

**HEALTH BURDEN OF WILDLIFE INDUCED INJURIES AMONG THE
MAASAI CATTLE HERDERS IN KAJIADO COUNTY, KENYA**

**ISAAC KASILU MAKAU (M.Sc. OSH)
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DECLARATION

This research thesis is my original work and has not been presented for a degree in any other University.

Signature Date.....
Isaac Kasilu Makau
Q97/25090/2012

Department of Environmental and Occupational Health

SUPERVISORS

This research thesis has been submitted with our approval as University supervisors.

Signature Date.....
Prof. Margaret Keraka

Department of Population and Reproductive Health

Signature Date.....
Dr. Daniel Akunga

Department of Environmental and Occupational Health

Signature Date.....
Dr. Peterson Warutere

Department of Environmental and Occupational Health

DEDICATION

To my Mum Beatrice and Dad Rodgers: you have always wanted the best, whatever the circumstance. To my wife Sarah Margaret, together with our children, Joy, Jaison and Joan for all the amazing love, support and wisdom, not only for the three years of this PhD, but for every day of every year beforehand.

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LIST OF ABBREVIATIONS

CS	Cabinet Secretary
CWCCC	County Wildlife Conservation and Compensation Committee
DALY	Disability Adjusted Life Years
FAO	Food and Agricultural Organization
FGD	Focus Group Discussion
HWC	Human-Wildlife Conflict
KCIDP	Kajiado County Integrated Development Program
KII	Key Informant Interview
KPHC	Kenya Population and Housing Census
KUERC	Kenyatta University Ethical Review Committee
KWS	Kenya Wildlife Services
MANOVA	Multivariate Analysis of Variance
MDFA	Multiple Discriminant Function Analysis
NACOSTI	National Commission for Science, Technology and Innovation
PAs	Protected Areas
SPSS	Statistical Package for Social Science
TWA	Time Weighted Average
WCMA	Wildlife Conservation and Management Act
WHO	World Health Organization
YLD	Years Lived With Disability
YLL	Years of Lost Life

OPERATIONAL DEFINITIONS

Boma (Manyatta): A typical Maasai compound/homestead consisting, at minimum, of a thorn bush enclosure with inner thorn enclosures for livestock.

Cattle herding: It is the act of bringing individual cattle together into a group (herd) and moving the group from place to place in search of water and pastures.

Disability Adjusted Life Years (DALYs): The DALY is a summary measure of health loss, combining both fatal and non-fatal health outcomes into a single measure. The DALY sums years lived with disability (YLD) and years lost due to premature death (YLL). One DALY represents the loss of one year of healthy life.

Disability: It is short-term or long-term health loss other than death which includes any impairment or functional limitation.

Habitat: A place or site where wildlife naturally occurs and which provides food, cover and water on which wildlife depend directly or indirectly.

Human-Wildlife Conflict: The negative interaction between people and wildlife; where human beings are affected negatively by wildlife and vice-versa and also where the interests of different stakeholders concerned with wildlife differ, and also wildlife suffer.

Major Injury: It is any injury with loss of bodily parts such as eye, limbs, etc.

Minor Injury: Injury without loss of bodily parts and not life threatening

Moran: A moran is an individual who is part of a warrior age set.

Morbidity Rate: The frequency with which a disease or injury appears in a population.

Morbidity: It is the incidence of ill health or disability in a population.

Mortality Rate: The frequency with which cases of deaths occur in a population or the number of deaths due to a given cause divided by the total population.

Mortality: It is the incidence of death or the number of deaths in a population.

Premature Death: Death that occurs before the age to which a person could have expected to survive assuming a life expectancy at birth approximately equal to that of the world's longest-surviving population – Japan.

Prevalence Rate: It is the total number of cases of a disease or injury existing in a population divided by the total population.

Prevalence: The proportion of a population found to have a condition such as a disease or injury.

Protected Area: A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.

Protective Mechanisms: They are regarded as ‘survival skills’. They are strategies or measures that people use in order to mitigate problems, pain or natural changes that they experience in life.

Risk Factor: Any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or an injury.

Wild Animal: It is any animal that has not been domesticated or tamed and usually lives in a natural environment, including both game and non-game species.

Wildlife: It is any wild and indigenous animal, plant or microorganism or parts thereof within its constituent habitat or ecosystem on land or in water, as well as species that have been introduced into or established in Kenya.

Years Lived With Disability (YLD): Measures health loss from time spent in less than full health taking into account the severity of ill health or disability.

Years of Life Lost (YLL): Measures health loss from early death, taking into account the age when death occurred.

ABSTRACT

Wildlife induced injuries are a major but neglected emerging public health problem which contributes significantly to high mortality and morbidity among cattle herders. The objectives of the study were to determine the health burden of wildlife induced injuries, to identify the risk factors and establish the risk indices associated with wildlife induced injuries and to determine the protective measures adopted to mitigate wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties. The study adopted a descriptive cross-sectional study design and mixed methods where quantitative and qualitative data were collected. Multi-stage sampling method was used. A total of 262 respondents were sampled for this study. The data collection tools used in this study included researcher administered questionnaires, Focus Group Discussions (FGDs) and key informant interviews (KIIs). Questionnaire was pre-tested to ensure validity and reliability. Quantitative raw data from the field was checked for errors and completeness, through editing of responses. The cleaned data was exported to Statistical Package for Social Sciences (SPSS) software version 22 and Disability-Adjusted Life Years (DALYs) software for analysis. Descriptive statistical analysis was used to reveal the distribution of tendencies in the sample data. Descriptive statistics namely frequency tables and percentages were used to describe, organize and summarize the study findings. Chi-square test was used to establish if associations existed between study variables. A p-value of ≤ 0.05 was considered significant. Multivariate Analysis of Variance (MANOVA) was used to the association between risk factors and wildlife induced injuries. Multiple Discriminant Function Analysis (MDFA) was used to determine the linear relationship between variables. Study findings show that wildlife induced injuries accounted for a total of 3,352 DALYs among cattle herders in Kajiado Central and Loitokitok sub-counties. Of this, 1,988 DALYs resulted in male Maasai cattle herders and 1,364 DALYs resulted in female Maasai cattle herders which indicate that male Maasai cattle herders lost more healthy years of life due to cattle herding than female Maasai cattle herders. Overall evidence generated from the study will be used to influence policy and direct focus on interventions geared towards addressing public health issues of significance to the poor Maasai cattle herders.

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Human-Wildlife Conflict (HWC) is one of the many dimensions to be considered for maintaining harmony between humans and wild animals. The HWC is more intense in the tropics and in developing countries where herding is an important part of rural people's livelihoods and incomes (Budhathoki, 2009). In these regions, competition between cattle herders and wild animals, for the use of natural resources, is particularly intense and direct and residents are very vulnerable. Living in and around Protected Areas (PAs), more often a way of life for many local communities and indigenous people is augmented with multiple risks and threats (Wambugu, 2011).

Direct contact with wildlife occurs in both urban and rural areas, but it is generally more common inside and around protected areas, where wildlife population density is higher and wild animals often stray into adjacent grazing areas. Frequent attacks on cattle herders by wild animals leading to death and injury are emerging as critical park management issues in Kenya (Wambugu, 2011).

Wildlife induced human casualty is becoming one of the many burning issues of human-wildlife conflict worldwide (WHO, 2013). The issue is serious especially where limited resources and space are shared by both humans and wild animals (WHO, 2013). Globally, 90% of wildlife induced injuries occur in the lower and middle-income countries, especially those with emerging economies (Holly and Richard, 2010). In 2004, approximately 150,000 to 200,000 wildlife induced injuries occurred in the states of Haryana and Punjab in India (Stout and Harrison, 2005).

In Njombe District of Southern Tanzania, wild animals killed 563 cattle herders and injured at least 308 others between 1990 and 2005 (Craig, 2006). In Kajiado Central and Loitokitok sub-counties of Kajiado County, wildlife resides in protected areas, but more than half of the wildlife subsists in lands outside protected areas in pastoral and agro-pastoral lands (Lindsay and Burnsilver, 2012).

In Kenya, the conflict between wildlife and human has been escalating due to human population growth, land use transformation, species habitat loss, degradation and fragmentation of group ranches, growing interest in ecotourism and increasing access to natural reserves (Muruthi, 2005; Ogada *et al.*, 2003; KWS, 2013). More than half of wildlife in Kenya stray outside protected areas (PA) in communal grazing lands and group ranches, where wildlife, people, and livestock all interact and compete for the same natural resources therefore increasing the rate of conflicts (Kameri and Mbote, 2005). The existing conservation policies also tend to ignore the needs of the local communities by attaching a higher premium on wildlife over human needs hence the changing perception towards wildlife conservation (Hackel, 2009). Human-wildlife conflicts also arise from a range of direct and indirect negative interactions between humans and wildlife. These can culminate into potential harm to all involved, and lead to negative human attitudes, with a decrease in human appreciation of wildlife and potentially severe detrimental effects for conservation. Wildlife induced injuries among cattle herders are some of the many burning issues of human-wildlife conflict in Kenya which has taken a sharp rise in Kajiado County in recent times (KWS, 2013). These conflicts have resulted into wildlife induced injuries among cattle herders to the extent that the herders gang to kill the wild animals in retaliation.

This amounts to criminal offences since wild animals are a national heritage protected by law under the mandate of Kenya Wildlife Service (KWS). Indeed, it would appear that for KWS, protection of wildlife is key compared to protecting humans. However, humans are also obliged to defend themselves when an impending disaster is inevitable. This exacerbates the problem and has led to increased human-wildlife conflict around the protected areas in Kajiado County in recent times (KWS, 2013).

Little is known about the health burden of wildlife induced injuries among the Maasai cattle herders in Kajiado County and therefore this study sought to fill this gap. The study sought to quantify health loss associated with wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties. The study also sought to identify risk factors that contribute to wildlife induced injuries as well as explore the preventive measures adopted to mitigate the problem of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties. According to Willis *et al.* (2010), the first step in a public health approach to injury prevention is to gain a better understanding of risk indices of potential risk factors. Therefore, this study sought to establish risk indices of potential risk factors associated with wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties.

1.2 Problem Statement

Morbidity and mortality related to injury in low and middle income countries is not recognized as a major public health issue because of poor availability of robust data on the injury burden, thereby inhibiting the development of effective preventive strategies (Kuhn and Ruf, 2008).

Wildlife induced injuries account for 1 in 7 potential life-years lost worldwide, but by 2020 they will account for 1 in 5, with the developing countries bearing the brunt of this increase (WHO, 2013). In Kenya, the conflict between cattle herders and wild animals has existed for years. The high degree of friction between cattle herders and wildlife reflects ongoing competition over access to scarce land and water resources that has been conspicuous for over 30 years and is intensifying (KWS, 2013). Cases of wildlife induced injuries among the Maasai cattle herders has taken a dramatic increase in Kajiado County in recent times but little is known about the health burden associated with wildlife induced injuries among the Maasai cattle herders in Kajiado County.

Competition among wildlife and the Maasai cattle herders for scarce resources has escalated incidents of human-wildlife conflicts around protected areas in Kajiado County. In 2013, Loitokitok sub-county recorded the highest number of wildlife induced injuries in Kenya at 28% followed by Lamu East sub-county at 25% (KWS, 2014). Direct contact with wildlife occurs in both urban and rural areas, but it is generally more common inside and around protected areas, where wildlife population density is higher and animals often stray into adjacent grazing areas. Frequent attacks on cattle herders by wild animals leading to premature death (mortality) and non-fatal injuries (morbidity) are emerging as critical public health issues. However, there is not much information regarding injury related health burden orchestrated by wildlife among the Maasai cattle herders. Not many studies have been undertaken to ascertain the risk factors associated with wildlife induced injuries and the preventive measures adopted to mitigate the problem yet. Lack of sufficient information on this issue may become a major constraint in the long term conservation and management of wildlife.

This in turn, may ultimately increase the degree of friction between the Maasai cattle herders and wildlife. Hence, this study sought to determine health burden of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties.

1.3 Justification of the Study

Over the years, reports of human-wildlife conflicts have been reported in Kajiado County. These conflicts have resulted into wildlife induced injuries among the Maasai cattle herders. There is scanty documentation, if any exists, of the extent to which these conflicts have resulted into human mortality and morbidity in Kajiado County. Besides, there is scarce documented data on risk factors that contribute to wildlife induced injuries and the preventive measures adopted to mitigate the problem among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties. Therefore, the study findings on quality of life lost due to wildlife induced injuries will allow health policy makers and program funders to gauge whether the health policies and programs in place are succeeding in adding life to years as well as years to life or whether the Maasai cattle herders are not only living longer but also living longer in good health.

1.4 Research Questions

1. What are the risk factors and risk indices associated with wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties?
2. What are the protective measures adopted to mitigate wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties?
3. What is the health burden of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties?

1.5 Research Hypotheses (H_0)

The study was guided by the following null hypotheses:

H_{01} : There is no association between Years of Life Lost (YLL) and wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-Counties

H_{02} : There is no association between Years Lived with Disability (YLD) and wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-Counties

1.6 Study Objectives

1.6.1 Broad Objective

The main objective of this study was to assess the health burden of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties of Kajiado County.

1.6.2 Specific Objectives

1. To identify the risk factors and establish the risk indices associated with wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties.
2. To determine the protective measures adopted to mitigate wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties.
3. To determine the health burden of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties of Kajiado County.

1.7 Significance of the Study

Rationing of health care resources is a fact of life in every country. Choices on how best to use resources for health in regard to addressing the injuries resulting from wildlife and human conflicts must be made. The study findings will advise on resource allocation and priority setting in order to ensure that the Maasai cattle herders are not only living longer but also living longer in good health. The study findings, further, will inform health policy analysis, particularly assessment of priorities in terms of health research and development relating to wildlife injuries among the Maasai cattle herders. Sound risk ranking is essential to effective risk management. Without it, small risks may receive unwarranted attention, while large ones are neglected.

1.8 Delimitation and Limitation of the Study

The study was conducted in Kajiado Central and Loitokitok Sub-Counties of Kajiado County. It covered the health burden of wildlife induced injuries, the risk factors and risk indices associated with wildlife induced injuries and the protective measures adopted to mitigate wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties?

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction Literature Review

This chapter outlines introduction to literature review, overview of health burden of wildlife induced injuries, risk factors associated with wildlife induced injuries, risk indices of potential risk factors, preventive mechanisms adopted to mitigate wildlife induced injuries and health burden associated with wildlife induced injuries. The existing literature gap on health burden of wildlife induced injuries among Maasai cattle herders has also been highlighted.

2.2 Risk Factors Associated with Wildlife Induced Injuries

2.2.1 Competition for Scarce Natural Resources

The main cause of human-wildlife conflict worldwide is the competition between growing human populations and wildlife for the same declining living spaces and resources (Ogada, 2012). The transformation of forests, savannah and other ecosystems into agrarian areas or urban agglomerates as a consequence of the increasing demand for land, food production, energy and raw materials, has led to a dramatic decrease in wildlife habitats. This is particularly true in Africa where the human population came close to tripling in the four decades from 1960 and where, in consequence, settled agriculture and livestock keeping has spread to more marginal rangelands leading to encroachment into wildlife habitats. Under these conditions, conflict between wildlife and local communities has inevitably increased (Rainy and Worden, 2013). This is perfectly illustrated by the conflict between humans and elephants.

It is estimated that about 80 percent of elephant range lies outside protected areas. This habitat is rapidly being eliminated and fragmented by intensified agriculture, and is resulting in one of the most serious human-wildlife conflicts (Bauer and Kari, 2011).

2.2.2 Creation of Settlements in Areas Prone to Wildlife Attacks

Treves and Karanth (2013) noted that opening of new settlements or villages in areas prone to wildlife attacks as well as creation of new bush paths between these settlements is a predictor of wildlife induced injuries. This generates a greater traffic of cattle herders, increasing the risk of contact with wild animals. Other activities organized around the new settlements such as the daily collection of wild fruit, berries and fuel-wood, fishing, and poaching further expose cattle herders to encounters with wildlife. Permanent settlements are developed close to a source of water, but this prevents access to wildlife. Despite efforts to develop alternative water supplies, in rural Africa water is still most frequently drawn from natural or man-made surface waters, i.e. rivers, lakes and dams (Treves and Karanth, 2013). Cattle herders are dependent on access to these water bodies for their daily needs such as collection of water for domestic use, washing clothes, utensils and bathing. Many of these water bodies are habitats for crocodiles and with growing human populations needing to make use of water “the scene is set for increasing human-crocodile conflict”.

2.2.3 Migration of Cattle Herders for Reasons of Security or Food Safety

Drought, floods, civil unrest, natural disasters or war disrupt the normal production and distribution of food, resulting in famines. In Africa, this phenomenon is on the increase and the number of food emergencies each year has almost tripled since the 1980s.

Across sub-Saharan Africa, one in three cattle herders are undernourished (Bell and Caluzi, 2009). These factors spur the continuing migration of cattle herders into areas where resources could be obtained, and which are frequently occupied by wildlife. The resultant occupation of the habitat of wild animals by cattle herders leads to conflict. War and civil unrest force people to seek shelter in protected areas where they exert a strong pressure on natural resources and enter into competition with wildlife. For example, it is estimated that more than 120 000 people displaced by civil war are currently living in protected areas in Mozambique (FAO, 2010). Political upheaval can have indirect repercussions on the human-wildlife conflict situation.

2.2.4 Attitudes and Perceptions

In general, rural Africans have little sympathy for wildlife and see animals purely in terms of their meat value. This is illustrated by the fact that, in several Bantu idioms, the word Nyama used for wildlife also means “meat” (Charudutt, 2007). Rural communities consider wildlife, particularly large mammals, as threats to their safety and food security. This adverse perception is particularly strong near protected areas where the presence of wildlife populations threatens the safety and security of local inhabitants, which can erode local support and tolerance. In turn, local people can develop a negative attitude towards reserves and wildlife, exacerbating conflict and undermining conservation efforts (Croes *et al.*, 2008). The continued negative attitude of communities towards wildlife emanates from losses (including human life, property, crops and even agricultural land set aside for conservation purposes) incurred by wildlife. The association of wildlife with damage is now so integrated in the minds of local populations that they will even blame beneficial species. Elephants seem to crystallize the hatred of rural communities.

Field reports from across Africa describe local antipathy to elephants beyond that expressed for any other wildlife. Rural Ugandans complain bitterly about elephants, except where they have been eradicated (Driciru *et al.*, 2012). In the minds of most rural communities in Africa, lions are considered a pest that should be eliminated. In a study conducted in and around Queen Elizabeth National Park, Uganda, 37 percent of 156 respondents thought that the best way to deal with stray lions entering the village was to kill them; 35 percent said a fence should be erected around the protected area, and only 28 percent felt people should be taught how to avoid lions (Tsukahara, 2008).

In Cameroon, of 236 cattle herders questioned from 10 different villages along the borders of Waza National Park, 50 percent had a negative perception of lions (Bauer and Kari, 2011). In the Niger, 81.5 percent of 154 people questioned between 2007 and 2010 in 87 villages in the peripheral zone of the Trans-boundary Park had a negative attitude towards predators, and 14 percent confirmed that they would kill predators (Croes *et al.*, 2008).

2.2.5 Habitat Factors

Thirgood *et al.* (2010) noted that the gradual loss of habitat has led to increasing conflict between cattle herders and wildlife. As wildlife range becomes more and more fragmented and wildlife is confined into smaller pockets of suitable habitat, cattle herders and wildlife are increasingly coming into contact and in conflict with each other. In the Kakum Conservation Area in Ghana, the forest area available to elephants has decreased by about half since the 1970s. This explains why the density of elephants (about 0.6/km²) is now higher than in most other West African forests, thereby resulting in increased attacks on cattle herders (Bauer and Kari, 2011).

Nowadays, the last suitable habitats generally survive inside protected areas. This explains why conflicts are particularly common in reserve buffer zones where healthy wildlife populations stray from the protected areas into adjacent cultivated fields or grazing areas. In this respect, border zones of protected areas may be considered population sinks; critical zones in which conflict is one of the major problems (Frank and Woodroffe, 2012).

2.2.6 Natural Factors

Madden (2013) notes that droughts, bush fires, climatic changes and other unpredictable natural hazards can contribute to a decrease in suitable wildlife habitat and therefore affect the occurrence and extent of conflict between cattle herders and wildlife. Similarly, the seasonal modification of habitats due to rainfall can also have an impact on the conflict between cattle herders and wildlife. One of the main consequences of the loss of habitats is the decrease in natural resources available for wildlife. The destruction of natural vegetation around protected areas and in some cases the total disappearance of buffer zones force herbivore species to feed in cattle grazing areas. Likewise, species with a more diversified regime such as primates will encroach on cattle grazing and cultivated areas when the availability of natural food diminishes, as demonstrated in the case of baboons stripping bark from trees. The decline in numbers of natural prey is one of the major reasons why carnivores shift their diets to livestock, which are easier to capture and have limited possibilities of escape. Indeed many authors recognize that when native prey is abundant, wild predators consume it in preference to livestock (Tsukahara, 2008).

