5.51%	
Hired human guards and dogs	Dogs to alert	Alert of wildlife invasion	Opportunity cost	96	10.57 %	23	2.30%	Opportunity cost-time and money used
	Casual guards	Avoid attacks	Health cost	76	8.37 %	101	10.11%	
			Total	908	100%	999	100.00 %	

Source: Researcher (2019)

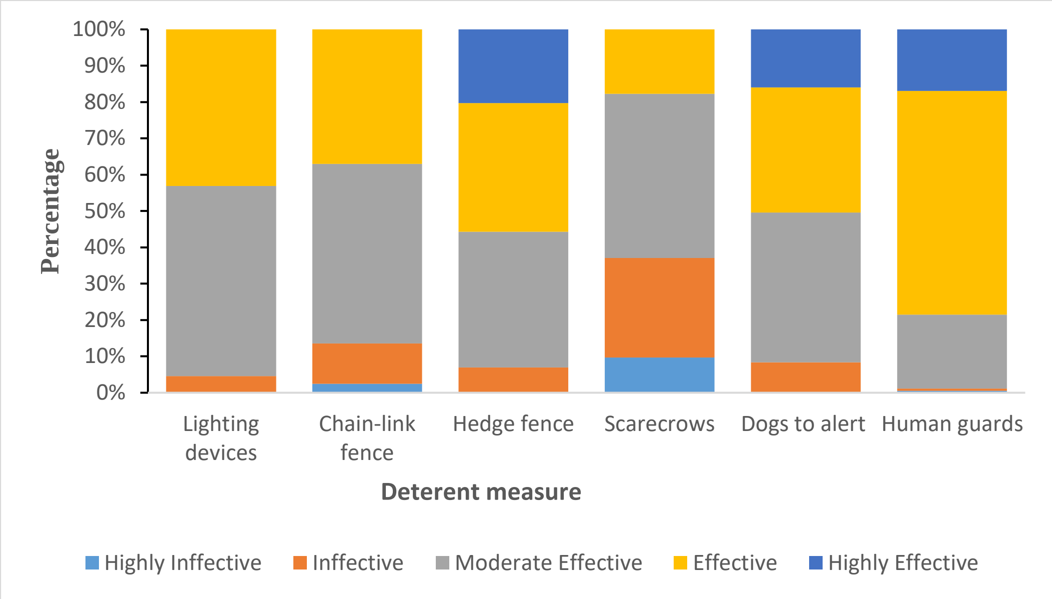

Figure 5.6 HWC deterrent measures ratings

Source: Researcher (2019)

The engagement of livestock guards and security dogs were the deterrent measures against the common problematic wildlife species in AE and MKE (**Table 5.28**). Other than the use of hedge fences and scarecrows, all other deterrent measures were deployed against the elephants. Makeshift security houses of varied size were used for the accommodation for young livestock and poultry (**Plate 6**).

Plate 6 A makeshift house for enclosing young sheep and goats in AE

Source: Researcher (2019)

Twenty key informants were asked for their opinion on how to reduce the hidden cost of HWC. Thirteen out of 20 informant were of the opinion that the government should invest in preventive measures and subsidize the cost of implementing such measure by the communities living adjacent to the wildlife conservation areas. Two key informants suggested that the government should create community awareness on the how to reduce HWC. Another two key informants said that the victims should be paid immediately and since all wildlife owned by the government, any damage arising from all species should be compensated. One key informant suggested that community should be supported by the government to diversify their source livelihoods as a way of reducing the impacts of HWC.

Table 5.28 Deterrent measures and the targeted wildlife species

	Targeted wildlife species								
Deterrent measures	Elephant	Zebra	Baboon	Quelea birds	Mouse birds	Lion	Hyena	Cheetah	Jackal
Delay reporting to work	x					x			
Delay reporting to school	x					x	x		
Leave school early	x								
Water and fire wood fetching	x								
Escorting children to school	x					x	x		
Watch towers	x								
Make-shift houses	x					x			x
Lighting devices	x					x	x	x	x
Fence (chain & barbed wires)		x	x			x	x	x	x
Hedge fence		x				x	x	x	x
Scarecrows			x	x	x		x		x
Dogs to alert	x	x	x	x	x	x	x	x	x
Casual guards	x	x	x	x	x	x	x	x	x

Source: Researcher (2019)

5.4.1.2 Hypothesis testing: Hidden cost mitigation measures

H_O: There is no differences in the approaches used in preventing hidden impacts of HWC in AE and MKE.

H_A: Alternative

As tabulated in **Table 5.29** a Chi-square statistic test revealed that the approaches used to deal with hidden impacts of HWC in AE and MKE were significantly different ((χ^2=32.715, d.f=2, p=0.00). Therefore, the null hypothesis was rejected.

Table 5.29 Chi-square test for hidden preventive measures

Ecosystem	**Category of hidden deterrent measures**					
	Rescheduling activities		Physical structures		Hired human guards and dogs	
	Observed	Expected	Observed	Expected	Observed	Expected
AE	450	509.95	286	257.12	172	140.94
MKE	621	561.05	254	282.88	124	155.06

Source: Researcher (2019)

5.5 MECHANISMS AND STRATEGIES FOR HWC COMPENSATION

5.5.1 Compensation mechanisms

Respondents outlined six strategies for compensating HWC victims **(Table 5.30)**. Overall, majority (36.76%, n=150) of the respondents were of the opinion that the KWS compensation process took long for victims to be paid, and hence they proposed the process should be shortened. Another 28.19% proposed that compensation process should be handled by local leaders, who should verify damages of HWC and pay the victims.

Table 5.30 Proposed payment mechanisms

Mechanisms	**No. of people**		**No. of people**		**Total no. of people**	**Total Percent**
	AE	Percent	MKE	Percent		
Shorten the compensation process	87	42.65%	63	30.88%	150	36.76%
Pay the victims directly	39	19.12%	35	17.16%	74	18.14%
Use local leaders to verify damages and pay claims	47	23.04%	68	33.33%	115	28.19%
Use existing consolation schemes to pay government compensation	17	8.33%	3	1.47%	20	4.90%
Use private insurance schemes to pay victims	2	0.98%	1	0.49%	3	0.74%
Pay for all wildlife species damages	12	5.88%	34	16.67%	46	11.27%
	204	100.00%	204	100.00%	408	100.00%

Source: Researcher (2019)

In addition, 18.14% were of the opinion that the government should pay the compensation money directly to the victims of HWC, while 11.27% of the respondents felt that compensation should be associated with all wildlife species rather than the few-gazetted species in Schedule III of WCMA 2013. The use of the existing consolation schemes for wildlife damages was also proposed by 4.90% of the total respondents but this was preferred by more people (17) in AE than MKE (3 people). Only 0.74% of the respondents were of the opinion that the government should use private insurance companies to pay victims of HWC.

Majority of the respondents in AE (56.37%, n=115) and in MKE (51.47%, n=105) indicated that they were fully aware of the government HWC compensation process. Generally, the remaining 46.08% (n=188) were not conversant with the HWC compensation procedures. Majority of the respondents in AE (47.55%, n=97) and MKE (38.24%, n=78) were aware of the KES 5 million eligible for victims of HWC in case of human death. Also, 33.33% (n=68) of respondents in AE and 20.10% (n=41) were aware that the government should pay KES 3 million to victims of HWC in the case of human injuries that resulted to permanent disability. Only 15.20 % (n=31) of the respondents in AE and 17.16% (n=35) in MKE aware of the maximum amount of KES 2 million compensation in case of any other body injuries with no permanent disability.

5.5.1.1 Effectiveness of compensation in addressing HWC

Majority (63.24%, n=258) of the respondents in both AE and MKE said that compensation for victims of wildlife attacks was an effective way of dealing with HWC (**Table 5.31**).

Table 5.31 Explanation for HWC compensation effectiveness

	Frequency		Frequency		Total frequency	Total percent
Explanations	**AE**	**Percent**	**MKE**	**Percent**		
Reduces anger and retaliatory killings of wildlife	67	32.84%	44	21.57%	111	27.21%
Encourage people to support wildlife conservation	33	16.18%	9	4.41%	42	10.29%
Reduces food insecurity and poverty	47	23.04%	58	28.43%	105	25.74%

Source: Researcher (2019)

First, the respondents said that compensation had a potential to reduce anger and retaliatory killings of wildlife (27.21%, n=111), secondly, the compensation can reduce food insecurity (25.74%, n=105), and thirdly, such compensation could encourage people to support government efforts towards wildlife conservation (10.29%, n=42) in the country.

The remaining 150 (36.76%) of respondents were of contrary opinion, with majority (17.16%, n=70) citing the inability of the compensation to stop wildlife attacks (**Table 5.32)**. Others said that compensation was not effective in dealing HWC because most people were not aware of the compensation procedures (6.86%, n=28) and is subject to corruption (5.15%, n=21). In addition, some respondents (4.90%, n=20) said compensation was ineffective as there is a delay in paying victims, which triggers more HWC due to retaliatory killings of wildlife.

On the other hand, the 20 key informants interviewed in the study in addition to the household respondents, were of varied opinions, with 8 saying that compensation was not effective because it is not a proactive strategy, but rather a reactive response that only addresses the consequences of HWC. Five key informants felt that compensation is a bureaucratic process which is hard to implement effectively. Those in support of compensation for HWC said that paying victims usually comforts them and confirms that the government is concerned about them (4 informants). Three key informants cited the ability of compensation to ensure that victims were food secure after wildlife attacks.

Table 5.32 Explanation for ineffectiveness of compensation

Explanation	AE frequency	Percent	MKE frequency	Percent	Total frequency	Percent
Does not stop wildlife attacks	23	11.27%	47	23.04%	70	17.16%
It is expensive and not sustainable	2	0.98%	1	0.49%	3	0.74%
Delay in paying victims triggers more HWC	15	7.35%	5	2.45%	20	4.90%
It is subject to corruption	4	1.96%	17	8.33%	21	5.15%
Targets only a few species of wildlife	4	1.96%	4	1.96%	8	1.96%
People are not aware of the compensation procedure	10	4.90%	18	8.82%	28	6.86%

Source: Researcher (2019)

5.5.2 Strategies for sustainable compensation

Households proposed timely processing and payment, and insurance schemes as the main strategies for sustainable compensations.

5.5.2.1 Processing and payment of compensation

The County Wildlife Conservation and Compensation Committees (CWCCC) are mandated under section 18 of WCMA 2013 to review and recommend claims resulting from HWC. According to the GoK (2018) audit report of KWS, out of the 47 CWCCC required country wide, only 35 committees were in place by November 2015, about two years after the WCMA 2013 came into force. However, in August 2019, all the 47 CWCCC were gazetted with variant in their operations (GoK, 2019).

Respondents were asked to rate the CWCCC in enabling victims to access the compensation (**Table 5.33)** with the aim of bringing out the areas that can be improved for sustainable compensation. Most of the CWCCC functions were rated as "Poor", with majority of the respondents (94.85%, n=387) citing non-payment of claims. Receiving HWC complains (24.51%, n=100), response by government assessors to reported cases (11.27%, n=46) and valuing the HWC damages (11.52%, n=47) were cited as "Good" by the respondents.

Table 5.33 Rating of CWCCC on compensation processing

	Rating				
Statement	**Poor**	**Fair**	**Good**	**Very good**	**Excellent**
Government assessor response to reported cases of HWC	50.74%	34.07%	11.27%	3.43%	0.49%
Rate of CWCCC meeting to hear cases of HWC	85.78%	13.48%	0.74%	0.00%	0.00%
Payment of claims to affected people	94.85%	4.90%	0.25%	0.00%	0.00%
Estimating the value for the damage by wildlife	62.50%	25.00%	11.52%	0.98%	0.00%
Receiving HWC complains from victims	48.53%	23.28%	24.51%	3.43%	0.25%

Source: Researcher (2019)

5.5.2.2 Insurance schemes

The use of insurance as a compensation strategy against HWC was proposed by only three respondents as an alternative to the current compensation scheme. However, after the strategy was carefully explained, most (34.07%, =139) said it is likely to be "ineffective" while another 32.35% (n=132) indicated that it is likely to be "highly ineffective" (**Table 5.34**). Twenty-four(24) respondents accounting for 24.75% (n=101) indicated that insurance would be "moderately effective" in dealing with HWC as a compensation strategy while twenty-three considered it as an "effective" measure and thirteen rated it as a "highly effective" compensation strategy. In addition, 10 key informants from both ecosystems suggested an insurance scheme as an alternative option to the current compensation scheme.

Table 5.34 Insurance compensation strategy

Rating	AE frequency	Percent	MKE frequency	Percent	Total frequency	Percent
Highly ineffective	80	39.22%	52	25.49%	132	32.35%
Ineffective	64	31.37%	75	36.76%	139	34.07%
Moderately effective	32	15.69%	69	33.82%	101	24.75%
Effective	19	9.31%	4	1.96%	23	5.64%
Highly effective	9	4.41%	4	1.96%	13	3.19%
	204	**100.00%**	**204**	**100.00%**	**408**	**100.00%**

Source: Researcher (2019)

CHAPTER SIX: DISCUSSION

6.1 INTRODUCTION

In this chapter, the researcher compares the results of AE and MKE and interpret the findings, giving explanations and the effects of the results. First, the researcher critically discusses the household's characteristics, followed by economic magnitudes of HWC. The researcher compares the visible and hidden cost in AE and MKE and tease out explanations for the differences and similarities. Secondly, the different deterrent measures used for minimising hidden cost are discussed, giving possible explanation for the preferences of certain measures. Lastly, the HWC compensation mechanisms and strategies are discussed, with the author suggesting sustainable ways for the monetary HWC compensation. The researcher also discusses the proposed insurance scheme as an option for the current compensation scheme in the WCMA 2013.

6.2 HOUSEHOLDS SOCIO-ECONOMIC PROFILES

A considerable proportion of the respondents were between the age of 30 and 59 years and had stayed in their respective ecosystems for at least 22 years. This means that the respondents had enough experience in informing this study on the issues of human-wildlife conflict and livelihoods. There were more respondents in MKE with formal education than in AE. These findings can be attributed to the differences in the investment in the education infrastructure, enrolment, and retention rates. For example, Meru County in MKE has 773 pre-primary school centres with 65,393 children, and 1698 early education teachers (County Government of Meru-CGM, 2018) compared to Kajiado in AE, which has 888 pre-primary centres, 61,225 children and 400 ECD teachers (County Government of Kajiado-CGK, 2018). In addition, Meru County has a 90% school retention rate (CGM, 2018) compared to Kajiado with 67% (CGK, 2018).

Overall, the majority of the respondents were male. However, in AE the respondents were predominantly male. During the initial stages of this study, the women respondents in AE were reluctant to discuss about livestock numbers, farm size, and family sizes, as they are culturally restricted to share such information. As a result, this study focused on male respondents in AE.

The AE had a larger family size (about 9 people) than MKE, which had an average of 6 people. The contrast in family size in the two ecosystems can be attributed to birth rates and cultural practices. According to (KNBS, 2018) Kajiado had the highest birth rate of 59 per every 1000 people in Kenya.

In both ecosystems, most households received a monthly income of less than KES 10,000. Although about 60% of the AE population are wage earners (CGK, 2018) compared to only 10% of the MKE population (CGM, 2018), a large portion of the income was from the sale of crops. Additional income was derived from both employment and business operations, with households in AE earning more from employment (KES 25,627) and MKE from business investments (KES 33,215.35). The monthly earnings were below Kenya's gross monthly per capita income of Sh14, 508 (KNBS, 2020), an indication that those affected by HWC are already vulnerable. The vulnerability is attributed to over reliant on crops and livestock which are prone to extreme weather and wildlife attacks, and lack of fund to implement HWC deterrent measures. MKE residents were predominantly crop farmers with some large-scale private farming in the Timau area, while in AE people majorly practice livestock farming. This explains the differences in household income from livestock and crops in the two ecosystems. The relatively more income earned from employment in AE can be attributed to the higher number of tourism facilities such as lodges and hotels that could have prompted people to seek employment as an alternative source of livelihood. Moreover, Amboseli National Park is classified and marketed by the government of Kenya as a premier park, and according to KNBS (2020), the park received 191,700 tourists-compared, for example, to Mt. Kenya National Park in MKE, which had 24,800 tourists in 2019. The main crops grown in the two areas were maize, wheat, potatoes and beans. This can be attributed to their high demand which is associated with their higher annual per capita consumption in Kenya at 69.5kg for maize, 41.3kg for wheat-, 29.9kg for potatoes, and 16kg for beans (KNBS, 2019a).

Most people in AE and MKE had corrugated iron sheet roof house with either mud wall or timber. The presence of more makeshift houses in Amboseli can be linked to the land tenure system in AE, where people still live communally in-group ranches (AET, 2020). This could have discouraged people from investing in better houses, with the anticipation of being settled somewhere else after the subdivision of the group ranches. In addition, the AE respondents could have preferred the makeshift houses because of the easy availability of some of the construction material such as grass, cow dung and soil.

The respondents in AE possessed on averagely large pieces of land (about 8 acres) than their counterparts in MKE (3 acres). Although, land subdivision is ongoing in AE, land is still largely communally owned within the traditional group ranches, with few people having private land on the southern part of the Amboseli National Park, where crop farming is largely practised (Noe, 2003). As livestock is the main source of livelihood, the group ranches land ownership is ideal for the free ranging livestock and wildlife. The pressure to subdivide group ranches into individual land is likely to block wildlife corridors due to influx of agrarian communities into AE to do crop farming (Noe, 2003; AET, 2020). This will intensify HWC, as people intrude into wildlife reserves. On the other hand, MKE respondents privately owned small pieces of land with title deeds. Most places in MKE are densely populated than AE. For instance, Buuri East and Laikipia East have population density of 230 and 67 people per km^2 respectively, compared to Loitokitok in AE with a population density of 51 people per square km^2 (KNBS, 2019b).

6.3 ECONOMIC MAGNITUDE OF HWC

The HWC economic costs incurred by households are majorly categorised in to hidden and visible cost.

6.3.1 Hidden economic costs

6.3.1.1 Time opportunity costs

a). Time spent guarding against wildlife

The AE households spent more time guarding their livestock and crop both during the day and night than those in MKE. The time used to guard livestock and crop at night in AE and MKE were significantly different ($P<0.05$), but time spent during the day were similar in the two study areas. The difference in guarding time in the two ecosystems can be attributed to the wildlife species movements and implementation of deterrent measures. In AE, the Amboseli National Park is not fenced, and therefore there is free movement of wildlife between the park and the community group ranches, where human settlements are. The park accounts for only about 8 % of the AE size (5,700 Km^2), which is a small area to contain population of some of the highly mobile and problematic species such as elephant, lions, and hyena, whose home ranges are estimated to be 5200-7790 km^2 (Ngene et al., 2017), 28-37km^2 (Tuqa et al., 2014) and 24-1000km^2 (Hofer, 2002), respectively.

In MKE, there is also wildlife movements between Mt. Kenya National Park and the adjacent conservancies and forest. However, in MKE, there are several electric fences around conservation areas, which minimises wildlife entry into human settlements. For example, the movement of elephants from Mt. Kenya Forest Reserve into the Lewa Wildlife Conservancy is facilitated by an electric fence along the corridor that links the two conservation areas, with an underpass on the Nanyuki-Meru/Isiolo highway. Similarly, since 2016, the Big Life Foundation has been erecting several short electric fences around in AE (BLF, 2020). However, this was done for selected crop farm areas on the southern part of the Amboseli, Kimana and Namelok irrigation farms, leaving out other areas large areas such as Kuku, Rombo, Imbirikani, Eselenkei and Kaptei settlement areas. Therefore, households in AE had to spent more time guarding their livestock and crops because of the presence and wide spread of the wildlife in human settlement areas.

