ASSESSMNT OF HUMAN WILD ANIMALS CONFLICT AND MANAGEMENT STRATEGY IN GERA DISTRICT, SOUTH WESTERN ETHIOPIA

M.Sc. THESIS

BY

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JIMMA, ETHIOPIA
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APPROVAL SHEET

DEDICATION

To my beloved father Gadisa Gobosho, who had a great dream and delusion for my success in education but passed away at a very early age without seeing any of my success.

DECLARATION

I hereby declare that this thesis entitled assessment of human wild animals conflict and management strategy in Gera, south western Ethiopia is my own work except wherever acknowledged, no part of this thesis has been submitted to any other university.

Name_____

Place_____

Date of submission_____

Signature_____

BIOGRAPHICAL SKETCH

Leta Gobosho Amaja was born on 12 June 1983 in Horro district, Horro Guduru Wollega Zone of Oromia national regional state, Ethiopia. He grew up in rural village of Horro district and he graduated from Shambu senior secondary school in 2001. In 2002 he joined Asosa agriculture and TEVET College and awarded Diploma in Natural Resource Management in 2004. He worked in Oromia national regional state for four years as a Natural Resource Management expert at Keble level. In 2009/2010 he had got a chance of up grading his academic career and joined to Jimma university college of agriculture and veterinary medicine department of Natural Resource Management and he graduated in Bachelor's of degree in 2011 and successively in 2011/2012 he returned to Jimma University to pursue Master's of degree in Natural Resource Management with specialization in forest and nature conservation.

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ACRONYMS

CASCAPE	Capacity Building for Scaling up of Evidence –Based Best Practices in Agricultural Practices in Ethiopia
CITIES	Convention on International Trade in Endangered Species
DA	Development Agents
DPPA	Disaster Presentations and Preparation Agency
FAO	Food and Agricultural Organization of the United Nations
FEG	Food Economy Group
FGD	Focus Group Discussion
HH	House Hold
HWC	Human-Wildlife Conflict
IUCN	International Union for Conservation of Nature
NBSAP	National Biodiversity Strategies and Action Plans
NNP	Nagarahole National Park
SPSS	Statistical Package for Social Science

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ABSTRACT

Human-wildlife conflict exists in different forms all over the world and experienced more in developing countries. Presently in south western Ethiopia wild animals compete for resource with human being and in conflict with each other. Therefore, this study was conducted to investigate the current status of human wild animals' conflict and management strategy in Gera, south western Ethiopia. Data were collected in two trips via semi-structured questionnaires, focus group discussion, direct observation and key informant. Total count was used to estimate population of top ranked wild animals in sampled forest. One-way ANOVA was used to analyses cause of human wild animal's conflict whereas One-way ANOVA and t test were used to analyze damage caused by wild animals. Pearson correlation was used to test the relation between distance of study village and family size with damage events. Chi-square test was used to analyze number of top ranked wild animals between dry and wet season and traditional methods used by the respondents. The result showed that of all respondents about 50% and 22% of them reported that the existence of HWC manifested through crop damage and livestock predation respectively. The response of respondents was significantly different on each conflict type namely crop and livestock damage and crop damage only (P=0.00). Respondents report habitat disturbance, proximity to natural forest, increased subsistence agriculture, increased coverage of plantation forest, increased of wild animals' population as causes of HWC. Olive Baboon, Bush Pig, Warthogs, Grivet Monkey and Porcupine were the identified damage causing wild animals. The most predators on small ruminant and chickens were Olive Baboons. A total of 912 damage events were registered on five sample sites which was sown maize, teff and sorghum in the production season 2013/2014. The registered damage event were significantly different from site to site (P =0.037) in which it was high in sites which have less distance from forest edge. A total of 259 and 240 Olive Baboons, and 126 and 148 Grivet Monkey were estimated in the sampled forest in dry and wet season respectively. There was no significant difference between the number of both wild animals in wet and dry (P > 0.05). Respondents used guarding, chasing, fencing, scarecrow and smoking to defend crop raiders. There was significant difference between respondents (P = 0.000) in using those traditional methods in which about 30% of them used guarding and 0.8% of them used smoking which was the highest and lowest methods used by respondents respectively. The present study identified the existence of HWC in Gera south western Ethiopia and manifested through crop damage and livestock predation. Therefore encouraging local communities to grow unpalatable crops to wild animals, cooperatively keep their crop and changing their means of farming to cash crops like coffee, chat and livestock raring. Therefore, investment should base on proper site selection which is feasible economically and ecologically and encouraging the development of ecotourism is a way out, the food habits of wild animals should be systematically studied.

Key Words: Human-wild animals conflict, crop raiding, forest disturbance

1. INTRODUCTION

Natural resource management is in many ways a form of conflict management (Warner, 2000) .Increased competition for natural resources among multiple stakeholders with diverse interests is occurring worldwide within the current trends of globalization (Castro and Nielsen, 2003). Ecosystems and habitats are fast becoming human dominated, which means that more species, including primates, are forced to exploit new human resources to survive (Strum, 2010).

Competition for space between humans and wildlife is prevalent worldwide (Hoffman, 2011). Nowadays human-wildlife conflict exists in one form or another all over the world as wildlife requirements encroach on those of human populations and involve several animal species (IUCN, 2005; Lamarque *et al*., 2009). Despite the fact that all continents and countries, whether developed or not are affected by human-wildlife conflict (HWC) developing countries are altogether more vulnerable than developed nations (Fairet *et al*., 2012). Human wild life conflict is rapidly becoming one of the most important threats to the survival of many wildlife species and is an increasingly significant obstacle to the conservation of wildlife (Madden, 2008). It is a serious issue in Africa and other developing areas of the world where rapidly growing human populations and expanding settlements are reducing the areas left for wildlife habitat and increasing the interactions between humans and animals (Blair, 2008; Mwamidi *et al*., 2012).

The transformation of global landscapes from predominantly wild to predominantly anthropogenic over the last centuries has create competition between humans and wildlife for space and resources and it reached on unprecedented levels (Hanks, 2006; Ellis *et al*., 2010; Kate, 2012). As wildlife habitat becomes more and more fragmented and wildlife gets confined into smaller pockets of suitable habitat, humans and wildlife are increasingly coming into contact and in conflict with each other (Madden, 2008; Lamarque *et al*., 2009). For instance, in Ghana, the decrease in the forest area available to elephants in Kakum conservation area by about half since the 1970s, would explain why the density of elephants is

now higher than in most other West African forests thereby resulting in increased crop raiding activities and create HWC (Barnes *et al*., 2003).

Human-wildlife conflict is a well known phenomenon and is the interaction between wild animals and people. It is resulted in negative impact on people or their resources, and/or wild animals or their habitat and has existed for as long as humans and wild animals have shared the same landscapes and resources (Lamarque *et al*., 2009).

Usually, conflict takes place when wild animals cross a line or border between the domesticated and the wild and enter the human sphere uninvited (Johansson, 2002). A wide variety of wildlife comes into conflict with farming activities for searching of resource which causes crop damage and wildlife mortality (Madden, 2008). Human-induced wildlife mortality affects the population viability and has broader environmental impacts on ecosystem equilibrium and biodiversity preservation (Conover, 2002).

Crop damaged by wildlife is not only affecting a farmer's ability to feed his family, but it also reduces cash income and has consequence for health, nutrition, education and ultimately, development. For example, it has been estimated that the annual cost caused by elephant on crops ranges from US$ 60 in Uganda to US$ 510 in Cameroon per affected farmer (Naught on *et al*., 1999). The occurrence and frequency of crop raiding by crop raiding wild animals is depends on availability, variability and type of food sources in the natural ecosystem for wild life, the level of human activity on a farm and the type and maturation time of crops as compared to natural food sources (Lamarque *et al*., 2009).

Ethiopia is a large and ecologically diverse country with unique environmental conditions (Afework B *et al*., 2011; Melaku T, 2011). In contrary since many years ago, the natural vegetation of the country has been destroyed by human and natural catastrophic and converted into agricultural and pastoral land. Moreover, its vegetation has been deforested for various purposes (Demeke D and Afework B, 2011). As a result, wild animals resources of the country are now largely restricted to a few protected areas (Tewodros K and Afework B, 2008).

The forest area of south western Ethiopia is under great treat due to over exploitation (Kitessa H, 2007; De Beenhouwer, 2011) which forces wild animals to compete with human being for their resource and resulted in conflict between them. There are some major driving forces that increase pressures on forests in south western Ethiopia. The most important pressure causes deforestation is rising of population pressure and overexploitation of the remaining forest cover. Agricultural activities are expanding that leads to forests encroachment, habitat destruction and further to human-wildlife conflict which in turn lead the farmers have increasingly lost crops to pests/problem causing animals (Joseline, 2010; Mwamidi *et al*., 2012).

Rapid increase of population growth, investment in forested area, deforestation, wetland draining for cropland areas and using of forest edge for coffee plantations is more experienced in south western Ethiopia. These pose pressure on land resources and reduce the area of core habitat for wild animals and eliminate corridors for migration and increase the probability of contact, and possibly create conflict between animals' farmers and wild (Quirin, 2005). As majority of the Gera land is once covered by natural forest in the past, now a day it is shrinking in size due to increasing substance agriculture (Kitessa Hundera, 2007) and investment in the forest area(Quirin, 2005). This phenomenon was once and again disturbing the habitat of wild animals and forced wild animals to contact with human being which resulted in conflict (Strum, 2010).