2.2.7 Wildlife Conservation Laws and Programs

Misguided policies and laws, or gaps in legal and policy frameworks, can contribute to human-wildlife conflict which lead to wildlife induced injuries among cattle herders. By the same token, the mitigation and prevention of human-wildlife conflict requires adequate supportive legal and policy frameworks (Holly and Richard, 2010).

2.3 Risk Indices of Potential Risk Factors

According to Harvey (2008), risk Matrix is a tool used to allocate a level of risk to a hazard from a pre-defined set. Each band in a matrix and the allocated risk level is sometimes given a numerical value or range. The risk matrix should always allow the risk ranking for a scenario to move to a risk tolerable level after implementation of mitigation measures, otherwise it may be difficult to determine the effectiveness of mitigation measures (Willis *et al.*, 2010).

2.4 Preventive Measures Adopted to Mitigate Wildlife Induced Injuries

2.4.1 Guard Animals

Guard animals provide an alternative to a herder monitoring a flock, which is labor-intensive, time-consuming and costly. To be successful, a guard animal must bond with the animals they are to guard. This bonding, combined with the guard animal's natural aggression toward predators, can make a guard animal an effective protector. Dogs can be effective in protecting cattle herders, homesteads and livestock from attack by predators (Marker *et al.*, 2012).

The dogs are trained to alert cattle herders to the presence of predators, as well as chasing predators. These dogs are raised from puppyhood with sheep or cattle and live with the herd full-time. Several new training aids are now available to the dog handler including “shock collars” to provide stimuli to the animal in obedience training and are used in conjunction with whistles and global positioning system (GPS) collars in the event of animals becoming lost (Smith *et al.*, 2009). According to Marker *et al.* (2011), donkeys have been used as guard animals in many parts of the world. In some areas of Kenya one or two donkeys per herd of cattle have been used to guard against lions. Donkeys appear to have a higher defence instinct than cattle and are naturally more alert and aware of predators. They make formidable opponents; they are not afraid and will find predators and chase them away, even by biting and kicking. Mares with foals are particularly protective. Foals should be raised with livestock. However, stallions tend to break fences and become aggressive during breeding. Both dogs and donkeys have recently been used in Namibia and Botswana to accompany cattle. This has been reasonably successful in reducing incidences of wildlife induced injuries, especially where cheetahs and spotted hyenas are concerned (Okello and Wishitemi, 2010).

2.4.2 Fencing

If properly designed, constructed and maintained, fences can be almost completely effective in preventing conflict between cattle herders and wild animals. Fences are used to protect cattle herders and livestock. Fenced wildlife sanctuaries enable people to benefit yet be separated, from wildlife, so that they can practice other land uses such as pastoralism and agriculture (Thirgood *et al.*, 2010).

Fences also help prevent the transmission of certain endemic contagious diseases such as foot-and-mouth disease, African swine fever and theileriosis. The establishment of control areas, game-proof fences, sanitary cordons and movement control to separate wildlife from cattle herders has frequently given the best results. This method has generally been used in countries with an advanced land-use policy where nomadic pastoralism is not practiced. It is less likely to succeed against endemic arthropod-borne infections such as trypanosomiasis, epizootic hemorrhagic disease, African horse sickness, and Rift Valley fever, where vaccination and vector control may be required to reduce transmission. Although the introduction of fencing is a good way to manage human-wildlife conflict, it also brings a number of environmental and economic disadvantages and is never 100 percent efficient (Salomon *et al.*, 2012).

2.4.2.1 Artificial Fences

Fences constructed using strong material such as galvanized steel wires protect pastoralists' settlement successfully against many wild animals. The major factor limiting the wider use of wildlife fences is their cost, which varies depending on many factors such as topography, type of fence and the species it is designed to contain. The high maintenance cost of fencing is another limiting factor, which explains why fences are effective when managed effectively. This option is beyond the means of many pastoralists. Moreover, for some species, such as baboons, standard wire fencing is ineffective (Treves and Karanth, 2013).

2.4.2.2 Electric Fencing

In Namibia, in the East Caprivi region, electric fencing is an effective strategy in reducing the human-elephant conflict on a large-scale. Electric fencing has proved to be the only long-term deterrent to elephants. Despite the high cost of maintenance and installation, electric fencing is demonstrably cost-effective to the community because it reduces significantly elephant attacks. Electric fencing can be adapted to rural conditions. For example, it is possible to construct a fence with just a single live strand at 1.5 metres above the ground in order to stop elephants, while allowing other species to pass through (Croes *et al.*, 2008). In Mozambique, for instance, the cost per kilometre of a single strand of electric fence is US\$900 to \$1 000 compared to \$9 000 for a classic elephant-proof fence. Another means of cutting costs is to hang this single strand fence from bush poles instead of metal stanchions.

Nevertheless, the theft of the solar panels, batteries and energizers used to power television sets, noted for instance in Botswana and Mozambique, means that electric fences can only be considered where the security to guard them is adequate (Pariela, 2009). In Kenya, in Endarasha and Ol Moran villages in the Nyeri and Laikipia Districts, electric fencing is successfully used to separate wildlife from human settlements and agricultural areas (KWS, 2013). The electric fencing of pastoralists' settlements of Kimana and Namelok in Loitokitok sub-county, near the AWF Kilimanjaro Heartland has significantly reduced the levels of elephant menace. However, fence maintenance and the proximity of fences to areas with a high concentration of elephants appeared to be significant determinants in the long-term performance of electric fences in mitigating elephant attacks (Rainy and Worden, 2013).

Electric fencing is a more sophisticated and efficient solution. It is more durable, due to the reduced physical pressure from wild animals; it deters a wider range of species; and it is more aesthetically appealing. However, the cost of installation and maintenance is higher than for simple fences (FAO, 2010). The construction of a 3.3 m high electric fence around Aberdare National Park in Kenya cost an average of US\$20 000 per kilometre (KWS, 2013); in Namibia, the cost per kilometre of electric fence was US\$10 000 compared to US\$600 for a non-electric wildlife fence (Croes *et al.*, 2008).

2.4.3 Voluntary Relocation

Where alternative land and incentives are available, the voluntary relocation of local pastoralists to areas offering better access to natural resources and improved socio-economic opportunities can offer an adequate solution to managing human-wildlife conflict (Madden, 2013). In fact, resettlement schemes aimed at preventing the overlap of wildlife and pastoralists can be successful in the long run if some essential assumptions are met: the villagers must gain substantial benefits, such as better access to resources; they should be relocated to an area where the risk of being attacked is lower; and they should not face any political, social and cultural opposition. When socially acceptable, this option is expensive. For example, donors paid approximately US\$16 million to relocate the 6 000 people living inside the Limpopo National Park in Mozambique (Treves and Karanth, 2013).

2.4.4 Human Vigilance

According to Tsukahara (2008), FAO helped set up a cadre of community scouts in Kakum in Ghana to provide vigilance and promote community-based problem animal control in an area of high human-elephant conflict. A total of 11 communities were grouped into a community scout cadre with an average membership of 5 scouts per community. Each group had a leader and a secretary who was responsible for the custody and updating of the patrol record book. This record book was available for inspection by other community members and stakeholders. Some wild animals such as baboons show less fear, and simple vigilance therefore gives less effective results. Determined troops of baboons can intimidate guardians, particularly women, who are often chased away. Baboons will adapt rapidly to measures taken against them and are remarkably quick to find weaknesses in the guarding (Tsukahara, 2008).

Watchtowers providing good vantage points, built within grazing and cultivated areas, can increase the pastoralists and farmers' chances of being alerted to the presence of potentially harmful wildlife before damage has occurred. People need to cooperate among themselves to manage the watchtowers and set up duty rosters, as is widely practiced in Zimbabwe, Mozambique and Zambia (Croes *et al.*, 2008).

Vigilance is an important component of livestock protection and human-wildlife conflict management. The fear of humans normally dissuades animals from committing damage. In Kibale National Park in Uganda, elephants waited at the forest edge until pastoralists left the fields before they would enter, suggesting an aversion to the presence of humans (Frank and Woodroffe, 2012).

Pastoralists and farmers can cooperate by means of a rotating system of guard duty whereby only a few of them patrol during the night. If an elephant is sighted, other people are woken to chase them away. In Kenya, where human herders are effective and fearless in warding off predators, herders are reported to challenge and scare away dangerous carnivores such as lions, hyenas and cheetahs with nothing more than simple weapons such as spears, knives or firearms (Thirgood *et al.*, 2010).

Simple alarm systems, using a network of cowbells or tins filled with stones connected along a length of twine can also be effective and avoid the pastoralists and farmers having to stay alert all night long. Specifically constituted teams can act as guards (Ogada, 2012). Guarding herds and taking steps to actively defend them are essential features of animal husbandry. Where herdsmen are present, the rate of depredation is generally lower than in free-ranging herds.

2.4.5 Community Awareness

According to David and John (2009), raising awareness can be carried out in the community at different levels, for instance in schools or in adult education arenas. Educating children, coupled with raising awareness among adults through the traditional authority of chiefs and headmen, would certainly be highly cost-effective means of managing conflict. Education and training activities could be directed towards disseminating innovative techniques, building local capacity for conflict prevention and resolution, and increasing public understanding of human-wildlife conflict. Educating rural villagers in practical skills would help them deal with dangerous wild animal species and acquire and develop new tools for defending their crops and livestock.

Over time, it would result in a change of behavior among local populations and would contribute to reduced risks, improvements in local livelihoods and a reduction in their vulnerability. In an optimistic scenario, education and training would promote commitment towards conservation, raise awareness of the essential role of wildlife in ecosystem functioning and its ethical and economic value, as well as its recreational and aesthetic importance (Ogada *et al.*, 2010).

2.4.6 Traditional Barriers

Plant hedges of various spiny cacti (e.g. *Caesalpinia decapetala* and species of *Euphorbia*, *Opuntia* and *Agave*) have the advantage of being a low-cost solution, effective against both carnivores and ungulates. On the other hand, they are slow to establish, do not deter baboons and elephants, and are often made of exotic species which can spread uncontrollably.

Although less permanent, fences made of dead thorny branches are erected as kraals for cattle but also against elephants. In the Malian Gourma, they make up 32 percent of protective measures used, as against 28 percent for moats (Madden, 2013). Trenches, either covered or uncovered, have been widely used in Africa to keep elephants from pastoralists' settlement areas with considerable success. Stone walls have been used to exclude buffalo from invading settlement areas. Large, sharp rocks act as an effective elephant barrier in some parts of Namibia. In some areas, pastoralists simply run bark or sisal ropes from tree to tree or set up 3-metre long poles placed 30 metres apart and hang pieces of white cloth attached to twine at 5 metre intervals (Marker *et al.*, 2012).

This is done in conjunction with grease and hot pepper oil, which, when applied to the twine acts as a waterproofing media and causes irritation to any wild animal (such as elephants) making contact with the fence (FAO, 2010).

2.4.7 Compensation

Some of the major benefits attributed to compensation schemes are the ability to increase tolerance and promote more positive attitudes towards wildlife and conservation efforts in communities that live closest to vulnerable and/or dangerous animals. Also, when carried out effectively, compensation efforts can raise awareness about community concerns and shift economic responsibility to the participating community and contributing donors (Callaham *et al.*, 2008).

2.4.7.1 Direct Compensation Schemes

The payment of compensation in the event of loss is usually confined to a specific category of loss such as human death or livestock killed by predators or elephants. These schemes are often funded by a conservation organization, although government schemes also exist. All are designed to increase damage tolerance levels among the affected communities and prevent them from taking direct action themselves, such as hunting down and killing the elephants, lions or other species involved. In sub-Saharan Africa, some compensation schemes for losses caused by wildlife exist. However, few are effective (MacFie, 2009). Most African countries do not pay compensation for damage caused by wildlife, arguing that compensation schemes can do little to reduce the human-wildlife conflict and need to be modernized in order to become less bureaucratic, more reactive and transparent (KWS, 2013).

The African Elephant Specialist Group and Human-Elephant Conflict Task Force also advise against using compensation for elephant damage and argue that it can only at best address the symptoms and not the cause of the problem. The failure of most compensation schemes is attributed to bureaucratic inadequacies, corruption, cheating, fraudulent claims, time and costs involved, moral hazards and the practical barriers that less literate pastoralists must overcome to submit a compensation claim. They are also difficult to manage, requiring among other things reliable and mobile personnel, able to verify and objectively quantify damage over wide areas (KWS, 2013). This often leads to delays in decision-making, low rates, irregular and inadequate payments or the rejection of compensation claims. All these factors discourage pastoralists from submitting complaints. A study of elephant damages carried out in the region of Boromo in Burkina Faso in 2011–2012, for example, revealed that 98 percent (100 out of 133) of the damages caused by elephants were not reported to the administration because pastoralists and farmers knew there would not be any form of compensation (Frank and Woodroffe, 2012).

2.4.7.2 Insurance Schemes

The insurance scheme is an innovative compensation approach where pastoralists and farmers pay a premium for cover against a defined risk, such as livestock depredation. The premium can be set at the true market rate or be subject to subsidy provided by conservation organizations. The method also requires an accurate assessment of the cause of crop damage, livestock depredation, human injury or death, but because it operates on a more local scale, reports can be more easily verified.

Although the insurance scheme can impose certain practices which need to be undertaken by participating pastoralists and farmers to avoid human-wildlife conflict, overall the method seems promising. An example is the Human Animal Conflict Self Insurance Scheme (HAC SIS) in Namibia (Madden, 2013).

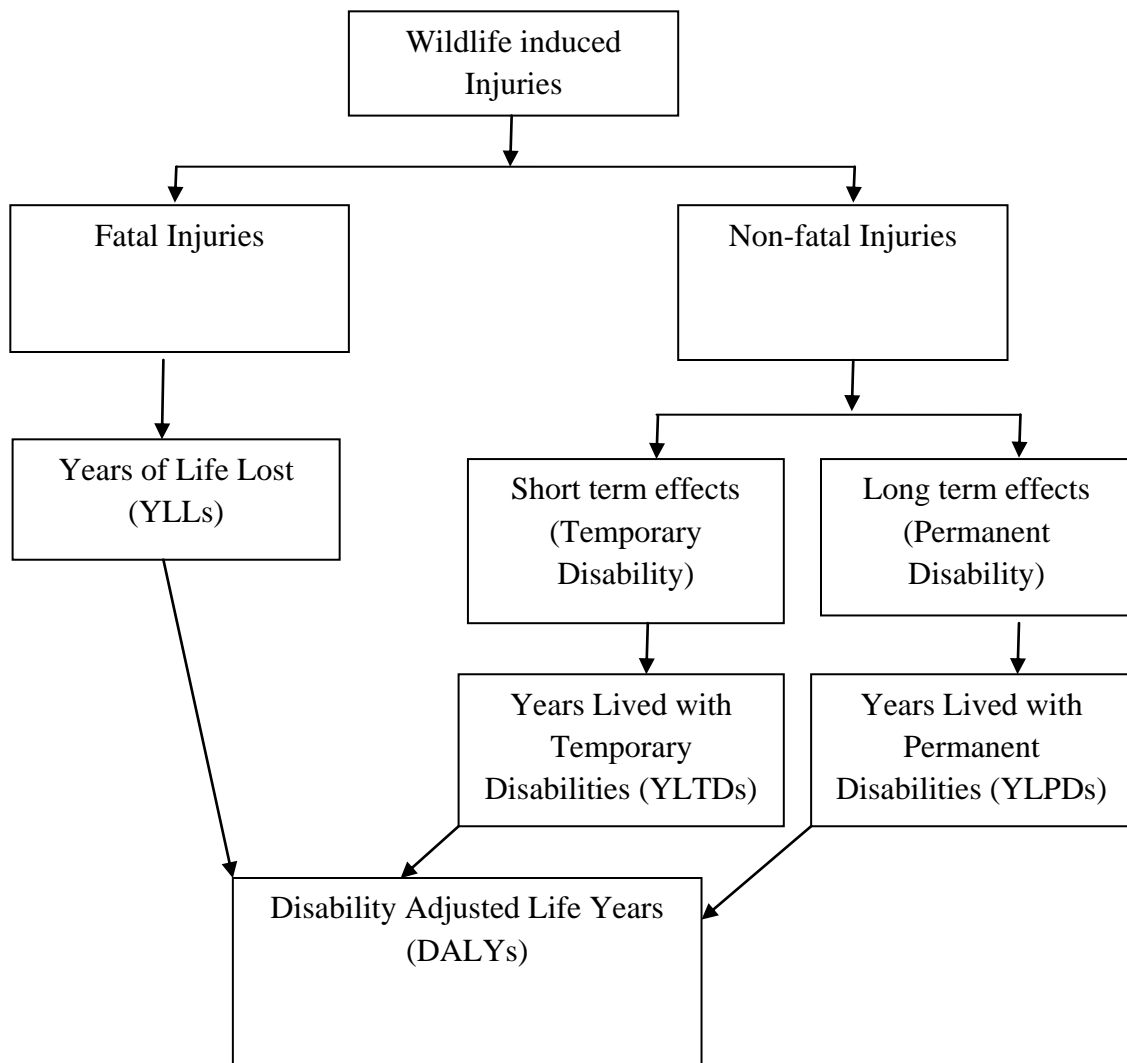
2.4.7.3 Indirect Compensation

Alternative compensation systems rely on giving out licenses to exploit natural resources, through tourism, hunting or collecting fuel-wood, timber, mushrooms, fodder, etc. This type of compensation scheme, also known as the “settlement of rights” to use natural resources, appears to be a more practical solution than monetary payment. Indeed, the benefits derived from the legitimate use of natural resources influence the attitudes and perceptions of rural residents.

Benefit-sharing can also be considered within this broader approach which provides tangible benefits to land owners in recognition of the role they play in hosting wildlife on their land and covering associated costs. In this way wildlife becomes a valuable resource rather than a liability (Treves and Naughto, 2009). In Mozambique, for instance, the law stipulates that local communities living in areas where natural resources are exploited should receive 20 percent of the income resulting from this exploitation, particularly through tourism in protected areas and hunting in coutadas also known as hunting blocks. This measure ensures that about US\$32 000 each year is distributed to the communities concerned (FAO, 2010).

2.5 Health Loss Associated with Wildlife Induced Injuries

Summary measures of population health are measures that combine information on mortality and morbidity to represent the health of a particular population as a single number. For the purpose of integrating the health burden of different health effects of agents, or comparing the effects of different agents, a common measure is necessary (Salomon *et al.*, 2012). Figure 2.1 shows injury-related health loss model.



Source: Salomon et al. 2012.

Figure 2.1: Injury-Related Health Loss Model

2.5.1 Overview of Health Burden of Wildlife Induced Injuries

Wildlife induced injuries are a major source of mortality and morbidity among cattle herders. Approximately 200 to 500 cattle herders die every year in United States of America (USA) due to wildlife induced injuries such as multiple fractures, extensive crush injuries and bites from venomous and non-venomous snakes (Adams and Sutton, 2012). A study by Stout and Harrison (2005) showed that India records the highest number of cattle herders either killed or injured by elephants.

In West Africa, wild animal attacks on cattle herders are perceived as occasional, but according to Pariela (2009), some attacks are not recorded because events such as nocturnal attacks on a single herder may not be reported. In Kenya, 658 cases of snakebites that resulted in 81 deaths and 577 injuries were reported between January 2003 and June 2009 (KWS, 2010). Between January 2011 and December 2013, 450 cattle herders were bitten by poisonous puff adders in Kajiado County (KWS, 2014).

Consequences of human-wildlife conflict are more felt in the tropics and in developing countries where livestock holdings are an important part of rural people's livelihoods and incomes (Madden, 2013). In these regions, local people with a low standard of living are particularly at risk, as are agro pastoralists who depend exclusively on production and income from their land. Injuries to people mostly occur as a result of chance encounters with wild animals usually along paths between dwellings and a water source (Frank and Woodroffe, 2012).

Contact with crocodiles when bathing or herding cattle within water points more frequently result in death than in permanent injuries, nevertheless many of these permanent injuries cause significant disability (Rainy and Worden, 2013). The amputation of limbs is quite frequent, as are attacks that result in major scarring, often on the trunk. The dramatic consequences of these attacks go well beyond the unfortunate victim, for they have a repercussion on the whole community. At national level, the loss of a human life due to wildlife induced injuries has little consequence, but at the family and village level, it can be catastrophic. The death of a family member caused by a wild animal is a traumatic experience.

For a poor peasant family in a developing country, the death or injury of the bread-winner can mean the difference between a secure life for all and one of destitution where simple day-today survival becomes a priority. If a mother is killed, the child has to take her place in carrying out family chores and has lost the opportunity to receive an education. In time, this will have consequences for her children and their future (Thirgood *et al.*, 2010). The danger of wildlife attacks restricts some activities considered “at risk” such as walking at night, herding along wildlife migratory corridors, herding near protected areas, etc. Security measures are then taken at the community level. In certain areas of Kenya, such as Taita Taveta District that borders Tsavo National Park, curfews have been imposed on villagers to protect them from the uncontrollable movement of wildlife through villages and farms (MacFie, 2009).