Guarding against wildlife damages is a widespread practice in areas where people live in close proximity to wildlife. The findings of this study resembles the observation by Howard (1995) in Nyabyeya forest reserves in Uganda, where household expenditure on crop guarding was $96-519. Similarly, a study conducted in Tanzania around Mpanga/Kipengere Game Reserve showed that majority of the people (53.4%, n=90) were forced to guard their crops against wild animals both during the day and night time (Mashalla & Ringo, 2015).

The findings in this study were similar to the study by Musyoki (2014) who established that farmers in Mahiga “B” village in Nyeri County, spent substantial time guarding their crops against wildlife raids. The difference in time scheduling for guarding in Mahiga “B” and this study can first be attributed differences on the time when the studies were conducted, duration, and sample size of the study. Musyoki’s study only covered 5 months (August -December) and was based on 9 farmers. Secondly, a 1000km of electric fence has been erected around Aberdare and Mt. Kenya to reduce contact between people and wildlife (Pearce, 2015).

The spending of time guarding livestock and crops has several socio-economic implications to the people. First, guarding at night denies individual an opportunity to engage in other income generating activities during the day due to lack of sleep. Secondly, as outlined by (Barua et al., 2013) property guarding against feared wildlife species such elephants causes fatigues and can escalate drug abuse among adults. This study found that household size positively correlated with time spent guarding crop and livestock at night, suggesting that larger households can share among themselves duties, guarding and socio-economic activities as opposed to smaller households, who will be stretched and thus spending less time guarding at night. The years households had stayed in their area also influenced the time spent guarding at night. Those who had lived in the area longer spent less time guarding at night. This can be attributed to the experience they have gathered over time, on when wildlife attacks are likely to happen, and therefore schedule guarding appropriately.

b). School time lost and adult delay in reporting to livelihood activities

The schooling hours for children in both ecosystems was affected because of wildlife presence but those in AE were affected more than those in MKE. Household activities of the parents were also affected due to the need to escort children to school. The researcher observed that livestock are released from the kraals to start grazing between 8:30 am and 9:30am. The more time lost by children and adults in AE can be explained by the location of the schools within human settlement areas that serves as dispersal and migratory routes for wildlife. According to Croze & Moss (2011) wildlife species such as elephants, zebra and buffaloes spent about 80% of their time outside the Amboseli National Park. As such, children wait for wildlife to either retreat back into the park or in the bush within their home locations. . Also in the evening, children had to leave school early before the wildlife started moving into human settlements. During the fieldwork, the researcher observed that villages such as Ol moti, Olgulului, Risa, Injakta, Lenkisem were all close to community boreholes. The presence of water attracts wild-life to the human settlements.

The observations in AE are similar to a study conducted on communities bordering protected areas in Tanzania, which indicated that 41.3% of the children had encountered wildlife on their way to school, mostly in the morning and evening. In the same study, all the 46 students inter-viewed, had encountered an elephant, mostly when drinking water at the boreholes (Sayuni & Sengelela, 2019). In addition, Sayuni and Sengelela further notes the pupils failed to arrive at the school, or arrived at the school late at 10am, hence missing some subjects.

Therefore, wildlife presence in communities can seriously interfere with children education. Those who report late in morning and leave early in the evening misses lessons, and this can negatively affect their long-term performance in exams and overall development of the chil-dren. For example, a study by Sitati et al. (2012) on schools in Transmara District in Kenya, established that pupils who had missed school for 20-60 days within the elephant ranges had lower mean scores (216-282 marks) compared to those outside elephants ranges (246-323 marks).

Wildlife did not only interfere with the children school time, but also their parents. The presence of wildlife prevented people from attending to their different social and economic activities on time. More people (32.4%) in MKE were affected than in AE (5.9%). This is because most households in MKE are crop farmers and people habitually wake up early in the morning to attend to their crops and assess if there is any damage caused by wildlife overnight. While those in AE are, typically pastoralist and livestock grazing starts when the dew has cleared from the grass and predators retreated into the thicket and parks. Wildlife restricting people's movement is not a new phenomenon. In 2003, residents of Taita-Taveta County were blocked from attending to their socio-economic activities because of uncontrolled movement of wildlife in their villages and farms around Tsavo National Park (Kimega, 2003). Kimega further notes that during the dry seasons, women in the Taita –Taveta County were restricted from fetching water as a result of elephants around water supply points.

c). Time spent on property repairs and replanting crops

The repair of damaged water tanks, fences, and other HWC related trouble-shooting activities were found to consume considerable time of the households in the two ecosystems. Although MKE households had more water tanks and fence damaged, the time used for repairs in AE was more than in MKE. The difference in the time of repairs can be connected to the extent of the damage to property, repair technical knowhow, and the availability of repair tools. Most MKE households, who largely depends on agriculture have tools such as hoe, machetes, and hammers that are required for repairs. In addition, this study found out that more people in MKE had formal education compared to those in AE, thus relatively exposed to some technical skills that can be used.

6.3.1.2 Monetary opportunity costs

a). Monetary cost of guarding against wildlife

The study established that a lot of money was spent on guarding crops and livestock against wildlife in the two ecosystems. However, the amount used in AE was significantly higher than in MKE. Households in AE had to forego a total of KES 255,376.04 safeguarding livestock and crops compared to KES 165,476.50 in MKE. Overall, these figures are higher than the total income earned from all sources by a household in AE (KES 120,000.70) and MKE (KES 107,968.02), implying that the return on investment was negative/loss.

Households spending their income on property guarding against wild animals is a wide spread practice. In South Africa, for example, farmers in different localities invested up to 300 dogs to safeguard their livestock (Stannard & Cilliers, 2018). However, a separate assessment of 94 farms which had invested in 97 dogs revealed that the cost per dog per year of US$ 2,780 was very expensive to small-scale farmers to afford (Rust et al., 2013).

In Uganda, a study conducted in Hoima District by Kate (2012) established that farmers spent between $10-35$ per month to hirer labour to guard their farms against baboons. Similarly, in Narok County, Korir (2015) reported that soya beans farmers were forced to employ at least three workers to guard their farms against zebras and gazelles raids. This forced each farmer to spend an average of KES 18,000 per month on employee wages. Spending money on property guarding against wildlife denies the farmer the expected full profit from their livestock and crops. It also reduces the famer's investment in agricultural produce and livestock because some money has to be allocated for the guarding against wildlife.

This study findings indicates that the amount spent on hired labour to guard crops correlated with the household monthly income, crop acreage and the total production cost for all crops. These three factors are a measure of the household wealth, and hence those who have a higher income, larger farms and can afford to produce more crops were able to spend more on hired guard wages. The inverse correlation in the amount spent on livestock guarding and the household duration of stay in an area indicated that the more the people stayed in HWC area, the more strategic and tactical they become in terms of dealing with the challenge, hence the lower spending. This findings supports Ogada et al. (2003) observation in Laikipia County, where proper livestock husbandry has been found to reduce the level of livestock predation.

b). Money spent on property repairs and replanting crops

This study did not find any significant differences in the money spent on repairing damaged properties and replanting of destroyed crops in AE and MKE. The commonly damaged properties were mostly household farm fences and water tanks. Overall, the money spent on the repairs was less compared to money spent on guarding crops and livestock. This finding is similar to the national analysis of human-wildlife conflict data between 2005 and 2016, which indicated that infrastructure damage constituted only 4% of the 29,647 HWC cases reported to the KWS (Long *et al*., 2020). The destruction of water tanks and farm fences occurs mostly in dry seasons when wildlife move into human settlement in search of water and pasture, and that could be reason as why the cases and related expenditure was lower. In addition, some of the affected water tanks are communally owned, which means that more than one household shares the damages.

Replanting crops in AE was found to be more expensive than in MKE. This finding can be attributed to the difference in the farm sizes with household in AE having twice the size of farms than those in MKE. Other factors, such as physical and geographical factors, which were not investigated in this study, could also have contributed to the difference. For instance, in a study conducted in farms within Trans Mara County, it was established that large farms bordered by hedges were more likely to be raided (Sitati et al., 2005) as hedges provides hiding areas for wildlife and the large farms require more efforts to prevent wildlife raiding the farms.

c). Money spent on mitigation measures

The hidden cost incurred through money spent on the various protection measures for crops and livestock in both AE and MKE were similar, except for the installation of chain-link fences. Scarecrows, dogs and noises producing devices were the preferred options for crop protection in MKE. This is because the methods are relatively cheap to implement, compared to fencing and light producing devices such as solar units. Most scarecrows were made of sticks and old clothes while noise-producing devise were old magnetic tapes and tin cans. These two methods were implemented with the intention of frightening wildlife, especially birds and small mammals. The choice by farmers to use scarecrows and magnetic tapes resembled the findings of a study conducted in Machakos County, where 60% of the farmers preferred to use scarecrows and magnetic tape to keep off birds because of is cost effectiveness (Mutune, 2017). In Moi's Bridge, where farmers recorded a 20% and 80% crop loss to bird and animal damage respectively, they spent between KES 70-150 to install a scare crow (FarmbizAfrica, 2016). Another study conducted by Nemtzov and Eli (2006), revealed that each scarecrow costs about US$ 10 to make. In this study, scarecrows were minimally used to frighten carnivores in both ecosystems. The low use of scarecrows for livestock protection could be as result of its ineffectiveness as demonstrated by Woodroffe et. al. (2006) in a study of African rangelands.

Dogs were used to protect crops in MKE and livestock in both ecosystems. They were mostly used to alert households of wildlife invasion, as well as to scare away small mammals and birds. Unlike trained dogs such as the Anatolian Shepherd used in Southern African countries, the people in AE and MKE depended on untrained dogs whose cost ranged from KES 1900-2200 per dog compared to the Anatolian Shepherd that cost between US$ 1000 in Tanzania (Ruaha Carnivore Project, 2020) and US$ 2,780 in South Africa and Namibia (Rust et al., 2013). Although dogs have been documented to be effective in guarding sheep against cheetah and other small carnivores, studies indicate that they are associated with some hidden ecological costs. For example, an analysis of the 183 scats from six livestock guarding dogs in South Africa revealed that the dogs preyed on 10 different wild mammals when unaccompanied by a human attendant (Drouilly et al., 2020). In Kisii County, an attempt by farmers to protect their crops from monkeys using dogs was unsuccessful because their barking whenever the monkey invaded the farms did not stop the monkeys from feeding on the crops (Okoyo, 2016).

Light emitting devices such as solar units and flashlights were used to guard livestock and crops in AE and MKE. Overall, the lighting devices cost about KES 4, 000 for crop protection and KES 17,017.44 and KES 8,375 to implement in AE and MKE, respectively. The flash light gives an illusion to the invading wildlife that humans are in the farm or around the livestock kraal. The difference in hidden cost can be linked to the type of lighting device used, where some farmers simply had a rechargeable solar panel with 3 bulbs, while others had a fully set solar flicking lights connected to a car battery and solar panels. In AE, the relatively high price for implementing light device for livestock protection can be attributed to introduction of a modern modified unit by Coexistech Ltd. Elsewhere, a study undertaken in the southern section of Nairobi National Park established that solar flashlight system designed by the Friends of Nairobi National Park with 4-6 bulbs and which cost KES 25,000 was capable of reducing livestock attacks by up to 96% (Lesilau, et al., 2018). Another study undertaken in Amboseli showed that flashlights were 90% effective in keeping off predators from kraals (Okemwa, 2015).

Chain-links fence also known as predator-proof boma were used to keep off predators from livestock enclosures. This involves the fencing of livestock enclosures with rolls of chains-links that are supported with strong posts and metal doors as opposed to the popular hedge fence that consist of the acacia twigs. The cost of chain-link fences was higher in AE than in MKE because, the predator-proof boma design used in AE comprised of recycled plastics poles, 1.8 metres high chain-links and a flattened iron drums. The project is implemented by Born Free Foundation and requires the beneficiaries to pay 25% of the total cost (estimated to be KES 240,000) which correlates with the size and number of livestock (Manoa & Mwaura, 2016). The lower cost of chain-link in MKE can be linked to the fewer number of livestock per household (38) compared to AE (98). In addition, the designs were different, with AE having been improved through community training (Manoa & Kasaine, 2019), while in MKE the design depended on individual technical knowledge. A cost-benefit analysis of predator-proof boma in Tanzania revealed that investing in boma fortification is cost effective compared to the traditional fence as it yielded positive net present values after two to three years (Kissui et al., 2019). The traditional hedge fences are less effective because of their low height and the ability of the predators to jump in and attack livestock (Manoa & Mwaura, 2016).

In addition to the above strategies, communities in AE and MKE also used barbed wire fence, but this method was only used by 4.66% of the total respondent which can be explained with the relatively high cost required to install the fence, which ranges between KES 23,000 and 34, 500. In addition to the rolls of barbed wire, the fence also requires the purchase of, installation poles (each KES 200-1200), nails (KES 150-250 per kg) and labour. The fencing of an acre requires 102 posts, 2 rolls of barbered wires, 3.5kgs of nails and labour are required, all totalling to about KES 40,000 fence (EcoPost Limited, 2020).

d). WTP and WTA for hidden costs

Respondents expressed their willingness to accept compensation and willingness to pay for the various hidden costs associated with HWC. The daily WTA and WTP values for households was higher in MKE than in AE. The WTA values for different opportunity costs were higher than the WTP by about 50%. The differences in the two values has been documented in other previous environmental economics studies as reviewed by Gregory and Brown (1999), with a WTA: WTP ratio ranging of 1.4- 61.0. The disparity in the WTA and WTP has been attributed to the fact that losses matter more to people compared to commensurate gains and reductions in losses are worth more than foregone gains. Most CVM studies in the world have reported exaggerated WTAs compared to the WTP. For example, duck hunters were willing to pay US$ 247 above the real cost to waterfowl for one year but demanded a minimum of US$ 1044 to forego the opportunity to hunt the same birds (Hammack & Brown, 1974).

This study found a strong statistical difference for both WTA and WTP for HWC related night travel restriction, school absenteeism, and loss of sleep. The difference could be as a result of the values put to each of the opportunity cost by respondents in the two ecosystems. That is why despite the lower total annual income for MKE respondents they were willing to pay more for all the opportunity costs than respondents in AE. A correlation test showed that there was weak relation between the respondent's household characteristics and WTA & WTP. Household income had the highest positive influence (24%) on WTA compensation for fear of attack by wildlife while all other household attributes (e.g., size, livestock, acreage) had less than 20% influence on the WTA and WTP values. This because payment is constrained by income, while demand of compensation is not (Grutters et al., 2008) and hence the use of WTP as the main outcome of the contingent valuation appears to reflect better value perception because the valuation subjects (Klose, 1999) more easily understand it.

The significant influence of gender and education WTP and WTA suggests that HWC mitigation awareness is factor of gender and education. Those with formal education were willing to make a choice in order to avert the impacts of HWC compared to those with no formal education. In addition, the decision to pay to prevent hidden cost appeared to be a made more by men than the women. In AE, households decisions are largely made by men based on the Maasai culture. Twyman et al. (2015) affirms that African women unlike men they are disadvantaged by the social and cultural norm, and low education levels. However, various studies (e.g. Osanya et al., 2019 & Gebreselassie et. al., 2013) have indicated that involving women in decision making positively influences the household's wellbeing.

6.3.1.3 Transaction costs

The WCMA 2013 gives a provision for victims of HWC to file for damage compensation at KWS. Both AE and MKE respondents experienced different type of HWC. Majority (53%) of the respondents registered crop raids, 50% livestock attacks, 11.27% property damage and 18 human fatalities. Out of the 56% complainants only 0.7% successfully filed and received their compensation claims from the government. Delay in the payment of HWC compensation claims by governments is not a new phenomenon in the world. For example, Madhusudan (2003) reported that villagers around Bandra Tiger Reverse in India received only 14% and 5% of crop and livestock incurred respectively after an extended delay. Another study conducted in Boromo region in Burkina Faso, found out that 98% of the people who incurred losses due to elephants opted not to report because of the government had not paid the previous damages (Marchand, 2002).

In Kenya, a performance audit report of KWS revealed that HWC cases worthy KES 2,235,388,000 had not been paid since 2013 (GoK, 2018). From the economic perspective, the delayed payment of HWC amount results to transaction costs over time. An analysis of the future value at 12.6% interest of the expected amount for crops indicated that AE had a higher transaction cost compared to MKE, while livestock loss, human fatalities and property loss were similar. The regional difference in crop transaction costs can be linked to the nature of crop, farm size, and intensity of crop raiding, while the resemblance for livestock, human fatalities and property loss can be attributed to the similarities of the wildlife species in AE and MKE. Overall, the delay in payment of wildlife damages has partly been blamed on the failure of KWS to put in place an implementation guideline to ensure that HWC related compensation obligations as outlined in WMCA 2013 is operational and fully implemented within a specified timeframe (GoK, 2018). In addition, KWS has insufficient budget for its operation. According to the Departmental Committee on Environment and Natural Resource, KWS required KES 4.7 billion per years to sustainably operate (GoK, 2019). Consequently, the agency does not have a vote to deal with the claims received from wildlife victims, hence the huge backlogs.

The HWC claims filed with KWS were only those associated with the 30 listed species in Schedule III of WCMA 2013. However, in this study, respondents reported about the problems caused by other species such as primates and birds. In July 2020, the National Task Force on HWC compensation recommended that the government should not compensate injuries and deaths arising from snakes (GoK, 2020). The task force further recommended compensation for death or injury only due to elephant, lion, leopard, rhino, hyena, crocodile, cheetah, buffalo, hippopotamus and wild dog attacks. These decisions are likely to heighten the transaction cost to the victims of HWC in Kenya (Koech, 2017). However, the task force recommended that upon submission of all the necessary documents, compensation should be paid within 60-90 days. The acquisition of the required documents which include police abstract, incident report from KWS, burial permit, post-mortem and death certificate, requires time and money to process, yet such cost are not factored into the final compensation figures. The additional transaction costs have previously been pointed out by Barua et al. (2013) The delay in compensation does not only lead to transaction cost, but also results to hostility, negative attitudes and perceptions toward wildlife conservation and its stakeholders.

6.3.1.4 Health costs

HWC had impacts on the health and wellbeing of the people in AE and MKE. The findings showed that people in MKE had more severe injuries that required more funds to treat because the people were referring their victims to private hospitals, which are more expensive than public hospital or travel far (e.g., Nairobi) to get specialised treatment hence spending more on transport. AE residents are within the Nairobi metropolitan area and are likely to spend less on transport compared to those in MKE.

Seventy percent (286) of the respondents in the two-ecosystem experienced fear, while 59.56% (243) had sleepless nights because of wildlife presence in their area. As a result, of sleepless nights, respondents could not effectively attend to their daytime social and economic activities. This explains why respondents were willing to pay between KES 112.91 and KES 143.03 to avert fear and another KES 102.44-118.45 to avoid missing daily income. These findings are similar to those by Manoa & Mwaura (2016). In another study conducted in Sagalla area of Taita-Taveta County, 92% of participants (n=26) affirmed that elephant crop raiding caused them emotional and mental distress (Weinmann, 2018). In Naivasha, farmers in Mirera area were reported to have spent sleepless nights trying to secure their farms from wildlife the Longonot National Park which invaded their farms and destroyed crops. The farmers opted to guard their farms at night in fear of wildlife invasion (Kimani, 2016). And in Mwingi West (Kitui County), residents were reported to live in fear after a stray lion from Kora National Park killed two cows in their village, and effort by KWS to capture the lion was taking long. The resident feared that the lion could attack school-going children (Musangi, 2020).