However, as in other parts of the world, in Ethiopia, large herbivore mammals have been causing damage to agricultural crops and plantations. There are wide varieties of pest herbivores, primates and small mammals. These mammals cause serious damage to agricultural crops in different parts of the country (Demeke D and Afework B, 2011). Nevertheless, in Ethiopia only few studies were carried out on human-wildlife conflict in some specific regions of the country (Tewodros K and Afework B, 2008). The same is right in Gera, southwestern Ethiopia for that there was no studies were carried out about human wild animal's conflict.

Therefore, this study was conducted in view of bridging this gap and come up with recommendations for future dissemination of the solutions. The result of the study was providing information to planners, researchers, extension organizations, development institutions and individual farmers to enhance farming process. Hence this study was initiated to document the magnitudes of human wildlife conflict in the study area to contribute to future intervention plan. Therefore, the main objective of the study was to investigate the current status of human wild animals' conflict and management strategy in Gera district, south western Ethiopia with the following specific objectives:

- To identify causes of human-wild animals conflicts and major crop raiding wild animals,
- To estimate the magnitude of agricultural field crop and domestic animals loss caused by wild animals,
- To estimate the population density of the top ranked crop raiding wild animals and
- To identify key human wild animals conflict management options in Gera district, south western Ethiopia.

2. LITERATURE REVIEW

2.1. Concept and Definition of Conflict

Conflict is differences or incompatibilities in interests, goals, or perceptions (Yasmi *et al*., 2010). Human- wild animals conflict is interactions between humans and wild animals where there are costs borne by humans (Blair, 2008). Increased competition for resources among multiple stakeholders with diverse interests is occurring worldwide (IUCN, 2005).

Human- wild animals conflict (HWC) is term commonly used by conservationists to describe friction between wild animals and people (Roy and Sah, 2012). HWC can be defined by a complex mix of characteristics which include instances of crop raiding, wildlife-livestock disease transmission, livestock depredation, destruction of property by wildlife and killing of wildlife by people (Madden, 2006).

Human- wild animals' conflict can be viewed in two contexts. Wildlife behavior conflicting with human goals such as safety, satisfaction, property and human behavior conflicting with wildlife safety and well-being includes harassment, noise, direct mortality due to hunting, destruction of habitat. Regardless of either situation, human behavior and the decisions made regarding human-wildlife interactions ultimately determine the outcome for both humans and wildlife (Castro and Nielsen, 2003).

There has always been HWC and most societies have developed reasonably successful strategies to with it, problems arise when these are constrained. However, with diminishing habitat and increasing human populations, local perception of HWC incidents and the way in which these are dealt with critical in terms of conserving those species deemed important/ threatened (Madden, 2004). Dickman *et al.* (2011) point out that HWC is usually derived from groups of people holding different values e.g. local people versus protected area authorities, or protection of species that are highly valued at a global scale but have little or

even negative value at a local scale. It is therefore, from nearly every perspective more of a human than a wildlife problem.

The term ‘pest’ is typically defined as any animal that consumes crops during any stage of the agricultural cycle, from planting to post-harvest storage (Porter and Sheppard 1998 cited in Naughton Treves and Treves, 2005). Crop raiding- is the act of entering into a cultivated area by an animal which results in the consumption and/or destruction of domesticated plant life with in the designated region (Priston, 2009; Colonna, 2011). Wild animals moving from their natural habitat in to agricultural land to feed on the produce those humans grow for their own consumption (Sillero-Zubiri and Switzer, 2001).

2.2. Human- Wild Animals’ Conflict

Naturally, organisms live together in an ecosystem for a long period of time by showing high degree of intrinsic stability through time and resilience to climate and other environmental factors in the given ecosystem. However, when humans’ action entered these systems, the natural phenomena become disturbed and came with humans in contact. No wild animal is inherently a ‘nuisance’ or ‘pest’. However, when their habitats are increasingly altered or managed by humans, certain wild species or individual animals may cause a significant problem to humans other animals or the environment and resulted in HWC (Mesele Y *et al*., 2008).

Human- wild animals’ conflict occurs as wildlife's requirements overlap with those of human populations, incurring expenses/damages to residents and wild animals (Madden, 2004; IUCN, 2005; Kumara *et al*., 2012). Direct contact with wildlife occurs in both urban and rural areas, but it is generally more common in rural forested areas, where the wildlife population density is high and animals often stray into adjacent cultivated fields or grazing areas**.** HWC can take many forms, the main ones including human fatality or injury, livestock depredation, crop-raiding and infrastructure damage (Blair, 2008).

2.3. Nature of Human-Wild Animals' Conflicts

Human- wild animals' conflicts were happened when the actions of humans or wild animals have an adverse impact upon the other (IUCN, 2005). Conflict between humans and wildlife is one of the most widespread and intractable issues facing conservation biologists today (Dickman, 2010). It is recognized that humans have profoundly impacted wildlife and the environment in many ways, through habitat loss, pollution, introduction and spread of exotic and invasive species, overexploitation, and climate change. Human-wildlife conflicts vary according to geography, land use patterns, human behavior, and the habitat and behavior of wildlife species or individual animals within the species (Ontario Ministry of Natural Resources, 2008; FAO, 2010). Eyebe *et al.* (2012) recorded incidents of Human- wild animals' conflict highlight three forms as the most recurrent in all ecological zones, these are crop destruction, killing of domestic animals and human death and injuries.

2.3.1. Crop Destruction

Crop raiding is not a new phenomenon and it has most likely been occurring since humans started practicing agriculture (Blair, 2008; Datta-Roy *et al*., 2009; Joseline, 2010). And is one of the most prevalent forms of HWC and is particularly severe around forest and protected areas (Lamarque *et al*., 2009; Priston, 2009). The primary causes were the ineffective land-use planning policies including protected area creation and management coupled with the increase of inhabitants around these areas (Eyebe *et al*., 2012).

2.3.2. Attacks on Domestic Animals

People lose their crops, livestock, property and sometimes their lives (Patil, 2011) to wild animals. Human-carnivore conflict figures among the HWC patterns in many parts of Africa (Lamarque *et al.*, 2009). They are more frequent in the savannah and grasslands where pastoralist remains the main source of livelihood for many people (Madden, 2004; Datta-Roy *et al*., 2009; Eyebe *et al*., 2012).

2.3.3. Human Death, Injuries and Damage to Property

Though not frequent as the two principal types of HWC, crop destruction and livestock predation (Patil, 2011), human death and injuries are sometimes recorded (Datta-Roy *et al*., 2009). For example in Cameroon wildlife species responsible for human deaths and injuries include elephants, buffalo, lions and hippopotamus (Lamarque *et al*., 2009; Eyebe *et al*., 2012).

2.4. Attitude of Local People towards Wild Animals

2.4.1. Attitude towards Herbivores

In many parts of Africa and Asia, large mammalian herbivores cause crop loss. The extent of damage is almost insignificant when it is considered at the global level as compared to the damage caused by invertebrates and rodents. Among the common agricultural pests like primates, rodents, birds and insects the damage caused by elephants is often far greater (Hoare, 2000). This is because elephant raids are unpredictable and can cause more damage per raid. Almost all countries in Africa reported problems with elephant crop raiding (Yirmed D, 1997). Local people living in and around protected areas and at the edge of forest, who are unable to control the crop losses caused by wild herbivores, are likely to develop negative attitude and those who get benefit from the wildlife develop positive attitude towards pest herbivores.

2.4.2. Attitude towards Primates

One fundamental influence on perceptions of local people towards primates is the general cultural attitude. Levels of tolerance, acceptance and even demand for interactions vary with cultural context (Biquand *et al*., 1992). Cultural perceptions towards primates vary enormously and have shifted over time. Historically primates were sacred as guardians of human settlements, as spirits of ancestors, or as an embodiment of sexuality, wisdom and

fortune in some areas. In some societies, monkeys may even be incorporated into the kinship or cosmological belief system (Cormier, 2002).

2.5. Cause of Human-Wild Animals Conflict

No single factor or cause explains Human-wild animals' conflict across the continent (Naught on-Treves and Treves, 2005). According to Lamarque *et al.* (2009) the following are the main causes of human-wildlife conflict and manifested through a set of global development relating to human populations, habitat evolution and animal distribution and behavior.

2.5.1. Human Factors

2.5.1.1. The Requirements of Human Development

The main cause of Human- wild animals' conflict worldwide is the competition between growing human populations and wildlife for the same declining living spaces and resources (Madden, 2008; Kumara *et al*., 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 (Sillero-Zubiri and Switzer, 2001;Lamarque *et al* .,2009 ; Eyebe *et al* .,2012).

Since 1950 most of the increasing demand for food in the developed world has been met through intensified agriculture and husbandry rather than increased production areas (Joseline, 2010). So far, the increase in production in sub-Saharan Africa cannot be secured by greater productivity because technical progress does not match the rate of demographic increase. Continued expansion of agriculture and husbandry areas will have various impacts on habitats and biodiversity: at this stage, rural development in sub-Saharan Africa inevitably involves accelerated transformation of natural landscapes at the expense of wilderness that sustains biodiversity and finally resulted in HWC (Madden, 2008; FAO, 2010).

2. 5.1.2. Migration of Peoples 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. This phenomenon is on the increase; the number of food emergencies in Africa each year has almost tripled since the 1980s. Across sub-Saharan Africa, one in three people are undernourished. These factors spur the continuing migration of rural people into areas where resources could be obtained, and which are frequently occupied by wildlife. The resultant occupation of the habitat of wild animals by humans leads to conflict (Madden, 2008; Lamarque *et al*., 2009; Joseline, 2010).