Wildlife induced injuries vary by region depending on the type, size, and behavior of animals living in that geographical region, and on the profession, tradition, and sport activities of the inhabitants. When disability resulting from wildlife induced injuries is taken into consideration, such injuries appear as an even more important health problem. The magnitude of this problem can be explained by the fact that injuries affect many young people, resulting in a large number of years of healthy life lost because of premature death or a large number of years lived with disability (Odero and Watts, 2011). Wildlife induced injuries account for a significant health burden on all populations, regardless of age, gender, income, or geographical region. Decreasing the health burden of wildlife induced injuries is among the main challenges facing public health experts (Mitchell *et al.*, 2011). Among the important lessons learned during the past decades is certainly that wildlife induced injuries are preventable.

Another lesson is that the approach to injury prevention needs to be multidisciplinary. In many cases, it is only through effective collaboration between physicians, sociologists, psychologists, lawyers, politicians, engineers, designers, human rights experts, journalists, and other professionals from the public and private sectors that the right injury prevention strategy can be developed and promoted. The tasks that public health officials in all countries face are diverse (Thirgood *et al.*, 2010). The health burden of wildlife induced injuries can be quantified using the Disability Adjusted Life Years (DALYs) approach. The DALY is a summary measure of health loss, combining both fatal and non-fatal health outcomes in a single measure. The DALY sums years lived with disability (YLD) and years lost due to premature death (YLL). One DALY represents the loss of one year of healthy life. The DALY provides a common metric by which the health impact of different diseases, injuries and risk factors can be compared (Hanson, 2009).

2.5.2 Disability Adjusted Life Year (DALY)

The Disability Adjusted Life Year (DALY) is part of a family of population health summary measures which is based on measuring health gaps, as opposed to measuring health expectancies. DALY measures the difference between the current conditions and a selected target, for example an ideal health state. This integrated measure combines years of life lost from premature mortality (YLL) with Years Lived with Disability (YLD), standardized by means of severity weights.

Health gaps measure lost years of full health in comparison with some ‘ideal’ health status or accepted standard (Hanson, 2009). DALY is a single indicator that uses time to equate death and disability. In its most commonly used form, it is an incidence-based rather than prevalence-based measure. The DALYs are the sum of the present value of future years of lifetime lost through premature mortality, and the present value of future years of lifetime adjusted for the average severity of any mental or physical disability caused by a disease or injury. The number of DALYs estimated at any moment reflect the amount of health care already being provided to the population.

2.5.2.1 Years of Life Lost (YLL)

YLL due to premature mortality is usually taken as the difference between a selected life expectancy and age at death. The expectation of life at a given age is used as an optimal value from which to calculate the loss of life associated with the specific death at a particular age (Hanson, 2009). According to Salomon *et al.* (2012), years of life lost associated with a specific death at a particular age can be calculated using the formula below.

$$YLL = \frac{N}{r} (1 - e^{-rL})$$

Where:

N = Number of deaths

L = Standard life expectancy (years)

r = Discount rate (e.g. 3% corresponds to a discount rate of 0.03)

e = Engineering constant (2.713)

Salomon *et al.* (2012) further demonstrated how to calculate years of life lost due to premature death following the demise of a man at the age of 30 years in a car accident. In terms of years of life lost, 50 years were lost due to this premature death.

2.5.2.2 Years Lived with Disability (YLD)

A measure of years lived in health states less than ideal health is known as "Years Lived with Disability" (Jankovic, 2009). YLD is the disability component of DALY which is based on non-fatal health outcomes. The YLD takes the severity and duration of the disability into account. The severity weight assigned to each disabling condition reflects the average degree of disability a person suffers from such a condition (Harvey, 2008). To estimate YLD on a population basis, the number of cases must be multiplied by the average duration of the injury or disease and a weight factor that reflects the severity of injury or disease on a scale from 0 (perfect health) to 1 (dead).

Similarly, the formula for YLD is:

$$YLD = \frac{I \times DW \times L (1 - e^{-rL})}{r}$$

Where:

- I = Number of incident cases
- DW = Disability weight
- L = Duration of disability (years)
- r = Discount rate
- e = Engineering constant (2.713)

2.6 Conceptual Framework

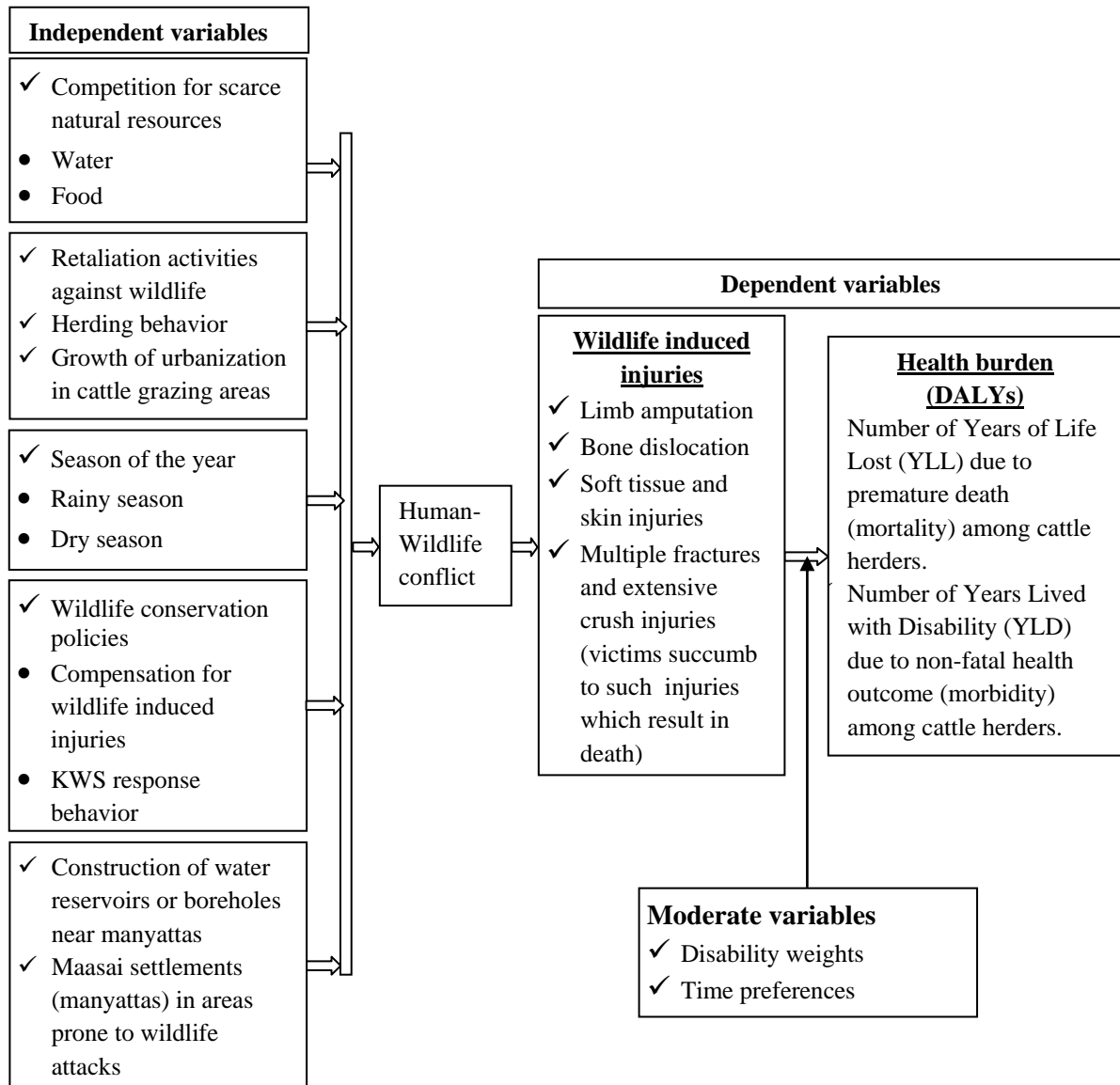
There are many factors that have been associated with wildlife-induced human casualties. More and more wildlife habitats are being converted to settlements, cattle grazing areas and other forms of land-use in order to cater for the needs of the growing population. When wildlife species lose their natural habitats and their access to natural food sources get reduced, they prey on livestock, destroy property and injure or kill people. Wildlife in many protected areas is under threat from human encroachment, insularisation, poaching for commercial or subsistence purposes, habitat degradation, encroachment of incompatible land uses, loss of migration and dispersal areas, and ever increasing human-wildlife conflicts. In a scenario where wildlife-induced damages to human property and life are neither controlled nor compensated, negative local attitudes towards conservation and wildlife resources become entrenched. Lack of suitable habitat and ample food for wildlife in protected areas is a risk factor for wildlife induced injuries among cattle herders. Due to lack of suitable habitat and ample food, wild animals stray out of protected areas to adjoining villages.

Availability of nutritional forage and easy prey for wild animals in the pastoralist's settlements and cattle grazing areas naturally creates higher chances of encounter and confrontation with cattle herders leading to incidents that result in premature death and injuries among cattle herders. Increase in human population and the decrease in suitable habitat for key wildlife species contributes greatly to conflict between humans and wild animals.

Food scarcity in protected areas is related to reduction and degradation of animal habitat whereas shrinkage and degradation of habitat is correlated with the increase in human population and their activities in and around protected areas. Living in and around protected areas, more often a way of life for many cattle herders is augmented with multiple risks and threats from wild animals. They include wildlife induced injuries, livestock depredation and property loss. Behavior such as taking cattle through forest path by short cut especially after taking alcohol, wearing brightly colored clothes, disturbing wild animals, carelessness, especially during winter season, etc. often contribute to wildlife induced injuries among cattle herders. A chronic issue for local people that seems to influence attitudes towards wildlife conservation and management is the lack of compensation policy for wildlife induced injuries among cattle herders.

One way to potentially minimize or eliminate retributive killing of predators is through the implementation of compensation policy. In their most common form, compensation schemes reimburse and/or reduce the financial loss of cattle herders who have experienced physical damage or death of a family member caused by wildlife. Wildlife induced injuries have a substantial impact on the health of population, both as a leading cause of premature death and through disability following an injury.

The impact of injury is quantified in terms of both its fatal burden (impact on premature mortality) and its non-fatal burden (impact on disability), combined in a summary measure, the disability-adjusted life year (DALY). The DALY can be used to compare health loss resulting from a wide range of diseases and injuries, from fatal car crashes in adolescence to falls in the elderly. Figure 2.2 shows the illustration of a conceptual framework.



Source: Adapted from Salomon et al., 2012

Figure 2.2: Conceptual framework

2.7 Gaps to be filled

The fatal and non-fatal health outcomes resulting from wildlife induced injuries represent healthy life lost by the victim. Health gaps in a population include mortality gaps as well as time lived in states of sub-optimal health. The health gap measures provide information on years of healthy life lost and thus, focus on the quantification of health losses in a population. The most common tool used to measure health gaps or health losses is the Disability Adjusted Life Years (DALY). There is little documented data on the health burden of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties and therefore this study sought to fill this gap.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides details on the study area, research design, study variables, study population, sampling techniques and sample size determination, construction of research instruments and data collection methods. The chapter also contains details on reliability and validity of the research instruments, pre-testing of data collection tools, data processing and statistical analysis. Finally, ethical considerations pertaining to the research work are also discussed.

3.2 Location of the Study

The study was carried out in Kajiado Central and Loitokitok sub-counties of Kajiado County. The areas were selected using simple random sampling techniques. Kajiado Central covers an approximated area of 5,186 square kilometers with 32 administrative locations whereas Loitokitok covers an approximated area of 6,411 square kilometers with 16 administrative locations. Most of the expansive National Parks such as Amboseli, Tsavo West and Chyulu Hills are located in Kajiado Central and Loitokitok sub-counties where wild animals migrate outside these National Parks into areas that are highly dominated by Maasai cattle herders causing deaths and injuries to the herders. Cases of wildlife induced injuries among the Maasai cattle herders have taken a dramatic increase in Kajiado County in recent times. Wild animals have been reported to cause a significant number of wildlife induced injuries among the Maasai cattle herders in this County (KWS, 2013).

3.3 Research Design

The study employed a descriptive cross-sectional study design to assess the health burden of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties. Descriptive cross-sectional study design was used in this study as it gives good measurement of population characteristics and attributes (Mugenda and Mugenda, 2003). Therefore, the study design chosen was relevant to this study as it helped generate facts and opinions about the risk factors, risk indices, protective measures and the health burden of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties. Descriptive cross-sectional study design describes "what exists" with respect to variables or conditions in a situation (Forthofer *et al.*, 2007). The study also employed mixed method design where both quantitative and qualitative data were collected. Qualitative data justify the quantitative data.

3.4 Study Variables

3.4.1 Independent Variables

The independent variables for this study were Risk Factors (RFs) associated with wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties, namely competition for scarce natural resources, Maasai settlements in areas prone to wildlife attacks, herding behavior, retaliation activities against wildlife, growth of urbanization in cattle grazing areas, season of the year, construction of water reservoirs or boreholes near manyattas.

3.4.2 Dependent Variable

The dependent variables for this study were wildlife induced injuries and health burden of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties. The Disability Adjusted Life Years (DALYs) approach was used to quantify the health burden. It combines both Years of Life Lost (YLL) due to premature mortality (fatal injuries) with Years Lived with Disability (YLD) due to morbidity (non-fatal injuries).

3.5 Study Population

The study targeted all the Maasai cattle herders who are potentially at risk of sustaining wildlife induced injuries since the results of this study can be generally applied to them. Kajiado County comprises of five sub-counties, namely Kajiado North, Kajiado Central, Isinya, Mashuru and Loitokitok. The study population consisted of Maasai cattle herders who are residents in 846 manyattas in Kajiado Central and Loitokitok sub-counties and met the criteria for inclusion in this study.

3.5.1 Inclusion Criteria

The inclusion criteria for questionnaire respondents involved cattle herders aged 18 years and above, living in the study area for more than three years at the time of the study, familiar with cattle herding challenges and who consented to be involved in the study.

3.5.2 Exclusion Criteria

Exclusion criteria for the respondents involved participants who were not residents in the study area, those who were not mentally stable or were under the influence of alcohol, and those who were unable to communicate for reasons of sickness or dementia.

3.6 Sample Size Determination and Sampling Techniques

3.6.1 Sample Size Determination

The sample comprised of 262 respondents who were administered the questionnaires to (heads of manyattas). The sample size was determined based on Kothari (2003) formula. The total number of manyattas in each of the administrative location in the study area was obtained from the location chief's office.

$$\text{The formula is } n = \frac{Z^2 pqN}{d^2 (N-1) + Z^2 pq}$$

Where:

n = Sample size of questionnaire respondents

Z = Standard normal deviate which at 95% confidence level is 1.96

P = Sample proportion or proportion in the population estimated to be at risk (0.5)

q = 1– p which is the proportion in the population not at risk

N = Study population (Total number of Manyattas or heads of manyattas)

d = The level of significance set at 0.05

With Z = 1.96, p = 0.5, q = 0.5, d = 0.05 and N = 846

$$n = \frac{1.96^2 \times 0.5 \times 0.5 \times 846}{0.05^2 \times (846 - 1) + 1.96^2 \times 0.5 \times 0.5} = 262 \text{ Manyattas or heads of manyattas}$$

Hence, 262 heads of manyattas participated in this study as questionnaire respondents. The sample size generated from the formula was then used to calculate distributed to each study location based on probability proportionate to size technique. The choice of the Focus Group Discussion (FGD) sample was guided by proposals of Creswell (2003) who proposed 3 to 6 FGDs to complement quantitative data. Creswell (2003) further observed that FGDs comprising of members ranging from 6-12 have been found by most researchers to be the most appropriate in facilitating maximum participation for each member. This guided the researcher's choice of 6 FGDs each comprising of 8 participants. Four FGDs were carried out in Kajiado Central Sub-county while only two were done in Loitokitok Sub-county. This was based on population density of the two sub-Counties.

3.6.2 Sampling Techniques

Multi-stage sampling technique was used to arrive at the questionnaire sample of 262 heads of manyattas. The sampling was done sequentially across four hierarchical levels. Firstly, at the county level whereby Kajiado county was purposively selected, secondly at the sub-county level whereby Kajiado Central and Loitokitok sub-counties were sampled using cluster and simple random sampling techniques, thirdly at the location level whereby random sampling technique was used to select locations and finally at the manyatta level whereby systematic random sampling technique was used to select manyattas for the study. Figure 3.1 shows the multi-stage sampling technique used to arrive at the 262 questionnaire respondents.

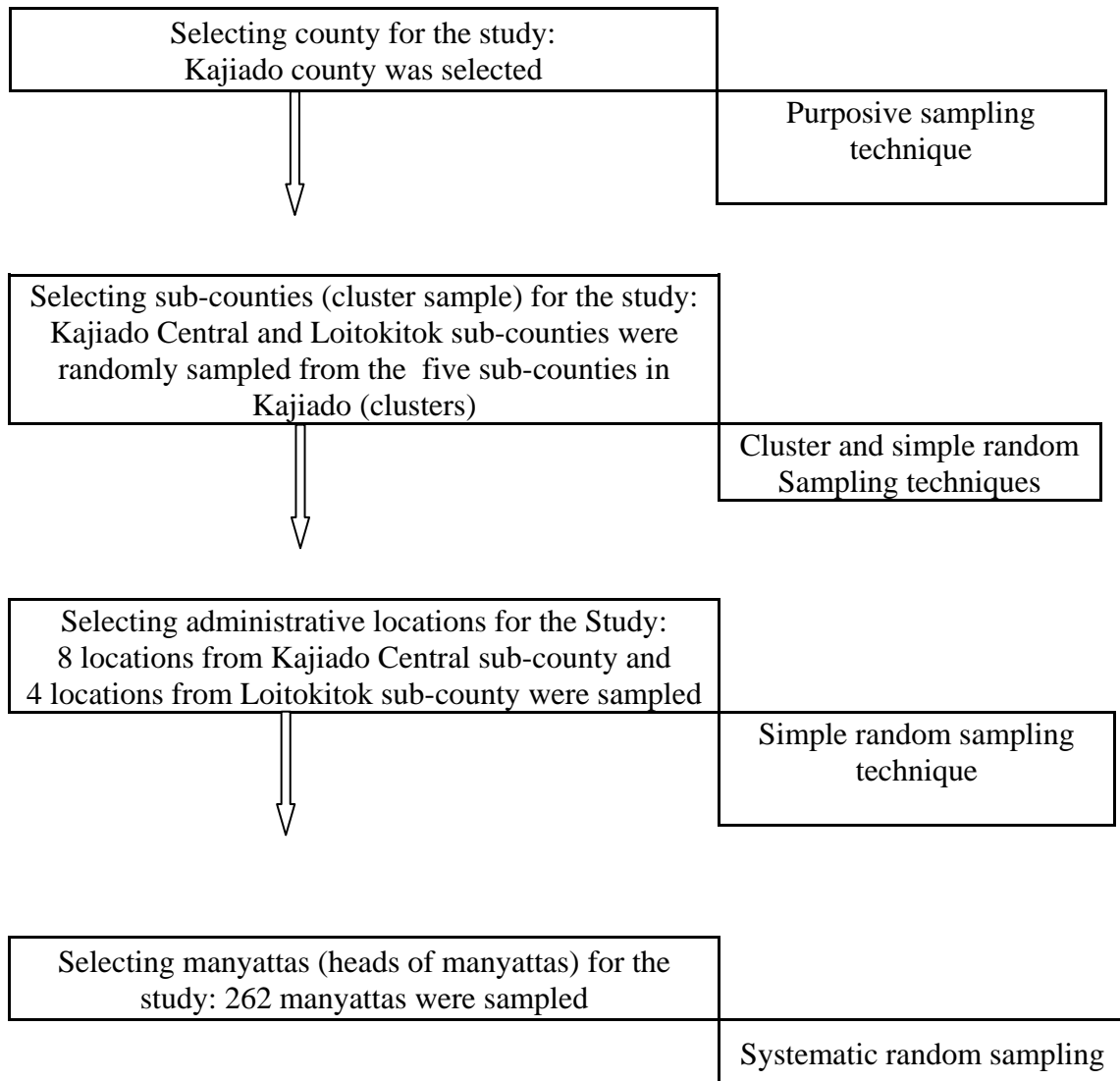


Figure 3.1: Illustration of the Multi-Stage Sampling Technique

3.6.2.1 Sampling Technique at the County Level

Purposive sampling technique was used to select the County for this study. Kajiado County was purposively selected from among 47 Counties. This was informed by the escalating cases of conflicts between the Maasai cattle herders and wild animals in Kajiado County in recent times (KWS, 2013).