Sleepless nights and fear have negative impacts on human health. According to Harvard Medical School [HMS], 2020), the lack of adequate sleep has both short term and long-term effects. In the short term, lack of adequate sleep can affect judgment, mood, ability to learn and retain information, and may increase the risk of serious accidents and injury. In the long term, chronic sleep deprivation may lead to a host of health problems including obesity, diabetes, cardiovascular disease, and even early mortality. This assertions are similar to the psychiatrist Dr Frank Njenga, who has previously stated that sleep deprivation results to one having difficult concentration, visual hallucinations, and extreme nervousness (British Broadcasting Corporation [BBC], 2002). Towey (2016), a mental health expert, points out that living in persistent fear can results to weaken immune system that can cause cardiovascular damages and gastrointestinal problems. Fear can also impair formation of long-term memories and cause brain damage.

Guarding crops and livestock at night also resulted to contracting diseases. According to CGK (2018), respiratory diseases contributes 45.1% of the morbidity in the county. Similarly, in Meru County (MKE), respiratory related diseases contributed to 79.07% of all the common diseases (County Government of Meru [CGM], 2018). Although, this study did not find any direct evidence to link guarding and respiratory diseases, exposure to cold during the night can increase a person's risk of contracting severe illness such as flu, bronchitis, and pneumonia. In addition, cold temperatures may also reduce the immune response and make it harder for the body to fight off germs (Eske, 2018). WWF SARPO (2005) further affirms that guarding crops and livestock at night also results to higher exposure to malaria.

About 12% (n=48) of the respondents associated food shortages to wildlife raids. Food shortage has been associated with wildlife species such as elephants which usually target staple food crops such as maize (Food and Agricultural Organization-FAO, 2008). The findings of this study resembles observations of other studies on wildlife and food insecurity. For example, a study on settlements around Lake Manyara National Park and Mkomazi Game Reserve in Tanzania showed that crop destruction resulted to 0.08 ton/annum which was equivalent to two-month household's food insecurity (Kaswamila, Russell, & McGibbon, 2007). In Laikipia County, a study by Nyamwamu (2016) revealed that wildlife contributed to significant food shortage, equivalent to 100% loss for crops such as maize. In Meru County, farmers from Ntukai, Murera, Kinaduba and Kiruyu villages had their crops severely destroyed by elephants, monkeys and buffaloes, leaving hardly any be harvested (Baraza, 2016).

Other than contributing to food insecurity, HWC also reduced the livestock numbers, thereby affecting peoples' livelihoods. For example, around Hwange National Park in Zimbabwe, lion's attacks significantly decreased the number of cattle resulting to low agricultural production since the residents depend on draught power (Moyana, 2014). In Kunene region (Namibia), a pride of desert lions killed a farmer's 86 sheep and goats, worth US$ 10,074 in one night (Africa Geographic, 2017). Likewise, Muriuki et al. (2017) reported that households lost an average of 36 livestock within 18 months, estimated to be worthy KES 800,000 in group ranches around Amboseli and Tsavo National Parks.

6.3.2 Visible economic costs

6.3.2.1 Crop and livestock economic losses

a). Crop economic loss

Crop loss in AE and MKE was rated as severe by majority of the respondents. Wildlife damage to maize, beans, and tomatoes, which were common in the two ecosystems, resulted to higher economic loss per household. The significant difference in the economic loss of maize and beans in the two ecosystem can be attributed to the land ownership and fencing practices. Most of the MKE is dominated by large scale private ranches with most properties secured using live electric fences as opposed to Kajiado, where wildlife still roam freely between Amboseli National Park and community group ranches, increasing the chances of crop raiding. The high losses registered for both tomatoes and potatoes per household can be linked to the average higher production cost per acre of KES 170,000 (Ndegwa et al., 2019) and KES 77,000 (FarmbizAfrica, 2016), respectively, compared to maize and beans whose production cost ranges between KES 30,000 and 40,000 per acre (Ndegwa, 2019).

The main wildlife species involved in crop loss were elephant, zebra, baboons and Quelea birds. Overall, elephants (31.18%) and baboons (25.84%) resulted to a higher crop economic loss. The high contribution of elephant to the HWC dilemma can be attributed to its large body size, extensive territorial space that requires large quantities of food (average of 150 kg of vegetation and water up to 190 litres per day) (IUCN, 2020). In addition, elephants have been documented to break through electric fences to gain access to farms. For example, a study carried out by Mutinda, et al. (2014) in Laikipia County, fence-breaking by elephants gave access to other non-fence-breaker elephants, making the whole herd to gain access to the farms.

This study established that baboons were the second in contributing to crop loss in AE and MKE. This is because baboons are widely distributed in different habitats within the two ecosystems and were common in grassland, woodland, and bushland bordering human settlements. These findings are like those by Syombua (2013) in a study of Taveta-Taveta County where elephants and baboons were recorded as the most problematic HWC species. Manoa et al. (2020b) also made similar observation in Laikipia and Kajiado County. Quelea birds also contribution to relatively high crop loss incidents by destroying wheat, which was predominantly grown in MKE. Quelea damages to sorghum, wheat, barley, millet, and rice is also common in other parts of Kenya (Cherono, 2019, Kamwanga, et al., 2016).

b). Livestock economic loss

The AE households registered an average livestock loss of KES 88, 975 compared to the MKE (KES 38,405). However, the cattle loss, in the two ecosystems, was not significantly different to the shoat loss per household. This can be attributed to the stock of cattle and shoats in two ecosystems. For example, between 2014 and 2015, it is estimated that Kajiado County, which lies in the AE had 682,291 cattle compared to 1,082, 933 goats and 981,271 sheep (KNBS, 2015). Similarly, Laikipia County partly in MKE had 243,290 cattle, 239,050 goats and 314,900 sheep (KNBS, 2019c). The high loss of sheep and goats can therefore be linked to their high numbers in the two ecosystems, thereby making them more prone to predator attacks. This study established that lions mostly preyed on cattle while hyenas killed mostly sheep and goats. The findings are similar to those by Mukeka et al. (2018) whose study in Tsavo and Maasai Mara regions, where livestock loss to lions and hyena were found to be higher than those of other species.

According to Coblentz (2019), the loss of livestock to lion and hyena is determined by the profitability level (the prey energy expended per unit handling time). Compared to the wild ungulates, livestock are easy prey for the lion and hyena to attack and kill. In addition, it has been documented that wild carnivore prey across Kenya has declined significantly almost by about 70% (Ogutu et al., 2016). The low number of wildlife preys forces lions, hyenas and other predators to target livestock, thus increasing HWC related livestock loss.

The findings on livestock economic loss in this study are similar to those in other studies. For example, a study conducted in a Maasai homesteads around Amboseli National Park, showed that 9,000 livestock worthy KES 28 million were lost to predators between 2008 and 2012 (Okello et al., 2014). Another study, which analysed KWS data between of 2010 to 2018, revealed that the total monetary loss associated with livestock predation in Kajiado was, KES 1,785,000 (US$ 16826.92) compared to KES 407,000 (US$3836.73) in Laikipia County (Manoa et al., 2020). Economic losses arising from livestock predation can be huge within a very short period which sometimes results to retaliatory killing of wildlife. For example, in 2017, a pride of lion invaded a 900-acre ranch in Kajiado and killed sheep estimated to be worthy KES 655,000 in a single night (Kurgat, 2017). In a similar incident, pastoralist community in Rumuruti area in Laikipia County laced a camel carcase killed by lions with poison. As result, two jackals, one hooded vulture, seven Ruppell's Griffon vultures (G*yps ruppellii*), and 11 Tawny Eagles (*Aquila rapax*) that scavenged on the camel carcase died. This was a retaliatory attack by the community following the killing of their 10 cattle, 4 camels and a sheep by lions (Mutura, 2020).

6.2.2.2 Human deaths, injuries, and property damage

Human deaths were few compared to injuries in both AE and MKE. Although more people were killed in MKE than AE, it seemed that wildlife attacks were experienced almost equally across the two ecosystems. Based on the WCMA 2013 compensation rates, the human deaths in MKE were equivalent to KES 15 million, compared to KES 5 million in AE. On the hand, human injuries were equivalent to KES 16 million and KES 12 million in AE and MKE, respectively. Although human deaths and injuries cases were fewer than crop and livestock, wildlife attacks on humans can be emotive and results to huge expenses for the government. For example, between 2014 and 2017, the government registered 400 human death and 4,555 human injury amounting to billions of shillings (GoK, 2020). Human death can also result to retaliatory killings of wildlife. For instance, in 2018 residents of Mashuru in Kajiado County speared and killed two elephants, when an elephant (Marindany, 2018) killed a 43-year-old man.

Wildlife attack on humans has also been reported in other countries. For example, in Zambia, 49 people were killed annually by five species of wildlife, namely, crocodile, elephant, hippo, lion and buffalo from 2002 to 2008 (Chomba *et al.* 2012). Similarly, in Tanzania, 96 people were killed and another 90 injured by various wildlife species that raided farms between July 2018 and July 2019 (Global Times, 2019). In Kyamajaka village, in western Uganda, people are in constant conflict with chimpanzees due to habitat loss (Quammen, 2019). The chimpanzees are reported to have killed three human infants and injured several others between 2014 and 2017 (Quammen, 2019). According to Quammen (2019), in one incident, the chimpanzee attacked an infant opened the stomach and removed the kidneys.

In this study, more men were attacked by wildlife than women. The finding can be attributed to the differences in social behaviour of men and women. Men are likely to stay out late in the night socializing and returning to their homes late in the evening or when dark. This can increase the chances of men encountering wildlife than women. This has occurred in other parts of the world. For example, out of the 159 people were killed by elephants in north Bengal between 2006 and 2016, 74% of the victims were intoxicated males (Naha et al., 2019). Another study conducted in Loitokiotok Sub-County, by Makau (2012) revealed that more male (27 per 1000 livestock herders) than women (9 per 10,000 livestock herders) were attacked by wildlife.

Most (78.6%) of HWC injuries recorded in this study were associated with victims aged between 31 and 65 years, which is within the economically active age set (KNBS, 2019b). This can have a negative implication on the wellbeing of households, especially those whose families depends on them for survival. Elephants accounted for the highest number of human deaths and injuries in the two ecosystems. This finding supports the study by Makau (2016) in Loitokitok Sub-County, where elephants were found to contribute to 50% of human deaths and injuries. However, the finding in this study are contrary to the findings of a countrywide study by Mukeka et al. (2019) in terms of the key wildlife species associated with human death and injury, which attributed 43.1% of the total number of deaths to snakes followed by elephants (18.8%). The difference can be attributed to the wider distribution of snakes within most of the seven ecological zones compared to the elephants, which are not common in some areas (Manoa et al., 2020b).

In terms of property damage, HWC was associated with economic losses in terms of damaged water tanks, fences, and houses in both AE and MKE. A significant difference was recorded for the losses incurred with regard to water tanks and fence damage in AE and MKE. The difference can be attributed to the source of water in the two ecosystems, with MKE having more permanent rivers than AE. In AE most of the water source is from boreholes, as many rivers are seasonal, compared to MKE with several permanent river such as Ewaso Narok, Ngare Naro, Narumoru, Likii, Sirimon, Ontulili, Ngare Ndare, Melwa, and Timau. According to the CGK (2018), the main sources of water in the rural areas are water pans, dams and protected springs with the most reliable source being boreholes. As such, water for both domestic consumption and irrigation is ferried by donkeys, motor bikes and small cars and stored in water tanks. The scarcity of water therefore could be prompting AE households to purchase more and bigger tanks to store water than their counter parts in MKE, hence a higher loss when damaged by wildlife.

This study also revealed that AE households incurred more loses on farm fences than in MKE. This is because, AE households who are predominantly pastoralist were found to invest more in the predator-proof bomas, which are made of chain-links. The predator-proof bomas are popular as a tool to prevent livestock predation at night in AE, compared to MKE. According to Manoa & Mwaura (2016), an average predator-proof boma cost the KES 240,000, including 25% (KES 60,000) contribution by the beneficiary. The 25% contribution toward the predator-proof bomas and other expenses incurred on other types of fences such as hedge and barbed wire fence for crop farm could the reason as to why wildlife damage to fences was higher in AE than MKE.

Overall, this study found fewer cases of human deaths and property damage in both ecosystems. The findings are similar to the national trends in HWC, where human deaths were reported to be in the range of 400 cases and 500 cases of property damages between the years 2014 and 2017, compared to 5,073 crop damages (GoK, 2020).

6.3.3 Hidden cost categories and deterrent measures

Households in the two ecosystem mostly rescheduled their social and economic activities to avoid the hidden cost of HWC. More people rescheduled activities in MKE (62.16%) than in AE (49.56%). On the hand, physical structure/barriers and guarding by humans and dogs were used more in AE than in MKE. A statistical analysis revealed that there was a significant difference in the broader categories used in preventing hidden costs in AE and MKE. The difference can be associated with the land use practice dissimilarities in AE and MKE, where the former was dominated by pastoralism and the latter by crop farmers, hence the difference in HWC deterrent techniques and costs. This is similar to the finding in other studies. The study in Nyeri County by Musyoki (2014) also revealed that farmers used a combination of techniques to reduce crop damage by wildlife. Osborn and Parker (2003) emphasise that "every field site has specific characteristics and that it is unlikely that any single method will work in all situations at all times due to the influences of geographic, social, cultural, historical, political, and economic factors". For example, in 2001, live traps were introduced around Budongo Forest Reserve in Uganda to reduce primate crop raiding. However, three years later the community abandoned the strategy, with majority indicating that they did not believe the strategy was effective in reducing crop raiding (Webber et al., 2007).

The findings in this study showed that the adopted prevention methods for dealing with the hidden costs of HWC resulted to other hidden costs including reduced income for the affected households. In some in cases, the affected households opted not to report the HWC incident to

KWS because that would result to aggravated expenses. The expenses might also prevent the victims from making it to the nearest KWS office within 48 hours, as restricted in the WCMA 2013. Since the enactment of the WCMA 2013, there has been a delay in paying the victims, with some cases being dropped for insufficient evidence. This could discourage victims of HWC from reporting the incidences. Unreported cases of HWC can undermine efforts towards effective wildlife management and conservation. First, the management cannot effectively identify the HWC hot spot areas to take the necessary action. Secondly, the species involved in a given locality may not be clearly ranked for proper mitigation, and lastly, unreported cases can create a negative perception about conservation and prompt people to retaliate when conflict happens. The subsequent costs of the HWC deterrent measures and unreported cases indicate how complex the issue of resolving the HWC can be.

Most of the HWC deterrent measures targeted the elephants, lions, and hyena because these three were responsible for high HWC losses. In a study conducted in Nyeri County, Musyoki (2014) concludes that guarding against dangerous wildlife species such as elephants is risky, difficult, and frustrating activity which is also common in other areas. For example, in Serengeti district- Tanzania, one person was killed as a family attempted to drive elephants from their farms (The Guardian, 2019). This study established that despite the women rescheduling the time for firewood and water fetching to avoid wildlife attacks, wildlife related deaths and injuries still occurred. For example, in March 2020, a woman was trampled to death by an elephant while fetching firewood in the afternoon in Olgulului group ranch, which surrounds Amboseli National Park, (KWS, 2020b).

6.3.4 HWC compensation mechanisms and strategies

6.3.4.1 Compensation mechanisms

Monetary compensation has been used to appease victims of HWC. However, the strategy has various challenges as outlined by Nyhus et al. (2005). In this study, respondents proposed six mechanisms to improve the monetary compensation for HWC based on the WCMA 2013. Shortening the compensation process will ensure that the victims do not incur extra transaction costs while processing their payments. Within a period of one year, this study revealed that on average AE and MKE households incurred a loss ranging from KES 15, 260.16 to KES 2,034,319.45 due to delay in payments of compensation for HWC. According to the WCMA 2013, HWC victims are expected to get compensation after the CWCCC deliberates on the claims and gives recommendations as to whether the claimant qualifies for compensation. Verified claims are then forwarded to the Cabinet Secretary, who reviews them and if satisfied releases payment to the claimants through the CWCCC. This process usually takes a long time before a decision is arrived at. For example, since the enactment of the WCMA 2013, there were 13,125 pending claims by December 2019 (GoK, 2020). Several scholars including Ogra and Badola (2008) and Gubbi (2012) have pointed out that compensation funds are usually insufficient, delayed and entails time consuming. The Ministry of Tourism and Wildlife (2020) in its recommendation for the review of the current compensation scheme, also notes that the costs for performing such administration is often high, time consuming and inefficient (GoK, 2020). To hasten the compesation, local leadership together with KWS representaitive were proposed to handle the claim verification and payment process. This suggestion has been echoed by various people from Amboseli, Tsavo, Meru, Laikipia, Maasai and Isiolo ecosystems as reported by the Task Force on HWC (GoK, 2020).

Payment of claimants through the existing consolation schemes were also proposed, mostly by AE households. In AE, there is the Big Life Foundation Predator Compensation Scheme and Maasai Wilderness Conservation Trust's wildlife pays program. The two schemes run by NGOs require the community to contribte about 30% of the compensation funds. The verification of cases is done by selected community members together with a non local persons, and payments for livestock losses are done on a quaterly basis. Although the amount paid is not equal to the livestock lost, the timely payment save the victims additional transaction costs of processing the claims. However, the consolation schemes are dependent on the availability of external funding including donations and may therefore not a be a long-term solution. In addition, just like the WCMA 2013, the consolation schemes targets only certain species such as lions, hyena and cheetah and do not cover all the dimensions of HWC loss. This study also reveals that some household (11.27%) in AE and MKE wanted all the wildlife species that cause damages being compensated for. Wildlife species such baboons, are not listed in the third schedule of WCMA 2013, yet they have been documented to result to both livestock (Butler, 2001) and crop loss (Syombua, 2013).

This study has revealed that 46.08% of the households were unware of the full compensation process, with some not aware of the amount of money they were supposed to receive in case of widlife attacks. This suggests the need for community education and public awareness.

Depite the challenges of compensation schemes, most households (63%) felt that the scheme helps to deal with HWC, by reducing retaliatory killings, ensuring that the victim's food security and motivating people to support conservation of wildlife. These findings support other studies conducted in AE and MKE. For example in Laikipia County, HWC is reported to have largely contributed to maize shortage among the small-scale farmers, resulting to 61,900 and 56, 600 people to depend on relief food in the year 2011 and 2012 respectively (Nyamwamu, 2016). In addition, the Food and Agricutlural Organization of the United Nation (FAO) notes that HWCs currently ranks amongst the major threats to the security and well-being of community livelihoods in Africa (FAO, 2018). Consolation schemes operated by different NGOs, have been cited as suitable incentives for encouraging community members to employ best best practice strategies for safeguarding their livestock.

6.3.4.2 Strategies for sustainable compensation

a). Processing and payment of HWC compensation

Compensation schemes have defined procedures that should be followed by HWC claimants. Generally, victims makes a claim, which is verified by the compensating agency. Although the steps seem to be simple, in reality the time taken before victims get their payments is usually too long. This study has shown that the initial stages of HWC compensation claims are generally complicated and ineffective, ranging from receiving complains, assessment of the damage, meeting to discuss the HWC cases, to payment of damages. A realistic assessment of the damage is essential for both the farmer and the government for the correct payment to the made. The current compensation leaves the KWS assessor to make individual verdict of damages, and this opens up the window for corruption. In other instances, the assessors do not respond to the reported HWC incidents thereby making people feel wildlife is valued more than their welfare. According to the audit general report of 2018, KWS has failed to respond to HWC risks in real time because of not receiving sufficient and timely information to combat the risks. This is attributed to the bad rapport between community and KWS, which prompts the community to share vital information with NGO's instead of relevant agencies (GoK, 2018).