2. 5.1.3. Increase in Wild Animals and Human Populations

The major causes of Human- wild animals' conflict could be attributed to many factors ranging from wild animals population increase to human population increase (Edward and Frank, 2012). Although there is a general concern over declining wild animals' populations, particularly in tropical ecosystems, some species may actually be increasing in numbers. For example, increasing reports of crop raiding by elephants in Africa may reflect the recovery of population numbers since the CITIES' ban on ivory trade and the subsequent decline in poaching. More peoples means more cultivated land and, hence a greater interface between people and wildlife. The world population is predicted to grow by over 50% in the next fifty years, from six billion in 2000 to over nine billion in 2050 and the increment in both wildlife and human population create competitions on fixed natural resource which leads to conflict (Sillero-Zubiri and Switzer, 2001).

2.5.2. The Habitat Factor

A set of global trends has contributed to the rise of Human- wild animals' conflict world-wide. These can be due to human population growth, land use transformation, species habitat loss, degradation and fragmentation, growing interest in ecotourism and increasing access to nature reserves, increasing livestock populations and competitive exclusion of wild herbivores,

abundance and distribution of wild prey, increasing wildlife population as a result of conservation program (Hill, 2000; Joseline, 2010).

The gradual loss of habitat has led to increasing conflict between humans and wild animals (Edward and Frank, 2012). As wildlife wild animals' habitat becomes more and more fragmented and wildlife is confined into smaller pockets of suitable habitat. And humans and wildlife are increasingly coming into contact and in conflict with each other (Sillero-Zubiri and Switzer, 2001; Lamarque *et al*., 2009). Competition for space, resource and the reduction of habitat may be a powerful factor which threatening wild lives. If habitats are converted to agricultural or pastoral land, HWC are bound to increase (Hill, 2000).

A common consequence of human occupation of wild life habitat is the development of negative perceptions of wild life. Human-carnivore conflicts have intensified in most African countries in recent decades. These is due to exponential human population growth and economic activities (Conover, 2002 cited by Demeke Datiko and Afework Bekele, 2013). Several factors can contribute to the modification of the quantity or quality of wildlife habitats. Of these, Lamarque *et al.* (2009) put the following two most important factors.

2.5.2.1. Natural Factors

Droughts, bush fires, climatic changes and other unpredictable natural hazards can contribute to a decrease in suitable wild animals' habitat and therefore affect the occurrence and extent of Human- wild animals' conflict. Similarly the seasonal modification of habitats due to rainfall can also have an impact on Human- wild animals' conflict. One of the main consequences of the loss of habitats is the decrease in natural resources available for wildlife. The destruction of natural vegetation and in some cases the total disappearance of buffer zones force herbivore species to feed in cultivated fields. This phenomenon is on the increase because the growth rate of cultivated areas is high at the edge of protected areas and forest areas.

2.5.2.2. Impact of Human Activities

More people means, more cultivated land, and hence a greater interface between people and wildlife. The world population is predicted to grow by over 50% in the next fifty years, from six billion in 2000 to over nine billion in 2050 (Sillero-Zubiri and Switzer, 2001). Most of this increase is expected to take place in the least developed countries of Africa, Asia and Latin America (Hill, 2000). As the human population keeps expanding, there is an increasing demand for land for agriculture, expansion of cultivated land into previous wildlife habitat, and natural resources for industry, leading to increased contact opportunities for wildlife and people, crop raiding is becoming one of the most common conflicts antagonizing human-wildlife relationships and resulting in conflict (Sillero-Zubiri and Switzer, 2001; Eyebe *et al.*, 2012).

Human activities such as husbandry, agriculture, fishing, the development of infrastructure or even of tourism or wildlife protection itself, can dramatically modify wildlife habitats either directly or indirectly (Kate, 2012). For instance, in Kenya the fencing of farms to keep wild animals away has created physical barriers for migratory species. Conflicts can arise when migratory species such as zebras and wildebeest, which had previously migrated without any hindrance, destroy fences and crops in a bid to reclaim their traditional routes from dispersal areas to the parks. Baboons have been eradicated from some areas of South Africa and Zimbabwe, particularly where they interfered with commercial agriculture. Because of this the extent of the current distribution range of baboons is largely restricted to areas that are not used for commercial cropping and horticulture. Baboons are now concentrated instead in areas where subsistence agriculture is practiced, where they can raid crops grown by subsistence farmers (Lamarque *et al*., 2009).

2.6. Impact of Human Wild Animals' Conflict on Humans

Human- wild animals' conflict is a growing problem in today's crowded world, and can have significant impacts on human populations (Dickman, 2008). As human population and the extent of landscape transformation increase the probability of competition for resource

between human being and wild animals also increase. As the needs and behavior of wildlife and human being become close to each other it impact negatively the goals of humans and finally create conflict between them (Distefano, 2010). This event resulted for humans in property damage, economic losses related to crop raiding, and harassment (Hoffman and O'Riain, 2010; Kaplan *et al.*, 2011 cited in Hoffman and O'Riain, 2012; Eyebe *et al.*, 2012).

Wild animals can have very significant impacts upon human directly and indirectly. These impacts range from clear-cut economic hardship to less tangible effects such as increased opportunity costs and decreased quality of life. Living alongside of wild animals can incur a variety of additional costs aside from the direct impact of depredation. As people have to invest more heavily in strategies such as livestock herding, guarding and predator control which need additional cost (Dickman, 2008). The consequences of the human-wildlife conflict are more serious in the tropics and in developing countries where livestock holdings and agriculture are an important part of rural people's livelihoods and incomes (Lamarque *et al*., 2009).

2.7. Impact of Human Wild Animals' Conflict on Wild Animals

Human- wild animals' conflict is an increasingly significant obstacle to the conservation of wildlife (Madden, 2008). Human being can be developing a range of options for attempting to lessen conflict with wildlife. The options includes reducing the likelihood of attacks through livestock guarding dogs, electric fencing, improved construction of livestock enclosures, toxic collars, disruptive stimuli and other aversive techniques. All these can have substantial impacts on the wild animal populations concerned (Dickman, 2008; Eyebe *et al*., 2012).

2.8. Human- Wild Animals Conflict Management

2.8.1. Conflict Resolution

No single management strategy can prevent all crop raiding. The goal of management should not only be to reduce the levels of crop raiding but also to raise the tolerance level of crop

raiding by lessening its impact to farmers (Sillero-Zubiri and Switzer, 2001). No solution will work without site-specific knowledge of what is possible, practical, or acceptable in any particular area. Unfortunately human-wildlife conflict situations are often complex so are unlikely to be resolved quickly and cannot be solved solely by technical means. Human-wildlife conflict can be managed through a variety of approaches. Prevention strategies endeavor to avoid the conflict occurring in the first place and take action towards addressing its root causes (Hill *et al*., 2002).

Protection strategies are implemented when the conflict is certain to happen or has already occurred. Mitigation strategies attempt to reduce the level of impact and lessen the problem. The main difference between the options is the moment at which the measure is implemented. By definition, management techniques are only cost-effective if the cost of implementing the technique is less than the value of the damage, taking into account the fact that a short period of active management may have a continued effect, by instating longer-term protection of crops or herds (FAO, 2010). The various management possibilities are presented according to the characteristics of conflict whether they relate to humans, production, animals and the environment, rather than according to their ability to prevent or mitigate damage (Lamarque *et al*., 2009).

2.8.2. Goals of an Intervention

According to Hill *et al.* (2002) conflict resolution/management methods have the following possible goals: reducing the amount of crop losses to wildlife; improving local people's attitudes and perceptions towards protected area and its wildlife; helping affected farmers to improve agricultural production; increasing the amount of crops being harvested locally through improved local yields and reducing levels of poaching.

2.8.3. Community Involvement

Once the individual goals have been established and the availability of the necessary resources determined, then discussion with the communities can important. Communities

living around forest areas are different from those in other areas as they often receive a disproportionate amount of interest from the conservation and development contributor. This can influence people's expectations with respect to who should take responsibility for developing, implementing and/or maintaining any control scheme. Those wise it is very important that farmers be involved in the process of developing new solutions from the beginning (Hill *et al*., 2002; Treves, 2007). Not only does this foster a sense of commitment and involvement amongst them, but it is also vital that they be involved from the beginning. Because they understand how the situation affects them and what kinds of intervention are likely to be acceptable and feasible within the local culture, providing there is adequate representation from the different types of stakeholder involved (Parkhurst, 2006).

2.8.4. Reducing Crop Losses

According to Hill *et al.* (2002) the most viable options to reduce crop loss were increasing vigilance by farmers. This has been shown to make a considerable difference in the amount of crops lost, increasing farmer tolerance for a pest species and lost crops and increasing the ability of farmers to repel crop raiders using existing local methods. This has a number of obvious benefits, if these methods do not make a considerable impact on crop loss, and larger impact interventions such as electric fencing, lethal control of pest animals or moving farmers from the conflict zone can be considered (Treves, 2007). Many traditional repelling techniques are fairly effective if formalized, but are labor intensive. But where an animal can be repelled adequately using conventional methods it seems in appropriate, and certainly not particularly cost effective, to try to introduce more expensive techniques requiring greater technological input or backup (Conover, 2002).