3.6.2.2 Sampling Sub-Counties for the Study

In this study, each sub-county was treated as an independent cluster. Cluster and simple random sampling techniques were then used to generate a simple random sample of two sub-counties which was based on computer generated random numbers. Kajiado Central and Loitokitok sub-counties were sampled from the five sub-counties (clusters) as demonstrated by table 3.1. Cluster sampling is economical, and the sampling frame is often readily available at cluster level (Jamison *et al.*, 2006).

Table 3.1: Sampling Sub-Counties for the Study

Population	Groups (Sub-Counties)	Simple random Sample
All the Maasai cattle herders in Kajiado county	Five sub-counties in Kajiado county (Kajiado North, Kajiado Central, Mashuru, Loitokitok and Isinya sub-counties)	Kajiado Central and Loitokitok sub-counties were sampled using cluster and simple random sampling techniques from the five sub-counties based on computer generated random numbers.

3.6.2.3 Sampling Administrative Locations from the Two Sub-Counties

Simple random sampling technique was used to sample locations from the two sub-Counties (Kajiado Central and Loitokitok sub-counties) for this study based on computer generated random numbers. Table 3.2 shows the number of sampled administrative locations from each sub-county.

Table 3.2: Number of Sampled Administrative Locations from Each Sub-County

Name of sub-county	Number of administrative locations in each sub-county	Number of sampled administrative locations from each sub-county for the study	Percent (%)
Loitokitok sub-county	16	4	25
Kajiado Central sub-county	32	8	25

As demonstrated by table 3.2, 25% of administrative locations were sampled from each sub-county to represent the different geographical areas. According to Mugenda and Mugenda (2003), a sample size of at least 10% of the total study population is considered adequate for a descriptive study. This implies that a sample size of 25% of administrative locations from each sub-county was within the required proportion, hence adequate. Simple random sampling technique was used to sample administrative locations for the study because it gives each subject in a study population an equal chance of being selected for a study (Kothari, 2003).

3.6.2.4 Sampling Manyattas from the Administrative Locations for the Study

A list of manyattas from each sampled administrative location was obtained from the area location chief. Table 3.3 shows the sample size for each study administrative location based on probability proportionate to size technique.

Table 3:3 Number of Sampled Manyattas from Each Location

Name of the Sub-county	Name of the location	Number of manyattas in each location	Number of sampled manyattas in each study administrative location
Loitokitok Sub-County	Amboseli	94	29
	Imbirikani	68	21
	Olchorro	128	43
	Kimana	114	37
Kajiado Central Sub-county	Enkaroni	54	17
	Kikuro	36	10
	Nkoile	79	23
	Olobelibel	46	14
	Meto	52	16
	Oloililai	81	24
	Torosei	45	13
	Kumpa	49	15
	Total	N = 846	n = 262

With the help of the area location chief and the two research assistants, the researcher was able to locate a central starting point for the administrative location. Using a list of manyattas obtained from the area location chief, a fresh numbering of manyattas was done by the researcher with the help of two research assistants in order to determine the head of manyatta to participate in the study (questionnaire respondent) using systematic random sampling technique. Systematic random sampling technique is a type of probability sampling method in which sample members from a larger population are selected according to a random starting point and a fixed, periodic interval (Kothari, 2003). The periodic interval (K^{th}) was determined by dividing the study population size (846 manyattas) by the desired sample size (262 manyattas) which is three. This was applied to all locations since almost all had similar intervals.

Despite the sample being selected in advance, systematic sampling technique is still thought of as being random, provided the periodic interval is determined beforehand and the starting point is random (Kothari, 2003). Choosing a sample size through a systematic approach can be done quickly. In the event that a manyatta did not meet the inclusion criteria, the next manyatta head was selected for the study. Plates 3.1 and 3.2 show examples of manyattas located in the study area.



Plate 3.1: A photo of a manyatta in Olchorro Location of Loitokitok sub-county (3rd February, 2015 at 10 am)



Plate 3.2: A photo of entrance which is also an exit from a manyatta in Olchorro Location of Loitokitok sub-county (4th February, 2015 at 2 pm)

3.7 Data Collection Tools and Methods

Data was sought using researcher administered questionnaires, focus group discussions, key informant interviews, direct observation, note taking and photography. The tools were developed from the literature review and organized according to research objectives. Four research assistants (two from each sub-county) were employed to help in the collection of data. They were trained in the various techniques of data collection and in particular how to establish a working rapport with respondents. Plate 3.3 shows a field training of research assistants from Enkaroni Location in Kajiado central sub-county.



Plate 3.3: A photo showing a field training of research assistants from Enkaroni Location in Kajiado central sub-county (5th February, 2015 at 11 am)

3.7.1 Questionnaires

The questionnaire (Appendix II) was a useful tool in helping achieve the main objective of the study. A total of 262 questionnaires were researcher administered to the sampled heads of manyattas with the help of four duly trained research assistants (two from each sub-county). All the research assistants recruited for this study were community health volunteers in their respective sub-counties and had post primary education.

This mode of questionnaire administration was used because it ensured clarification of questions, completion of questionnaires and also enabled the researcher to achieve a 100% return rate which is a key advantage articulated by Lynn (2008). The questionnaires consisted of three sections; section one which sought information on wildlife induced injuries, section two which sought information on risk factors for wildlife induced injuries and section three which sought information on protective measures adopted to mitigate wildlife induced injuries. In occasions where the questionnaire respondent was not conversant with English language, the locally recruited research assistants assisted in translating the questions to the local Maasai language (Maa) and again translated back to English for purposes of recording. In situations where the manyatta head was not available, details about his availability were sought from the members of the manyatta and a revisit appointment was made.

3.7.2 Key Informant Interviews (KIIs)

KIIs with community health volunteers, area location chiefs, heads of nyumba kumi (village elders) and heads of churches were conducted to seek views on fatal and non-fatal health outcomes associated with wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties. Purposive sampling and snowball techniques were used to select the key informants for this study. It was important to find key persons who were thought to have the necessary information. Goodman (2006) described snowball technique as a technique used to gather information by asking an initial key informant to suggest other prospective key informants in the same study area. The key informants had to be conversant with challenges facing cattle herders in the study area.

The selection of key informants for this study was also guided by qualitative sampling principles described by Mugenda and Mugenda (2003) that “Qualitative researchers recognize that some informants are richer in information than others and that these people are more likely to provide insight understanding of the problem”. A total of twelve key informants were interviewed (6 from each sub-county). Interview schedules were used which involved face-to-face contact with the key informants. This ensured that questions were clarified and unclear answers followed up. Note taking was done during key informant interviews.

The main task of the researcher and the research assistants was to pose questions, evaluate answers and probe for evaluation in the event of incomplete responses, noting down answers and leading the discussion. Interview schedules complemented information from the questionnaires (appendix II). The interview questions were translated to the local Maasai language (Maa) and then retranslated back to English for the purpose of recording.

3.7.3 Focus Group Discussions (FGDs)

A successful group discussion brings out contrasting views, encourages reflection and often makes people state the reasoning behind the views they express (Newing, 2010). FGDs allow the collection of descriptive data via direct and interactive contact of the researcher with the participants, obtaining information where the meaning of something or of a situation is the essential topic of interest. Data from FGDs was collected by the researcher with the help of four research assistants.

FGDs comprised of male and female respondents from several manyattas within the neighborhood who were purposively selected from those willing to participate following consultations with community health volunteers and the heads of manyattas. The researcher and the research assistants acted as the moderators in all the 6 FGDs (3 FGDs from each sub-county) and also guided the respondents through the FGD questions. A set of open-ended questions was used to prompt participants into free discussions focusing on the objectives of the study. A focus group guide provided the framework for discussion, allowing a focus on any aspects considered to be relevant (Appendix IV). Plate 3.4 shows a focus group discussion session in Amboseli location of Loitokitok sub-county.



Plate 3.4: A photo of a focus group discussion session in Amboseli location of Loitokitok sub-county (15th February, 2015 at 11 am)

Plate 3.5 shows photos taken after focus group discussions in Loitokitok sub-county.



Plate 3.5: A photo taken on 15th February, 2015 at 12.30 pm showing end of a focus group discussion in Amboseli location of Loitokitok sub-county

Note taking was done during focus group discussions. Sessions were held in the local language (Maa) and the locally recruited research assistants assisted in translations from English language into the local language and back to English for purposes of recording.

The questions were not structured so as to illicit interaction and create an environment where participants felt they were merely engaging in conversation about topics provided. FGDs centered on wildlife induced injuries among cattle herders, risk factors associated with wildlife induced injuries, protective measures to mitigate wildlife induced injuries, and the strategies put in place by Kenya Wildlife Service to reduce cases of wildlife attacks. Each FGD lasted for one hour on average and was undertaken outside manyatta compound as instructed by the head of manyatta.

3.7.4 Direct Observation and Photography

Qualitative data was also collected through direct observation of the respondents' behavior, reactions and feelings towards particular issues sought by the study. Negative feelings were noted when the issue of victim compensation over wildlife induced injuries by the Government was mentioned. The researcher also used photography to capture certain visual data in the field as evidence of existence of situations which contribute to wildlife induced injuries and to show some protective measures already adopted to mitigate the problem (see plates 3.1 and 3.2).

3.8 Reliability and Validity of the Data Collection Tools

Reliability refers to the accuracy and consistency of information obtained in a study and the term is most associated with the methods used to measure research variables. Data collection tools were subjected for critique by other researchers and supervisors so as to deal with ambiguities. Unclear items were reviewed, reconstructed and adjustments were made to the final questionnaire. Validity of the research instruments was increased through the use of cluster and random sampling techniques, the homogeneity of the selected group and the random selection of a large sample which was representative.

3.9 Pretesting of Data Collection Tools

The questionnaires were pretested in Kajiado North sub-county because the Maasai Cattle herders in this sub-county also experience similar attacks from wild animals which escape away from the protected areas to the cattle grazing grounds. 50 heads of manyattas were picked using systematic random sampling technique and the questionnaires were researcher administered with the help of two research assistants. Pretesting was done to ensure that the data collection tools captured what they were intended to (validity) and that they consistently measured the variables in the study (reliability).

3.10 Data Processing and Statistical Analysis

3.10.1 Quantitative Data Analysis

Quantitative raw data from the field was checked for errors and completeness, through editing of responses. The cleaned data was exported to Statistical Package for Social Sciences (SPSS) software version 23 and Microsoft office excel spreadsheet software tools for analysis. Descriptive statistical analysis was used to reveal the distribution of tendencies in the sample data. Descriptive statistical tools used included tabulation to summarize the observations which were used as ratio measures for the variables. Frequency analysis was used to reveal tendencies in variable's distributions. Data was further subjected to cross tabulation analysis to give indication of associations and/or differences between variables.

In this study, Chi-square test was used to establish if associations existed between study variables. The expected and observed frequencies were used to determine X^2 statistic. This was then subjected to significance testing. Disability-Adjusted Life Years (DALYs) approach was used to quantify the health burden of wildlife induced injuries among the Maasai cattle herders which encompassed both the Years of Life Lost (YLL) due to premature mortality and Years Lived with Disability (YLD) due to non-fatal injuries (morbidity). General linear models were used to identify if independent variables (risk factors) placed together in combination were significant predictors of wildlife induced injuries and the health burden. Multivariate Analysis of Variance (MANOVA) was carried out in order to test the hypothesis that there is no association between risk factors and wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok Sub-Counties. Statistical Package for Social Sciences (SPSS) software version 22 was used to perform the MANOVA. Comparisons between the mean canonical variate values for each independent variable (fixed factor) were computed. MANOVA was followed up with Multiple Discriminant Function Analysis (MDFA) in order to describe the linear relationship between the canonical variate i.e. a combination of the independent variables (risk factors) and the dependent variables. This means that the independent variables were tested in combination using MDFA.

Further test results using MDFA generated standardized canonical discriminant function coefficients for each independent variable under investigation. These coefficients indicated the relative contribution of each independent variable to the two dependent variables (wildlife induced injuries and the health burden).

The function coefficients signified the importance of each predictor variable in the relationship with the grouping variable. Because predictor variables with very small coefficients have weak linear relationships with the grouping variable, they likely add little to the predictability of the model. When some variables have high canonical variate correlations while others have low ones, then the ones with high correlations contribute most to the group separation.

Likert scale was used to determine the risk indices for potential risk factors that contribute to wildlife induced injuries among the Maasai cattle herders in the study area. According to Kothari (2003), likert scale is used to analyze questionnaires in a survey research which consists of a number of statements which express either a favorable or unfavorable attitude towards a given issue the respondent is asked to respond. It is the sum of responses on several items and is used to measure respondent's attitude by asking the extent to which they agree or disagree with a particular statement.

In this study, the scale used consisted of “strongly agree, agree, not sure/undecided, disagree and strongly disagree” which were coded as: Strongly agree=5, agree=4, not sure=3, disagree=2 and strongly disagree=1. A response of 5 or 4 (strongly agree or agree) was associated with high risk for that particular statement on potential risk factors whereas a response of 1 or 2 (strongly disagree or disagree) was associated with low risk for that particular statement on potential risk factors.

To establish risk indices of potential risk factors associated with wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties, respondents were presented with 10 statements on potential risk factors associated with wildlife induced injuries (See appendix 3). The respondents were required to indicate their level of agreement (risk rating) to the 10 statements on potential risk factors associated with wildlife induced injuries on a scale of 1-5 by ticking 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree and 5= Strongly Agree.

The Likert Scale expressed either a favorable or unfavorable attitude towards a given statement on potential risk factors which the respondent was asked to respond. According to Kothari (2003), Likert Scale is used to measure respondent's attitude by asking the extent to which they agree or disagree with a particular statement. The risk ratings from each questionnaire respondent on the ten statements regarding potential risk factors associated with wildlife induced injuries were summed up to get a risk score for that respondent. This risk indexing method was repeated for each respondent. The mean score (\bar{X}) from the 262 respondents was calculated by summing up all the individual risk scores and dividing the total by the number of respondents. The mean score was computed as shown below:

$$\bar{X} = \frac{\Sigma X}{N}$$

Where:

- \bar{X} = Mean score
- Σ = Summation of all respondents' risk scores
- X = Respondents' risk scores (262 risk scores for this study)
- N = Total number of respondents (Equivalent to total number of scores)
- \bar{X} = $\frac{5764}{262} = 22$ (Mean score)

The mean risk score (22) was considered moderate risk which was defined by a range of values (scores) around it, that is $16 \leq 25$. Any risk score above 25 was considered high risk and any score below 16 was considered low risk. Table 3.4 shows a summary of the above details.

Table 3.4: Risk Indexing Methodology

Category of risk scores	Risk indexing
< 16	Low risk
$16 \leq 25$	Moderate risk
> 25	High risk

In calculation of health burden of wildlife induced injuries, life expectancy was based on model life-table West Level 26, which provides a potential life expectancy at birth for females of 82.5 years and the potential life expectancy at birth for males of 80 years (Salomon et al., 2012). World Health Organization (2003) disability weights for both minor and major injuries were used. The disability weights for minor and major injuries used were 0.25 and 0.75 respectively. A discount rate of 3 percent was used to discount time preference. The formula to discount time preference is $e^{-r(x-a)}$:

Where,

$r = 0.03\%$,

$x = \text{age}$,

$e = 2.713$,

$a = \text{onset year}$.

3.10.2 Qualitative Data Analysis

Qualitative methods were used to analyze qualitative data using thematic approach. Qualitative data mainly from the focus group discussions, key informant interviews and records from health facilities were analyzed mainly qualitatively using thematic approach.

3.11 Logistical and Ethical Considerations

Permission to carry out this study was sought from the National Commission for Science, Technology and Innovation (NACOSTI) and the area local chiefs where the research was conducted. Ethical approval was sought from Kenyatta University Ethics Review Committee. The researcher provided the research participant with full disclosure about the nature of the study, the risks, benefits and alternatives, and an extended opportunity to ask questions before deciding whether or not to participate. The participant's consent to participate in the research was voluntary, free of any coercion or inflated promise of benefits from participation. Care was taken to ensure that the consent form was administered by someone who does not hold authority over the participant. The participant was given the opportunity to discuss their participation in the study with the other members in the manyatta and also trusted friends before reaching a decision. The researcher also used all available information to identify potential risks to the participants, to establish means of minimizing those risks, and to continually monitor the ongoing research for adverse events experienced by participants and if serious unanticipated risks manifest, the researcher was prepared to stop the study. Anonymity, confidentiality and privacy were safeguarded.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents results and discussions on the health burden of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties. The specific objectives were to identify the risk factors which contribute to wildlife induced injuries; to establish the risk indices of potential risk factors associated with wildlife induced injuries; to explore the protective measures adopted to mitigate wildlife induced injuries and finally to quantify the health burden associated with wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties of Kajiado County. The quantitative data was collected using researcher administered questionnaires and semi-structured interviews and the qualitative data on the other hand, were collected using Focus Group Discussions (FGD), Key Informant Interviews, general observations and photography.

4.2 General Findings

4.2.1 Socio-Demographic Profile of the Respondents (Heads of Manyattas)

Most (32.3%) of the respondents in Loitokitok sub-county were aged between 40-49 years. In Kajiado Central sub-county, it is observed that most (40.9%) of the respondents were aged between 50-59 years. It is also observed that majority (94.6%) of the heads of manyattas in Loitokitok sub-county are married and living together with their spouses whereas 3.8% are widowed. A relatively small number (1.6%) of them have separated with their spouses.

A similar trend is observed in Kajiado Central sub-county where majority (90.2%) of the respondents are married and living together with their spouses whereas 9.8% are widowed. The study findings as demonstrated by table 4.1 show that 71.5%, 24.6% and 3.9% of the respondents in Loitokitok sub-county did not have any formal education, had primary education and post primary education respectively. A similar trend is observed in Kajiado Central sub-county where 75.8%, 20.4% and 3.8% of the respondents did not have any formal education, had primary education and post primary education respectively. It is also observed that most (44.6%) of manyattas in Loitokitok sub-county had between 122-182 cattle herders whereas most (40.9%) of manyattas in Kajiado Central sub-county had more than 183 cattle herders (Table 4.1).

Table 4.1: Socio-Demographic Characteristics of the Respondents

Investigative variable	Categories	Sub-county	
		Loitokitok n=130	Kajiado Central n=132
		n (%)	n (%)
Gender	Male	130 (100.0)	132 (100.0)
Age	30-39 years	25 (19.3)	21 (15.9)
	40-49 years	42 (32.3)	25 (18.9)
	50-59 years	36 (27.7)	54 (40.9)
	60-69 years	18 (13.8)	24 (18.2)
	70+ years	9 (6.9)	8 (6.1)
Marital status	Married (living together)	123 (94.6)	119 (90.2)
	Widowed	5 (3.8)	13 (9.8)
	Separated	2 (1.6)	0 (0.0)
Educational level	No formal education	93 (71.5)	100 (75.8)
	Primary education	32 (24.6)	27 (20.4)
	Post primary education	5 (3.9)	5 (3.8)
Number of cattle herders in the manyatta	≤ 60 cattle herders	14 (10.8)	6 (4.6)
	61-121 cattle herders	17 (13.1)	25 (18.9)
	122-182 cattle herders	58 (44.6)	47 (35.6)
	183+ cattle herders	41 (31.5)	54 (40.9)

4.2.2 Total Number of Cattle Herders in the Study Area

As Table 4.2 shows a total of 37,684 Maasai cattle herders are residents in the 262 manyattas sampled for this study. Estimated 21,574 (57.2%) were male cattle herders and 16,110 (42.8%) were female cattle herders.

Table 4.2: Total Number of Cattle Herders in the Study Area by Gender and Sub-County

Investigative variable	Categories	Number of cattle herders in the 262 manyattas in the study area (n=37,684)		
		Sub-county		
		Loitokitok (n=16,958)	Kajiado Central (n=20,726)	Total
		n (%)	n (%)	n (%)
Gender	Male	10,175 (60.0)	11,399 (55.0)	21,574 (57.2)
	Female	6,783 (40.0)	9,327 (45.0)	16,110 (42.8)
	Total	16,958 (100.0)	20,726 (100.0)	37,684 (100.0)

4.2.3. Attack by the wild animals

4.2.3. 1. Number of Cattle Herders Attacked by Wild Animals by Sub-County, Gender, Severity and Level of Education in the Study Area

It is observed that a total of 89 cattle herders were attacked by various wild animals in the study area in 2014. As demonstrated by table 4.3, Loitokitok sub-county suffered the blunt of wildlife induced injuries at 36 per 10,000 cattle herders as compared to Kajiado Central sub-county at 14 per 10,000 cattle herders.

Most of the wildlife induced injuries were non-fatal at 47 per 10,000 cattle herders and a relatively small proportion (3 per 10,000) were fatal. As presented by table 4.3, all fatal injuries occurred in Loitokitok sub-county and none occurred in Kajiado Central sub-county. Similarly, most of the non-fatal injuries occurred in Loitokitok sub-county at 33 per 10,000 cattle herders as compared to Kajiado Central sub-county at 14 per 10,000 cattle herders.