Response to reported cases of HWC was rated "Poor" by majority of the respondents (50.74%). Lack of assessment denies the government an opportunity capture information on how to improve the reporting of HWC by community. It also gives a false impression that some HWC cases reported were false when it is not the case. Eventually, the government based on the previous cases of HWC end up under budgeting for compensation. For example, in 2018/19 budget year, the government allocated KWS KES 439 million for HWC compensation (Ministry of Tourism and Wildlife, 2020). Yet, in the year 2018 only, the human deaths cases were 77; serious injuries-1263 cases, and 501 damaged properties. These damages are estimated to be not less than KES 3. 5 billion, based on the WCMA 2013 rating. This is almost eight times the allocated budget for compensation and yet the crop and livestock cases had not been factored in. One way the government can increase the budget for compensation scheme, would be to impose taxes on all users of wildlife names and pictures for commercial use as logos and emblems. This is similar to the United Nation Development Programme initiative to lobby companies using wildlife in advertisements to donate funds toward conservation. The initiative dubbed "The Lion's Share" targeted to raise KES 10 billion per year, with companies contributing 0.5% of amount spent on media. (Steinberg, 2013).

Payment of victims of HWC was rated by most households (94.85%) as "Poor". The lack of payment of victims of HWC can be attributed to the low budget allocated to KWS to deal with compensation. Other than under budgeting, the process of releasing the fund to victims is bureaucratic in nature. KWS is tasked with gathering information on HWC; CWCCC to discuss and recommend to the Cabinet Secretary before treasury is requested to release the funds. Investment in preventive measures can largely help to reduce the overall budget allocated to compensation. For example, electric fence although not 100% effective, can minimise the number of attacks by wildlife species such as buffaloes, zebra, and elephants. The Ministry of Tourism and Wildlife notes that preventive measure such as safeguarding of livestock by herder above 18 years, and use of predator-proof bomas can complement compensation schemes (GoK, 2020).

Human deaths and injuries, which raise emotion and results to human-human conflicts, should be reviewed. Currently, human death is paid compensated at KES 5 million. It is not well known how the figure was arrived at. This amount does not factor in the role the deceased played in the family and the larger society. Although, it is incredibly difficult to place a monetary value on a human life, Kutner (2020) proposes several factors, which should be considered about the deceased to arrive at the compensation amount. These are age of the person, the earning capacity, deceased's state of health, income at the time of death, the age and circumstances of the deceased's dependents, education and training, medical bills and other expenses incurred for the deceased, funeral expenses, and value of lost benefits such as pension and health insurance. For impartiality, each case should be examined based on these factors to arrive at the figures for human deaths and injuries. Compensation should not just cover damages from mega fauna of international conservation concerns, but also other species, which are destructive and not threatened like baboons and birds.

b). Insurance schemes

Insurance schemes as alternative means of compensation was rated low by majority of the respondents. However, 50% of the key respondents recommended insurance scheme. This finding can be attributed to the lack of the knowledge on the insurance scheme by majority of the respondents. A national study of 215 respondents from different economic sectors, revealed that awareness of insurance products was high in motor related products (79%), medical insurance (76%) and theft (73%). However, a low awareness was noted in Workmen Compensation Act (31%) and Agricultural/livestock insurance and liability, 15% (Oino et al., 2012). Surpisingly, it is not just the community living adjacent to wildife who have little knowledge about insurance, Burand (2018) argues that most producers and customer service represenatives do not fully understand many insurance coverages, either.

Regardless of the general challenges facing the insurance schemes, various countries including China (crop damage), India (livestock predation), and Pakistan (livestock predation), are opertaing insurance compensation schemes for wildlife damages. In May 2019, the Government of Kenya through the Ministry of Tourism and Wildlife, brought together private insurance sector, government representatives and conservation to discuss suatainble HWC insurance products. This was in abid to provide Public and Private Partnership (PPP), for the insurance industry to get business opportunity and complement government in addressing the HWC through compensation. A Task Force on HWC compensation schemes, formulated in 2019 recommended the an insurance premium should be calculated based on the past KWS HWC incidence and compensation reports.

CHAPTER SEVEN

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

7.1 INTRODUCTION

This chapter summarizes the findings and outlines the conclusions of the study. The chapter also provides the recommendations to the government and the wildlife agencies to help reduce the human-wildlife conflict, particularly the hidden costs. The hidden costs of HWC are high in both the AE and MKE, and this call for change in wildlife policy to conform to the reality. This will require funds, and this study suggest ways to raise funds to sustain conservation in Kenya.

7.2 SUMMARY OF FINDINGS

7.2.1 Households profile

Averagely, the respondents had lived in the two ecosystems for at least 22 years and were 30 to 59 years, an indication that they were conversant with the HWC issues to share their experiences. In both AE and MKE, households earned less than the recommended per capita gross income of KES 14,508 per month. This can be attributed to the over reliance on the crops (in MKE) and livestock (in AE), that are prone to environmental stress and shocks. However, most people cautioned themselves from the extreme weather and wildlife attacks by diversifying their livelihoods**.**

7.2.2 Hidden economic costs

Although the two ecosystems have similar wildlife species, the AE has free movements of wildlife from the Amboseli National Park into community group ranches, increasing the contact between people and wildlife. As result, people in AE spent more time guarding livestock and crops than their counter parts in MKE, where wildlife movement is relatively restricted with the electric fences in private ranches and around Mt. Kenya National Park. Smaller family size allocated less time to guarding, as they had fewer members to effectively attend to all the social and economic activities including guarding. Guarding livestock and crops against wildlife denies people an opportunity to engage in other social and economic activities.

The schooling hours for children in both ecosystems was affected because of wildlife presence, but those in AE were affected more than the MKE. Household activities by parents was also affected due to the need to escort children to school for safety reasons. In AE, most wildlife spent about 80% of their time outside the Amboseli National Park, in human settlements and therefore children had to wait for wildlife to retreat back into the park or in bush in the morning.

This study established that substantial amount of money was spend on guarding crops and livestock against wildlife in the two ecosystems. However, the amount in AE was significantly higher than in MKE. Overall, the figures were higher than total income earned by households from all sources, implying that return from investment was negative/loss. This study did not find any significant difference in the money spent on replating crops in AE and MKE. Overall, the amount spent on repairs was less compared to money spent on crop and livestock guarding.

Households in AE and MKE experienced difficult in processing compensation, with only 0.7% who filed complain being paid. Delayed compensation results to transaction costs. This study found that AE had a higher transaction cost than MKE on delayed crop damage over one year period. Other than delayed payment, some damages caused by wildlife species not listed in WCMA 2013 further heighted the transaction cost.

There was no significant difference in the time and money used to treat injured victims of HWC AE and MKE, although MKE household used a slightly higher amount and time. Other than the physical injuries, households experienced fear, sleepless nights and contracted disease such as malaria. As result, households were willing to pay more than their daily income to avert fear and sleep comfortably.

7.2.3 Visible economic costs

Wildlife damage to crops resulted to high economic loss in AE and MKE. There was a significant difference in the economic loss of maize and bean in the two ecosystems. Elephants and baboons contributed to the highest economic loss. This can be linked to the elephant's large body sizes that require large quantity of food and their extensive range , while the baboons thrive in several habitats and are widely distributed.

On comparison, there was a significant difference in the number economic loss of sheep and goats in the two ecosystem. However, cattle loss was similar in the two ecosystems. Livestock loss result to both economic and ecological losses. With the delayed compensation, community retaliate by poisoning predators, which results to death of other non-targeted species such as vultures.

Wildlife attacked people in both AE and MKE. However, wildlife killed more people in MKE (3) than in AE (1). The total human death in MKE was equated to KESH 15 million compared to AE's KES 5 million. On the other hand, more human injuries losses were registered in AE (KES 16 million) than in MKE (KES 12 million). Elephants contributed to the highest human fatalities.

7.2.4 Categories of deterrent measures for hidden HWC

Households used three main categories of deterrent measures: rescheduling activities, physical barriers and guarding to minimise the hidden cost of HWC. There was a significant difference in the categories used to prevent hidden costs in AE and MKE, and this is linked to the dissimilarities in the main land uses of pastoralism and crop farming, respectively. The two-land use require difference approaches. Households also used a combination of methods to deal with the hidden costs. Using amalgamation of deterrent measures is a strategy to ensure minimal hidden costs, as no single method can be effective for all wildlife species. In an effort to deal with the hidden cost, the deterrent measures adopted yielded more hidden costs. This explains why some households opted not to report HWC cases to avoid incurring further opportunity, transaction and health costs.

7.2.5 HWC compensation mechanisms and strategies

Compensating victims of HWC has been used as mitigation measures with various challenges. There are several ways of improving the monetary mechanism. To minimise the victims incurring more transaction costs, the payment process should be shortened by engaging the local leadership to verify and make payments to victims. Households preferred consolation schemes that are operated by NGOs as payment are done on regular basis. A large proportion of the households in the two counties (63%) were of the opinion that compensation was ideal for dealing with HWC as it reduces retaliatory killings and food security and encourages communities to support wildlife conservation.

The initial stages of compensation are poorly executed, and this leads to either over compensation or under compensation of HWC victims. Over compensation results to quick diminishing of the compensation kitty, while under payment results to resentments. Therefore, every step of the compensation process must be thoroughly assessed by a team comprising of experts in conservation, economy, social, agriculture, veterinary, and health. Every reported case must be attended to, just like when wildlife is killed or injured as result of HWC. This will help change the community perception that wildlife is valued more than people are. It will also encourage community to report HWC case, which is essential for the government when budgeting for compensation. Over the years, the government of Kenya has allocated less amount for compensation and operation budget for KWS. This limits KWS ability to attend to cases thus raffling the relationship with the community, who share vital information with NGOs and not state agency. Lack of sufficient information means that decision-making on HWC and compensation is hampered.

The government can also increase the allocation of the compensation funds by imposing taxes on companies that make use of wildlife as logos and emblems, particularly the HWC problematic species. Previous studies for example (Steinberg, 2013) have indicated that companies make more profit and gain more publicity when they use the animals in their advertisements. To reduce the overall budget for compensation, the government can invest in effective preventive measures to help deter certain species, thus reducing damages and claims. Human deaths and injuries should be based on the age, earning capacity, number of dependants, education and training levels, medical bills, and funeral expenses. The current compensation of KES 5 million regardless of the victim’s status is a skewed approach.

The insurance initiative promotes the PPP in conservation. However, this study reveals that households were not knowledgeable about agricultural/livestock insurance. However, 50% of key respondents recommended the insurance scheme for compensation of HWC. Currently, the government of Kenya is creating an insurance scheme to take over the compensation of HWC. The scheme is likely to face challenges as the premium for the scheme is huge, KES 3.5 billion and relies on the community to take up preventive measures to lower the premium. Just like the current compensation scheme, the insurance scheme omits certain species, which are rated to be destructive, creating the impression that such species are not important in conservation and to the government. There are several consolation schemes operated by NGOs in Kenya, and the proposal for insurance scheme fails to bring on board such schemes. It will be advantageous to pull the NGOs funds together into the National Compensation scheme to standardize the payments and boost the premium.

7.3 CONCLUSIONS

7.3.1 Economic magnitude of HWC

Although both households in AE and MKE experienced HWC, the magnitude of opportunity, transaction and health costs were more in AE than MKE. This suggest that the economic magnitude of hidden HWC largely dependent on the types of wildlife species in an area in relation to the human population and land use practices. In addition, physical barriers such as electric fences also influence the magnitude of HWC. The investment in time and money to minimise hidden costs depends on the household income and experience with HWC.

The crop and livestock economic loss incurred in AE were higher than in MKE, with the elephants and baboons contributing the highest crop loss and lion and hyena to livestock loss. The higher the number of livestock, the more loss to predator and economic loss. Human death and injuries resulted to the highest visible cost in both AE and MKE. Elephants accounted for the highest human deaths and injuries. On comparison, more people were attacked in MKE than in AE.

7.3.2 Deterrent measures for hidden costs

The land use practices determine the deterrent measures used for minimising the hidden HWC. Using a combination of different deterrent measures as a strategy, help to reduce hidden cost, but also result to more hidden costs. Therefore, hidden costs of HWC are difficult to mitigate because of the multiplier effects. Investment in deterrent measures that prevents the most problematic species such elephants, lions and hyena can overall, reduce both the visible and hidden cost of HWC.

7.3.3 HWC compensation mechanism and strategies

Monetary payment for victims of HWC can be improved by reducing the time taken to process the claims. This can be achieved by use of technology to capture information, process and even paying the victims. The compensation scheme should also cover all the wildlife species, to minimise resentment by people. Lessons learned from the various NGO operated consolation schemes can be used to strengthen the national compensation scheme. It is also imperative to have one scheme, with the funds operated by an endowment funds to supplement the annual budgets. Compensation should be complemented by investment in preventive measures to lower the insurance premiums to a sustainable level. Compensation alone is not a solution to the HWC problem, as it addresses the damages instead of preventing.

7.4 RECOMMENDATIONS

7.4.1 Policy and management

a). The government should review the WMCA 2013 to incorporate the hidden cost of HWC and measures of addressing them. The hidden costs are key driver to community resentments because of the substantial amount of money and time spent and not compensated.

b). The list for the wildlife species that can be compensated for need to be reviewed to incorporate other species that are problematic such as baboons which may not be threatened or are not of international conservation concerns. Instead of excluding certain species from list because of the huge economic damage/loss, the government should invest in simple preventive measures (for examples predator-proof bomas for livestock) and community education/awareness on how to deal with some conflict issues such as snakebites. The government also need to invest in specific anti-venom as per the problematic snake species in different areas, which have registered high number of snakebites.

c). Compensation should be standardised countrywide. The existing NGO consolation schemes should be incorporated into the national scheme, so that there is no discrepancy in payment of HWC victims.

d). The proposed heavy investment in HWC insurance scheme by the government must not outweigh the plans and investment in preventive measures. Compensation for human deaths and injuries should be guided by the role of the individual in the society, training, age, health conditions and number of dependants. The proposed reduction of human deaths compensation from KES 5 million to KES 3 million must be weighed against the community perceptions and resentments.

e). To address the issue of limited resources for conservation, a tax imposition on the use of selected problematic wildlife species on commercial businesses can greatly help to raise funds to cater for preventive measures, hidden costs and the proposed insurance schemes.

f). This study revealed that community members were not aware of the compensation process and the amount they were required to get in case of HWC. There is therefore a need to create Community and Public Awareness on the Compensation (CPAC) section in the WCMA 2013. Attention on HWC may go a long way to changing community negative attitudes toward KWS and wildlife.

g). The |Government of Kenya needs to allocate a substantial budget to KWS to enable it carryout its core function of wildlife conservation and addressing the HWC issue.

h). Although Kenya reviewed it's wildlife law that culminated to the WCMA 2013, the Act still heavily borrows from the colonial wildlife Act that did not recognize the indigenous people knowledge on the use of natural resources. A wildlife law and policy that matches the current situations with the people in mind is wanting.

7.4.2 Further Research

a). This study analysed the health cost of HWC but dwelled on the physical injuries costs. Examining the mental and psychological impacts of the HWC on people is therefore recommended.

b). Despite the change in wildlife policy in many African countries, the issue of HWC persists. An analysis of the wildlife policy from the colonial period to date shading light on the wildlife population, human population, and HWC and forging the way forward for conservation in Africa is proposed.

REFERENCES

Adams, J.S. and McShane, T.O. (1992). *The myth of wild in Africa: conservation without illusion*. W.W. Northon and Company.

Adams, W.M, and Hutton, J. (2007). *People, Parks and Poverty: Political Ecology and Biodiversity Conservation. Conservation Society*. http://www.conservationandsociety.org/text.asp?2007/5/2/147/49228.

Africa Geographic. (2017). *Lion pride kills over 250 livestock in Namibia in one week of carnage.* https://africageographic.com/stories/lions-kill-almost-300-livestock-namibia/

Ahemba T. (2005). *Quelea Birds Ravage Crops in Nigeria's Arid North Bird Life International*, 2004, Quelea.

Alchian, A. (1968). *"Cost,"* in David L. Sills (ed). International encyclopaedia of the social sciences. Macmillan, 1968, pp. 404-415.

Alchian, A.A., Demsetz, H. (1972). Production, information costs, and economic organization. *American Economic Review* 62,777–795.

Amboseli Ecosystem Program (2009). *Drought in the Amboseli Ecosystem*. http://www.amboseliconservation.org/drought-in-the-amboseli-ecosystem.html

Amboseli Ecosystem Trust (2020). *Amboseli Ecosystem Management Plan 2020-2-30*.

Ament, R., Callahan, R., McClure, M., Reuling, M., and Tabor, G. (2014). *Wildlife Connectivity: Fundamentals for conservation action. Centre for Large Landscape Conservation*.

Baraza, P. (2016). *Farmers count losses after wild animals invade 4 villages*. (Royal Media Services). Citizen Digital. https://citizentv.co.ke/news/farmers-count-losses-after-wild-animals-invade-4-villages-130924/

Barua, M., Bhagwat. S. A., and Jadhav, S. (2013). The hidden dimensions of human-wildlife conflict: health impacts, opportunity and transaction costs. *Biological Conservation, 15*, 309-316.

Bath, A.J. (1998). The role of human dimensions in wildlife resource research in wildlife management. *Ursus*, 10, 349-355.

Bauer, H., Longh, H.H., Princée, F.P.G., Ngantou, D. (2001). *Status and needs for conservation of lions in West and Central Africa – an information exchange workshop. Conservation Breeding Specialist Group (CBSG)*, IUCN Species Survival Commission.

BBC. (2002, November 14). *BBC News*. In Depth: Africa Live! http://news.bbc.co.uk/2/hi/in_depth/africa/2002/africalive/2478187.stm

Beaumont, N. J., Austen, M. C., Mangi, S. C., and Townsend, M. (2008). *Economic valuation for the conservation of marine biodiversity*. Marine Pollution Bulletin 56, 386-396. http://dx.doi.org/10.1016/j.marpolbul.2007.11.013

Bhagati, T and Mattu, V.K. (2015). Effect of Honeybee Pollination on Quantity and Quality of Apple Crop in Kullu Hills of Himachal Pradesh, India. *International Journal of Science and Research*, 4(4), 2319-7064

Big Life Foundation. (2020). *A short fence with an impact*. https://biglife.org/program-updates/bush-journal/a-short-fence-with-a-big-impact

Bowie, H.G. (2009). *Wildlife conflict management and biodiversity conservation for improved rural livelihoods in Botswana.* Alternative Development Services.

Brown, T. C., and Gregory, R. (1999). Why the WTA-WTO disparity matters. *Ecological Economics, 28*(1999), 323-335.

Bryant, R. L., & Bailey, S. (1997). *Third world political ecology*. Psychology Press.

Buchanan, J. (1987). *"Opportunity Cost,"* in John Eatwell, Murray Milgate and Peter Newman, (eds). The New Palgrave: A Dictionary of Economics. Macmillan Press, pp. 718-721

Bulte, E. R. (2005). Research and management viewpoint: Why compensating wildlife damages may be bad for conservation. *Journal of Wildllife Management, 69*(1), 14-19.

Burns, N. and Grove, S.K. (2003). *Understanding nursing research*. 3rd ed. Saunders Company.

Butler, J. R. (2001). The economic costs of wildlife predation on livestock in Gokwe communal land, Zimbabwe. *African Journal of Ecology*. https://doi.org/10.1046/j.1365-2028.2000.00209.x

Carson, R.T. (1997). *Contingent Valuation: Theoretical Advances and Empirical Tests since the NOAA Panel.* American Journal of Agricultural Economics, Proceedings Issue, 79(5), 1501-1507.