2.8.5. Implementation of an intervention

Before developing and implementing an intervention a number of points need to be addressed. The reasons for the conflict must be considered, information needs to be gathered about the type of conflict issue, farmers' perceptions of the situation and perhaps their expectations as

regards a potential intervention program. The researcher should understand the ecology of the pest species. The goals of the intervention must be clearly defined. A decision should be made regarding the deterrence or removal of the crop pest and finally, farmers need to be involved to ensure their support for and acceptance of the intervention (Hill *et al*., 2002).

2.8.6. Increasing Human Tolerance for Wild Animals' Damage

Another approach that has been used successfully to manage Human- wild animals' conflict involves changing the perceptions of people experiencing the damage, thus, increasing their willingness to tolerate damage (Conover, 2002; Treves, 2007). This can be accomplished by enhancing an individual's appreciation for wildlife and its non-tangible benefit. Agricultural producers already are receptive to this argument and appreciate the wildlife on their farms to enhance wildlife habitat and their tolerance for some wildlife damage. This tolerance can be enhanced by providing economic incentives (Messmer, 2009).

3. Materials and Methods

3.1. Description of the Study Area

3.1.1. Location

The study was carried out in Gera district which is located in Jimma zone of Oromia National Regional State, about 448km south west of Addis Ababa and 93km south west from the zonal town Jimma. Geographically, it is located between $7^0$15'N - 8^0 45'N latitude and 35^0 30" E - 37^0 30' E longitudes (Kitessa H, 2007). Gera is bordered by Sigmo on the northwest, Setema on the north, Gomma on the northeast and Seka Chokorsa on the east (Fig.1) and has area coverage of 1,330.1 Km^2. The administrative center of Gera is Chira.

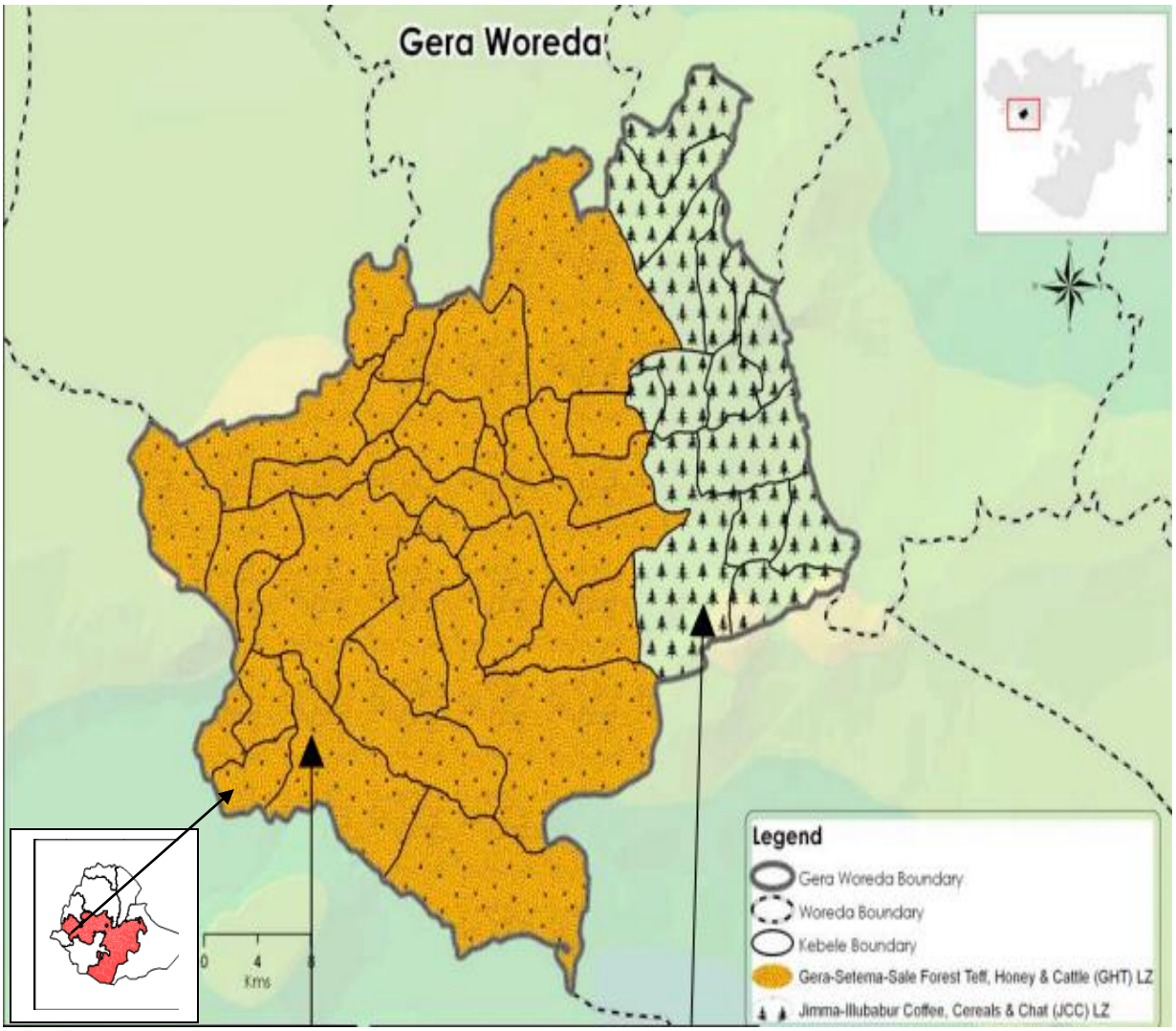

Figure 1.Map of the study area

Source: FEG, 2009

3.1.2. Socio Economic and Demographic Features

The total population of Gera was 86,849. Of the total population about 83,375 of them were rural and 3,474 were urban. Out of the rural population 41,437 and 41,938 were females and males respectively (CSA, 2007).

The land cover categories of the district comprise about 26.5% potential arable or cultivable land of which 23.4% under annual crops, 7.0% pasture, 56.6% forest and the remaining 9.9% was classified as degraded, built-up or otherwise unusable. Major crops grown include Teff, Maize, Wheat, Sorghum, Barely, Bean and Field pea. Coffee was an important cash crop of the district. The livestock population of the study area was 42,446 cattle, 21,573 sheep, 3,809 goats, 432 mules, 12,658 horses, 285 donkeys and 21, 205 poultry.

3.1.3. Climate

The study area characterized as humid, subtropical climate, with a yearly rainfall ranges about 1800mm to 2080mm per annum and a short dry season with relatively high cloud cover. A peak rainfall occurs between June and September, which is the long rainy season of the district and short rainy season between March and April (Kitessa H, 2007). Differences in temperature throughout the year are small. The mean minimum and maximum annual temperature of the study area was 11.9 and 26.4°C respectively (Schmitt, 2006 cited by De Beenhouwer, 2011).

3.1.4. Soil and Topography

The geology and soils of Ethiopia fall within the geological structural units of the horn of Africa. In south-western Ethiopia, soils are deep and belong to the Order Oxisols and Ultisols, Oxisols/ Rhodic Ferrasols occur in the 1500-2000 mm annual rainfall of western and southwestern Oromia as in Jimma, Ilu-babor, Wollega (Ochtman *et al*., 1977; cited in Feyera A, 2010).

3.1.5. Vegetation and wildlife

The south-western forests of Ethiopia are characterized as moist montane forest ecosystems (NBSAP, 2003; Feyera A, 2010). High forest, woodland and plantation forests are available in Gera district. Even though the majority of the natural forests are under the government

protection it is presently under great treat because of over exploitation (Kitessa H, 2007). There is no wildlife conservation area. However, Buffalo, Lion, Leopard Colobus Monkey, Grivet Monkey, Olive Baboon, Leopard, Warthog, Pig, Civet cat and Antelope are found in the study area.

3.2. Methods

3.2.1. Site Selection and Sampling Design

The study district was purposively selected as the area represents one of the highest case scenarios in HWC. Out of 24 Kebeles found in Gera district two Kebeles namely Ganji chala and Wanja kersa were selected through stratified random sampling for this study. In the second stage, each village found in the selected Kebeles were categorized in to three groups based on their proximity towards to forest edge as near, medium and far. Following this one village from each group were selected. The total villages from each Kebeles were three and the study covers a total of six villages from the two Kebeles. Based on distance of farm land they have from forest egged households were selected from each village for formal interview.

Following this households' sample frame was established by collecting complete landholders list record from their respective administration office. The sample frame was all household head living in the two Kebeles and finally the selections of sample household was proportional to each stratification which based on farm land distance from forests to keep uniformity. Accordingly, the total numbers of household head living in both Kebeles were 915 from Kebeles administration. From all stratification house hold head having farm land in the selected stratification was randomly selected for formal interview.

After getting the total number of household heads living in each selected Kebeles, the fourth step was determining total sample size of household head. Following this; total sample size was determined using probability proportional to sample size-sampling technique (Cochran, 1977 cited in Bartlett *et al*., 2001).

$$no = \frac{Z^2 * (P)(q)}{d^2} \longrightarrow n_1 = \frac{no}{(1 + no/N)}$$

Where;

n_o = desired sample size Cochran's (1977) when population greater than 10000

n_1 = finite population correction factors (Cochran's formula, 1977) less than10000

Z = standard normal deviation (1.96 for 95% confidence level)

P = 0.1 (proportion of population to be included in sample i.e. 10%)

q =is 1-P i.e. (0.9)

N = is total number of population

d =is degree of accuracy desired (0.05)

Based on Cochran (1977) population correction factors, a total of 120 sample household head were selected using simple random sampling techniques from the total population of 915 (435 from Ganji chala and 480 from Wanja Kersa). Allocations of the number of sample households to each Kebeles was proportional to the number of household head living in each selected Kebeles, accordingly 57 HH from Ganji chala and 63 HH from Wanja kersa were selected for this study.