The findings show that majority of cattle herders attacked by wild animals in Loitokitok sub-county were male at 27 per 10,000 cattle herders as compared to female cattle herders at 9 per 10,000 cattle herders. A similar trend is observed in Kajiado Central sub-county where majority of cattle herders attacked by wild animals were male at 10 per 10,000 cattle herders as compared to female cattle herders at 4 per 10,000 cattle herders. It is observed that 30 per 10,000, 4 per 10,000 and 2 per 10,000 cattle herders attacked in Loitokitok sub-county did not have any formal education, had primary education and post primary education respectively. A similar trend is observed in Kajiado Central sub-county where 9 per 10,000, 3 per 10,000 and 2 per 10,000 cattle herders attacked by wild animals did not have any formal education, had primary education and post primary education respectively as Table 4.3 shows.

Table 4.3: Number of Cattle Herders Attacked by Wild Animals by Sub-County

Investigative Variable	Category	Number of cattle herders in the study area (n=37,684)			
		Number of cattle herders attacked by wild animals in the study area in 2014 = 89			
		Sub-county			
		Loitokitok sub-county (n=16,958)	Proportion per 10,000	Kajiado central (n=20,726)	Proportion per 10,000
Distribution of wildlife induced injuries	Sub-county wise	60	36	29	14
Severity of injury	Fatal	5	3	0	0
	Non-fatal	55	33	29	14
Gender	Male	46	27	22	10
	Female	14	9	7	4
Level of education	No formal education	50	30	20	9
	Primary education	7	4	5	3
	Post primary education	3	2	4	2

4.2.3. 2. Mortality due to Injury among Cattle Herders by Age

As demonstrated by table 4.4 below, two cattle herders aged between 30-35 years and two others aged between 45-50 years succumbed to wildlife induced injuries. There were no reported cases of fatal injuries among cattle herders below the age of 29 years, between 35-45 years and even between 50-55 years. However, there was one case of fatal injury above the age of 55 years.

Table 4.4 Mortality due to Injury among Cattle Herders by Age

Fatal injuries = 5								
Investigative variable	≤29 year s	30-35 years	35-40 years	40-45 years	45-50 years	50-55 years	≥55 Year s	Total
Distribution of fatal injuries by age	0	2	0	0	2	0	1	5

4.2.3. 3. Types of Wildlife Induced Injuries among Cattle Herders by Type of Injury and Age

From table 4.5 below, it is observed that majority (52.4%) of cattle herders suffered soft tissue and skin injuries followed by amputation of limb at 26.2%. A relatively smaller percentage (7.1%) of cattle herders suffered broken ribs. Generally, at least three cattle herders from each age category were attacked by wild animals. The cattle herders in the age category 40-45 years bore the blunt of the wildlife induced injuries.

Table 4.5 Morbidity due to Injury among Cattle Herders by Type of Injury and Age

Non-fatal injuries = 84												
Type of injury	≤10	10-	15-	20-	25-	30-	35-	40-	45-	50-	≥55	Total n (%)
	years	15	20	25	30	35	40	45	50	55	years	
	rs	years	rs	rs	rs	rs	rs	rs	rs	rs	rs	
Broken ribs	0	0	0	1	1	1	1	0	0	2	0	6 (7.1)
Amputation of limb	1	1	4	7	1	3	0	3	2	0	0	22 (26.2)
Soft tissue and skin injuries	2	2	6	1	6	5	6	10	1	4	1	44 (52.4)
Bone dislocation	0	0	2	3	0	2	2	0	1	0	2	12 (14.3)
Total	3	3	12	12	8	11	9	13	4	6	3	84 (100)

4.2.3. 4. Wildlife Responsible for Reported Injuries and Deaths by Sub-County

Table 4.6 below summarizes the reported injuries and deaths based on wild animal responsible where elephants, buffaloes, snakes and lions were reported to be responsible for most of the wildlife induced injuries. It is observed that 41.6% of the wildlife induced injuries were caused by elephant followed by buffalo at 21.3% in the both sub-counties. The rest of the wildlife induced injuries were caused by lion, leopard, cheetah and spotted hyena as demonstrated by table 4.6.

Table 4.6: Wildlife Responsible for Reported Injuries and Deaths by Sub-County

Name of the wild animal	Sub-County		Total n (%)
	Loitokitok n=60 n (%)	Kajiado Central n=29 n (%)	
Elephant	30 (50.0)	7 (24.1)	37 (41.6)
Lion	3 (5.0)	3 (10.3)	6 (6.8)
Leopard	3 (5.0)	0 (0.0)	3 (3.4)
Cheetah	0 (0.0)	4 (13.8)	4 (4.5)
Spotted hyena	2 (3.3)	1 (3.5)	3 (3.4)
Snake	9 (15.0)	8 (27.6)	17 (19.1)
Buffalo	13 (21.7)	6 (20.7)	19 (21.3)
Total	60 (100.0)	29 (100.0)	89 (100)

4.3 Risk Factors Associated with Wildlife Induced Injuries among Cattle Herders

4.3.1 Multivariate Analysis of Variance (MANOVA)

The study sought to identify risk factors contributing to wildlife induced injuries and health burden among the Maasai cattle herders in Loitokitok and Kajiado Central sub-counties. As demonstrated by table 4.7, the factors investigated are scarce grazing area, sharing of water points, rescuing cattle from wild animal, season of the year, shrinking habitat, increasing population of people in the area, emergency of urbanization and finally encroachment by cattle herders to wildlife corridors and parks. The questionnaire respondents who reported the 89 cases of wildlife induced injuries were asked to state the factors that contributed to those injuries. Multivariate Analysis of Variance (MANOVA) was undertaken so as to test the hypothesis that one or more of the above risk factors or independent variables had an effect on the two dependent variables under this study, i.e. wildlife induced injuries and the health burden (severity).

According to Multivariate analysis in which Pillai's trace was used, there was no significant relationship between wildlife induced injuries and their severity with scarce grazing areas {Pillai's Trace = 0.009, $F(1, 78) = 0.669$, $P=0.416$ }, sharing water points {Pillai's Trace =0.001, $F(1, 78) = 0.040$, $P=0.842$ }, rescuing cattle from wild animals {Pillai's Trace =0.006, $F(1, 78) = 0.477$, $P=0.492$ }, season of the year when attack occurred {Pillai's Trace =0.012, $F(2, 78) = 0.489$, $P=0.615$ }, shrinking habitat {Pillai's Trace =0.016, $F(1, 78) = 1.231$, $P=0.271$ }, increasing population of people in the area {Pillai's Trace =0.006, $F(1, 78) = 0.475$, $P=0.493$ }, emergency of urbanization { Pillai's Trace =0.001, $F(1, 78) = 0.017$, $P=0.897$ } and encroachment by Maasai cattle herders to wildlife corridors and parks { Pillai's Trace = 0.001, $F(1, 78) = 0.043$, $P=0.836$ }.

Table 4.7 Multivariate Test Results

Effect	Value (Effect size or Pillai's Trace outcome)	F	Hypothesis df	Error df	Sig.
Intercept	0.655	147.829	1.000	78.000	P<0.001
Scarce grazing area	0.009	0.669	1.000	78.000	0.416
Sharing of water points	0.001	0.040	1.000	78.000	0.842
Rescuing cattle from wild animal	0.006	0.477	1.000	78.000	0.492
Season of the year	0.012	0.489	2.000	78.000	0.615
Shrinking habitat	0.016	1.231	1.000	78.000	0.271
Increasing population of people in the area	0.006	0.475	1.000	78.000	0.493
Emergency of urbanization	0.001	0.017	1.000	78.000	0.897
Encroachment by Maasai cattle herders to wildlife protected areas	0.001	0.043	1.000	78.000	0.836

4.3.2 Multiple Discriminant Function Analysis (MDFA)

MANOVA was followed up with MDFA in order to describe the linear relationship between the canonical variate i.e. a combination of the independent variables (risk factors) and the dependent variables. This means that the independent variables were tested in combination using MDFA. Based upon the significance value as demonstrated by table 4.8, the independent variables sufficiently contributed to the wildlife induced injuries and the health burden when in combination ($X^2 = 34.822$, $df = 9$, $P < 0.001$).

Table 4.8 Multiple Discriminant Function Analysis (MDFA) test results

Function	Chi-square (X^2)	Df	Sig.
1	34.822	df=9	P<0.001

4.3.3 Standardized Canonical Discriminant Function Coefficients (SCDFC)

Further test results from Multiple Discriminant Function Analysis (MDFA) indicated the standardized canonical discriminant function coefficients for each independent variable under investigation. These coefficients indicate the relative contribution of each independent variable to the two dependent variables (wildlife induced injuries and the health burden). Table 4.9 presents findings on standardized canonical discriminant function coefficients for each independent variable (risk factor). The analysis shows that encroachment by Maasai cattle herders to wildlife protected areas and shrinking habitat were the main predictors of wildlife induced injuries with function coefficients of 0.110 and 0.086 respectively. On the other hand, emerging of urbanization and sharing of water points between cattle herders and wildlife have small function coefficients and hence, weak linear relationships with the grouping variables (dependent variables) which implies that they contributed little to the wildlife induced injuries and the health burden. These function coefficients signify the importance of each predictor variable in the relationship with the grouping variable. When some variables have high canonical variate correlations while others have low ones, then the ones with high correlations contribute most to the group separation.

Table4.9: Standardized Canonical Discriminant Function Coefficients

Factors	Function coefficients
Scarce grazing zones	0.051
Sharing water points	0.029
Rescuing cattle from wild animal	0.050
Season of the year	0.053
Shrinking habitat	0.086
Increasing population in the area	0.049
Emergency of urbanization	0.005
Encroachment by Maasai cattle herders to wildlife protected areas	0.110

During focus group discussions and key informant interviews, it was reported that,

“Water tanks and boreholes located near manyattas contributed to confrontation between cattle herders and wild animals.....water from these water tanks and boreholes lure wild animals such as elephant which increases chances of encounter and confrontation between cattle herders and wildlife leading to death or injuries among cattle herders”.

Plate 4.1 shows a locally constructed water tank outside a manyatta in Oloililai Location of Kajiado Central sub-county.



Plate 4.1: A photo taken on 13th March 2014 at 11.20am showing a locally constructed water tank outside a manyatta in Oloililai Location of Kajiado Central sub-county

The focus group discussion participants reported that when an elephant spots a water tank, it destroys it in an effort to access the water. The destruction of water tanks sparks a conflict between cattle herders and wildlife. These conflicts result into wildlife induced injuries among cattle herders.

During the focus group discussions and key informant interviews, it was reported that alcoholism did contribute greatly to wildlife induced injuries among the Maasai cattle herders. One FGD discussant reported that some cattle herders were attacked by wild animals while under the influence of alcohol. He reported that,

“When cattle herders are under the influence of alcohol, they tend to be ignorant and careless to an extent of provoking wild animals on spotting them, leading to incidents that result in death and injury of the herders”.

Negative attitude held by cattle herders towards wildlife was cited as a key predictor of wildlife induced injuries. It was observed during Focus Group Discussions and Key Informant Interviews that cattle herders have negative attitude towards wildlife such as elephant, lion, buffalo and leopard. Kenya Wildlife Service (KWS) is the body mandated to take care of wildlife in protected areas and those that roam outside protected areas. Participants expressed their dissatisfaction with the way KWS managed conflicts between wildlife and cattle herders in the area. A participant reported,

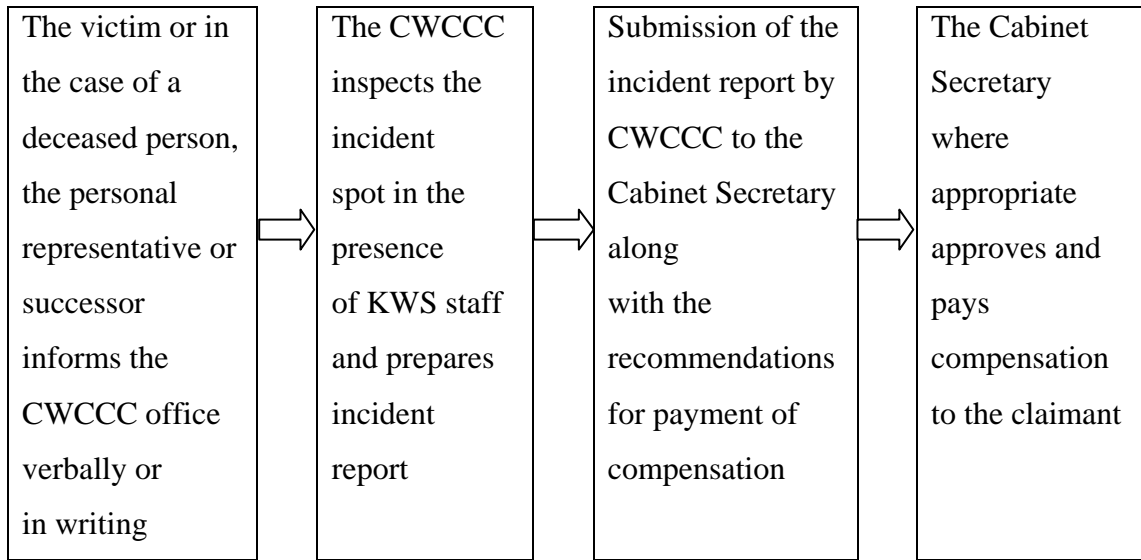
“They do not get enough attention from KWS when they report wildlife problems. KWS officers only come to move or direct the wild animals back to protected areas”.

In addition, compensation for cattle herders who suffer bodily injury or is killed by wildlife was also cited as one of the risk factors behind wildlife induced injuries. A participants in a FGD expressed the view that,

“Compensation procedure and the time it takes to access the money claimed is lengthy and cumbersome and these force cattle herders to engage in retaliatory activities against wild animals”.

Section 25 of Wildlife Conservation and Management Act (WCMA), 2013 states “Where any person suffers any bodily injury or is killed by any wildlife listed under the Third Schedule, the person injured, or in the case of a deceased person, the personal representative or successor, may launch a claim to the County Wildlife Conservation and Compensation Committee (CWCCC) within the jurisdiction established under this Act”.

Section 18 of WCMA, 2013 states “The County Wildlife Conservation and Compensation Committee established under section 18 shall verify a claim made under subsection (1) and upon verification, submit the claim to the Cabinet Secretary together with its recommendations thereon”. Figure 4.1 shows steps for claim compensation.



Source: Kajiado County Wildlife Conservation and Compensation Committee office, 2015

Figure 4.1: Steps for Claiming Compensation

Section 25(3) of WCMA, 2013 states “The Cabinet Secretary shall consider the recommendations made under subsection (1) and where appropriate, pay compensation to the claimant as follows—

- (a) In the case of death, five million shillings;
- (b) In the case of injury occasioning permanent disability, three million shillings;
- (c) In the case of any other injury, a maximum of two million shillings, depending on the extent of injury”

4.4 Risk Indices of Potential Risk Factors Associated with Wildlife Induced Injuries

The study also sought to establish risk indices of potential risk factors associated with wildlife induced injuries among cattle herders in Kajiado Central and Loitokitok sub counties.

Summary of Risk Indices by Sub-County

As demonstrated by table 4.10, most of the scores fall within the moderate risk index category followed by high risk index category. It is observed that 3 (2.3%), 109 (83.8%) and 18 (13.9%) of the questionnaire respondents in Loitokitok sub-county had their risk scores within low risk rating (< 16), moderate risk rating ($16 \leq 25$) and high risk rating (> 25) respectively. A similar trend is observed in Kajiado Central sub-county where 1 (0.8%), 117 (88.6%) and 14 (10.6%) had their risk scores within low risk rating (< 16), moderate risk rating ($16 \leq 25$) and high risk rating (> 25) respectively.

Table 4.10: Summary of Risk Indices by Sub-County

Category of risk scores	Risk indexing category	Sub-county	
		Loitokitok n=130 n (%)	Kajiado Central n=132 n (%)
< 16	Low risk	3 (2.3)	1 (0.8)
$16 \leq 25$	Moderate risk	109 (83.8)	117 (88.6)
> 25	High risk	18 (13.9)	14 (10.6)
Total		130 (100.0)	132 (100.0)

4.5 Protective Measures Adopted to Mitigate Wildlife Induced Injuries

The respondents were asked to state the role of Maasai morans in mitigating wildlife induced injuries. As demonstrated by table 4.11, 51.5% of the respondents from Loitokitok sub-county indicated that Maasai morans are used to hunt and kill dangerous wild animals whenever requested by the area residents whereas 45.4% of them indicated otherwise. However, 3.1% of respondents were not sure on what Maasai morans do. A similar observation is noted in Kajiado Central sub-county where 70.5% of the respondents indicated that Maasai morans are used to hunt and kill dangerous wild animals whenever requested by the area residents whereas 22.7% of them indicated otherwise. However, 6.8% of respondents were not sure on what Maasai morans do.

The respondents were further asked to state whether Maasai morans are used to guard manyattas as a protective measure against wildlife induced injuries besides hunting and killing dangerous wild animals whenever requested by the area residents. Table 4.11 shows that 60.8% of the respondents from Loitokitok sub-county indicated that Maasai morans are used to guard manyattas against dangerous wild animals whereas 36.2% of them stated otherwise. However, 3.0% of the respondents were not sure on what Maasai morans do. A similar trend is observed in Kajiado Central sub-county where majority (79.5%) of the respondents indicated that Maasai morans are also used to guard manyattas against dangerous wild animals whereas 15.2% of them stated otherwise. The remaining 5.3% of the respondents were not sure on what Maasai morans do. Approximately 7.7% of the respondents from Loitokitok sub-county indicated that KWS monitors and controls dangerous wild animals whereas 90.0% of them indicated that KWS does not monitor or control dangerous wild animals.

The remaining 2.3% of the respondents were not sure on what KWS does. A different observation was noted in Kajiado Central sub-county where 59.1% of the respondents indicated that KWS monitors and controls dangerous wild animals whereas 40.1% of them indicated that KWS does not monitor or control dangerous wild animals. However, the remaining 0.8% of the respondents was not sure on what KWS does. With regard to whether bio fence erected around the manyattas was helped to keep away wild animals from accessing the compound, both during the day and at night, 86.2% of the respondents from Loitokitok sub-county indicated that it helped to keep away wild animals from accessing the compound whereas only 6.1% of them indicated otherwise. Table 4.11 shows a summary of the results.

Table 4.11: Protective Measures Adopted to Mitigate Wildlife Induced Injuries

	Sub-county					
	Loitokitok n=130			Kajiado Central n=132		
	Yes n (%)	No n (%)	Not sure n (%)	Yes n (%)	No n (%)	Not sure n (%)
Use of morans to hunt and kill problematic wild animals	67 (51.5)	59 (45.4)	4 (3.1)	93 (70.5)	30 (22.7)	9 (6.8)
Guarding of manyattas by morans	79 (60.8)	47 (36.2)	4 (3.0)	105 (79.5)	20 (15.2)	7 (5.3)
Control of problematic wildlife by KWS	10 (7.7)	117 (90.0)	3 (2.3)	78 (59.1)	53 (40.1)	1 (0.8)
Bio fencing around manyattas to keep away wild animals	112 (86.2)	8 (6.1)	10 (7.7)	120 (90.9)	5 (3.8)	7 (5.3)
Lighting fires at night to keep away wild animals	86 (66.2)	44 (33.8)	0 (0.0)	93 (70.5)	39 (29.5)	0 (0.0)
Use of guard dogs both in the manyatta and while herding in the field	33 (25.4)	86 (66.2)	11(8.4)	64 (48.5)	51 (38.6)	17 (12.9)

However, the remaining 7.7% of the respondents were not sure on the use of bio fence.

Plate 4.2 shows a typical bio fence erected around a manyatta in Olchorro Location of Loitokitok sub-county.



Plate 4.2: A Typical Bio Fence around a Manyatta in Olchorro Location of Loitokitok Sub-County, 2015

A similar trend is observed in Kajiado Central sub-county where majority (90.9%) of the respondents indicated that bio fence put around a manyatta is meant to keep away wild animals from accessing the compound whereas only 3.8% of them indicated otherwise. However, the remaining 5.3% of the respondents were not sure on the use of bio fence. However, despite the fact that bio fence around a manyatta is widely used as a protective measure against wildlife attacks, it was reported during focus group discussions and key informant interviews that,

“Use of bio fence around manyattas to keep away wild animals is not effective enough because some wild animals such as snakes still find their way into the manyattas”.

Respondents were asked to state whether lighting fires at night is practiced as a strategy to keep away problematic wild animals from accessing manyatta compounds.