Central Bank of Kenya (2020). Commercial Banks Weighted Average Rates. https://www.centralbank.go.ke/commercial-banks-weighted-average-rates/

Chen, S., Yi, Z. F., Campos-Arceiz, A., Chen, M. Y., and Webb, E. L. (2013). Developing a spatially-explicit, sustainable and risk-based insurance scheme to mitigate human–wildlife conflict. *Biological Conservation*, *168*, 31-39.

Cherono, S. (2019, July 29). *Quelea birds bring misfortune to Narok farmers.* https://www.nation.co.ke/kenya/counties/narok/quelea-birds-bring-misfortune-to-narok-farmers-190338

Chomba, C., Ramadhani , S., Harry , C., Jacob , M., & Vincent , N. (2012). Patterns of human wildlife conflicts in Zambia, causes, consequences and management responses. *Journal of Ecology and the Natural Environment*, *4*(12), 303-313.

Chowdhury, A.N. and Jadhav, S. (2012). *Ecopsychiatry: culture, mental health and ecology with special reference to India.* In: Chavan, B.S., Gupta, N., Arun, P., Sidana, A., Jadhav, S. (Eds.), Community Mental Health in India. Jaypee Brothers Medical Publishers, pp. 522–542.

Chowdhury, A.N., Mondal, R., Brahma, A., and Biswas, M.K. (2008). *Eco-psychiatry and environmental conservation: study from Sundarban Delta, India*. Environ. Health Insights 2, 61–76.

Coase, R.H. (1937). The nature of the firm. *Economica*, 16:386–406.

Coblentz, K. E. (2019). Relative prey abundance and predator preference predict individual diet variation in prey-switching experiments. *Ecology*, *101*(1). https://doi.org/10.1002/ecy.2911

County Government of Kajiado. (2018). *County Integrated Development Plan, 2018-2022*.

County Government of Meru. (2018). *Meru County Integrated Development Plan, 2018-2022*.

Croze, H and Moss, C. J. (2011). Patterns of occupancy in time and space. In J. M. Cythia, H. Croze, & C. P. Lee (Eds.), *The Amboseli elephants: a long-term perspective on a long-lived mammal.* University of Chicago Press.

Delahay, R. J., Smith, G. C., Barlow, A. M., Walker, N., Harris, A., Clifton-Hadley, R. S., and Cheeseman, C. L. (2007). Bovine tuberculosis infection in wild mammals in the South-West region of England: A survey of prevalence and a semi-quantitative assessment of the relative risks to cattle. *The Veterinary Journal*, 173 (2): 287–301.

DeMotts, R., and Hoon, P. (2012). *Whose elephants? Conserving, compensating, and competing in Northern Botswana*. Soc. Natural Resource http://dx.doi.org/10.1080/

Denizen, N. and Lincoln, Y. (2000). *Handbook of Qualitative Research*. Sage, Thousand Oaks.

Deutsch, M. and Coleman, P.T. (2012). *Psychological components of Sustainable Peace*. Springer.

Dickman, J.A. (2008). *Key Determinants of Conflict between people and wildlife particularly large Carnivores, a round Ruaha National Park, Tanzania*. PhD Thesis, University College London and Institute of Zoology, Zoological Society of London

Dixon, A.B., Hailu, A., Semu, T., Taffa, L., (2009). *Local responses to marginalisation: human–wildlife conflict in Ethiopia's wetlands.* Geography 94, 38–47.

Drouilly, M., Kelly, C., Cristescu, B., Teichman, K. J., and O'Riain, M. J. (2020). Investigating the hidden costs of livestock guarding dogs: a case study in Namaqualand, South Africa. *Journal of Vertebrate Biology*, *69*(3), 1-16.

Dunn, R. R. (2010). Global mapping of ecosystem disservices: the unspoken reality that nature sometimes kills us. *Biotropica*, *42*(5), 555-557.

EcoPost Limited (2020, July 21). *Ecopost Fencing Calculator*. http://www.ecopost.co.ke/index.php?page=calculator

Eske, J. (2018, July 30). *What's the link between cold weather and the common cold?* (A. Biggers, Ed.). Medical News Today. https://www.medicalnewstoday.com/articles/323431

FAO, IFAD, UNICEF, WFP, and WHO. (2018). *The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition.* FAO. https://www.who.int/nutrition/publications/foodsecurity/state-food-security-nutrition-2018-en.pdf

FAO. (2009). *Human-wildlife conflict: Elephant Technical Manual.* (Y. Osei-Owusu, & L. Bakker , Eds.) http://www.fao.org/tempref/docrep/fao/010/ai576e/ai576e00.pdf

FAO. (2011). *Rural structures in the tropics, Design and development.* http://www.fao.org/3/i2433e/i2433e.pdf

FAO. (2018). *Addressing human-wildlife conflict important to achieving SDG 2: Zero Hunger.* Food and Agricultural Orgnisation of United Nation: https://www.youtube.com/watch?v=zrtDgK9r53A&t=

FarmbizAfrica. (2016, July 20). *Eldoret artist earns Sh2000 a day selling scarecrows to farmers*.https://www.farmbizafrica.com/farmbizopinions/11-pest-control/1020-eldoret-artist-earns-sh2000-a-day-selling-scarecrows-to-farmers:

Fauna and Flora International. (2014). *Opportunity Cost Analysis. Lessons learned from REDD+ and other conservation strategies*. Fauna & Flora International.

Flader, S. L. (1994). *Thinking like a mountain: Aldo Leopold and the evolution of an ecological attitude toward deer, wolves, and forests*. University of Wisconsin Press.

Fourli, M. (1999). *Compensation for damages caused by bears and volves in the European Communities,* Lexemburg.

Frank, B., Glikman, J. A., and Marchini, S. (Eds.). (2019). *Human–wildlife interactions: turning conflict into coexistence* (Vol. 23). Cambridge University Press.

Fulton, D. C., Manfredo, M. J., and Lipscomb, J. (1996). Wildlife value orientations: A conceptual and measurement approach. *Human dimensions of wildlife*, *1*(2), 24-47.

Gebreselassie, K., Groote, H. D., & Friesen, D. (2013). *Gender analysis and approaches to gender responsive extension to promote quality protein maize (QPM) in Ethiopia (No. 309-2016-5267).* A paper presented at the 4th International Conference of the African Association of Agricultural Economists, September 22-25, 2013, Hammamet, Tunisia.

Geodecke, E.J., Ortmann, G.F. (1993). *Transaction costs and labor contracting in the South-African forestry industry.* South African Journal of Economics 61 (1): 67–83.

Global Times. (2019, August 7). 96 killed, 90 wounded by Tanzanian wild animals in one year. *Global Times*. https://www.globaltimes.cn/content/1172916.shtml

GoK (2009). *The Wildlife (Conservation and Management) Act of 1976*. Revised Edition 2009 (1985). Government printer.

GoK (2013). *The Wildlife Conservation and Management Act, 2013.* Kenya Gazette Supplement No. 181 (Acts No. 47).Government printer.

GoK (2019a). Report on budget implementation review for the following ministries/department for the first half of the 2018/19 financial year: a). Ministry of Water and Sanitation; b). Ministry of Environment and Forestry; c). State Department of Mining; d). State Department of Wildlife. National Parliament, 12th Parliament-Third Session. Departmental Committee on Environment and Natural Resources.

GoK (2019b). *The Kenya Gazzette*, Vol. 00/I —No. 105. Pp: 3388-3389

GoK. (2016). *Office of the controller of budget*. http://cob.go.ke/counties.

GoK. (2017). Kenya - Long Rains Season Assessments. https://www.wfp.org/publications/kenya-long-rains-season-assessment-report

GoK. (2018). *Performance Audit Report on Effectiveness of Measures Put in Place by Kenya Wildlife Services in Protecting Wildlife.* Government of Kenya, Tourism and Wildlife. Nairobi: Office of the Auditor-General. http://oagkenya.oagkenya.go.ke/index.php/reports/doc_download/2207-effectiveness-of-measures-put-in-place-by-kws-in-protecting-wildlife

GoK. (2020). *Report of the Task Force on Human-Wildlife Conflict Compensation Schemes in Kenya. Nairobi, Kenya.* Ministry of Tourism and Wildlife. http://www.tourism.go.ke/wp-content/uploads/2020/07/Task-Force-on-Human-Wildlife-Conflict-Compesation-Schemes-Final-Report.pdf

Goldman, M., J. Roque de Pinho, J., and Perry, J. (2010). Maintaining complex relations with large cats: Maasai and lions in Kenya and Tanzania. *Human Dimensions of Wildlife* 15(5): 332-246.

Gordon O. Ojwang, G.O., Wargute, P.W., Said, M.Y., Worden, J.S., Davidson, Z., Muruthi, P., Kanga, E., Ihwagi, F.and Ouma, B.O. (2017). *Wildlife Migratory Corridors and Dispersal Areas: Kenya Rangelands and Coastal Terrestrial Ecosystems*. Kenya Vision 2030 Flagship Project "Securing Wildlife Migratory Routes and Corridors", GoK.

Graham, M.D., Notter, B., Adams, W.M., Lee, P.C., Ochieng, T.N. (2010*)*. Patterns of crop-raiding by elephants, *Loxodonta africana*, in Laikipia, Kenya, and the management of human–elephant conflict. *Systematics and Biodiversity*. 8(4):435–45.

Grutters, J.P. C. ., Kessels, A. G. H.M. D., Dirksen, C. D.., van Helvoort-Postulart, D., Anteunis, L. J. C., and Joore, M. A. (2008). Willingness to Accept versus Willingness to Pay in a Discrete Choice Experiment. *International Society for Pharmacoeconomics and Outcomes Research, 11*(7), 1110–1119.

Gubbi, S. (2012). Patterns and correlates of human–elephant conflict around a south Indian reserve. *Biological Conservation*, *148*(1): 88-95.

Gusset, M., Maddock, A.H., Gunther, G.J., Szykman, M., Slotow, R., Walter, M., Somer, M.J. (2008). Conflicting human interests over the re-introduction of endangered wild dogs in South Africa. *Biodiversity Conservation*. 17:83-101

Hammack, J., and Brown, G.M. Jr. (1974). Waterfowl and Wetlands:Toward Bioeconomic Analysis.

Harvard Medical School. (2020, July 30). *Why Sleep Matters*. (Division of Sleep Medicine at Harvard Medical School in partnership with WGBH Educational Foundation.) . Healthy Sleep: http://healthysleep.med.harvard.edu/healthy/matters/consequences

Hill, C. (1997). Crop-raiding by wild vertebrates: the farmer's perspective in an agricultural community in Western Uganda. *International Journal of Pest Management* 43(1): 77–84.

Hill, C. (2004). Farmers perspectives of conflict at the wildlife-agriculture boundary: Some lessons learned from African subsistence farmers. *Human dimension of wildlife*, 9(4):279-286.

Hoare, R. (2012). Lesson from 15 years of human-elephant conflict mitigation: Management consideration involving biological, physical and governance issues in Africa. *Pachyderm, 51*, 60-74.

Hoare, R.E. **(**1999). *Data collection and analysis protocol for human-elephant conflict situations in Africa*. Document prepared for the IUCN African Elephant Specialist Group's Human-Elephant Conflict Working Group.

Hofer, H. (2002, July 15). "Spotted Hyaena" (On-line). IUCN Species Survival Commission Hyaenidae Specialist Group. https://animaldiversity.org/accounts/Crocuta_crocuta/

Holmern, T., Nyahongo, J., and Røskaft, E. (2007). *Livestock loss caused by predators outside the Serengeti National Park, Tanzania*. Biological, 135: 534-542

Howard, C. P. (1995). *The Economics of Protected Areas in Uganda: Costs, Benefits and Policy Issues, MSc.* University of Edinburgh.

Hudson, P.J., Rizzoli, A.P., Grenfell, B.T., Heesterbeek, H., and Dobson, A.P. (2002). *The Ecology of Wildlife Diseases*. Oxford University Press, Oxford

Hunter, M., Hitchcock, R., Wyckoff-Baird, B. (1990). Women and wildlife in Southern Africa. Conservation. *Biology*, 4: 448–451.

IUCN (2003). *World parks congress press release*. https://cmsdata.iucn.org/downloads/recommendationen.pdf.

Jackson, R., and Wangchuk, R. (2001). Linking snow leopard conservation and people wildlife conflict resolution: Grassroots measures to protect the endangered snow leopard from herder retribution. *Endangered Species Update*, 18(4), 138–141.

Jadhav, S., and Barua, M. (2012). *The elephant vanishes: impact of human-elephant conflict on people's wellbeing*. Health Place. http://dx.doi.org/10.1016/

Ndegwa, A., Gathambiri,C., Magoti,R., Pole,F., Wesonga, J., and Maina, M. (2019). *Inventory of climate smart agriculture tomato technologies, innovations and management practices*. Kenya Agricultural and Livestock Research Organization & Kenya Climate Smart Agriculture Project. http://www.kalro.org/sites/timps/KCSAP%20TIMPS%

Kamwanga, J., Macharia, G., Boyd, L., Chiurugwi, T., Midgley, I., Canales, C., . . . Maina, I. (2016). Kenya Wheat Production Handbook. (K. T. Mukundi, Ed.) Nairobi. https://www.kalro.org/sites/default/files/Wheat-Handbook-2016.pdf

Kaswamila, A., Russell, S., & McGibbon, M. (2007). Impacts of Wildlife on Household Food Security and Income in Northeastern Tanzania. *Human Dimensions of Wildlife, 12*(6), 391-404. doi:10.1080/10871200701670003

Kate, K. (2012). *Possible strategies/practices in reducing wild animal (Primate) crop raids in unprotected areas in Hoima District.* PCLG-Uganda. https://www.povertyandconservation.info/sites/default/files/Crop%20raids%20study%20Report-Hoima.pdf

Kimani, K. (2016, July 1). Wild animals destroy crops worth millions in Naivasha. (Royal Media Services). https://citizentv.co.ke/news/wild-animals-destroy-crops-worth-millions-in-naivasha-132165/

Kimega, G. M. (2003). Unresolved human/wildlife conflict in Kenya – the source of misery and poverty. *Ecofiles*. https://www.ogiek.org/indepth/human-wildlife-conflict.htm

Kiringe, J.W., Mwaura, F. and Kimeu, M.M. (2016). *Watershed Ecosystem Services and Watershed Ecosystem Service and Water Management Tools for the Kirisia forest Ecosystem in the Samburu Landscape*. Report to the African Wildlife Foundation (AWF).

Kissui, B and Kenana, L. (2013). *Amboseli-West Kilimanjaro Large Carnivore census Report,* 2013.

Kissui, B. M., Kiffner, C., König, H. J., & Montgomery, R. A. (2019). Patterns of livestock depredation and cost-effectiveness of fortified livestock enclosures in northern Tanzania. *Ecology and Evoluation, 9*, 11420-11433. doi:DOI: 10.1002/ece3.5644

Klose, T. (1999). The contingent valuation method in health care. . *Health policy, 47*(2), 97-123.

https://www.sciencedirect.com/science/article/abs/pii/S016885109900010X?via%3Dihub

KNBS (2013). *Statistical Abstract 2013*. https://www.knbs.or.ke/?wpdmpro=statistical-abstract-2013

KNBS. (2015). *Kajiado County Statistical Abstract* . Economic Survey, Kenya Bureau of Statistics. https://www.knbs.or.ke/?wpdmpro=kajiado

KNBS. (2016). *Economic Survey 2016.* Kenya National Bureau of Statistics. https://www.knbs.or.ke/?wpdmpro=economic-survey-2016

KNBS. (2018). *Basic Report Based on 2015/16 Kenya Integrated Household Budget Survey (KIHBS).* Government of Kenya.

KNBS. (2019a). *Enhanced Food Balance Sheet for Kenya, 2014-2018 Results.* Government of Kenya.

KNBS. (2019b). *2019 Kenya Population and Housing Census Volume I: Population by County and Sub-County.* Government of Kenya.

KNBS. (2019c). *Laikipia County Statistical.* KNBS. https://laikipia.go.ke/assets/file/3cc125a1-laikipia-county-statistical-abstract.pdf

KNBS. (2020). Economic Survey 2020. *Government of Kenya*.

Knight, J. (e.d.) (2000). Introduction. In Natural Enemies. People-wildlife conflict in anthropological perspective. London: Routledge.

Koech, G. (2017, July 29). *Sh1.5b snakebite compensations cripples Environment ministry*. The Star Newspaper: https://www.the-star.co.ke/news/2017-12-08-sh15b-snakebite-compensations-cripples-environment-ministry/

Korir, K. (2015). *Farmers count losses as wildlife invade farms.*

Kurgat, M. (2017, August 28). *Lions kill dozens of sheep in Kajiado*. https://africasustainableconservation.com/2017/08/28/kenya-lions-kill-dozens-of-sheep-in-kajiado/

Kutner, A. S. (2020). How Do You Calculate a Wrongful Death Settlement? Are Wrongful Death Payments Taxable? *ASK.* https://www.askadamskutner.com/wrongful-death/calculating-wrongful-death-settlements/

KWS (2008). *Amboseli Ecosystem Management Plan*, 2008-2018.

KWS (2010). *Mt. Kenya Ecosystem Management Plan*, 2010-2020.

KWS (2017). *ANNUAL REPORT 2017.* http://www.kws.go.ke/file/3247/download?token=U9aq559c

KWS. (2019). *Alert on increased incidences of human wildife conflict.* http://www.kws.go.ke/content/alert-increased-incidences-human-wildlife-conflict-0

KWS. (2020a). *National Recovery and Action Plan for Lion and Spotted Hyena in Kenya (2020-2030).*

KWS. (2020b, August 12). *Woman trampled by an elephant in Amboseli.* https://twitter.com/kwskenya/status/1237613468829642752/photo/1

Lamarque, F., Anderson, J., Fergusson, R., Lagrange, M., Osei-Owusu, Y., and Bakker, L. (2009). *Human-wildlife conflict in Africa: causes, consequences and management strategies* (No. 157). Food and Agriculture Organization of the United Nations (FAO).

Latour, B. (2004a). How to talk about the body? The normative dimension of science studies. *Body and Society* 10, 205-229.

Lekolool, I. (2012, January). Mega-translocations: the Kenya Wildlife Service at its best. In *The George Wright Forum* (Vol. 29, No. 1, pp. 93-99). George Wright Society.

Lesilau, F., Fonck, M., Gatta, M., Musyoki, C., van 't Zelfde, M., Persoon, G. A., . . . de longh, H. H. (2018). Effectiveness of a LED flashlight technique in reducing livestock depredation by lions (Panthera leo) around Nairobi National Park, Kenya. *PLoS ONE, 13*(1). doi:https://doi.org/10.1371/journal.pone.0190898

Long, Huaping; Mojo, Dagne; Cha Fu, Icon; Wang, Guoqin; and Kanga Erustus. (2020). Patterns of human-wildlife conflict and management implications in Kenya: A national perspective. *Human Dimensions of Wildlife*, *25*(1). https://doi.org/10.1080/10871209.2019.1695984

Lu, W., Casanueva, M.O., Mahowald, A.P., Kato, M., Lauterbach, D., Ferguson, E.L. (2012). *Niche-associated activation of rac promotes the asymmetric division of Drosophila female germline stem cells*. PLoS Biol. **10(7)**: e1001357.

Mackenzie, C. A., and Ahabyona, P. (2012). Elephants in the garden: financial and social costs of crop raiding. *Ecological economics*, *75*, 72-82.