3.2.2. Data Collection Period

Data for this study was collected between December 2012 and December 2013. Data of the dry season was collected between December 2012 to March 2013 which covers socio economic and population estimation of top ranked damage causing wild animals. Population estimation of top ranked crop raiders of wet season was taken between May to September 2013. Data on crop loss estimation were collected in two trips as before flowering and after flowering. Data of the first trip which was before the crop flowers were taken from April to August 2013 in varying time hence the crop not flowers equally whereas data of the second trip after the crop flowers were taken from September to December 2013.

3.2.3. Data Collection Methods

Preliminary study

Preliminary survey was conducted in December 2012. Information on accessibility, temperature, vegetation, fauna, topography and approximate size of the study area were accessed. Following the procedure of Mesele Y *et al.* (2008) information was also gathered on cause of HWC and the prevalence of crop damage and livestock depredation since locals are aware of the problem. Finally to incorporate the obtained information to questioner, pilot survey was carried out.

Pilot survey

Pilot survey was conducted in the selected Kebeles from December 2012 end to January 2013 based on the information gathered during the preliminary survey. During the pilot survey 30 households were randomly selected and interviewed. The main purpose of the pilot survey was to evaluate the questionnaire and to check whether it was applicable and suitable in the study area, to check the questionnaire was understood by the respondents, to identify the period and the occurrence of human-wild animals' conflict and cause of HWC in the study area. Based on the pilot survey results the questionnaire was revised and developed as used by Mesele Y *et al.* (2008) and Fairet *et al.* (2012).

Four complementary data collection methods namely household survey (individual-interviews), focus group discussions, key informant interviews and direct observation were used during present study. Secondary data which obtained from written documents, internet, and books were also used to collect detailed information on human-wild animal conflict.

Household survey

This was a formal survey method where a semi- structured interview scheduled was employed with closed and open-ended questions. It helps to eliciting information from respondents regarding demographic data (such as age, sex, religion, marital status, family size and

educational status), crops grown, acreage, damage caused to crops livestock, species of wild animals' responsible for damage, type of crop more affected, type of crop raiding wild animals that causes more damage, perceived wild animals' population trend, protection measures practiced, attitudes of local communities towards wild animals' management, and causes of HWC (Appendix I). Three trained person and one researcher have administered the interview. The interviews were conducted within the respondent's territory and in interviewing atmosphere by translating questionnaire to their local language.

Focus group discussion (FGD)

To complement the household survey, basic descriptive information was collected. This technique was help to acquire useful and detailed information, which might be difficult to collect through the household survey regarding population trends, land holding and management system, population trends of top ranked damage causing wild animals and cause of HWC. Discussions were made with randomly selected 6-10 respondent in each Kebeles under the guidance of a moderator. Checklists were prepared to guide topics for open-ended discussion with group of farmers (Appendix II).

Key informant interview

To strengthen the information collected using questionnaire and to have a detailed in sight about HWC in the areas, in-depth interviews and discussion covering about cause, consequences, type, density and history of top ranked damage causing wild animals, farming system and cropping season of the study area were held (Appendix III).

Direct observation

Direct survey was another method used to collect primary data and carry out through systematic observation. And used to obtain data on, distance between forest and farm lands, the affected crops, nature of wild animals' habitat fragmentation, and frequency of coming

crop raiding wild animals to farm lands, estimating crop lost by crop raider, type and diversity of the top ranked damage causing wild animals.

3.3. Specific Data Collection Methods for Each Specific Objective

3.3.1. Identify Causes of HWC and Major Crop Raiding Wild Animals

The current status of HWC in the study area was investigated through observations, FGD, and questionnaires following Anderson and Pariela (2005). To find out the causes that made wild animals forced to crop raiding and livestock depredation which create conflict between farmers and wild animals, variables such as nature of human habitat disturbance, distance of farm land from residence, cropping season and farm land expansion to forest area were assessed using interview as similarly used by Kivai (2010).

The presence or the absence of human activities which creates forest disturbance or fragmentation was assessed. Human activities assessed was includes cutting of under stories, selective cutting of trees, burning and complete clearing of forest mainly for expansion of cultivation. These activities were recorded using quadrant methods. A total of 30 and 20 Quadrants having 10*10m size were randomly used in Ganji chala and Wanja-Kersa sampled forests. The area coverage of Ganji chala and Wanja-Kersa sampled forest were 12.0km^2 and 7km^2 respectively. The size of the forest was taken from district Agricultural office.

The overall status of the forest due to human activities was assessed by observation through giving scale of 1-4. Scale 1 was recorded if slight activities of human action was observed in a form of cutting of trees to favors running inside the forest and firing for case of honey harvest Scale 2 was recorded when moderate levels of human activities (clearing the understory, cutting tree branches, left over of burned tree) were observed whereas scale 3 was used when extensive human activities (cutting big size trees, continuous burning, but no section of the forest was completely cleared) were observed. Finally forests in which human activities form complete clearing were assigned scale 4 as used by Muoria *et al.* (2003).

3.3.2. Estimating the Magnitude of Agricultural Field Crop Loss by Crop Raiders

Agricultural crop losses due to crop raiding wild animals were achieved through direct and indirect methods (Hill *et al*., 2002). Independent assessment of the crop damage by the researcher was direct method of data collection. For direct observation on crop damage by wild animals, totally five study sites from each stratifications used for formal interview were used. From each site, crop land having areas of 5,000 m^2 which have equal distance from forest edge were randomly selected from Bonche, Chala, Seke, Wanja and Gado. On the selected farm lands, three crops namely Maize, Teff and Sorghum were sown in the production season of 2013/2014. However, Sorghum was not sown in Bonche and Chala in the production season. For each cultivated land, the type of crop grown, condition of the crop before damage, area of damaged portion, part of the crop eaten and the type of crop species eaten were recorded (Naught on-Treves, 1997) (Appendix V).

Following Rugunda (2004) method the area of the crops damaged by wild animals was measured. After the yield obtained from one hectare was obtained from district agricultural office for each crop types, the amount of yield loss was estimated per hectare. A total of ten days (12 hours each) direct observation was conducted in each study site during each trip. Thirteen data collectors were participated during the time of direct observation in each trip and their steps forward were supervised by DAs and researcher at weekly and monthly bases respectively to ensure that coverage was sufficient to detect all crop-raiding incidents within the sample area for entire period. Mostly supervision of data collector was carried out on a weekly or monthly basis (Priston, 2008; Graham *et al.*, 2010; Kagoro-Rugunda, 2004 cited in Fungo, 2011).

Some animals do not damage crops during the day time as such. Therefore, it requires using its marks left such as dung, feeding, foot prints, diggings and other physical remains like spines. Following the suggestions of Rugunda (2004) and Tweheyo *et al.* (2011) animal marks and signs to identify the type of crop raiding wild animals feeding on a particular crop were used. Local farmers and local assistants were useful in helping to identify signs of crop raiding damage on crops.

3.3.3. Population Estimation of Top Ranked Damage Causing Wild Animals

To determine population of Olive Baboon and Grivet Monkey, preliminary survey supported by farmers' well-know Olive Baboons' and Grivet Monkey habitat and their place of overnight was undertaken and identified. Once their habitat and their overnight were identified, three day each in dry and wet season count were under taken in the sampled forest and finally the average of the three day count was used to estimate the population. Before estimating the population in the area, the total numbers of the troops in each sampled forest were identified from well knowing farmers of the area hence they are familiar. Estimating of population was carried out by moving on foot. Researcher and seven trained data collector were participated in the counting process with the help of binocular.

The population of Olive Baboon and Grivet Monkey were categorized into three age groups namely adult male, female and sub adults and juvenile (Appendix IV). Body size was used in age determination (Mesele Y *et al*., 2008). Male with overall size about twice that of females and sub adults were considered as adult male .The sexual organs of the male are quite distinct and the males are considerably bigger than the females. Sub-adult and adult females were identified by their body size. All other individuals were considered as juvenile based on their body size hence they are small in size than the others. The population density is calculated by the following formula. The area of the forest were taken from district agricultural office:

$$D = \frac{N}{A}$$

Where D=density of population per km^2

N=number of individual counted in the entire sampled forest

A=Area of the sample forest in km^2

3.3. 4. Identifying Key Human Wild Animals' Conflict Management Options

Following methods of Hill *et al*. (2002) and Anderson and Pariela (2005) questionnaires, FGD and physical observations were used to identify the management methods. In addition, following Kivai (2010) procedure, questionnaires were administered targeting key informants

especially farmers who experienced the problem and were actively involved in farm supervision.

3.4. Method of Data Analysis

Data were analyzed using SPSS version 16.0 computer software. Accordingly, descriptive statistic in a form of percentage and frequency were used to analysis socioeconomic profile of the respondents and responses were compared using chi-square test. One-way ANOVA were used to analyze amount of crop lost, damage events registered between site and crop raiders and cause of HWC. Pearson Correlation was used to test the relation between distance of study village from edge of forest and the occurred damage. Chi-square test was used to analyze association of HWC, number of olive baboon between wet and dry and traditional methods used by the respondents. To compute the variation among different age group of Olive Baboon and Grivet Monkey student's paired t-test was used.