As demonstrated by table 4.11, majority (66.2%) of the respondents in Loitokitok sub-county indicated that lighting fires at night to scare away wild animals is practiced whereas 33.8% of them stated otherwise. A similar trend is observed in Kajiado Central sub-county where majority (70.5%) of the respondents indicated that lighting fires at night to scare away wild animals is practiced whereas 29.5% of them stated otherwise. Respondents were asked to state whether use of dogs to protect cattle herders against wild animals both during the day and at night is practiced in the area. Results in table 4.11 show that majority (66.2%) of the respondents in Loitokitok sub-county do not use dogs to protect cattle herders against wildlife whereas a relatively small percentage (25.4%) of them stated that use of dogs to protect cattle herders is practiced in the area. However, the remaining 8.4% of the respondents were not sure on the use of dogs. A different observation is noted in Kajiado Central sub-county where most (48.5%) of the respondents indicated that use of dogs to protect cattle herders is practiced in the area whereas 38.6% of them stated otherwise. However, 12.9% of the respondents were not sure on the use of dogs.

4.6 Health Burden of Wildlife Induced Injuries among the Maasai Cattle Herders in Kajiado

The study sought to determine the health burden of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties of Kajiado County. The specific objective addresses quantification of Years of Life Lost (YLL) and Years Lived with Disabilities (YLD). It is in this section that research hypotheses two and three are tested.

The study used Kajiado County Integrated Development Plan (KCIDP) 2013-2017, population projections for 2014 to estimate the health burden associated with wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties. The 2009 KPHC results show that Kajiado County has an annual population growth rate of 5.5 percent. Table 4.12 presents the population projections and the estimated number of Maasai cattle herders in Kajiado Central and Loitokitok sub-counties. According to the 2009 KPHC Kajiado Central sub-county had a population of 162,278. Of this, 80,354 were males and 81,924 were females whereas Loitokitok sub-county had a population of 136, 996, out of which 68,337 were males and 68,659 were females, almost in the ratio of 1:1. The Kajiado Central sub-county population projections for 2014 was 175,212 up from 162,278 in 2009 whereas for Loitokitok sub-county was 148,455 up from 136, 996 in 2009. The KCIDP 2013-2017 indicate that Maasai cattle herders living in manyattas in Kajiado Central and Loitokitok sub-counties accounted for 60.3% of the projected population. In 2014, the total projected population for the two sub-counties was 323,667.

60.3% of this projected population represented the entire population of Maasai cattle herders in the two sub-counties which was 195,171 and this constituted the study population in 846 manyatta residents in Kajiado Central and Loitokitok sub-counties. Of this, 96,969 were males while 98,202 were females almost in the ratio of 1:1.

Table 4.12: The 2014 Population Projections and the Estimated Number of Maasai Cattle Herders

2009 KPHC			
Sub-County	Male	Female	Total
Kajiado Central Sub-county	80,354	81,924	162,278
Loitokitok sub-county	68,337	68,659	136,996
Population Projections for 2014			
Kajiado Central Sub-County	86,758	88,454	175,212
Loitokitok Sub-County	74,053	74,402	148,455
Total	160,811	162,856	323,667
Estimated Number of Maasai Cattle Herders in 2014 (60.3%)			
Kajiado Central Sub-County	52,315	53,338	105,653
Loitokitok Sub-County	44,654	44,864	89,518
Total	96,969	98,202	195,171
Combined total number of cattle herders in the two sub-counties who were residents in 846 manyattas (N)	(60.3% of 160,811 =96,969)	(60.3% of 162,856 =98,202)	(60.3% of 323,667 =195,171)
Number of Maasai Cattle Herders in 262 Sampled Manyattas (n)			
Combined total number of cattle herders in the two sub-counties who were residents in 262 manyattas (n)	21,574 (57.2%)	16,110 (42.8%)	37,684 (100.0%)

A total of 262 manyattas were sampled for this study and the researcher established that a total of 37,684 Maasai cattle herders were living in the 262 sampled manyattas in 2014. Of this, 21,574 were male and 16,110 were female. It follows that 89 cases of wildlife induced injuries occurred among 37,684 Maasai cattle herders. Table 4.13 shows the proportionate mortality and morbidity due to injury by age and gender in Kajiado Central and Loitokitok sub-counties.

Table 4.13 shows that there were 4 male injury deaths per 21,574 male cattle herders distributed as 1 male injury death in 30-34, 2 male injury deaths in 45-49 and finally 1 male injury death in 60-64 age groups. Proportionately, there were 5, 10 and 5 male injury deaths within the age groups 30-34, 45-49 and 60-64 respectively giving a total of 20 male injury deaths per 96, 969 male cattle herders. It is observed that there was only one female injury death per 16, 110 female cattle herders who was aged between 30-34 years. Proportionately, there were 6 female injury deaths per 98, 202 female cattle herders who were aged between 30-34 years.

On the other hand, there were 18 male cattle herders who sustained major injuries per 21, 574 male cattle herders distributed as 9, 7, and 2 within the age groups 15-29, 30-44 and 45-59 respectively which led to permanent disabilities. Proportionately, there were 82 male cattle herders who sustained major injuries per 96, 969 male cattle herders distributed as 41, 32, and 9 within the age groups 15-29, 30-44 and 45-59 respectively which led to permanent disabilities. It is also observed that there were 10 female cattle herders who sustained major injuries per 16, 110 female cattle herders distributed as 1, 6, 1 and 2 within the age groups 5-14, 15-29, 30-44 and 45-59 respectively which led to permanent disabilities. Proportionately, there were 61 female cattle herders who sustained major injuries per 98, 202 female cattle herders distributed as 6, 37, 6 and 12 within the age groups 5-14, 15-29, 30-44 and 45-49 respectively which led to permanent disabilities. Analysis further revealed that there were 46 male cattle herders who sustained minor injuries per 21, 574 male cattle herders distributed as 3, 12, 22, 7 and 2 within the age groups 5-14, 15-29, 30-44, 45-59 and 60-69 respectively which led to temporary disabilities.

Proportionately, there were 208 male cattle herders who sustained minor injuries per 96, 969 male cattle herders distributed as 14, 54, 99, 32 and 9 within the age groups 5-14, 15-29, 30-44, 45-49 and 60-69 respectively which led to temporary disabilities. According to analysis there were 10 female cattle herders who sustained minor injuries per 16, 110 female cattle herders distributed as 1, 6 and 3 within the age groups 5-14, 15-29 and 30-44 respectively which led to temporary disabilities. Proportionately, there were 61 female cattle herders who sustained minor injuries per 98, 202 female cattle herders distributed as 6, 37 and 18 within the age groups 5-14, 15-29 and 30-44 respectively which led to temporary disabilities.

Table 4.13 Proportionate Number of Fatal and Non-Fatal Injuries by Age and Gender

Male			Female	
Mortality – Proportionate Number of Fatal Injuries (Deaths) by Gender				
Age group	Deaths per 21,574 male cattle herders	Proportionate deaths per 96, 969 (male cattle herders)	Deaths per 16,110 female cattle herders	Proportionate deaths per 98, 202 (female cattle herders)
30-44	1	5	1	6
45-59	2	10	0	0
60+	1	5	0	0
Total	4	20	1	6
Morbidity – Proportionate Number of Non-Fatal Injuries among Cattle Herders with Permanent Disabilities (Major Injuries)				
Age group	Number of cases per 21,574 male cattle herders	Proportionate number of cases per 96, 969 (male cattle herders)	Number of cases per 16,110 female cattle herders	Proportionate number of cases per 98, 202 (female cattle herders)
<14	0	0	1	6
15-29	9	41	6	37
30-44	7	32	1	6
45-59	2	9	2	12
60+	0	0	0	0
Total	18	82	10	61
Morbidity - Proportionate Number of Non-Fatal Injuries among Cattle Herders with Temporary Disabilities (Minor Injuries)				
Age group	Temporary disability (Minor injuries) per 21,574 male cattle herders	Proportionate temporary disability (Minor injuries) per 96, 969 (male cattle herders)	Temporary disability (Minor injuries) per 16,110 female cattle herders	Proportionate temporary disability (Minor injuries) per 98, 202 (female cattle herders)
<14	3	14	1	6
15-29	12	54	6	37
30-44	22	99	3	18
45-59	7	32	0	0
60+	2	9	0	0
Total	46	208	10	61

Table 4.14: Years of Life Lost (YLL) – Injury Deaths

Males

Age	Population	Deaths	Deaths per 1,000	Av. Age at death	YLLs	YLL per 1,000
0-4	18,056	-	0.0	-	-	0.0
5-14	30,178	-	0.0	-	-	0.0
15-29	25,261	-	0.0	-	-	0.0
30-44	13,599	5	0.4	37.0	127	9.3
45-59	6,198	10	1.6	52.0	210	33.9
60-69	1,891	5	2.6	64.5	74	39.0
70-79	1,046	-	0.0	-	-	0.0
80+	740	-	0.0	-	-	0.0
Total	96,969	20	0.2	51.2	411	4.2

Females

0-4	17,342	-	0.0	-	-	0.0
5-14	29,112	-	0.0	-	-	0.0
15-29	27,374	-	0.0	-	-	0.0
30-44	14,233	6	0.4	37.0	150	10.5
45-59	6,104	-	0.0	-	-	0.0
60-69	1,917	-	0.0	-	-	0.0
70-79	1,143	-	0.0	-	-	0.0
80+	977	-	0.0	-	-	0.0
Total	98,202	6	0.1	37.0	150	1.5

Table 4.15: Years Lived with Permanent Disability (YLD) – Major Injuries

<i>Age</i>	Population	Incidence	Incidence per 1,000	<i>Males</i>			YLDs	YLD per 1,000
				Age at onset	Duration (years)	Disability Weight		
0-4	18,056	0	0	2.0	0.0	0.750	-	0.0
5-14	30,178	0	0	9.5	0.0	0.750	-	0.0
15-29	25,261	41	1.6	22.0	58.0	0.750	840	33.2
30-44	13,599	32	2.4	37.0	43.0	0.750	580	42.6
45-59	6,198	9	1.5	52.0	28.0	0.750	131	21.1
60-69	1,891	0	0	64.5	0.0	0.750	-	0.0
70-79	1,046	0	0	74.5	0.0	0.750	-	0.0
80+	740	0	0	80.0	0.0	0.750	-	0.0
Total	96,969	82	0.8	37.0	43.0	0.75	1,551	16.0
				<i>Females</i>				
0-4	17,342	0	0	2.0	0.0	0.750	-	0.0
5-14	29,112	6	0.2	9.5	72.5	0.750	132	4.5
15-29	27,374	37	1.4	22.0	60.0	0.750	777	28.4
30-44	14,233	6	0.4	37.0	45.0	0.750	112	7.9
45-59	6,104	12	2.0	52.0	30.0	0.750	185	30.3
60-69	1,917	0	0	64.5	0.0	0.750	-	0.0
70-79	1,143	0	0	74.5	0.0	0.750	-	0.0
80+	977	0	0	82.0	0.0	0.750	-	0.0
Total	98,202	61	0.6	30.1	51.9	0.75	1,206	12.3

Table 4.16: Years Lived with Temporary Disabilities (YLD) – Minor Injuries

<i>Males</i>								
Age	Population	Incidence	Incidence per 1,000	Age at onset	Duration (years)	Disability Weight	YLDs	YLD per 1,000
0-4	18,056	0	0.0	2.0	0.5	0.250	-	0.0
5-14	30,178	14	0.5	9.5	0.5	0.250	2	0.1
15-29	25,261	54	2.1	22.0	0.5	0.250	7	0.3
30-44	13,599	99	7.3	37.0	0.5	0.250	12	0.9
45-59	6,198	32	5.2	52.0	0.5	0.250	4	0.6
60-69	1,891	9	4.6	64.5	0.5	0.250	1	0.5
70-79	1,046	0	0.0	74.5	0.5	0.250	-	0.0
80+	740	0	0.0	80.0	0.5	0.250	-	0.0
Total	96,969	208	2.1	37.0	0.5	0.25	26	0.3
<i>Females</i>								
0-4	17,342	0	0	2.0	0.5	0.250	-	0.0
5-14	29,112	6	0.2	9.5	0.5	0.250	1	0.03
15-29	27,374	37	0.3	22.0	0.5	0.250	5	0.2
30-44	14,233	18	1.3	37.0	0.5	0.250	2	0.1
45-59	6,104	0	0	52.0	0.5	0.250	-	0.0
60-69	1,917	0	0	64.5	0.5	0.250	-	0.0
70-79	1,143	0	0	74.5	0.5	0.250	-	0.0
80+	977	0	0	82.0	0.5	0.250	-	0.0
Total	98,202	61	0.6	22.8	0.5	0.25	8	0.1

Table 4.17: Disability Adjusted Life Years, DALYs = Total YLLs + Total YLDs

Male						Female					Persons	
Age	Population	YLL	YLD Permanent	YLD Temporary	Male DALYs	Population	YLL	YLD Permanent	YLD Temporary	Female DALYs	Population	TOTAL DALYs
0-4	18,056	-	-	-	-	17,342	-	-	-	-	35,398	-
5-14	30,178	-	-	2	2	29,112	-	132	1	133	59,290	135
15-29	25,261	-	840	7	847	27,374	-	777	5	782	52,635	1,629
30-44	13,599	127	580	12	719	14,233	150	112	2	264	27,832	983
45-59	6,198	210	131	4	345	6,104	-	185	-	185	12,302	530
60-69	1,891	74	-	1	75	1,917	-	-	-	-	3,808	75
70-79	1,046	-	-	-	-	1,143	-	-	-	-	2,189	-
80+	740	-	-	-	-	977	-	-	-	-	1,717	-
Total	96,969	411	1,551	26	1,988	98,202	150	1,206	8	1,364	195,171	3,352

4.6.1 Years of Life Lost (YLL)

YLL due to cattle herding by age and gender are presented in table 4.14. The constant interaction between wildlife and cattle herders increases chances of encounter and confrontation which leads to incidents of premature death. Analysis of results in table 4.14 shows that in Kajiado Central and Loitokitok sub-counties in 2014, wildlife induced injuries accounted for a total of 411 Years of Life Lost (YLL) due to premature death in male cattle herders and 150 Years of Life Lost (YLL) in female cattle herders.

4.6.2 Years Lived with Disabilities (YLDs)

Results on YLDs are presented in tables 4.15 and 4.16. YLDs were categorized into those resulting from permanent disabilities and those resulting from temporary disabilities. According to World Health Organization (2010) on National burden of disease and injury studies, an estimated 0.75 disability weighting was used for all major injuries and 0.25 disability weighting was used for all minor injuries for YLDs calculation. Table 4.15 presents results on the YLDs due to major injuries (permanent disabilities) which demonstrate that wildlife induced major injuries accounted for 1,551 Years Lived with permanent Disabilities (YLDs) in male cattle herders and 1,206 Years lived with permanent Disabilities (YLDs) in female cattle herders in the year of reference. As demonstrated by table 4.16, wildlife induced minor injuries accounted for 26 Years Lived with temporary Disabilities (YLDs) in male cattle herders and 8 Years Lived with temporary Disabilities (YLDs) in female cattle herders in the year of reference.

Tables 4.15 and 4.16 show that wildlife induced major injuries accounted (those that resulted in permanent disabilities) for more Years Lived with Disabilities (YLD) than wildlife induced minor injuries (those that resulted in temporary disabilities).

4.6.3 Disability Adjusted Life Years (DALYs)

Table 4.17 presents results on DALYs resulting from Years of Life Lost (YLL) and Years Lived with Disabilities (YLD). It is observed that wildlife induced injuries accounted for a total of 3,352 DALYs among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties in the year of reference. Of this, 1,988 DALYs resulted in male Maasai cattle herders and 1,364 DALYs resulted in female Maasai cattle herders which indicate that male Maasai cattle herders lost more healthy years of life due to cattle herding than female Maasai cattle herders. Figure 4.2 gives a summary of quantification of health burden of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties.

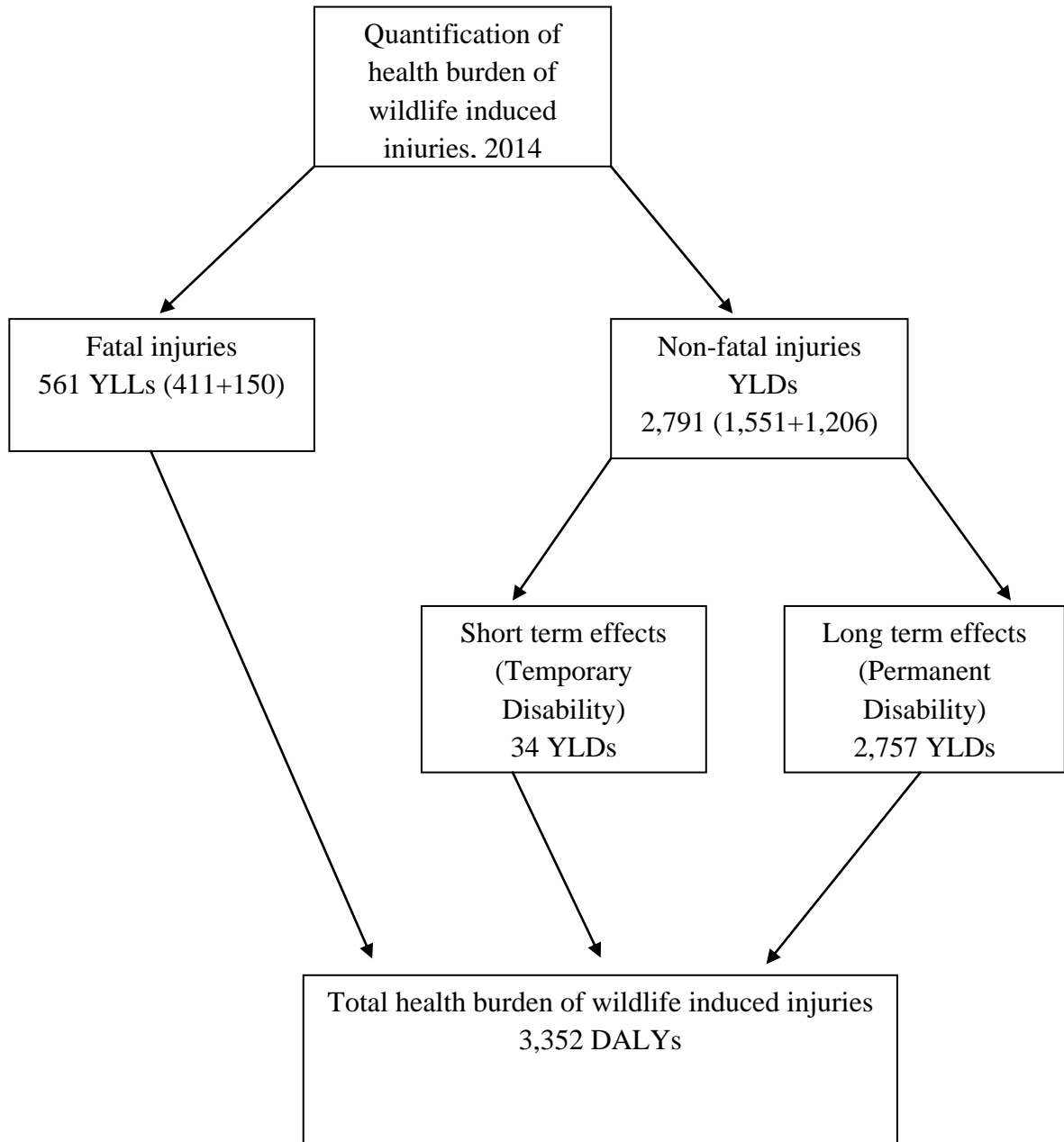


Figure 4.2 Quantification of Health Burden of Wildlife Induced Injuries among the Maasai Cattle Herders in Kajiado Central and Loitokotok Sub-Counties.

CHAPTER FIVE: DISCUSSION OF RESULTS

- ❖ All the respondents in this study were male which concurs with Ogutu (2011) findings that Maasai households and indeed Manyattas are headed by men. Majority of the respondents from both sub-counties were married and living together with their spouses. The results concur with Okello and Wishitemi (2010) findings that Maasai community accords strong values to marriage. Most of the respondents did not have any formal education which concurs with Sachedina (2006) study findings that Maasai cattle herders give more preference to livestock keeping than formal education. The study findings indicate that Loitokitok sub-county suffered the blunt of wildlife induced injuries both with regard to incidences and severity. All injury deaths occurred in Loitokitok sub-county. Deaths of cattle herders, though relatively less common exerts a significant impact because of the loss of a family member and the associated impact on the dependants of the victim.

It was also observed that most of the non-fatal injuries occurred in Loitokitok sub-county as compared to Kajiado Central Sub-county. The study findings indicate that wildlife induced injuries differ greatly from one location to another which concurs with Gurung (2008) findings on tiger-human conflicts: Investigating ecological and sociological issues of tiger conservation in the buffer zone of Chitwan National Park, Nepal. It is evident from the study findings that male cattle herders in both sub-counties bore the brunt of wildlife induced injuries which is an indication that male cattle herders play a dominant role in cattle herding and hence are more prone to wildlife attacks.

The findings indicate that different animals are responsible for different types of incidents in different sub-counties. Elephant, buffalo, snake and lion caused more wildlife induced injuries in the two sub-counties. Elephant attacks were more common in both sub-counties.