Madden, F. M. (2004). Creating Coexistence between Humans and Wildlife: Global Perspectives on Local Efforts to Address Human-Wildlife Conflict. *Human Dimensions of Wildlife*, 9:247-257.

Madden, F. M. and Nyhus, D. (2003). Taking the Bite out of Wildlife Damage: The Challenges of Wildlife Compensation Schemes. *Conservation in Practice,* 4(2): 37-43.

Madden, F.M. and McQuinn, B. (2014). Conservations blind spot: The case of conflict transformation in wildlife conservation. *Biological Conservation*, 178: 97– 106.

Madhusudan, M. (2003). Living admist large wildlife:Livestock and crop depredation by large mammals in the interior villages of Bhadra Tiger Reserve, South India. *Environmental Management, 31*(4), 466-475.

Makau, I. K. (2016). *Health burden of Wildlife Induced Injuries Among the Maasai Cattle Herders In Kajiado County, Kenya*. PhD Thesis, Kenyattta University.

Manfredo, M. J. (2008). *Who cares about wildlife?: Social science concepts for exploring human-wildlife relationships and conservation issues*. Springer.

Manfredo, M.J., Vaske, J.J. and Decker, D.J. (1995) Human Dimension of Wildlife Management: Basic Concepts. In Knight, R.L and Gutzwiller, K. (eds) (1995). Wildlife and Recreationist: Coexistence Through Management and Research. Island Press.

Manoa, D. O. (2015). Perceptions toward cost-sharing projects in hard times: Lessons from Amboseli, Kenya. *International Journal of Recent Research in Social Sciences and Humanities (IJRRSSH)*, 2 (4): 73-178.

Manoa, D. O., Mwaura, F., Thuita, T., and Mukhovi, S. (2020a). A Review of the Visible and Hidden Opportunity Costs of Human-Wildlife Conflict in Kenya. *J Biodivers Manage Forestry 9, 2*, 2. doi: 10.37532/jbmf.2020.9(2).228

Manoa, D. O., Mwaura, F., Thenya, T., and Mukhovi, S. (2020b). Comparative analysis of the typology, seasonality and economic cost of human-wildlife conflict in Kajiado and Laikipia Counties, Kenya. *East African Journal of Science, Technology and Innovation, 1*(4). https://doi.org/10.37425/eajsti.v1i4.188

Manoa, D.O, and Kasaine, S. (2019, July 21). Lions and People. (W. Travers, & C. Nicholls, Eds.) *Widlife Times-Kenya Edition*(1). https://www.bornfree.org.uk/publications/wlt-kenya-summer-2019

Manoa, D.O. and Mwaura, F. (2016). Predator-Proof Bomas as a Tool in Mitigating Human-Predator Conflict in Loitokitok Sub-County, Amboseli Region of Kenya. Natural Resources, **7**: 28-39. http://dx.doi.org/10.4236/nr.2016.71003

Marchand, F. (2002). *Management of human-wildlife conflicts in the region of Bormo, Burkina Faso.* IUCN. French Committee.

Mariki, S. B. (2016). Social Impacts of Protected Areas on Gender in West Kilimanjaro, Tanzania. *Open Journal of Social Science*, 4: 220-235.

Marindany, K. (2018, January 15). Maasai morans kill two jumbos from Amboseli. *The Star*: https://www.the-star.co.ke/news/2018-01-15-maasai-morans-kill-two-jumbos-from-amboseli/

Mariru, P. (2015, September). What about Public Participation? Where Are We? International Institute for Legislative Affairs Board. http://ilakenya.org/what-about-public-participation-where-are-we/

Mashalla, A., and Ringo, J. (2015). Status of Human-Wildlife Conflict in Mpanga/Kipengera Game Reserve, Tanzania. *10*(1), 26-40. http://www.modernscientificpress.com/Journals/ViewArticle.aspx?gkN1Z6Pb60HNQPymfPQlZJugqETe6imeWASObHTFL1BLREjK7NaYIVtG+B626QBN

Massé, F. (2016). The Political Ecology of Human-Wildlife Conflict: Producing Wilderness, Insecurity, and Displacement in the Limpopo National Park. *Conservation and Society*, 14(2): 100-111, 2016.

Mbaria, J. and Ogada, M. (2016). *The Big Conservation Lie. The Untold Story of Wildlife Conservation in Kenya*. Lens and Pens Publishing.

McGregor, D (2004). *Traditional Ecological Knowledge and Sustainable Development: Towards Coexistence In The Way of Development Indigenous Peoples, Life Projects and Globalization* (Mario Blaser, Harvey A. Feit, and Glenn McRae Zed Eds). IDRC

Meru County Government (2013). *First Meru County Integrated Development Plan 2013-2017.*

Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Synthesis*. Island Press.

Mishra, C. (1997). Livestock depredation by large carnivores in the Indian Trans-Himalaya: conflict perceptions and conservation prospects. *Environmental Conservation*, 24:338–343.

Moyana, F. (2014, July 31). Human-wildlife conflict threat to food security? *Chronicle*. https://www.chronicle.co.zw/human-wildlife-conflict-threat-to-food-security/

Mukeka, J. M. (2018). Characteristics of human-wildlife conflicts in Kenya: Examples of Tsavo and Maamai Mara Regions. *Environment and Natural Resources Research, 8(3)*(148).

Muldavin, J.S.S. (1996). *The Political Ecology of Agrarian Reform in China*. In Peet, R and Watts, M. (eds) (1996). Liberation Ecologies: Environment, Development, Social Movements. Routledge.

Muluken, M. F. (2014). Human-Wildlife Conflicts: Case Study in Wondo Genet District, Southern Ethiopia. *Agriculture, Forestry and Fisheries*, 3(5):352-362.

Muriuki, M., Ipara, H., & Kiringe, J. W. (2017). The cost of livestock lost to lions and other wildlife species in the Amboseli ecosystem, Kenya. *European Journal of Wildlife Research*, *63*(60). https://doi.org/10.1007/s10344-017-1117-2

Muruthi, P. (2005). *Human Wildlife Conflict: Lessons Learned from AWF's Africa Heartlands. African Wildlife Foundation Working Papers.* African Wildlife Foundation-Working Papers.

Musangi, L. (2020). Villagers fearful after stray lioness kills two cows in Mwingi. (P. Obuya, Ed.) Retrieved July 30, 2020, from *The Star*: https://www.the-star.co.ke/counties/eastern/2020-03-02-villagers-fearful-after-stray-lioness-kills-two-cows-in-mwingi/

Musyoki, C. (2014). Crop defense and coping strategies:wildlife raids in Mahiga "B" village in Nyeri District, Kenya. *African Study Monographs*, *35*(1).

Mutai, E. (2017, July 16). *MPs want pay for wild animal attacks limited to parks*. http://www.businessdailyafrica.com/news/MPs-want-pay-wild-animal-attacks-limited-parks/539546-3884004-11i4nml/index.html.

Mutinda, M., Chenge, G., Gakuya, F., Otiende, M., Omondi, P., Kasiki, S., Ramón C. Soriguer, R.C and Alasaad, S. (2014). Detusking Fence-Breaker Elephants as an Approach in Human-Elephant Conflict Mitigation. *9*(3). https://doi.org/10.1371/journal.pone.0091749

Mutune, J. (2017). The Use of Old Tapes as Scarecrows by Farmers to Protect Millet and Sorghum Against Birds in Machakos County in Eastern Kenya. *Innovative Techniques in Agriculture , 1*(3), 152-160.

Mutura, J. (2020, August 15). KWS clashes with community after poisoning of 18 birds and jackal. *The Standard*. https://www.standardmedia.co.ke/rift-valley/article/2001368985/kws-clashes-with-community-after-poisoning-of-18-birds-and-jackal

Mwangi, D. K., Akinyi, M., Maloba, F., Ngotho, M., Kivai, S., Kagira, J., and Ndeereh, D. (2016). Socioeconomic and health implications of human wildlife interactions in Nthongoni, Eastern Kenya. *African Journal of Wildlife Research, 46*(2): 87-102.

Mwathe, K.M (2007). *The nature, economic costs and management strategies for human wildlife conflict in Magadi area, South Rift Kenya.* Master's Thesis, University of Nairobi.

Mwaura, F., Kiringe, J. W., Warinwa, F., and Wandera, P. (2016). *Estimation of the Economic Value for the Consumptive Water Use Ecosystem Service Benefits of the Chyulu Hills Watershed, Kenya.* Unpublished Article.

Naha, D. S. (2019). Assessment and prediction of spatial patterns of human-elephant conflicts in changing land cover scenarios of a human-dominated landscape in North Bengal. *PLoS ONE, 14*(2). https://doi.org/10.1371/journal.pone.0210580

Naidoo, R., Balmford, A., Costanza, R., Fisher, B., Green, R.E., Lehner, B., Malcolm, T. R., and Ricketts, T. H. (2008). *Global mapping of ecosystem services and conservation priorities* Proceedings of the National Academy of Sciences, USA 105: 9495–9500.

Naughton-Treves, L. (1998). Predicting patterns of crop damage by wildlife around Kibale National Park, Uganda. *Conservation biology*, *12*(1): 156-168.

Naughton-Treves, L., and Treves, A. (2005). Socio-ecological factors shaping local support for wildlife: crop-raiding by elephants and other wildlife in Africa. *Conservation biology series-cambridge*, *9*, 252.

Ndegwa, D. (2019, August 3). Set high production targets for all crops (Maize case study). *Society of Crop Agribusiness Advisors of Kenya*. http://socaa.or.ke/set-high-production-targets-for-all-crops-maize-case-study/#:~:text=Through%20a%20maize%20growing%20budget,above%20Ksh%201500%20per%20bag.

Nelson, R. H. (2003). Environmental colonialism:" saving" Africa from Africans. *The Independent Review*, *8*(1) 65-86.

Nemtzov, Simon C. and Galili, Eli. (2006). A New Wrinkle on an Old Method: Successful Use of Scarecrows as a Non-Lethal Method to Prevent Bird Damage to Field Crops in Israel. In R. M. Timm, & J. M. O'Brien (Ed.), *Proceedings of the Vertebrate Pest Conference* (pp. 222-224). University of California. doi:10.5070/V422110080

Neumann, R. (1992). Political ecology of wildlife conservation in the Mt. Meru Area of northeast Tanzania. *Land Degradation and Rehabilitation*, 3, 85-98.

Ngene, S., Okello, M. M., Mukai, J., Moya, S., Njumbi, S., and Isiche, J. (2017). Home range sizes and space use of African elephants (Loxondonta africana) in the Southern Kenya and Northen Tanzania boarderland landscape. *International Journal of Biodiversity and Conservation*.

Ngene, S.M and Omondi, P. (2008). The costs of living with elephants in the areas adjacent to Marsabit National Park and reserve. Pachyderm, 45 July 2008–June 2009.

Ngene, S.M. and Omondi, P. (2005). *Elephants and Man Destroy Vegetation in Marsabit Protected Area, Northern Kenya*. A technical report to United States Fish and Wildlife Service, Nairobi, Kenya.

Noe, C. (2003). Dynamics of land use changes and their impacts on the wildlife corridor between Mt. Kilimanjaro and Amboseli National Park, Tanzania. LUCID Working paper No. 31, ILRI.

North, D.C. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge University Press.

Nyaligu, M.O. and Weeks, S. (2013). An Elephant Corridor in a fragmented conservation landscape: preventing the isolation of Mount Kenya National Park and National Reserve. *Parks*, 19(1), 91-102

Nyamwamu, R. O. (2016). Implications of Human-Wildlife Conflict on Food Security among Smallholder Agro-Pastoralists: A Case of Smallholder Maize (Zea mays) Farmers in Laikipia County, Kenya. *World Journal of Agricultural Research, 4*(2), 43-48. doi: 10.12691/wjar-4-2-2

Nyhus, P. J., Osofsky, S. A., Ferraro, P., Madden, F., and Fischer, H. (2005). Bearing the costs of human-wildlife conflict: the challenges of compensation schemes. *Conservation Biology Series-Cambridge*,9, 107.

Ochieng, W. O. (1985). *A history of Kenya.* London: Macmillan Publisher Ltd.

Ogada, M., Woodroffe, R., Oguge, O.N. and Frank, G.L. (2003). Limiting depredation by African carnivores: the role of livestock husbandry. *Conserv. Biol*. 17, 1521–1530.

Ogra, M. (2008). Human-wildlife conflict and gender in protected area borderlands: A case study of costs, perceptions, and vulnerabilities from Uttarakhand (Uttaranchal), India. *Geoforum*, 39,1408-1422.

Ogra, M., and Badola, R. (2008). Compensating human–wildlife conflict in protected area communities: ground-level perspectives from Uttarakhand, India. *Human Ecology*, *36*(5), 717-729.

Ogutu, J. O.-P. (2016). Extreme wildlife declines and concurrent increase in livestock numbers in Kenya: What are the causes? *PloS One, 11*(9). doi:e0163249.

Oino, T., Osiemo, P., and Kuloba, R. (2012). *National Survey on Enterprises Perception of Insurance in Kenya.* Insurance Regulatory Authority. https://www.google.com/search?q=national+survey+on+enterprises+perception&rlz=1c1chbf_enke791ke791&oq=national+survey+on+enterprises+perception&aqs=chrome..69i57j69i60&sourceid=chrome&ie=utf-8

Ojwang, G.O., Wargute, P.W., Said, M.Y., Worden, J.S., Davidson, Z., Muruthi, P., Kanga, E., Ihwagi, F. and Okita-Ouma, B. (2017). *Wildlife Migratory Corridors and Dispersal Areas: Kenya Rangelands and Coastal Terrestrial Ecosystems*. Kenya Vision 2030 Flagship Project. Securing Wildlife Migratory Routes and Corridors.

Okello M.M, and Kioko, J. (2010). Contraction of wildlife dispersal area in Olgulului-Ololorashi Group Ranch around Amboseli National Park, Kenya. *Open Conserv*. Biol. J., 4: 28-39.

Okello, M. M., Bonham, R., and Hill, T. (2014). The pattern and cost of carnivore predation on livestock in maasai homesteads of Amboseli ecosystem, Kenya: Insights from a carnivore compensation programme. *6*(7), 502-521. https://academicjournals.org/journal/IJBC/article-full-text-pdf/492C21546199

Okello, M.M., Kiringe, J., Njumbi, J.S., and Isiche, J. (2016). Prevalence of human – elephant conflicts in Amboseli ecosystem, Kenya: Current opinions of local community. *International Journal of Biodiversity and Conservation,* 8(3), 60-71.

Okello, M.M., Njumbi, S.J., Kiringe, J.W. and Isiche, J. (2014*).* Prevalence and Severity of Current Human-Elephant Conflicts in Amboseli Ecosystem, Kenya: Insights from the

Field and Key Informants. *Natural Resources*, 5, 462-477. http://dx.doi.org/10.4236/nr.2014.59043

Okemwa, B. O. (2015). *Evaluating Anti-Predator Deterrent Against Lions in Group Ranches Surrounding Amboseli Park, Kenya.* MsC thesis, University of Nairobi, Nairobi.

Okoyo, M. (2016, July 21). Framers count losses as monkeys invade farms. *Hivisasa*. https://hivisasa.com/posts/farmers-count-losses-as-monkeys-invade-farms

Osanya, J., Adam, R. I., Otieno, D. J., Jaleta, M., and Nyikal, R. (2019). *An Analysis of Intra-household Spousal Decision-Making Intensities on Agricultural Income Use in Kenya: A Multinomial Logit Approach.* Working paper, Australian Centre for International Agricultural Research. https://simlesa.cimmyt.org/wp-content/uploads/Intrahousehold-decision-making-paper_Kenya-4.16.2019.pdf.

Osborn, F. V., & Parker, G. E. (2003). Towards an integrated approach for reducing the conflict between elephants and people: a review of current research. *Oryx, 37*(1), 80-84.

Owuor, S.O. (2011). Livelihood strategies of low-income households in Nakuru Town, Kenya. *HEKIMA Journal of the Humanities and Social Sciences,* 5 (1): 1-18.

Packer, C., Ikanda, D., Kissui, B., and Kushnir, H. (2005). Lion attacks on humans in Tanzania. *Nature*, *436*(7053), 927-928.

Parahoo, K. (1997). *Nursing research: principles, process and issues*. Basingstoke: Macmillan; 1997.

Parker, GE & Osborn, F.V. (2006). Investigating the potential for chilli Capsicum annuum to reduce human–wildlife conflict in Zimbabwe. *Oryx,* 40: 1-4.

Patterson, B.D., Kasiki, S.M., Selempo, E. & Kays, R.W. (2004). Livestock predation by lions (*Panthera leo*) and other carnivores on ranches neighbouring Tsavo national parks, Kenya. *Biological Conservation*, 119, 507-516.

Pearce, F. (2015, July 16). Kenya's electrified route to human-wildlife harmony. *NewScientist*. https://www.newscientist.com/article/mg22530104-200-kenyas-electrified-route-to-human-wildlife-harmony/

Peterson, M. N., Birckhead, J. L., Leong, K., Peterson, M. J., & Peterson, T. R. (2010). Rearticulating the myth of human-wildlife conflict. *Conservation Letters, 3*, 74-82. http://dx.doi.org/10.1111/j.1755-263X.2010.00099.x

Philips, A. (1998). *Economic Values of Protected Areas: guidelines for protected areas managers. Best practice protected area guidelines series no. 1*. The world Conservation Union, Gland.

Potgieter, C.G. (2011). *The Effectiveness of Livestock Guarding Dogs for Livestock Production and Conservation in Namibia*. Master's Thesis in Science , Nelson Mandela Metropolitan University.

Praxis. (1988). *Public involvement: planning and implementing public involvement programs*. Executive Overview. Calgary, Alta., Can. 13pp.

Quammen, D. (2019, December 8). Chimps and people are clashing in rural Uganda. *National Geographic*. https://www.nationalgeographic.com/animals/2019/11/chimps-and-people-are-clashing-in-rural-uganda-feature/

Redpath, S., Bhatia, S., and Young, J. (2015). Tilting at wildlife: Reconsidering human–wildlife conflict. *Oryx*, *49*(2), 222-225. https://doi.org/10.1017/S0030605314000799

Rheker, J.R. (1992). *Forest management and timber industry at Mount Kenya. Laikipia-Mount Kenya Report N0.16*. Laikipia Research Programme LRP. Group for Development and environment. Institute of Geography, University of Berne.

Robbins, P. (2004). Political Ecology. In John, P.J.II. (ed). *Critical Introduction to Geography*. Malden: Blackwell Publishing.

Robert, R. (2018, August 18). Insurance Flipsides: Countering the Industry's Negative Perception Problem (Comments). *Insurance Journal*. https://www.insurancejournal.com/blogs/insurance-flipsides/2018/05/10/488857.htm/?comments

Rossi, P.H., Wright, J.D., and Anderson, A.B. (ed). (1983). *Handbook of Survey Research*. Academic Press.

Ruaha Carnivore Project. (2020, July 20). Ruaha Carnivore Project. https://www.ruahacarnivoreproject.com/protecting-livelihoods/guarding-dogs/

Rust, N. A., Whitehouse-Tedd, K. M., and MacMillan, D. C. (2013). Perceived Efficacy of Livestock-Guarding Dogs in South Africa: Implications for Cheetah Conservation. *Wildlife Society Bulletin*, *37*(4), 690-697. https://www.jstor.org/stable/wildsocibull2011.37.4.690?seq=1

Salafsky, N. (2000). Linking Livelihoods and Conservation: A Conceptual Framework and Scale for Assessing the Integration of Human Needs and Biodiversity. *World Development*, 28(8):1421-1438.