4. RESULTS AND DISCUSSIONS

4.1. Socioeconomic Profile of the Respondents

Communities residing in the study area are Oromo, Amhara, Tigre and Kaficho. Respondents taken for formal interview include: 70.8% Oromo, 13.3% Amhara, 10% Tigre and 5.8% Kaficho. And about 79.2% of them were males whereas 20.8% of them were females. Among the respondents, most of them which represents 47.5% and 30.0% had 3-5 and 1-3 family size respectively. The rest which was 18.3% and 4.2% of them had 5-7 and more than 7 families respectively.

The main crop growing months were April to December. And there is also crop grown during dry season from end of January to June based on type of crop. Maize and potato were grown in wet land areas. In the six surveyed villages, maize, teff and sorghum were the major crop grown and they were the most important crops grown and they were the most important crop cultivated by many farmers in the cropping year of 2012/2013. However, farmers to some extent cultivate potato and wheat during the main cropping calendar (Fig 2). Out of total respondents interviewed, 51.7% of them have coffee inside natural forests and garden coffee whereas 48.3% of them have only garden coffee.

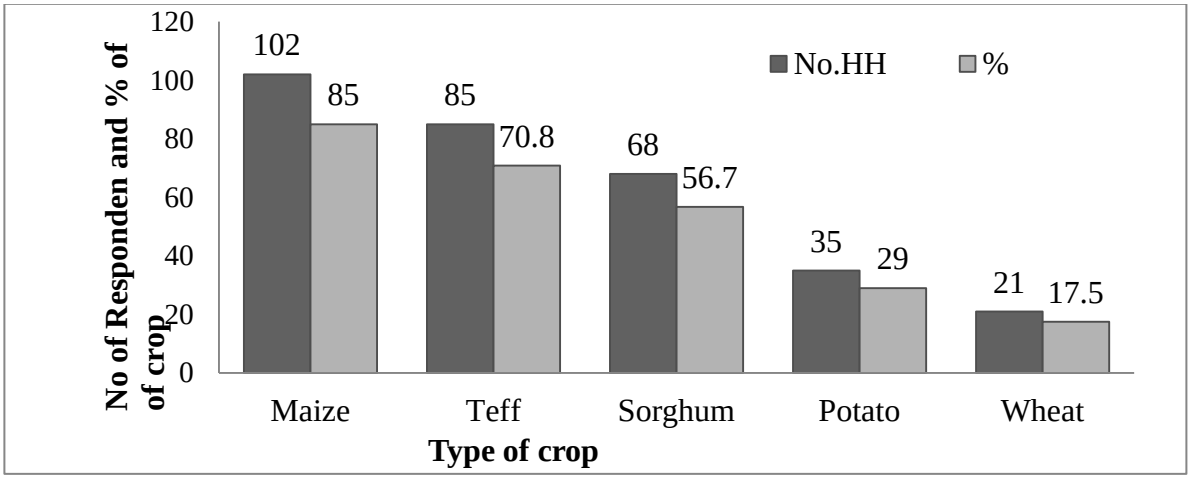

Figure 2.Number and percentage of respondents who cultivate major crops in the study area in 2012/2013 cropping year

The major economic activities of the sampled house hold in the study area were subsistence agriculture, which include crop farming, livestock rearing, and/or a mixture of animal rearing and crop farming. About 70% of the respondents earn their income from mixed agriculture (crop farming, animal rearing and bee farming). The remaining 16.7% depends only on crop farming and 13.3% depends on both crop farming and other income sources like daily labor works (Appendix Table 1).

Respondents listed 14 major wild animals in the study area (Appendix Table 2). Respondents also explained only five wild animals were causes crop and domestic animals depredation. Namely, Olive Baboon, Grivet Monkey, Bush Pig, Warthog and Porcupine were listed as damage causing wild animals.

4.2. Human-Wild Animals' Conflicts

4.2.1. Crop Raiding Wild Animals and Causes of HWC

Of the total respondents interviewed about 50% of them reported that there was both the problem of crop damage and livestock predation by wild animals. Whereas 22% of them reported that they face problem of wild animals causes crop damage only. And about 28% of them reported that they did not face any conflict whereas there were no respondents who reported that there was problem of livestock predation only. Result of FGD summarizes that the existence of HWC in all site except Agalo. The response of respondents from each site were significantly different on different types of conflict namely crop raiding, livestock predation caused by wild animals in the study area ($\chi 2 = 25.55$, df = 2, $P < 0.05$ (0.00)). From Agalo 100% and from Seke 52.7% respondents reported that they did not face any conflict caused by wild animals respectively. Respondents from Bonche, Wanja, Chala, Seke and Gado were reported the existence of both crop damage and livestock predation particularly sheep goat and chickens (Table 1).

Table 1.Percentage of respondents those faced different conflict by wild animals in each village

Villages	both crop damage and livestock depredation %	no conflict at all %	crop damage only %	livestock predation only %
Bonche	100	0.0	0.0	0.0
Chala	68	0.0	32	0.0
Seke	32.3	52.7	15	0.0
Wanja	72	0.0	28	0.0
Gado	27	15	58	0.0
Agalo	0.0	100	0.0	0.0
Mean	50	28	22	0

Based on respondents, Olive Baboon, Bush Pig, Warthog, Grivet Monkey and Porcupine were causes crop raiding in different degrees. Farmer ranked crop raiding wild animals from the one which causing most damage to the one that cause the least damage (Table 2). Olive Baboon was the most commonly reported crop raiders which cause much damage and ranked first. Respondents put Bush Pig as second crop raiders in the study area mostly in night time. Warthog was the third crop rider followed by Grivet Monkey and Porcupine.

Table 2.Lists of crop raiding wild animals and their respective rank based on damage they caused as revealed by respondents.

Wild Animals	Scientific Name	No. of farmers	Rank based on damage they cause
Olive Baboon	*Papio anubis*	89	1
Bush Pig	*Potamochoerus larvatus*	78	2
Warthog	*Phacochoerus africanus*	60	3
Grivet Monkey	*Chlorocebus aethiops*	45	4
Porcupine	*Hystrix cristata*	35	5

The result agrees with finding of Kate (2012) who reported that Baboons were ranked number one crop raiders in Uganda. Aharikundira and Tweheyo (2011) also reported that Baboons and Bush Pig were ranked as first and second crop raiders in Uganda respectively. Both studies agree with the present study. Other reports also explained that worldwide primates and in East Africa Bush Pigs (*Potamochoerus larvatus)* were among the species most

frequently cited by farmers as notorious crop raiders, capable of causing heavy crop damage; Warthogs (*Phacochoerus africanus*) are also involved (Sillero Zubiri and Switzer, 2001).

The interviewed households reported that cause of human wild animals' conflict were wild animals' habitat disturbance due to inappropriate site selection of investment in forest area, expansion of subsistence agriculture around forest edge, proximity to natural forest, increment of wild animal's population and the contribution of all mentioned causes (Fig 3).

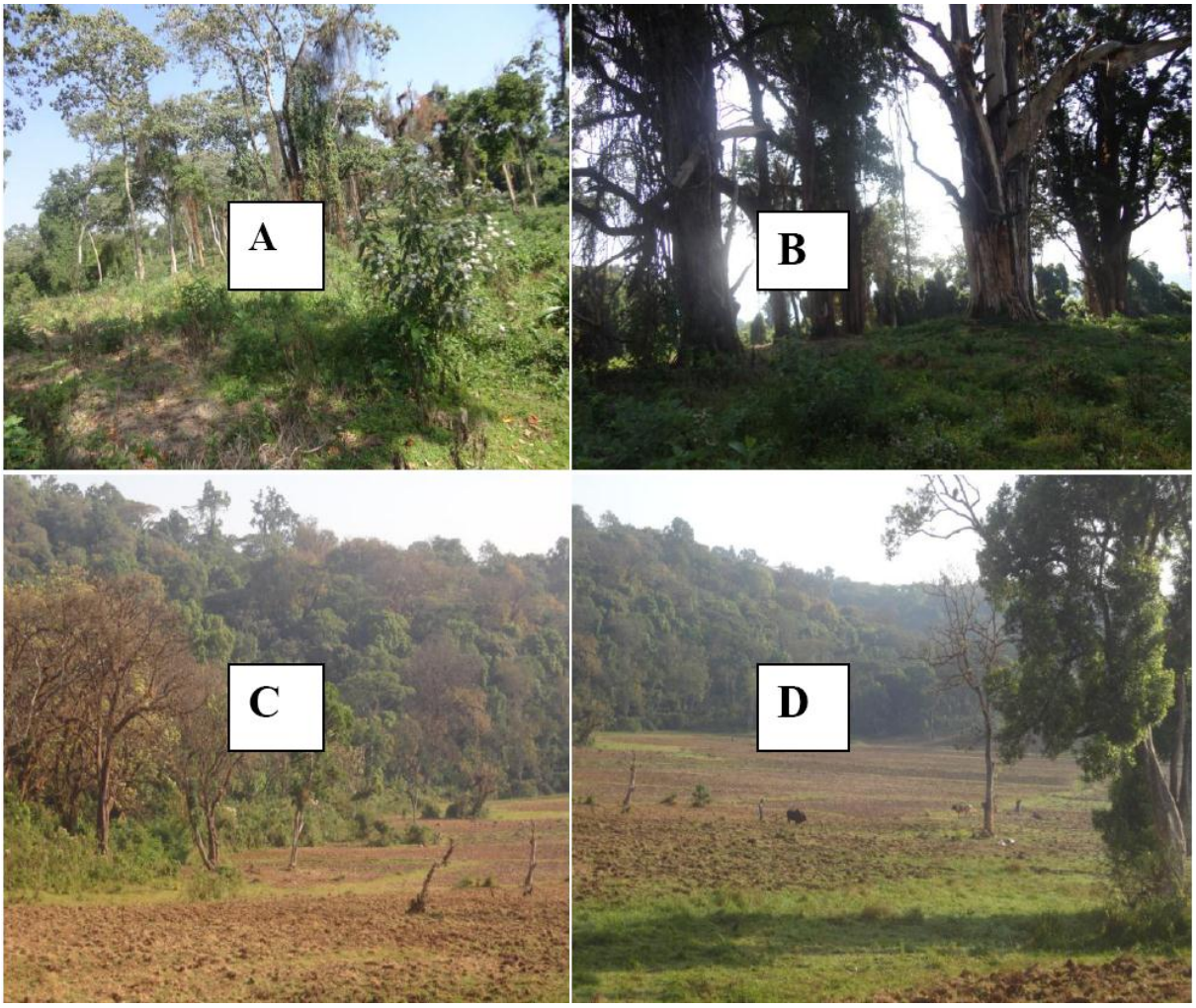

Figure 3.Habitat disturbances due to inappropriate site selection of investment (A and B) and increased subsistence agriculture to forest edge (C and D).