The study established that there was no significant association between each individual risk factor and the dependent variables i.e. scarce grazing areas {Pillai's Trace =0.009, $F(1, 78) = 0.669$, $P=0.416$ }, sharing water points {Pillai's Trace =0.001, $F(1, 78) = 0.040$, $P=0.842$ }, rescuing cattle from wild animals {Pillai's Trace =0.006, $F(1, 78) = 0.477$, $P=0.492$ }, season of the year when attack occurred {Pillai's Trace =0.012, $F(2, 78) = 0.489$, $P=0.615$ }, shrinking habitat {Pillai's Trace =0.016, $F(1, 78) = 1.231$, $P=0.271$ }, increasing population of people in the area {Pillai's Trace =0.006, $F(1, 78) = 0.475$, $P=0.493$ }, emergency of urbanization {Pillai's Trace =0.018, $F(1, 78) = 0.017$, $P=0.897$ } and encroachment by Maasai cattle herders to wildlife corridors and parks {Pillai's Trace =0.021, $F(1, 78) = 0.043$, $P=0.836$ }.

Multiple Discriminant Function Analysis (MDFA) was used to identify if the independent variables (risk factors) placed in combination were significant predictors of wildlife induced injuries. The study findings show that when placed in combination, their combined effect significantly contributed to wildlife induced injuries and the health burden ($X^2 = 34.822$, $df = 9$, $P < 0.001$). In terms of individual contribution to the wildlife induced injuries and the health burden, the study established that encroachment by Maasai cattle herders to wildlife protected areas and shrinking habitat were the main predictors of wildlife induced injuries with function coefficients of 0.110 and 0.086 respectively.

This is consistent with WWF (2008) findings which indicate that when wildlife species lose their natural habitats and their access to natural food sources is also reduced, they eat agricultural crops, prey on livestock, destroy property and injure or kill people. A study done in Bandipur, Karnataka reported that man-animal conflict increased from the year 2001-2004 where there were more agricultural fields and human habitation (Hindu, 2005). Likewise, people from Jhapa district of Nepal also realized that the shrinkage of habitat was a driving force behind the elephants' behaviour of straying out to the settlements. The rise in human-wildlife conflict is inevitable due to the ever increasing agricultural fields and settlements along wildlife corridors and also near protected areas (Shrestha *et al.*, 2007).

The study findings show that emergency of urbanization and sharing of water points between cattle herders and wildlife have small standardized canonical discriminant function coefficient. The function coefficients signify the importance of each predictor variable in the relationship with the dependent variables. When some variables have high canonical variate correlations while others have low ones, then the ones with high correlations contribute most to the group separation. Predictor variables with very small coefficients have weak linear relationships with the grouping variable and hence, they likely add little to the predictability of the model (Harvey, 2008).

Sharing of water resources between wildlife and cattle herders is a predictor of wildlife induced injuries which impacts on health burden among cattle herders as most of the injuries that occurred while herding took place near or within a water point (standardized canonical discriminant function coefficient = 0.029).

This is consistent with a study conducted by Thapa (2010) which showed that there are many area-specific risk factors likely to influence the level of wildlife induced injuries. This can include proximity to edges of protected areas and or water sources. This implies that a cattle herder is at risk of being attacked by wild animals near or within water point.

The negative attitude that cattle herders have towards wildlife is a predictor of wildlife induced injures and hence health burden among cattle herders. The study participants expressed their view that wildlife benefits Government more than cattle herders. This makes them feel that the Government values wildlife more than them. A study conducted by Okello and Wishitemi (2010) indicated that when people have positive attitude towards wildlife, they can co-exist. The negative attitude towards wildlife determines the way people treat them. Such people are more open to learning sustainable methods of dealing with wildlife. Enhancing positive attitude towards wildlife reduces conflict and enhances tolerance. Similar study findings by Salafsky et al. (2001) indicated that identifying a pattern of deep conflict rooted in local peoples' animosity and attitudes towards wildlife and the local authorities is crucial. Thus, before any external mitigation interventions can be put into place, it is vital that the relationship between the local people and wildlife be improved to shift attitudes. Wildlife should be seen as an asset to the community, not a hindrance, which currently is not the case.

In the global context, support and involvement from all stakeholders, local people, local authorities and organizations with vested interests is consistently urged to ensure long-term conservation success (Treves *et al.*, 2006). Study findings show that alcoholism is a predictor of wildlife induced injuries and hence health burden among cattle herders.

It was reported that when cattle herders are under the influence of alcohol, they become daring to an extent of moving cattle to wildlife prone areas or vulnerable areas such as inside and around protected areas and even along wildlife corridors which increases chances of encounter and confrontation with wild animals. During one of the focus group discussion, a participant stood up and said “my neighbor was attacked by an elephant along a wildlife corridor while moving his cattle back home and the people who went to take him to Loitokitok sub-county hospital said that he smelled alcohol”.

- ❖ Study findings on risk indices show that majority of the respondents were in agreement that the potential risk factors investigated in this study contribute to wildlife induced injuries and consequently the health burden among cattle herders. This is because most of the respondent’s risk scores on potential risk factors fall within moderate risk category followed by high risk category. The risk factors subjected to risk indexing include scarce grazing zones, sharing water points, rescuing cattle from wild animals, season of the year, shrinking habitat, increasing population in the area, emergency of urbanization and finally encroachment by Maasai cattle herders to wildlife protected areas. Results on risk indices show that these risk factors are predictors of wildlife induced injuries among cattle herders.

- ❖ The study established that various protective measures are adopted by cattle herders to mitigate the problem of wildlife induced injuries as well as health burden among cattle herders. They include putting up bio fence around manyatta to keep away wild animals, guarding of manyattas by morans, lighting fires at night to scare wild animals and control of dangerous wildlife by Kenya Wildlife Service. However, despite the fact that bio fence around manyattas is widely used as a protective measure, it was reported during focus group discussions and key informant interviews that use of bio fence around manyattas is not effective enough because some wild animals such as elephant, lion and snakes still find their way into manyattas.

- ❖ The study yielded significant estimates of Years of Life Lost (YLLs), Years Lived with Disabilities (YLDs) and Disability Adjusted Life Years (DALYs) among cattle herders in the two sub-counties. Wildlife induced injuries caused 411 YLLs in male cattle herders and 150 YLLs in female cattle herders in the year of reference. In South Africa, injuries were responsible for an estimated 2.3 million DALYs in 2013. The male burden was three times the female one which concurs with the findings of this study. Major injuries which led to permanent disabilities contributed significantly to the health burden accounting for a total of 2,757 YLDs. Of this health burden, the major injuries accounted for 1,551 YLDs in male cattle herders and 1,206 YLDs in female cattle herders. Minor injuries accounted for only 26YLDs in male cattle herders and 8 YLDs in female cattle herders which represent a small fraction of the total 3,352 DALYs yielded by the study.

A study conducted in 2010 in New Zealand on the burden of animal related injuries showed 7 DALYs per 100 000 population compared to the findings of this study which yielded 8,895 DALYS per 100 000 population, permanent disabilities causing 1,551 YLDs in male cattle herders and 1,206 YLDs in female cattle herders. In the study area, temporary disabilities accounted for 26 YLDs in male cattle herders as compared to 8 YLDs in female cattle herders. The findings show that male cattle herders bore the blunt of wildlife induced injuries.

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of the Study Findings

- ❖ The study established that wild animals in the study area caused more non-fatal injuries as compared to fatal injuries among the Maasai cattle herders. However, even though less in number, the fatal injuries cause severe and intolerable loss to the families concerned. Moreover, the physical deformities suffered as a result of such incidents create emotional and psychological stress for the injured cattle herders. Similarly, death of a cattle herder also results in emotional problems in addition to economic hardship for dependent family members. The study established that Loitokitok sub-county bore the blunt of wildlife induced injuries as compared to Kajiado Central sub-county. This was attributed to the presence of more wildlife corridors and protected areas in Loitokitok sub-county as compared to Kajiado Central sub-county. It was also established that wildlife induced injuries differ greatly from one region to another.

In terms of gender, most of the victims of wildlife induced injuries in the study area were male cattle herders as compared to female counterparts which implies that male cattle herders play a dominant role in cattle herding which makes them more vulnerable to wildlife attacks. The study revealed that most of the Maasai cattle herders who were attacked by wild animals suffered soft tissue and skin injuries followed by amputation of limb/limb paralysed. Some of them suffered broken ribs and bone dislocation. In terms of the most dangerous wild animals, elephant, buffalo, snake and lion were reported to be responsible for most incidents of fatal and non-fatal injuries with the elephant leading followed by buffalo.

Encroachment by Maasai cattle herders to wildlife protected areas and shrinking habitat were the main predictors of wildlife induced injuries. On the other hand, emergency of urbanization and sharing of water points between cattle herders and wildlife have weak linear relationships with the dependent variables which implies that they contributed little to the wildlife induced injuries and the health burden. The findings of this study showed that competition for grazing areas among wildlife and the Maasai cattle herders was a risk factor contributing to wildlife induced injuries. Majority of the respondents reported that shrinkage and degradation of wildlife habitats forces wild animals to stray out of the protected areas into adjacent Maasai cattle grazing areas and manyattas in search of food.

This increases the population density of wild animals around the manyattas and within the grazing areas which creates higher chances of encounter and confrontation with the Maasai cattle herders leading to incidents that result in death and injury of the cattle herders. It was established that competition for water resources among wildlife and the Maasai cattle herders was a risk factor associated with wildlife induced injuries. Most of the wildlife induced injuries that were reported occurred in the field whilst herding cattle near or within a water point. Study findings show that cattle herders have a negative attitude towards the management of wildlife by Kenya Wildlife Service (KWS). It was revealed that they blame KWS whom they accuse of not doing enough to prevent wild animals from straying outside the protected areas causing damage to life and property.

The respondents cited that compensation amount for victims of wildlife induced injuries was not proportionate with their loss and the process was quite lengthy and cumbersome and demanded development of a sustainable mechanism to cope with this issue.

- ❖ Regarding the risk indices of potential risk factors associated with wildlife induced injuries, more than half of the risk scores from the respondents fall within the moderate and high risk categories. Few scores fall within the low risk category. The risk factors subjected to risk indexing include shrinking wildlife habitat, competition for grazing areas and water resources, encroachment to protected areas by cattle herders, encroachment to wildlife corridors by cattle herders, emergence of towns and trading centers and the season of the year.
- ❖ Regarding the protective measures practiced in the study area to mitigate wildlife induced injuries, the study findings show that guarding of manyattas by Maasai morans, use of morans to hunt and kill dangerous wild animals, putting up bio fences around manyattas, lighting fires at night and to a less extent use of guard dogs were practiced in the study area.
- ❖ Regarding the health burden of wildlife induced injuries; the study established that permanent injuries were responsible for an estimated 2,757 YLDs as compared to temporary injuries which accounted for only 34YLDs. Fatal injuries accounted for a total of 561 YLLs which is a small component of the total DALYs.

6.2 Conclusion

- ❖ Major injuries accounted for most of the years of healthy life lost followed by premature death. Minor wildlife induced injuries (temporary disabilities) accounted for a small percentage of healthy years of life lost. Wildlife induced injuries is a growing concern in Kajiado County as elsewhere in the globe where rapid shrinkage and degradation of wildlife habitat is taking place. The issue is serious especially where limited resources and space are shared by both cattle herders and wild animals.

Shortage of water resources within protected areas forces wild animals to move out in search of water outside the protected areas which increases the population density of wild animals within cattle grazing areas and adjacent manyattas. Consequently, this creates higher chances of encounter and confrontation with the Maasai cattle herders leading to incidents of death and injury of the cattle herders. Cattle rescue activities from wild animals is a predictor of wildlife induced injuries among cattle herders. The questionnaire respondents who reported cases of wildlife attacks on cattle herders also reported that most of the wildlife attacks occurred when rescuing cattle from wild animals which indicate that the risk of sustaining wildlife induced injuries when rescuing cattle from dangerous wild animals is high. Study findings show that dry season of the year contributes to wildlife induced injuries among cattle herders. The respondents cited that during dry season, more Maasai cattle herders move long distances in search of water and food for their cattle and this increases the chances of encountering and confronting wild animals.

Majority of the respondents expressed that most of the wildlife attacks on the Maasai cattle herders occurred when the wild animal was alone.

- ❖ Study findings on risk indices of potential risk factors for wildlife induced injuries show that most of the risk scores from the two sub-counties were found to be within the moderate to high risk category. This is an indication that encroachment to wildlife corridors and protected areas by cattle herders, inadequate space for habitat (Shrinking wildlife habitat), competition for grazing areas (food) among wildlife and cattle herders, competition for water resources among wildlife and cattle herders, emergence of towns and trading centers in cattle grazing areas and the season of the year are potential risk factors that pose high risk of wildlife induced injuries among the Maasai cattle herders.
- ❖ Analysis of data from questionnaires, focus group discussions and the key informant interviews show that protective measures practiced in the study area to mitigate wildlife induced injuries include guarding of manyattas by Maasai morans, use of morans to hunt and kill dangerous wild animals, putting up bio fences around manyattas, lighting fires at night and to a less extent use of guard dogs.
- ❖ Male Maasai cattle herders suffered more loss of healthy years of life (1,988 DALYs) as compared to female Maasai cattle herders (1,364 DALYs). This is an indication that the male Maasai cattle herders play a dominant role in cattle herding. They are more exposed to risks of wildlife induced injuries than the female Maasai cattle herders.

The study also established that wild animals in the study area caused more Years Lived with Disabilities (2,791 YLDs) as compared to Years of Life Lost (561 YLLs) among the Maasai cattle herders, however, even though less in number, the YLLs can lead to intolerable loss to the families concerned. The associated effect of human loss is even more brutal on the dependants in cases where a sole bread earner is killed in such wildlife induced fatal injuries. Moreover, the physical deformities suffered as a result of such incidents create emotional and psychological stress for the injured cattle herders. Similarly, death of a cattle herder also results in emotional problems in addition to economic hardship for dependent family members. There is a significant health burden associated with wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok sub-counties. A total of 3,352 years of healthy life were lost as result of wildlife induced injuries.

6.3 Recommendations

- ❖ The problem of wildlife induced injuries among the Maasai cattle herders persists till now due to the overlap of limited resources for wild animals and the cattle herders. So, the issue of wildlife induced injuries cannot be eliminated. However, it can be minimized by exploring innovative ways. Thus, the Kenya Wildlife Service (KWS) should focus on achieving practical solutions for sustainability. This can be done in two ways – one by addressing the protective solutions, and the next, by introducing curative solutions. Moreover, there is the need to assess the relief requirements as the victims opined on various measures. The following recommendations are given for self-sustaining human wildlife co-existence.

- ❖ The study recommends the immediate need for improving wildlife habitat or the protected areas in order to provide ample food and appropriate shelter to wild animals in the protected areas. More water points within protected areas should be constructed such as bore holes in order to provide adequate water to the wild animals. Restoration of the wildlife habitats by effective management is necessary in order ensure that the grasslands and wetlands along with sustainable forest are well conserved. This will help reduce the number of wild animals straying away from protected areas in search of food, appropriate shelter and water points. However, to achieve the above goals, there is urgent need to carry out research on the condition of habitats and carrying capacity of the protected areas.

As the study shows most of the incidents occurred when the victims were out in the field herding and within wildlife corridors as well as within protected areas, it is recommended to encourage stall-feeding programs by providing subsidy to produce grass on their own land or in the barren community land and also construct water points within the same areas. By doing this, the Maasai cattle herders would not have to go to the field for grazing cattle or take the cattle to distant water points, which would ultimately reduce the chances of encountering wild animals. Awareness-raising programs related to the behaviour and movement of wild animals and the tactics to be used during encounter with wild animals should be designed and implemented, especially in areas prone to wildlife attacks among the Maasai cattle herders. Raising awareness among the Maasai cattle herders regarding the ecology and behaviour of problematic wild animals is important so that the cattle herders can avoid confrontation as a protective measure.

Incidents have often occurred due to the ignorance of Maasai cattle herders and the lack of knowledge. For examples, wearing colourful clothes while herding cattle in the field, walking through forest while taking cattle to the field or moving them back to the manyatta, herding while alcoholic were reported during focus group discussions as some of the risk factors contributing to wildlife induced injuries among the Maasai cattle herders. So, these aspects should be clearly addressed while designing an awareness program. Awareness would help the Maasai cattle herders to internalize the facts, and thus, help to reduce ignorance of them. Moreover, programs focusing on public safety measures should be conducted in the potentially vulnerable areas.

Sign posts should be posted in areas prone to wildlife attacks in order to warn the Maasai cattle herders of danger. It is necessary to identify the vulnerable areas in and around protected areas based on the movement of wildlife, dependency on the natural resources, etc. They should be categorized as: 1. Most affected/vulnerable area, 2. Affected area and 3. Least affected area. For instance, Gurung (2008) reported 66% of tiger kills occurred in 1km distance from the protected areas. This might be a useful reference for the identification of vulnerable areas. Once the vulnerable areas are identified, sign posts should be placed indicating “dangerous” areas or “no go” zone. Moreover, the Kenya Wildlife Service should design and implement conservation and development programs accordingly in such a way that the affected Maasai cattle herders receive a greater share of the benefits and bear fewer costs of living with wild animals.

- ❖ The Government through Kenya Wildlife Service should support the Maasai community to build electric and solar fencing around the Maasai homesteads to reduce the chances of wildlife attacks on Maasai cattle herders. The Government should support the Maasai community to build animal watch towers in areas more prone to wildlife attacks in order to reduce the chances of encounters between the Maasai cattle herders and wild animals. Similarly, the Government should consider assisting the Maasai cattle herders install electric and bio fences around the manyattas in order to deny wildlife access to such homesteads.

The study found out that one-time monetary compensation as it exists now seems to be not so desirable and feasible in the long run. Rather, it would be better if the Kenya Government through Kenya Wildlife Service could establish an insurance system for the Maasai cattle herders in vulnerable areas like Loitokitok sub-county. Similarly, provision for (as and when needed) regular allowance and placement of the victims and victims' families in suitable jobs could be a more reasonable and practical approach to compensation for wildlife victims. Detailed information on the children of victims especially those of school going age should be recorded in order to prevent children from being deprived of education. The Government should collaborate with relevant stakeholders and especially schools for making arrangement for admission of such children. The Government should organize skill-enhancement trainings and explore job opportunities by focusing on the victims and their associates as per their capacity.

During the field visit, the victims showed great desire to work somewhere as per their capacity. Some victims were young enough to work but are not working because of poverty and lack of opportunity.

6.4 Suggestions for Further Studies

The researcher recommends studies on the following areas:

1. Obstacles to effective management of conflict between national parks and surrounding human communities in Narok County, Kenya.
2. Economics and policy attitudes of the rural communities to animal wildlife and its utilization in Kajiado County, Kenya.
3. Determinants of attitudes towards predators in Rift Valley region of Kenya and suggestions for increasing tolerance in livestock dominated landscape.
4. Values, gender and concern on potentially dangerous wildlife among the residents of Narok County, Kenya.
5. Interactions between humans and wildlife: Landowner experiences regarding wildlife damage, ownership and benefits in Makueni County, Kenya.

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APPENDICES

APPENDIX I: Informed Consent

Dear Respondent:

Please read and understand before signing the consent form below.

Title: Health Burden of Wildlife Induced Injuries among the Maasai Cattle Herders in Kajiado Central and Loitokitok Sub-Counties of Kajiado County, Kenya

By:

Isaac K. Makau (Researcher)

This descriptive cross-sectional study aims at determining the health burden of wildlife induced injuries among the maasai cattle herders in Kajiado Central and Loitokitok Sub-Counties of Kajiado County, Kenya. The study also seeks to identify the risk factors that contribute to wildlife induced injuries as well as the coping mechanisms among the maasai cattle herders in Kajiado Central and Loitokitok Sub-Counties of Kajiado County. The study findings will contribute greatly to the limited existing knowledge on the burden of wildlife induced injuries. The results will also be of significant interest to health policy makers, health program funders and researchers within the maasai community and finally the outcome of the study will help in resource allocation, priority setting and investment in health services meant to improve the lives of the Maasai cattle herders in Kajiado Central and Loitokitok Sub-Counties.

This study and its procedures have been approved by the Kenyatta University Graduate School Board and the School of Public Health. The procedure includes voluntary participation and responding honestly and accurately. All information given will be confidential and anonymous. Structured questionnaires which comprise closed and multiple choice questions, interview schedule and focus group Discussions shall be used to collect primary data.

Consent

I have read, understood and voluntarily consent to participate in this study. I have understood the nature and purpose of this study and that my identity will not be revealed in the study.

Respondent's signature.....Date.....

I have explained the nature and purpose of this study to the above respondent in writing and have sought his/her understanding for informed consent.

Researcher's Signature.....Date.....

APPENDIX II: QUESTIONNAIRE

Questionnaire No.....

Name of the head of manyatta (respondent).....

Name of interviewee (research assistant).....