Sayuni, B. and Mathew L. Sengelela. (2019). Coexisting with Wildlife: Its Effects on Pupils and Children in a Maasai Community, Tanzania. *Journal of Social and Political Sciences 2*(1), 142-159. DOI: 10.31014/aior.1991.02.01.56

Schwerdtner, K., and Gruber, B. (2007). A conceptual framework for damage compensation schemes. *Biological conservation*, *134*(3): 354-360.

Shackleton, C.M., Ruwanza, S., Sinasson Sanni, G.K., Bennett, S., De Lacy, P., Modipa, R., Mtati, N., Sachikonye, M., and Thondhlana, G. (2016). Unpacking Pandora's Box: Understanding and Categorising Ecosystem Disservices for Environmental Management and Human Wellbeing. *Ecosystems*, 19, 587

Sitati, N. W., Walpole, M. J. and Leader-Williams, N. (2003). Factors affecting susceptibility of farms to crop raiding by African elephants: using a predictive model to mitigate conflict. *Journal of Applied Ecology*, 42, 1175–1182

Sitati, N. W., Walpole, M., Leader-Williams, N., and Stephenson, P.J. (2012). Human-elephant conflict:Do elephants contribute to low mean grades in schools within elephant ranges? *International Journal of Biodiversity and Conservation, 4*(15), 614-620. https://doi.org/10.5897/IJBC12.005

Sitati, Noah; Walpole, Matt. J; and Leader-Williams, Nigel. (2005). Factors affecting susceptibility of farms to crop raiding by African elephants. *Journal of Applied Ecology, 42*(6), 1175-1182. doi:10.1111/j.1365-2664.2005.01091.x

Soto-Shoender, J. R., and Giuliano, W. M. (2011). Predation on livestock by large carnivores in the tropical lowlands of Guatemala. *Oryx, 45*(4), 561-568.

Speck, H. (1982). Soils of the Mount Kenya Area: their formation, ecological, and agricultural significance. *Mountain Research and Development*, 201-221.

Stannard, C and Cilliers, D. (2018). *Livestock guarding dog project progress report*. Cheetah Outreach Trust, South Africa.

Steinberg, B. (2013, August 18). Super Bowl ad prices rise: Worth the cost? (M. Jordan, Interviewer). *CBS News*. https://www.cbsnews.com/news/super-bowl-ad-prices-rise-worth-the-cost/

Stone, S. M. (2014). *The Psychology of Using Animals in Advertising.* Northwestern Oklahoma State University. Hawaii University International Conferences. https://silo.tips/queue/the-psychology-of-using-animals-in-advertising?&queue_id=-1&v=1597729890&u=NDEuODAuNDcuMTg5

Sukumar, R. (1990). Ecology of the Asian elephant in Southern India. II: Feeding habits and crop raiding patterns. *Journal of Tropical Ecology*, 6, 33 53

Syombua, M. J. (2013). *An Analysis of Human-Wildlife Conflicts in Tsavo West – Amboseli Agro-Ecosystem using an Integrated Geospatial Approach: A Case Study of Taveta District.* PhD Thesis, University of Nairobi.

Taylor, D. R. (1993). *Wildlife management and utilization in a Zimbabwean communal land: a preliminary evaluation in Nyaminyami District, Kariba*. WWF MAPS Project Paper No. 32 WWF Southern Africa Regional Office.

Taylor, R. G., J. P. Workman, and J. E. Bowns. (1979). The Economics of Sheep Predation in South-western Utah. *Journal of Range Management*, 34:317-321.

Tongco, M. D. C. (2007). Purposive Sampling as a Tool for Informant Selection. *A Journal of Plant, People and Applied Research Ethnobotany Research and Applications*, 1-12.

The Guardian. (2019, October 12). Marauding elephants kill three more people. *The Guardian*. https://www.ippmedia.com/en/news/marauding-elephants-kill-three-more-people

The IUCN Red List of Threatened Species (2017, June 17). Version 2017-1. <www.iu-cnredlist.org>.

The World Bank. (2019). Age dependency ratio (% of working-age population) - World Bank staff estimates based on age distributions of United Nations Population Division's World Population Prospects: 2019 Revision. *The World BanK.* https://data.worldbank.org/indicator/SP.POP.DPND?contextual=similar&locations=MW-ET-TZ-ZM-UG

Thirgood, S., Woodroffe, R., and Robinwitz, A. (2005).The impacts of human-wildlife conflict on human lives and livelihoods in *People and Wildlife or Coexistence?* Cambridge University press, PP.13-26.

Thouless, C.R. (1994). Conflict between humans and elephants on private land in northern Kenya. *Oryx*, 28, 119-127.

Towey, S. (2016, July 30). Impact of Fear and Anxiety. *Regents of the University of Minnesota*. https://www.takingcharge.csh.umn.edu/impact-fear-and-anxiety.

Treves, A. (2007). *Balancing the needs of people and wildlife: when wildlife damage crops and prey on livestock*. Land Tenure Center, Nelson Institute of Environmental Studies, University of Wisconsin.

Treves, A. and Naughton-Treves, L. (2005). *Evaluating lethal control in the management of human-wildlife conflict.* In Woodroffe, R., Thirgood, S. and Rabinowittz, A. (eds). People and wildlife: Conflict or coexistence? Cambridge University Press.

Treves, A., Wallace, R. B., and White, S. (2009). Participatory planning of interventions to mitigate human–wildlife conflicts. *Conservation biology*, *23*(6):1577-1587.

Treves, A., Wallace, R.B., Naughton-Treves, L., & Morales, A. (2006). Co-managing human-wildlife conflicts: A review, Human Dimensions of Wildlife: *An International Journal,* 11(6):383-396.

Tuqa, J.H., Funston, P., Musyoki, C., Ojwang, G.O., Gichuki, N.N., Bauer, H., Tamis, W., Dolrenry, S., Van't Zelfde, M., De Snoo, G.R. and De Iongh, H.H.(2014). Impact of severe climate variability on lion home range and movement patterns in Amboseli ecosyste, Kenya. *Global Ecology and Conservation, 2*, 1-10.

Twyman, J., Useche, P and Deere, C.D. (2015). Gendered Perceptions of Land Ownership and Agricultural Decision-Making in Ecuador: Who are the Farm Manager? *Land Economics 91 (3): 479-500, 91*(3), 479-500.

U.S. Department of Agriculture Animal and Plant Health Inspection Service Wildlife Services (USDA) (2013). *Wildlife Strikes to Civil Aircraft in the United States 1990–2013. Federal Aviation Administration National Wildlife Strike data base Serial Report Number 20*. USDA.

UNEP. (2020). *Consolidated Annual Financial Report of the Administrative Agent for The Lion Share Fund for the period 1 January to 31 December 2019.* United Nations Development Programme. http://mptf.undp.org/

UNEP-WCMC and IUCN (2016). Protected Planet Report 2016. UNEP-WCMC and IUCN: Cambridge UK and Gland, Switzerland. https://wdpa.s3.amazonaws.com/Protected_Planet_Reports/2445%20Global%20Protected%20Planet%202016_WEB.pdf

UNESCO (2020). Mount Kenya - Lewa Biosphere Reserve, Kenya. https://en.unesco.org/biosphere/africa/mount-kenya-lewa

USDA (2012, April 30). Maryland Farmers Estimate $10.0 Million in 2011 Wildlife Related Crop Losses [Press release]. https://www.nass.usda.gov/Statistics_by_State/Maryland/Publications/Wildlife_Damage/mpr04-12Wildlife.pdf

USIP (2001). *AIDS and Violent Conflict in Africa*. United States Institute of Peace.

Walpole M. J., Karanja, G.G., Sitati. N.W. and Leader-Williams, N. (2003). *Wildlife and People: Conflict and Conservation in Masai Mara, Kenya*. Wildlife and Development Series No.14, International Institute for Environment and Development.

Wang, S. and van Kooten, G.C. (1999). Silvicultural contracting in British Columbia: a transaction cost economics approach. *Forest Science*, 45 (2), 272–279.

Watson, R., Fitzgerald, K.H. and Gitahi, N. (2010). Expanding options for habitat conservation outside protected areas in Kenya: The use of environmental easements. African Wildlife Foundation Technical Papers Number: 2

Webber, A. D., Hill, C. M., and Reynolds, V. (2007). Assessing the failure of a community-based human-wildlife conflict mitigation project in Budongo Forest Reserve, Uganda. *Oryx, 41*(2), 177-184. https://doi.org/10.1017/S0030605307001792

Weinmann, S. L. (2018). *Impacts of Elephant Crop-Raiding on Subsistence Farmers and Approaches to Reduce Human-Elephant Farming Conflict in Sagalla, Kenya.* The University of Montana, Missoula, MT. https://scholarworks.umt.edu/etd/11194/?utm_source=scholarworks.umt.edu%2Fetd%2F11194&utm_medium=PDF&utm_campaign=PDFCoverPages

Western, D. (2005). *The Ecology and Changes of the Amboseli Ecosystem. Recommendation for Planning and conservation.* ARCP. A report submitted to: The Task Force for Developing the Amboseli Ecosystem Plan.

Western, D., and Waithaka, J. (2005). Policies for reducing human-wildlife conflict: a Kenya case study. *Conservation Biology Series-Cambridge, 9*: 357.

Western, D., Waithaka, J., and Kamanga, J. (2015). Finding Space for Wildlife Beyond National Parks and Reducing Conflict through Community-Based Conservation: The Kenya Experience. *Parks* (21), 1

Williamson, Oliver E (1985). The Economic Institutions of Capitalism, Free Press.

Woodroffe R., Frank L.G., Lindsey P.A., ole Ranah S.M.K., and Romañach S. (2006). Livestock husbandry as a tool for carnivore conservation in Africa's community rangelands: a case–control study. In A. T. Hawksworth, & D. L. Bull (Eds.), *Vertebrate Conservation and Biodiversity* (pp. 419-434). Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-6320-6_28

Woodroffe, R., Thirgood, S., and Rabinowitz, A. (2005a). *The impacts of human-wildlife conflict on natural systems. People and wildlife: Conflict or Coexistence*? (e.ds R. Woodroffe, S. Thirgood and A. Rabinowitz). Cambridge University Press.

WWF (2007). *Human-Wildlife Conflict*. Retrieved May 10, 2021, from https://wwf.panda.org/discover/our_focus/wildlife_practice/problems/human_animal_conflict/

WWF SARPO. (2005). *Human wildlife conflict manual.* WWF. Harare, Zimbabwe: WWF. Retrieved July 30, 2020, from https://wwfeu.awsassets.panda.org/downloads/human_wildlife_conflict.pdf

Yamane, T. (1967). *Statistics, An Introductory Analysis*, 2nd Ed., Harper and Row

Young, J.C., Marzano, M., White, R.M., McCracken, D.I., Redpath, S.M., Carss, D.N. et al. (2010) The emergence of biodiversity conflicts from biodiversity impacts: characteristics and management strategies. *Biodiversity and Conservation*, 19, 3973–3990. https://link.springer.com/article/10.1007/s10531-010-9941-7

Zakayo, F. (2014). *Human-crocodile conflicts in areas adjacent to Lake Rukwa and Momba River, Momba District, Tanzania*. Masters Dissertation, Sokoine University of Agriculture.

Zhang, L., and Wang, N. (2003). An initial study on habitat conservation of Asian elephant (Elephas maximus), with a focus on human elephant conflict in Simao, China. *Biological conservation*, *112*(3), 453-459.

Zhang, Y. (2000). Deforestation and forest transition: Theory and evidence in China. In: Palo M., Vanhanen H., (eds.), World Forests from deforestation to transition? Kluwer Academic, *The Netherlands*, 41–65.

Zhang, Y. (2001). Economics of transaction costs saving forestry. *Ecological Economics*, *36*(2), 197-204.

APPENDIX 1: QUESTIONNAIRE

UNIVERSITY OF NAIROBI
DEPARTMENT OF GEOGRAPHY & ENVIRONMENTAL STUDIES
RESEARCH: A COMPARATIVE ANALYSIS OF OPPORTUNITY, TRANSACTION AND HEALTH COSTS OF HUMAN-WILDLIFE CONFLICT IN AMBOSELI AND MT. KENYA ECOSYSTEMS

INTRODUCTORY STATEMENT:

Good morning/afternoon/evening, my name is David Manoa a Doctoral student from the University of Nairobi Department of Geography and Environmental Studies. I am carrying out a study to find out how the human-wildlife conflict problem interplays with people's social and economic aspects in your local area. I will therefore appreciate to hear your honest views and suggestions on this subject. Please feel free to ask me to repeat or clarify any question you will not have understood. I request you to carefully think over the past 12 months, as our discussion will be based on the HWC within this period.

Respondent No__

Name of the ecosystem___________________________________

County:____

Sub-County:____

Location:_____________________Sub-location:__________________________

Village name:____

GPS location of Household: X-coordinates_____________Y-coordinates________________

Approximate household distance from the park/reserve boundary (Km)____________

Household main land use activities____

PART 1: HOUSEHOLD (HH) CHARACTERISTICS

1. Gender: Male □ Female □
2. Marital status: □Married □Widowed □Divorced □Separated □Single
3. Age Category: □20-29yrs □30-39yrs □ 40-49yrs □ 50-59yrs □ 60-69yrs □Above 70yrs
4. Literacy level:

□ No formal education □ Primary certificate □ Secondary certificate □ College certificate □ College Diploma □ College/University 1st Degree □ Master's Degree □ Doctorate Degree

5. Total number of people in your household including you________

People in the HH	Gender (M/F)	Relation to the respondent	Age category (A,B, C,D E & F)	Highest Education level *(P, S, T)	Occupation	Main source of income	Estimated income per month (ksh)
Person 1							
Person 2							
Person 3							
Person 4							
Person 5							
Person 6							
Person 7							
Person 8							
Person 9							
Person 10							

Education level: P-primary; S-secondary; T-Tertiary); Age category A (20-29yr); B(30-39yrs); C(40-49yrs); D(50-59yrs); E(60-69yrs); F (70yrs and above); Relationship to respondent: 1-Spouse; 2-children; 3- Relative; 4-employee. Main Source of income: 1-No income; 2-waged labourer; 3-Crop farming; 4-livestock keeping; 5-business; 6-Full employment; 7-Others (specify)

6. Number of years you have lived in this village:

Less than 1 yr □ 1-5yrs □ 5-10yrs □ 10yrs and more.

Original home area:

County______________________Sub-county__________________Location_______________

7. House characteristics.

a). House type: □Make shift structure □Semi-permanent □Permanent house

b). Type of wall on the house: □Mud □Timber □Iron sheet □Brick/Stone

c). Type of roof: □Grass thatched □Iron sheet □Soil and cow dung □ Others:______________

d). Type of floor: □ Mud □ Concrete □ Wooden □ Mud and cow dung

8. Please tick the asset your household has below

Asset	Quantity	Estimated value(KES)
Radio		
Television		
Bicycle		
Generator		
Car		
Tractor		
Pick-up		
Lorry/Tracks		

9. Do you own livestock? □ Yes □No (*Please go to question 10*)

If Yes, please provide details below:

Livestock	Total in HH		No. received from relatives	No. given to relatives	No. consumed by HH	No. that died/killed (e.g., diseases, wildlife)			
						Killed by wildlife		Killed by diseases	
	Adult	Young				Adult	Young	Adult	Young
Cattle									
Sheep									
Goats									
Donkey									
Chicken, ducks, geese									
Pigs									
Others (specify)									

10. Household Land Tenure

a). Please indicate your Land holding status below:

□ I am squatter

□ Own land but I have no title. What is the of your land?___________

□ Own land (title, sale agreement, receipts, allotment letter). Please indicate size of land in acres____________

□ Leased land. Please indicate acreage you have leased ______________ and duration of lease in years/months____________and the lease amount per year/month_____________________

b). Seasonality and type of crops on your land.

Crops	**Size of the area grown (acres)**	**Total production last growing season in Kgs/bags**	***Ranking**

*Slightly Important=1; Important=2; Fairly Important=3; Very Important=4

c). Please indicate the total cost/expenses incurred to produce the above crops per year

Expenses	**Quantity**	**Unit price**	**Total Cost (KES)**
Wages			
Seeds			
Farm equipment			
Chemicals (pesticides & herbicides)			
Fertilizers			
Transport			

11. Are there months over the last 12months that your household did not get enough food from all the sources of food (such as farming, relief food, borrowed food, gifts) to meet your family's needs? □Yes □No

If Yes, please indicate the months below:

□Jan □Feb □Mar □Apr □May □June □July □Aug □Sept □Oct □Nov □Dec

What were the reasons for the shortage of food?

PART 2: HUMAN-WILDLIFE CONFLICT COSTS

12. Do you normally see wildlife in this area? □Yes No□. If Yes, how often? □Daily □Once a week□ Twice a week □Thrice a week □Four times a week, □Five times □Six times □Occasionally

13. What type of wildlife species are common in this area? (*Respondent to be shown pictures plates of different wildlife for ease of identification*)

Wildlife species	**Time when frequently spotted around your home**			**When was the last encounter, and how many were they?**		**How often do you see them in a month?**
	Day time	**At night**	**Both day and night**	**Month of encounter**	**Numbers**	

SECTION I: CROP DAMAGE/LOSS COSTS

14. Have you had any crop raiding by wildlife in the last 12 months? □Yes □No

If NO, please explain your answer above:________________________________

15. If YES above, please provide the details below:

Wildlife species	**Crop dam-aged**	**Quantity (kgs)**	**Area planted (Acres)**	**Area damaged by wildlife (Acres)**	**Average yield Kg/yr/unit**	**% of yield lost**
Total						

Economic loss =[Volume of crop loss = Area damaged by wildlife x Average yield x % of yield loss] x [market value of the crop]

16. Please rank the identified wildlife species above from the **Most problematic** to **the Least problematic** on crop raiding on the scale of 1-4 where 4 is the most problematic and 1 the least problematic

Wildlife species	***Ranking**

Least problematic=1, Moderate problematic=2, Problematic=3; Most problematic=4

17. In your opinion, how would you describe intensity of crop raiding problem?

□ Not a problem □ Moderate problem □ Severe problem □ Don't know

18. Does crop-raiding reduce the amount of food consumed in your household?

□ Strongly Agree □ Agree □Disagree Strongly Disagree□ Disagree □Don't know

19. From your past experience, when is crop raiding incidences very high in your area?

□Wet season □ Dry seasons

Please give reasons

20. In which month of the year is crop raiding very high?

□Jan □Feb □March □April □May □June □July □August □September □October □November □December

21. Why do you think crop raiding is very high in the months you have selected above?

22. Did you replant the crops that were destroyed by wildlife? □Yes □No

If No, where did you get food for your family the rest of the year?

If Yes, how many days did you take to plant crop again?_____

Did you grow the same crop, or you changed?______________________Please give a reason.

Please indicate the total cost you incurred to replant the crops

Expenses	Quantity	Unit Cost (KES)	Total (KES)
Seedlings/seeds			
Ploughing			
Labour cost/ No. of family members involved			
Fertilizer and pesticides			
Transport			
Other cost (specify)			

What was the final quantity and quality of the crops yielded (Kgs)

Crop type	Quantity (Kgs)	Expected Qnty with no crop raiding	*Quality rating

*Low, Medium, High

23. When your crops were damaged, did you file a compensation claim to the Kenya Wildlife Service? □Yes □No

If Yes, please explain your answer

____

If No, why?

____

24. Have you used any methods to prevent crop raiding by wildlife in the last 12 months?
□Yes □No (Please give a reason):____

If Yes, please provide the following information?