Discussions with FGD and key informant also list the stated cause and additionally put nature of the area and increased plantation forest coverage as driving cause of HWC. As the listed causes compared on the bases of reaction of respondent of the six village, there was significance difference between them (F= 4.2, P= 0.000) (Table 3). The highest cause for HWC in Chala, Bonche, Agalo, and Seke were disturbances of wild animals' habitat while in Wanja the main cause of conflict was proximity to natural forest. In Gado increased subsistence agriculture and wild animals' population were reported as main cause of HWC. Of the mentioned causes, increment of wild animals' population was listed as less cause of conflict on villages of Chala, Bonche, Agalo, and Seke.

Table 3.Causes of human- wild animals' conflict as revealed by respondents among sampled villages

Sample sites	Identified causes of HWC				
	Habitat disturbance	Combined effect	Proximity to natural forest	Increased subsistence agriculture	Increment of wild animals population
Bonche	7	2	4	3	3
Chala	8	3	3	4	2
Seke	7	2	3	5	2
Wanja	3	3	6	5	4
Gado	2	4	4	5	5
Agalo	6	2	5	5	3
Mean	5.3[a]	2.6[d]	4.2[b]	4.5[b]	3.2[c]
Std. D	2.3	0.8	1.2	0.8	1.1

*Means having the same letter have no significant difference

This result was in agreement with José line (2010) and Edward and Frank (2012) who reported increased habitat disturbance as caused of human wild life conflict in Uganda. Jones (2012) reported that habitat destruction and fragmentation was the main cause of human primate conflict in Indonesia. Priston *et al*. (2012) reported anthropogenic habitat alteration cause crop raiding in southeast Sulawesi, Indonesia by primates.

A variety of human activities including cutting of under stories, clear cutting with few tree remaining were observed in the sampled forest of the study area. The result of observation of each human activity was significantly different between two study Kebeles. As human activities observed in two Kebeles forest in a form of cutting of under stories was compared there was significant difference between the Kebeles (t= 16.925, P=0.000). Cutting of under stores in favor of reducing resource competition for coffee was observed more in Wanja kersa (Table 4). Clear cutting with few trees remaining for search of sun light was observed in Ganji chala only whereas slight disturbance was observed in Wanja kersa only (Appendix Fig 1). Finally in both Kebeles sampled forest complete clearing was not observed.

The main reason for the absence of clear cutting with few tree remaining (scale 3) in Wanja Kersa sampled forest was due to no investment in forest land. Respondents response showed that the main reason for the occurrences of clear cutting with few tree remaining in Ganji Chala were inappropriate site selection for investments. Concerning cutting under stories they responded that farmers have had a fear of coffee investment expansion in the area and they compete each other to have ownership from the forest land, hence it was once and again asked and given to investors.

Table 4.Human activities observed in sampled forest of the study area

Human activities (scale 1-4)	Observation of each activity in the Sampled study area (%)	
	Ganji chala	Wanja Kersa
Slight activities	no	20
Cutting of under stories(2)	60	80
Clear cutting with few tree remaining(3)	40	no
Clear cutting(4)	no	no

No =indicates not observed

4. 2.2. Magnitude of Crop Loss

The result showed that not all crops were equally affected by crop raiders. During the present study 70.8% of the respondents claimed that maize was the most vulnerable crop to crop raiders followed by sorghum (62.5%).Whereas about 35% the respondent reported that potato was the least vulnerable crop to damage caused by wild animals (Table 5). The result was agreed with finding of Warren (2008) who reported that Maize (ripe and dried) was the most frequently eaten crop by crop raiding in West Africa.

Table 5.Rank of crops in the order of destruction by crop raider (N=120)

Crop	Frequency	Percentage	Rank
Maize	85	70.8	1
Sorghum	75	62.5	2
Teff	70	58	3
Wheat	50	41.6	4
Potato	42	35	5

All of the respondents from Bonche, Chala, Wanja, Gado and 47.3% from Seke reported that there was an increase of crop damage by crop raider from time to time. However, all respondents from Agalo not give any response on trends of crop damage. But no one respondent reported that crop damage by crop raider was decreased (Table 6). Response on trend of crop damage by crop raiders among respondent differed significantly ($\chi 2 = 91.55$, df = 2, $P < 0.05$ (0.000)).About 74% of the respondents reported that it is increasing whereas 8.9% of them said it is unknown and finally no one reported that the trend of crop raiding was decreasing.

Table 6.Percentage of trend of crop damage by crop raiders based on respondents reply

Village	N(120)	Trends of crop damage (%)			
		Increased	No responses	Unknown	Decreased
Bonche	19	100	0.0	0.0	0.0
Chala	20	100	0.0	0.0	0.0
Seke	19	47.3	0.0	52.7	0.0
Wanja	21	100	0.0	0.0	0.0
Gado	20	100	0.0	0.0	0.0
Agalo	21	0.0	100	0.0	0.0
Mean		74	16.7	8.9	0.0

In the study area, three types of field crops were grown namely maize, teff and sorghum in the production season of 2013/2014 in the selected sites. Maize and teff had more size in terms of area coverage on the farmland taken as a sample hence it was sown in all sites which was 2.5 ha representing 38.4% of the total crop land taken. Sorghum covers less cultivated farmland which was 1.5ha (23.07%) of the total cultivated land in the taken sample farm land hence it was not sown in Bonche and Chala.

Olive Baboon, Bush Pig, Warthog, Grivet Monkey and Porcupine were observed when they damage crop directly and indirectly. Olive Baboon and Grivet Monkey damaged crop during day time whereas Bush Pig, Warthog and Porcupine damaged crop during night time (nocturnal). But Bush Pig and Warthog occasionally have been seen in the morning. Grivet Monkey and Porcupine mainly destroyed maize near maturation stage (Appendix Table 3). Olive Baboon and Bush Pig were observed causing damage on crops in all stages from the time of germination to the time of harvest whereas Warthog affects crop early in the seedling.

A total of 912 damage events were registered in all five sites (Table 7). There was significant difference on damage event registered between each trip namely before flowering and after flowering ($t=10.6$, $P=0.000$). Damage events was less after flowering than before flowering because almost all the owner of the crop give more emphases on visiting their crop , after

maturation of crops they were around their farm for case of harvest and the time of after flowering is shorter than time of before flowering.

Table 7 .Damage events caused by five crop raiders

Study Sites	damage event caused by crop raiders				
	Olive Baboon	Bush Pig	Warthog	G. Monkey	Porcupine
Bonche	107	62	50	20	26
Chala	56	53	35	19	10
Seke	34	34	25	19	18
Wanja	68	49	43	23	20
Gado	35	35	33	24	14
Mean	60[a]	46.6[b]	37.2[c]	21[d]	17.6[d]
Std. D	29.9	12	9.6	2.3	6.1

*Means having the same letter have no significant difference

Damage events caused by those five crop raiders were significantly different from animals to animals ($F = 12.602$, $P < 0.05(0.000)$. The highest damage event was caused by olive baboon (M= 60) whereas the lowest damage events was caused by porcupine (M=17.6) (Table 7). Olive Baboon was the most problematic animals for farmers around the study area. Baboons to be major pests not only because they are perceived to be more destructive than most other species but also they visit farms frequently, sometimes in large groups, and can be very persistent (Hill, 2000).

Damage events were significantly different from site to site ($F = 2.796$, $P < 0.05(.037)$. As the mean of registered damage event were compared the highest damage event was registered in Bonche (M=53) which have less distance from forest edge. Whereas the lowest damage events was registered in Seke (M=26) which was far from forest. Even though Bonche and Wanja have similar stratification from forest edges, due to higher disturbance of forest in Bonche area than Wanja crop raiders visit Bonche area more than Wanja frequently (Table 8).

Table 8 .Damage events caused by crop raiders in the sample sites

Crop raiders	Sample Site and damage event registered				
	Bonche	chala	Seke	Wanja	Gado
Olive Baboon	107	56	34	68	35
Bush Pig	62	53	34	49	35
Warthog	50	35	25	43	33
Grivet Monkey	20	19	19	23	24
Porcupine	26	10	18	20	14
Mean	53 [a]	34.6 [c]	26 [d]	40.6 [b]	28 [d]
Std. D	34.7	20.2	7.7	19.7	9.1

*Means having the same letter have no significant difference

There was a significant negative correlation between the number of damage event and the distance of the study village from forest edge (P <0.05(0.046). The study began by hypothesizing a negative relationship between frequency of damage event and the distance of the study village from forest edge. As the distance of study village from forest edge decreased damage event registered was high and vise verse. There was a significant negative correlation between the number of damage event registered and family size of the respondent (P=0.05). Damage event registered more in farm land of a farmer having less than four family members than for those having six and above families and the Pearson Correlation value were (-0 .879) (Table 9).