Questionnaire on the Personal Information of the Head of Manyatta

Instructions

Please tick the answers given below using a pen or pencil.

1. Gender

Male Female

2. What is your age bracket?

18-28 Years
29-39 Years
40-49 Years
50-59 Years
60-69
Above 70 Years

3. Marital Status

Married
Single
Divorced/Separated
Widowed

4. Education level

None
Primary
Secondary
Tertiary

5. Occupation

- Cattle herding
- Growing of crops
- Casual laborer
- Unemployed
- Others (please specify).....

6. How many households live in this manyatta?

- 1-3 households
- 4-7 households
- 8-12 households
- Above 13 households

7. How long have you lived in this manyatta?

- 3-13 years
- 14-24 years
- 25-35 years
- More than 35 years

Risk factors associated with wildlife induced injuries

8. Competition over natural resources

In your opinion do you feel that competition over resources between wildlife and Maasai cattle herders in this sub-county has got anything to do with conflict between the two?

- Yes** **No**

9. The table below lists areas where competition over natural resources between wildlife and people occurs, thus causing conflict which results into wildlife induced injuries. Please indicate your level of agreement to the risk factors that have triggered conflict between the Maasai cattle herders and wild animals in this sub-county by ticking SD – Strongly Disagree, D – Disagree, U – Uncertain, A – Agree, SA – Strongly agree.

10. Human encroachment to wildlife corridors and protected areas

Response on risk factors associated with wildlife induced injuries	SD	D	U	A	SA
Scarce cattle grazing areas		<input type="checkbox"/>			
Sharing of water points					
Rescuing cattle from wild animals					
Season of the year					
Shrinking habitat					
Increasing population of people in the area					
Emergency of urbanization					
Encroachment by Maasai cattle herders to wildlife protected areas					
Obstruction of water points by cattle herders and leaving no water streaming into protected areas for wildlife.					

Do you think there has been encroachment by Maasai cattle herders in wildlife corridors and protected areas and that this has created conflict between the herders and wildlife?

Yes

No

11. The table below shows some of the indicators of human encroachment to wildlife corridors and protected areas that creates conflict between people and wildlife. Please indicate your level of agreement to the following as regards Maasai cattle herders' encroachment to wildlife corridors and protected areas in this county by ticking SD – Strongly Disagree, D – Disagree, U – Uncertain, A – Agree, SA – Strongly agree

Maasai cattle herders' encroachment to wildlife corridors and protected areas	SD	D	U	A	SA
KWS protected area fence vandalism by the Maasai cattle herders					
Cases of Maasai cattle herders found grazing inside the protected areas					
Cases of Maasai cattle herders found inside the protected areas for unspecified reasons					
Cases of Maasai cattle herders found and arrested inside the protected areas for trespassing					

Risk indices of potential risk factors associated with wildlife induced injuries among cattle herders.

12. A respondent was presented with 10 statements regarding potential risk factors associated with wildlife induced injuries and was required to indicate the level of agreement (rating) to the statements on a scale of 1-5 by ticking 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree and 5= Strongly Agree for each particular reason given. The score for each respondent ratings based on the ten reasons was calculated.

Potential risk factors associated with wildlife induced injuries among the Maasai cattle herders	SD (1)	D (2)	N (3)	A (4)	SA (5)
1. Encroachment to wildlife corridors and protected areas by cattle herders					
2. Homesteads (manyattas) located near wildlife corridors/protected areas					
3. Inadequate space for habitat (Shrinking wildlife habitat)					
4. Competition among wildlife and cattle herders for grazing areas (food)					
5. Competition among wildlife and cattle herders for water resources					
6. Emergence of towns and trading centers in cattle grazing areas					
7. Season of the year					
8. Constructing water reservoirs or boreholes near manyattas					
9. Herding when under the influence of alcohol					
10. Wild animal alone or in a group of others					

Protective measures adopted to deal with wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok Sub-Counties.

13. In your opinion, what are the protective measures adopted by Maasai cattle herders to deal with or reduce cases of wildlife induced injuries among the Maasai cattle herders

- i.
- ii.
- iii.
- iv.
- Etc.....

14. (a) Protective measures adopted to deal with wildlife induced injuries among the Maasai cattle herders

Traditional and Modern Coping Strategies and Methods	Yes	Uncertain	No
Hunting and killing of problematic wild animals			
Control of problematic wildlife by KWS			
Fencing around the manyatta to keep away wild animals			
Guarding of manyattas by morans			
Lighting fires at night and banging tins			
Use of dogs to offer protection			

(b) KWS Response Measures in Reducing Wildlife Attacks on Maasai cattle herders

Has KWS developed measures by which you or the agency can use to control the movement of wild animals or reduce wildlife attacks on Maasai cattle herders?

Yes

No

15. The table below lists some of the control measures that KWS can develop to manage human wildlife conflict in a bid to reduce the burden of wildlife induced injuries among cattle herders. Please indicate your level of agreement to the following cases if applicable in this sub-county by ticking SD – Strongly Disagree, D – Disagree, U – Uncertain, A – Agree, SA – Strongly agree.

Management of human wildlife conflict	SD	D	U	A	SA
(Community awareness and education) We attend community awareness on importance of wildlife by KWS					
KWS has developed compensation policy for the affected families					
There is intense human vigilance by KWS rangers to reduce wildlife attacks on Maasai cattle herders					
KWS has intensified its fencing to bar wild animals from freely moving into Maasai cattle grazing grounds					
KWS had developed lethal control programs to kill dangerous animals which stray to Maasai cattle grazing grounds.					
KWS has corporate social responsibility for the effected families of Maasai cattle herders					

16. Has KWS developed some ways by which you or them can use to control the movement of wild animals and the health problems they cause to cattle herders?

Yes

No

Health burden associated with wildlife induced injuries among the Maasai cattle herders

17. Can you sort these pictures into wild animals that are a big problem, small problem or no problem at all around this manyatta or elsewhere and explain why? (Show the photo gallery of the wild animals-see appendix 4).

Name of Wild Animal	Problem			Don't know the wild animal	Doesn't occur here	Why is it a problem?
	Big Problem	Small Problem	No problem			
Giraffe						
Elephant						
Lion						
Leopard						
Cheetah						
Spotted hyena						
Striped hyena						
Tiger						
Rhino						
Crocodile						
Snake						
Buffalo						
Jackal						
Wildebeest						
Warthog						
Zebra						

18. How many cattle herders live in this manyatta?.....

19. Has any cattle herder in this Manyatta been attacked by (state the name or show the photo of the wild animal-see appendix 5) in the last 12 months?

Name of wild animal	Yes	No	Not Sure
Giraffe			
Elephant			
Lion			
Leopard			
Cheetah			
Spotted hyena			
Striped hyena			
Tiger			
Rhino			
Crocodile			
Snake			
Buffalo			
Jackal			
Wildebeest			
Warthog			
Zebra			
Any other			

20. If your answer to question 20 is yes, how many cattle herders in this manyatta have been attacked by (state the name or show the photo of the wild animal-see appendix 5) in the last 12 months?

Name of wild animal	Number of cattle herders attacked by (state the name or show the photo of the wild animal-see appendix 5) in the last 12 months
Giraffe	
Elephant	
Lion	
Leopard	
Cheetah	
Spotted hyena	
Striped hyena	
Tiger	
Rhino	
Crocodile	
Snake	
Buffalo	
Jackal	
Wildebeest	
Warthog	
Zebra	
Any other	

21. If your answer to question 20 is yes, state the age of each cattle herder when the attack occurred (state the age in years and months).

Name of wild animal	Age of each cattle herder following the attack by (state the name or show the photo of the wild animal-see appendix 4)
Giraffe	
Elephant	
Lion	
Leopard	
Cheetah	
Spotted hyena	
Striped hyena	
Tiger	
Rhino	
Crocodile	
Snake	
Buffalo	
Jackal	
Wildebeest	
Warthog	
Zebra	
Any other	

22. If your answer to question 20 is yes, state the type of injury sustained by the cattle herder.

Name of wild animal	Limb amputation	Tearing and shredding injuries of the skin as a result of biting	Head and facial injuries	Multiple fractures	Extensive crush injuries	Any other type of injury
Giraffe						
Elephant						
Lion						
Leopard						
Cheetah						
Spotted hyena						
Striped hyena						
Tiger						
Rhino						
Crocodile						
Snake						
Buffalo						
Jackal						
Wildebeest						
Warthog						
Zebra						
Any other						

23. If your answer to question 22 is limb amputation, please specify the type of limb amputation by ticking in the table below. State any other type of limb amputation.

Name of wild animal	Amputation of the entire leg	Partial amputation of the leg	Amputation of the entire hand	Partial amputation of the hand	Any other type of limb amputation
Giraffe					
Elephant					
Lion					
Leopard					
Cheetah					
Spotted hyena					
Striped hyena					
Tiger					
Rhino					
Crocodile					
Snake					
Buffalo					
Jackal					
Wildebeest					
Warthog					
Zebra					
Any other					

24. If your answer to question 20 is yes, did the attack by (state the name or show the photo of the wild animal-see appendix 5) on the cattle herder result in minor injury, permanent disability (major injury), death or none at all?

Name of wild animal	Minor injury	Permanent disability (major injury)	Death (fatal)	None at all
Giraffe				
Elephant				
Lion				
Leopard				
Cheetah				
Spotted hyena				
Striped hyena				
Tiger				
Rhino				
Crocodile				
Snake				
Buffalo				
Jackal				
Wildebeest				
Warthog				
Zebra				
Any other				

25. If your answer to question 20 is yes, state the location of the attack.

Name of wild animal	At the manyatta	Around the manyatta	At the protected areas	Around the protected areas
Giraffe				
Elephant				
Lion				
Leopard				
Cheetah				
Spotted hyena				
Striped hyena				
Tiger				
Rhino				
Crocodile				
Snake				
Buffalo				
Jackal				
Wildebeest				
Warthog				
Zebra				
Any other				

26. If your answer to question 20 is yes, state the season of the year when the attack occurred (dry or wet season).

Name of wild animal	Dry season	Wet season
Giraffe		
Elephant		
Lion		
Leopard		
Cheetah		
Spotted hyena		
Striped hyena		
Tiger		
Rhino		
Crocodile		
Snake		
Buffalo		
Jackal		
Wildebeest		
Warthog		
Zebra		
Any other		

APPENDIX III: Statements on potential risk factors associated with wildlife induced injuries

10 potential risk factors behind wildlife induced injuries among the cattle herders and the risk rating	SD	D	N	A	SA
	1	2	3	4	5
1. Encroachment to wildlife corridors and protected areas by cattle herders					
2. Homesteads (manyattas) located near wildlife corridors/protected areas					
3. Inadequate space for habitat (Shrinking wildlife habitat)					
4. Competition among wildlife and cattle herders for grazing areas (food)					
5. Competition among wildlife and cattle herders for water resources					
6. Emergence of towns and trading centers in cattle grazing areas					
7. Season of the year					
8. Constructing water reservoirs or boreholes near manyattas					
9. Herding when under the influence of alcohol					
10. Wild animal alone or in a group of others					

APPENDIX IV: Focus Group Discussion (FGD) Guide

1. What is your opinion regarding the following as contributors to wildlife induced injuries among cattle herders in this area?
 - a) Herding when under the influence of alcohol?
 - b) Constructing water reservoirs or boreholes near manyattas?
 - c) Season of the year?
 - d) Emergence of towns and trading centers in cattle grazing areas?
 - e) Competition among wildlife and cattle herders for water resources?
 - f) Encroachment to wildlife corridors and protected areas by cattle herders?
 - g) Homesteads (manyattas) located near wildlife corridors/protected areas?
 - h) Inadequate space for habitat (Shrinking wildlife habitat)?
 - i) Competition among wildlife and cattle herders for grazing areas (food)?
 - j) Wild animal alone or in a group of others?
2. Are there more factors that contribute to wildlife induced injuries among cattle herders?
3. Please enumerate the preventive measures adopted to mitigate the problem of wildlife induced injuries among cattle herders.....

APPENDIX V: Photographs used to identify survey species



Buffalo



Spotted hyaena



Crocodile



Serval



Hippopotamus



Zebra



Striped hyaena



Warthog



Wildebeest



Lion



Puff adder



Elephant



Leopard



Jackal



Black rhino



Tiger



African wild dog



Giraffe



Impala



Cheetah

APPENDIXVI: Photographs Showing Interactive Sessions during Data Collection at Loitokitok and Kajiado Central Sub-Counties











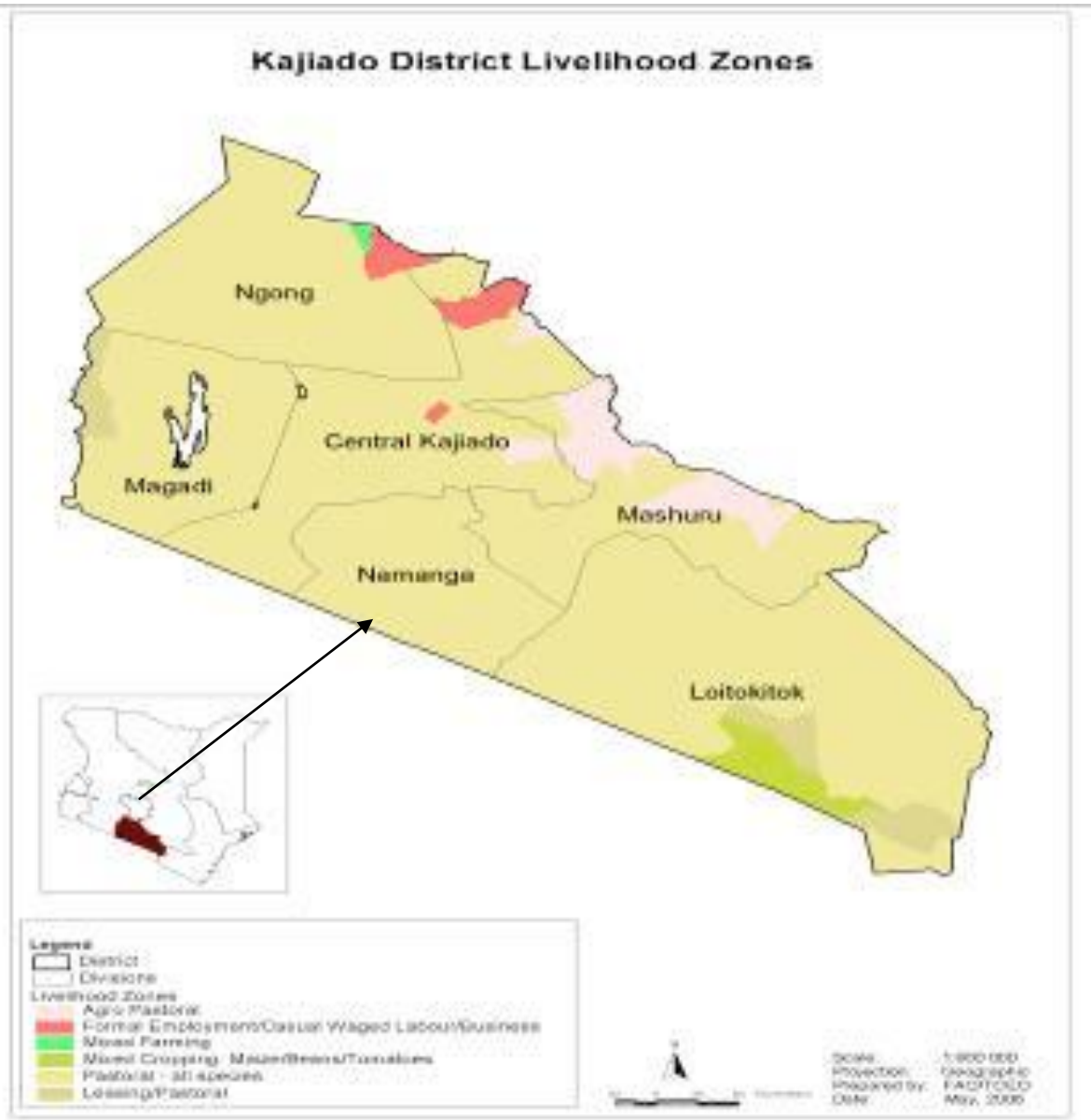








APPENDIX VII: A map showing the Location of Kajiado Central and Loitokitok Sub-Counties



Source: Kenya National Bureau of Statistics, 2013

APPENDIX VIII: A Table showing the Number of Sampled Manyattas from Each Location

Name of the Sub-County	Name of the location	Number of Manyattas per location	Number of Sampled Manyattas per location
Kajiado Central Sub-County	Enkaroni	54	18
	Kikuro	36	12
	Nkoile	79	26
	Olobelibel	46	16
	Meto	52	15
	Oloililai	81	23
	Torosei	45	13
	Kumpa	49	14
Loitokitok Sub-County	Amboseli	94	29
	Imbirikani	68	21
	Olchorro	128	40
	Kimana	114	35
	Total	N = 846	n = 262

APPENDIX IX: Kenyatta University Ethics Review Committee Approval Letter



KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE

Email: chairman_kuerc@ku.ac.ke
secretary_kuerc@ku.ac.ke
ercku2008@gmail.com
Website: www.ku.ac.ke

P. O. Box 43844 - 00100 Nairobi
Tel: 8710901/12
Fax: 8711242/8711575

Our Ref: KU/R/COMM/51/464

Date: 24th April, 2015

Isaac K. Makau
Kenyatta University,
P.O Box 43844, Nairobi.

Dear Makau,

APPLICATION NUMBER PKU/316/1 292- "BURDEN OF WILDLIFE INDUCED INJURIES AMONG THE MAASAI CATTLE HERDERS IN KAJIADO CENTRAL AND LOITOKITOK SUB-COUNTIES OF KAJIADO COUNTY, KENYA"
- VERSION 2.

1. IDENTIFICATION OF PROTOCOL

The application before the committee is with a research topic, "Burden of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok Sub-Counties of Kajiado County, Kenya," version 2 received on 15th April 2015.

2. APPLICANT

Isaac K. Makau

3. SITE

Kajiado Central and Loitokitok Sub-Counties of Kajiado County, Kenya

4. DECISION

The committee has considered the research protocol in accordance with the Kenyatta University Research Policy (section 7.2.1.3) and the Kenyatta University Ethics Review Committee Guidelines AND APPROVED that the research may proceed for a period of ONE year from 24th April, 2015.

5. ADVICE/CONDITIONS

The committee has considered the research protocol in accordance with the Kenyatta University Research Policy (section 7.2.1.3) and the Kenyatta University Ethics Review Committee Guidelines, and is of the view that against the following elements of review,

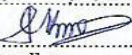
- (i) Scientific design and conduct of study,
- (ii) Recruitment of research participant,
- (iii) Care and protection of research participants,
- (iv) Protection of research participant's confidentiality,
- (v) Informed consent process,
- (vi) Community considerations.

If you accept the decision reached and advice and conditions given please sign in the space provided below and return to KU-ERC a copy of the letter.


PROF. NICHOLAS K. GIKONYO
CHAIRMAN: KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE



I ISAAC K. MAKAU accept the advice given and will fulfill the conditions therein.

Signature.....  Dated this day 24TH of APRIL 2015.


cc. Vice-Chancellor

**APPENDIX X: National Commission for Science, Technology and Innovation
Research Permit**



THIS IS TO CERTIFY THAT:
MR. ISAAC KASILU MAKAU
of **KENYATTA UNIVERSITY, 0-100**
NAIROBI, has been permitted to conduct
research in **Kajiado County**

on the topic: **BURDEN OF WILDLIFE
INDUCED INJURIES AMONG THE MAASAI
CATTLE HERDERS IN KAJIADO CENTRAL
AND LOITOKITOK SUB-COUNTIES OF
KAJIADO COUNTY, KENYA**

for the period ending:
20th August, 2015


.....
**Applicant's
Signature**

Permit No : NACOSTI/P/15/8427/4411
Date Of Issue : 8th May, 2015
Fee Received :Ksh 2,000



.....
**Director General
National Commission for Science,
Technology & Innovation**

**APPENDIX XI: National Commission for Science, Technology and Innovation
Research Authorization Letter**



**NATIONAL COMMISSION FOR SCIENCE,
TECHNOLOGY AND INNOVATION**

Telephone: +254-20-2213471,
2241349, 310571, 2219420
Fax: +254-20-318245, 318249
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Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No.

Date:

8th May, 2015

NACOSTI/P/15/8427/4411

Isaac Kasilu Makau
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on *“Burden of wildlife induced injuries among the Maasai cattle herders in Kajiado Central and Loitokitok Sub-Counties of Kajiado County, Kenya”* I am pleased to inform you that you have been authorized to undertake research in **Kajiado County** for a period ending **20th August, 2015.**

You are advised to report to **the County Commissioner and the County Director of Education, Kajiado County** before embarking on the research project.

On completion of the research, you are required to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.


DR. S. K. LANGAT, OGW
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Kajiado County.

The County Director of Education
Kajiado County.