*Highly ineffective=1; Ineffective=2; Moderately effective=3; Effective=4; Highly effective=5

25. Suppose that the Government of Kenya (GoK) through the Kenya Wildlife Service was to compensate you (in Kenya Shillings) for total crops loss you incurred for the last 12 months:

a). What is the Maximum amount you would expect? Ksh___________________________

b). What is the minimum amount you would expect? Ksh_________________________

And suppose the GoK was to prevent loss of your crops through the Most effective mitigations measures (______________________) you identified above, how many bags of your MOST IMPORTANT CROP would you be willing to give to GoK at the end of 12 months for maximised crop yield and returns? __________________bags

SECTION II: LIVESTOCK LOSS COSTS

26. Have any of your livestock been killed or injured by wild animals in the last 12 months?
□Yes □ No

If yes, provide details:

Chronology of incidents	Cattle killed	Goat killed	Sheep killed	Donkey killed	Cattle injured	Goats injured	Sheep injured	Donkey injured	Wildlife species that attached livestock	Time of attack(Night/Day)	Season of attack (Wet/Dry)	Month of the year
Incident 1												

Incident 2											
Incident 3											
Incident 4											
Incident 5											
Incident 6											
Incident 7											
Incident 8											
Incident 9											
Incident 10											
Total											

27. Did you report the livestock attacks to KWS? □Yes □ No. If No, please give reasons for not reporting the occurrences above.

28. How would you rate the problem of livestock attack within your HH?

□ Not a problem

□ Moderate problem

□ Severe problem

□ Don't know

29. Which methods have you used to protect your livestock against wildlife attacks and how effective have they been for the last 12 months?

Mitigation measures	**Target wildlife species**	***Ranking of the Effectiveness of the method**					**Indicate the numbers of goats, sheep, cattle, donkeys, pigs, chicken you sold to implement the mitigation method or the amount you used (if from other sources and not livestock.)**							
							Goats	**Sheep**	**Cattle**	**Donkey**	**Pigs**	**Chicken**	**Others**	**Amount (Ksh)**
		1	2	3	4	5								
		1	2	3	4	5								
		1	2	3	4	5								
		1	2	3	4	5								
		1	2	3	4	5								

		1	2	3	4	5								
		1	2	3	4	5								

*Highly ineffective=1; Ineffective=2; Moderately effective=3; Effective=4; Highly effective=5

30. A). Suppose that the GoK new policy was to pay people in Kenya shillings per year to continue experiencing livestock attacks. What is the maximum and the minimum amount you would expect to be paid per year?

Maximum amount in Ksh______________________________

Minimum amount in Ksh__________________________________

B). And suppose the GoK implemented your MOST effective mitigation measure you have identified above to protect your livestock for a period of 12 months, and as a new policy you are required to compensate GoK with livestock. What is the Maximum number of Goats__; Sheep__; Cattle__; Donkey__; Pigs___; and Chicken__ would you be willing give to the GoK in 12 months.

SECTION III: HUMAN DEATH AND INJURIES COSTS

31. Have you or any member of your family who live in this house had any type of injury or killed by wildlife in the last 12 months? □Yes □No

32. If Yes, please indicate their details below:

Gender (M/F)	**Relation to respondent**	**Marital status**	**Age**	**Status of victim**		**Wildlife species involved**	**Place of attack**	**Time of attack**		**Part of the body injured**	**Occupation**
				Injured	Killed			**Day/night**	**Date/month/year**		

33. Please indicate what care was given to the injured person and by whom below

	Type of treatment (Home or hospital treatment)	Person who took care of the in-jured	Amount used for treatment (Ksh)	Distance travelled to get treat-ment	Number of trips made so seek treat-ment	Time taken to and from the treat-ment point	Total amount used for transport
Victim 1							
Victim 2							
Victim 3							
Victim 4							
Victim 5							
Victim 6							

34. Did the injured person suffer any disability that prevented them to perform their usual activities or work or attend school because of the injury? □Yes □No

If Yes, please indicate the nature of disability

□ Inability to use hand or arm or decreased strength or pain on motion of the extremity

□ Walk with a limp

□ Unable to walk at all

□ Loss of eyesight

□ Unable to breathe normally

□ Paralysed

□ Others (specify):____

35. For how long was the injured person not able to perform their usual daily activity or work? _______

36. Was there any reduction of cash income because of the injured person not engaging in cash generating activities? □Yes □No

If Yes, how much for that period? _____

37. Was the injured person now able to perform his/her usual activities? □Yes □No

If No, how is your Household catering for the decrease in the income?

38. Please indicate the measure you have put in place to prevent further human injuries and possible death.

□ Working adult members arrive home early than usual from their daily activities

□ Adults delay reporting to work/or to their daily income generating activities

□ Children delay reporting to school in the morning

□ Children leave early from the school

□ Children are escorted to and from school by an adult

□ Fenced the homestead

□ I have Dogs to alert of wildlife invasion

□ Fetching of water and firewood done when wildlife has retreated into the park/forest

□ Reduced frequency of visit to neighbours and friends

□ Others (please clarify):____

SECTION IV: OTHER PROPERTY DAMAGE COSTS

39. Other than loss of lives, crop damage and livestock, has your household experienced any other property damage as result of wildlife in the last 12 months? □ Yes □ No

If Yes above, please provide the details of the damaged properties below:

Property	**Wildlife species involved**	**Property value (KES)**	**Time of damage(Day/Night)**

Did you repair the damaged properties? □Yes □No

If Yes, please specify the property repaired, time you used for repairs and the amount spent in the last 12 months.

Property damaged	**Time used (hours, days)**	**Amount used for repair(KES)**

40. Have you used any mitigation measure to prevent any further damage to your properties?
□Yes □No

If No, please give a reason

If Yes, please indicate the method you have used in the last 12 months and the cost incurred.

Method used	**Targeted wildlife species**	**Amount used in KES**	**Time it takes to implement the methods (hours)**

41. In the last 12 months, have you or your family members guarded your crops, livestock and properties against wildlife damages? □Yes □No

If Yes, please give the details below:

Livestock guarding

	No. of people guarding at a go	**Hours spent per Day time**	**Hours spent per Night time**	**Rate of guarding per month**	**Foregone activity while guarding**	**Estimated Amount (KES) the foregone activity would have generated**	**Amount (KES) spent on guarding**
Self							
Family members							
Hired labourers							

Crop guarding

	No. of people guarding at a go	**Hours spent per Day time**	**Hours spent per Night time**	**Rate of guarding per month**	**Foregone Main activity while guarding**	**Estimated Amount (KES) the foregone activity would have generated**	**Amount (KES) spent on guarding**
Self							

Family members							
Hired labourers							

Properties guarding

	No. of people guarding at a go	**Hours spent per Day time**	**Hours spent per Night time**	**Rate of guarding per month**	**Foregone Main activity while guarding**	**Estimated Amount (KES) the foregone activity would have generated.**	**Amount (KES) spent on guarding**
Self							
Family members							
Hired labourers							

42. During the crop, livestock and property guarding, did you construct any structures (e.g., watchtowers, make shift houses among others) or purchase any items (e.g., torches, battery) for this exercise? □Yes □No

If Yes, please list the structures and items purchased and the associated cost for the last 12 months.

Structure/Item	**Qnty**	**Unit Cost (KES)**	**Total (KES)**

43. Other than financial cost associated with guarding crops, livestock and properties guarding, please tick the other negative effects your HH experienced while guarding in the last 12 months.

Negative effects of guarding	**How much would you be willing to pay to the GoK HWC mitigation programme per day in Kenya Shillings for each of the activity to get rid of the negative effects associated with guarding livestock, crops and properties? (WTP)**	**Suppose the GoK HWC programme was to pay you in Kenya Shillings to continue experiencing the various negative effects associated with guarding your livestock, crop and properties. How much in Ksh would you accept to be paid per day? (WTA)**
a) Diseases		
b) Fear		
c) Travel restriction		
d) Missing social gathering		
e) School absenteeism		
f) Loss of sleep		
g) Family gathering and bonding		

SECTION V: COMPENSATION COSTS

44. Are you aware that the government can compensate you for damages caused by wildlife?

□Yes □ No

If Yes, what is the maximum amount in Kenya Shilling is paid for:

a). A human death________________________

b).Human body injury that results to permanent disability______________________

c). Any other body injury for human beings______________________________

45. Have you received any compensation/consolation for the wildlife damages you experienced for the last 12 months? □Yes □ No

If No, please give reasons

If Yes, please specify the damage/loss, the compensation paid, the source, and wildlife species involved.

Wildlife damage/loss	**Wildlife species involved**	**Amount Compensated (Ksh)**	**Amount you desired to be compensated with (KES)**	**Time taken to receive the Compensation**	**Distance travelled (Km)**	**Number of trips**	**Amount spent on transport(KES)**

46. Were you satisfied with the amount compensated for the damages/loss by wildlife? □Yes □No

If No, please give your reasons:

47. When you presented your case for compensation, was it honestly processed or did the compensation claim officers ask for a bribe? (*Respondents confidentiality of the information to be reassured before asking the questions*)________________________

How much bribe in KES did the officer demand?__________________________________ And how much did you end up paying in Ksh?___________________________________

48. What was the main source of your money you used to process the compensation claim?

□Crops □Livestock □Poultry □Salary □Borrowed from a friend/neighbour

From your experience of compensation, please rate the following stages during the compensation claim process on the scale of 1-5, where: Poor=1; Fair=2; Good=3; Very good=4; Excellent=5

Process	**Ranking**				
Timely response by the GoK wildlife assessor to reported cases of HWC	1	2	3	4	5
Rate of CWCCC meeting to hear HWC cases	1	2	3	4	5
Payment of claims to the affected people	1	2	3	4	5
Estimating the value for the damage by wildlife	1	2	3	4	5
Receiving HWC complains from people	1	2	3	4	5

From your past experiences, do you think compensation is an effective measure to reduce HWC? □Yes □No

Please explain:

49. In your opinion, what would be the appropriate way for the GoK to process and pay compensation for wildlife to victims?

50. Please rate the following methods capability in solving the HWC in your area, where Highly ineffective=1; Ineffective=2; Moderately effective=3; Effective=4; Highly effective=5

Method	Rating				
Regular ranger patrols	1	2	3	4	5
Insurance schemes	1	2	3	4	5
Compensation schemes	1	2	3	4	5
Fencing the park/reserve	1	2	3	4	5
Shooting problem animals	1	2	3	4	5
Translocation of problem animals	1	2	3	4	5
Traditional methods	1	2	3	4	5
Wildlife repellents e.g., chilli and smoke)	1	2	3	4	5
Consumptive Wildlife utilisation (e.g., spot hunting)	1	2	3	4	5
Non-Consumptive wildlife utilisation (e.g., tourism)	1	2	3	4	5
Community education on how manage problem animals	1	2	3	4	5

APPENDIX 2: INTERVIEW GUIDE FOR KEY INFORMANTS

INTRODUCTORY STATEMENT

Good morning/afternoon/evening, my name is David Manoa a Doctoral student from the University of Nairobi Department of Geography and Environmental Studies. I am carrying out a study to find out how the human-wildlife conflict problem interplays with people's social and economic aspects in your local area. I will therefore appreciate to hear your honest views and suggestions on this subject. Please feel free to ask me to repeat or clarify any question you will not have understood.

Date: ___________Profession:____________No. of years in the profession: __________

Interview questions

1. What is your understanding of Human-wildlife conflict?
2. What are the key causes of HWC in Kenya? Are these the same causes in this area?
3. In your opinion, how often did HWC occur in this area 5-10 years ago? How does the current HWC occurrence compare to say 5-10 years ago?
4. What are the impacts of HWC on wildlife?
5. What are the impacts of HWC on people's:
    i. Security?
    ii. Education?
    iii. Movements?
    iv. Health?
    v. Food security?
    vi. Social interactions
    vii. Attitudes
    viii. Livestock
    ix. Crops
    x. Physical properties
6. In your opinion, do you think financial compensation for HWC is a sustainable strategy?
7. Is it justifiable to use the tax payer money to compensate people for wildlife damage?
8. What mechanisms do you think can help improve the financial compensation scheme?
9. Apart from the financial compensation schemes, are there other appropriate and sustainable strategies that the government can use?
10. What do you think are the appropriate ways of community and the government addressing the hidden costs of HWC?
11. What do you think is the underlying causes of HWC?
12. In your opinion what are appropriate resolution mechanism for the underlying causes of HWC?

APPENDIX 3: ORIGINALITY REPORT

16/12/2022, 10:15 Turnitin - Originality Report - A COMPARATIVE ANALYSIS OF OPPORTUNITY, TRANSACTION AND HEALTH COSTS OF ...

Turnitin Originality Report

Processed on: 16-Dec-2022 08:56 EAT
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D.O. Manoa, F. Mwaura, T. Thenya, S. Mukhovi. "Comparative analysis of time and monetary opportunity costs of human-wildlife conflict in Amboseli and Mt. Kenya Ecosystems, Kenya", Current Research in Environmental Sustainability, 2021

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http://erepository.uonbi.ac.ke/bitstream/handle/11295/154535/Kemboi%20Togoch%20final%20phd%20thesis%202020.pdf?isAllowed=y&sequence=1

APPENDIX 4: NACOSTI RESAERCH PERMIT

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471,
2241349,3310571,2219420
Fax:+254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No. **NACOSTI/P/18/38627/23786**

Date: **27th July, 2018**

David Owino Manoa
University of Nairobi
P.O. Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"A comparative analysis of opportunity, transaction and health costs of human-wildlife conflict in Amboseli and Mt. Kenya Ecosystems"*** I am pleased to inform you that you have been authorized to undertake research in **Kajiado, Laikipia and Meru Counties** for the period ending **25th July, 2019.**

You are advised to report to **the County Commissioners and the County Directors of Education, Kajiado, Laikipia and Meru Counties** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Kajiado County.

The County Director of Education
Kajiado County.

APPENDIX 5: KWS RESEARCH AUTHORZATION LETTER

KENYA
WILDLIFE
SERVICE

KWS/BRPM/5001

23 May 2019

Mr. David Manoa Owino
University of Nairobi
P.O.Box 30197-00100
NAIROBI
E-mail: manoa@bornfree.or.ke
0721550317

Dear

PERMISSION TO CONDUCT RESEARCH IN AMBOSELI, MERU AND MT. KENYA AREAS

We acknowledge receipt of your application requesting for permission to conduct research on a project titled: **'A comparative analysis of opportunity, transaction and health costs of human-wildlife conflict in Amboseli, Meru and Mt. Kenya Areas'**. The study will generate data and information that will assist in mitigating human-wildlife conflicts in Kenya.

You have been granted permission to conduct the study from **May 2019 – May 2022** upon payment to KWS research fees of **Ksh.12,000** (PhD Study). However, you will abide by the set KWS regulations and guidelines regarding the carrying out of research in and outside protected areas. You will also be required to discuss your research proposal with our Senior Scientists in charge of Southern, Eastern and Mountain Conservation Areas before embarking on the field work.

You will submit a bound copy of your PhD thesis to the KWS Director, Biodiversity Research and Planning on completion of the study.

Yours

for
PATRICK OMONDI, PhD, OGW
DIRECTOR
BIODIVERSITY RESEARCH AND PLANNING

Copy:

- Assistant Director – MCA,SCA,ECA
- Senior Scientist, MCA, SCA,ECA
- Senior Warden, Mt. Kenya, Meru, &Amboseli National. Parks
- Senior Warden, Laikipia County,
- Wardens- Kajiado County, Meru Station

P.O Box 40241-00100, Nairobi, Kenya.
Tel: +254-020-2379407/8/9-15. Mobile: +254-735 663 421, +254-726 610 508/9.
Email: kws@kws.go.ke Website:www.kws.go.ke

APPENDIX 6: LAIKPIA COUNTY RESEARCH AUTHORIZATION LETTER

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY
STATE DEPARTMENT OF EDUCATION
COUNTY DIRECTOR OF EDUCATION OFFICE - LAIKIPIA

Telegrams: "Education" LKP.
Telephone: 062-31518, 31519
Email:laikipiacountydirector@yahoo.com

County Director of Education,
Laikipia County,
P.O. Box 253.
NANYUKI.

HARAMBEE

When replying please quote:
Ref: LPA/C/A/96. VOL.I/(23)

8th march, 2019

TO: WHOM IT MAY CONCERN

RE: RESEARCH AUTHORITY – DAVID OWINO MANOA

The National Commission for Science, Technology and Innovation letter ref. No. **NACOSTI/P/18/38627/23786** dated **27th JULY, 2018** refers.

This is to inform you that the above named person has been authorized to carry out research on **"A comparative analysis of opportunity, transaction and health costs of human-wildlife conflict in Amboseli and Mt .kenya ecosystems"** for a period ending **25th July, 2019.**

After completion of your research findings please furnish this office with a copy of the research.

Kindly assist him where possible.

COUNTY DIRECTOR OF EDUCATION
LAIKIPIA
P.O Box 253 - 10400
NANYUKI

SUSAN MURERWA (MRS)
COUNTY DIRECTOR OF EDUCATION
LAIKIPIA

C.C.
National Commission for Science,
Technology and Innovation,
NAIROBI.

The County Commissioner,
LAIKIPIA

ISO 9001:2008 CERTIFIED

SGS

APPENDIX 7: KAJIADO COUNTY RESEARCH AUTHORIZATION LETTER

THE REPUBLIC OF KENYA

THE PRESIDENCY

Telegrams: "DISTRICTER", Kajiado
Telephone: 0203570295
Fax: 0202064416
E-mail: kajiadocc2012@yahoo.com
Kajiadocc2012@gmail.com

MINISTRY OF INTERIOR
AND COORDINATION
OF
NATIONAL GOVERNMENT

OFFICE OF THE COUNTY
COMMISSIONER
KAJIADO COUNTY
P.O BOX 1-01100
KAJIADO

When replying please quote

Ref. KJD/CC/ADM/45 VOL II (140)

20th March, 2019

David Owino Manoa
University of Nairobi
P.o. Box 30197-00100
NAIROBI

RE: RESEARCH AUTHORIZATION: DAVID OWINO MANOA

Following the request made on your behalf by National Commission for Science, Technology and Innovation vide letter Ref. No. NACOSTI/P/18/28627/23786 Dated 27th July, 2018

You are hereby granted the above authority to carry out research on "A **Comparative analysis of opportunity, transaction and health costs of human-wildlife conflict in Amboseli and Mt Kenya Ecosystems**" for a period ending **25th July, 2019.**

It is expected you adhere to research ethics in doing your study.

JACK MBISO
FOR: COUNTY COMMISSIONER
KAJIADO COUNTY

CC:
All Deputy County Commissioners
KAJIADO COUNTY

County Director of Education
KAJIADO COUNTY

APPENDIX 8: MERU COUNTY RESEARCH AUTHORIZATION LETTER

THE PRESIDENCY
MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT

Telegrams:
Telephone:
Email: ccmeru@yahoo.com
Fax:

COUNTY COMMISSIONER
MERU COUNTY
P.O. BOX 703-60200
MERU.

When replying please quote
Ref: ED.12/VOL.III/107
And Date

17th April, 2019

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION – DAVID OWINO MANOA

This is to inform you that **David Owino Manoa** of University of Nairobi, has reported to this office as directed by the Commission for Science, Technology and Innovation and will be carrying out Research on **"A comparative analysis of opportunity, transaction and health costs of human-wildlife conflict in Amboseli and Mt. Kenya Ecosystems, Meru County, Kenya."**

Since authority has been granted by the said Commission, and the above named student has reported to this office, he can embark on his research project for a period ending **25th July, 2019.**

Kindly accord him any necessary assistance he may require.

COUNTY COMMISSIONER
MERU COUNTY
P. O. Box 703 -60200, MERU

W K KATONON
FOR: COUNTY COMMISSIONER
MERU