Table 9 .Correlation of damage event with family size and distance of study site from forest

	Study site	Damage event	Family size
Study site	1	-.283*	
Damage event	-.283*	1	-.879*
Family size		-.879*	1

Out of 6500m^2 sample taken crop land for direct observation, about 3581m^2 crop lands were damaged by crop raiders during 912 damage events. The size of damaged area of maize, teff

and sorghum were 2025 m^2, 1189 m^2 and 367m^2 respectively (Table 10). Maize were damaged by all the five crop raiders throughout its growth stage than teff and sorghum and this was the main reason for that more damage was registered during present study. This result is in agreement with Kivai (2010) who report land covered by Maize is most raided and farmers incurred huge financial losses due to crop raiding (47.19%) in Kenya.

Table 10 .Total damaged area (m^2) recorded in three crop type of sampled area

Sample site	Area of crop damaged in (m^2)		
	Maize	Teff	Sorghum
Bonche	570	420	no
Chala	365	250	no
Seke	275	108	78
Wanja	476	290	190
Gado	339	121	99
Mean	405	237.8	73.4
Std. D	104.9	115.3	70.7

As calculated based on quadrant sampling, from 2500m^2 maize, 2500m^2 teff and 1500m^2 sorghum sample taken farm land about, 6300kg maize, 2500kg teff and 2700kg sorghum yield were expected. The estimated yield loss of the three crops namely maize, teff and sorghum due to crop raiding wild animals were about 695kg. The loss covers 6.04% of the total annual production of the total sampled area of the three crops.

The maximum loss was registered on maize crop which covers 73.4 % of the total loss occurred. The loss of teff and sorghum were about 17% and 9.5% respectively from the total loss. The main reason was due to that maize crop weather ripe or/and dried, it was the most frequently eaten crop by crop raiders (Warren, 2008). This result was in agreement with finding of Eniang *et al.* (2011) in Nigeria, Kivai (2010) in Kenya and Warren (2008) in Nigeria.

As crops in kg for all sites compared significant difference was found in the amount of crop lost between all site (P = 0.016) (Table 11). At percent the highest loss was occurred in

Bonche and Wanja which covers 26.76% and 26.3% of the total loss respectively. The percentage of crop loss increase as the distance between forest edge and study village decrease which are inversely related. In monitory term, the overall loss to farmers in the sampled area was estimated to be 2448 ETB, 1190 ETB and 429 ETB per sampled farm land of Maize, Teff and Sorghum, respectively which represents 8.1%, 4.76% and 2.4 % of the monitory value of the annual production of the sampled area of the three crops respectively.

The result was in agreement with finding of Hill (2000) and Fungo (2011) who reported that farms most at risk to losses of crop were near to the forest edge than the far from the forest . Whereas disagreed with finding of Gubbi (2012) who reported Farmland at a distance of 3.1–5.0 km experienced more conflict than farmland at a distance 0–1.0 km from NNP (Nagarahole National Park) India.

Table 11.Amount of crops loss in each sample site in kg

Crop lost (Kg)	Study Sites				
	Bonche	Chala	Seke	Wanja	Gado
Maize	144	92	69	120	85
Teff	42	25	10.8	29	12
sorghum	0	0	14	34	18
Mean	62[a]	39[b]	31[c]	61[a]	38[b]
Std. D	60.4	38	26.7	51.2	30.8

* Means having the same letter have no significant difference

Livestock depredation

Even though, there were carnivores in the study area like leopard, common jackal, hyaena, and lion the response of all respondent showed that there was no any livestock predation caused by those carnivores. Respondents report that there was no damaged livestock by wild animals in the study area. The most predators on small ruminant and chickens during the present study were Olive Baboons.

Based on respondents' response the killed sheep, goat and chickens between January 2010 and 2013 were 213. Of this about 34.3%, 27.7%, 17.4%, 12%, and 8.5% were caused in Bonche, Wanja, Chala, Gado and Seke respectively. Out of the total kills caused by Olive Baboon in the last three years, about 60% were on chickens and 23.9% were on goat whereas 15.9% were on sheep. During present study no domestic animals were killed by wild animals in Agalo sites.

Market value of livestock was varied depending on species, age, and sex of the animals. On the base of local market, adult males and adult females differed in the market value. The market value for present estimation was the average of the three years market value. The economic loss due to depredations caused by Olive Baboon in the last three years on goat, sheep and chicken was 27,420 ETB (Table 12). Damage on goats and sheep accounted for a loss of 13550 ETB (49.4%) and 11950 ETB (43.58%) respectively. Whereas damage on chicken caused 1920 ETB loss which represents 7% of the total loss happened.

Table 12 .Monitory losses of chicken, goat and sheep killed by olive baboon between January 2010 and 2013 on bases of respondent response (ETB).

Livestock		Unit price	Respective no of each age category	Total price
Chicken		15	128	1920
Goat	Adult male	600	4	2400
	Adult female	450	7	3150
	Young	200	40	8000
Sheep	Adult male	800	3	2400
	Adult female	550	6	3300
	Young	250	25	6250
Total				27,420

4.2.3. Population Estimation of Top ranked crop raiders

Five wild animals were identified as top crop raiders during present study and include Olive Baboon, Bush Pig, Warthog, Grivet Monkey and Porcupine in order of problem they caused in the area. But due to the complexity of the forest, the behavior of nocturnal wild animals,

lack of instrument used to estimate and method used to estimate population of nocturnal wild animals, only population of diurnal crop raider were estimated during present study.

A total of 259 and 240 Olive Baboons were counted in the entire sampled forest area during dry and wet season respectively (Table 13). Statistically there was no significant difference between number of Olive Baboon counted in dry and wet season (χ^2 = .723, df = 1, P >0.05(.395). Further analysis on the number of the different age groups using student t test showed that the number of female and sub-adults were significantly higher than the number of the adult male and juveniles age groups (p < 0.05(0.003) in both dry and wet count. The density of Olive Baboon population in Ganji chala sampled forest was 13 Olive Baboon /km^2 and 12 Olive Baboon /km^2 in dry and wet respectively. Whereas 11 Olive Baboon /km^2 and 10 Olive Baboon /km^2 in dry and wet season respectively in Wanja kersa sampled forest.

A total of 6 troops of Olive Baboon were observed in Ganji Chala sampled forest both in dry and wet seasons respectively whereas a total of 3 and 2 troops of Olive Baboon were observed in Wanja Kersa sampled forest. On average troop's size ranged from 21 to 38. According to Sillero-Zubiri and Switzer (2001) the social structure of baboon ranges often form large troops, 30-80 individuals.

A total of 88 and 74 Grivet Monkey was estimated in the entire sampled forest area during wet and dry season respectively (Table 13). Statistically there is no significant difference between number of Grivet Monkey in dry and wet season (P >0.05). A total of 7 and 6 troops of Grivet Monkey were observed in the Ganji chala sampled forest in wet and dry seasons respectively. Whereas 5 and 4 troops in Wanja kersa sampled forest were observed in wet and dry season. On average, troop's size ranged from 9 to 15. The density of grivet monkey, in Ganji chala sampled forest were 7 Grivet Monkeys per km^2 and 6 Grivet Monkeys per km^2 in wet and dry respectively. Whereas 8.6 Grivet Monkeys per km^2 and 7 Grivet Monkeys per km^2 in wet and dry season respectively in Wanja kersa sampled forest.

Table 13.Number of Olive Baboon and Grivet monkey estimated in the sampled forest

Species with respect to age class		Number of Olive Baboon and Grivet Monkey estimated in dry and wet season in two sites			
		Ganji chala		Wanja kersa	
		wet	dry	wet	dry
Olive Baboon	Adult male	18	19	6	7
	Females & sub-Adults	119	122	51	56
	Juveniles	30	38	16	17
	Total	167	179	73	80
Grivet Monkey	Adult male	13	9	10	7
	Females & sub-Adults	58	50	41	37
	Juveniles	17	15	9	8
	Total	88	74	60	52

4. 2.4. Traditional Methods Used by Farmers to Defend Crop Raiders from their Crops

During the present study respondents used different methods to defend crop raider from their crop and include guarding, chasing, live fencing, scarecrow and smoking. There was significant difference between respondents ($\chi 2 = 74.93$, df = 7, $P < 0.05(0.000)$ in using the different traditional methods in which 30% of the respondents were used guarding their crop whereas 0.8% were used smoking to repeal the crop raiders from their crop mostly in the night time which was the highest and the lowest respectively (Fig. 4). Most respondents reported that as they guarded their crops throughout crop growing season. Chasing and fencing were also the second and the third important methods respectively. Smoking and scarecrow was also used to as supplementary (Fig. 5 A, B, C and D). This result was go with the finding of Sillero-Zubiri and Switzer (2001) in Africa, Eniang *et al.* (2011) in Nigeria; Kate (2012) in Uganda and Gandiwa *et al. (*2012) in Zimbabwe who founds that guarding and chasing away of animals was ranked first and second in protecting crop raiders from crops.

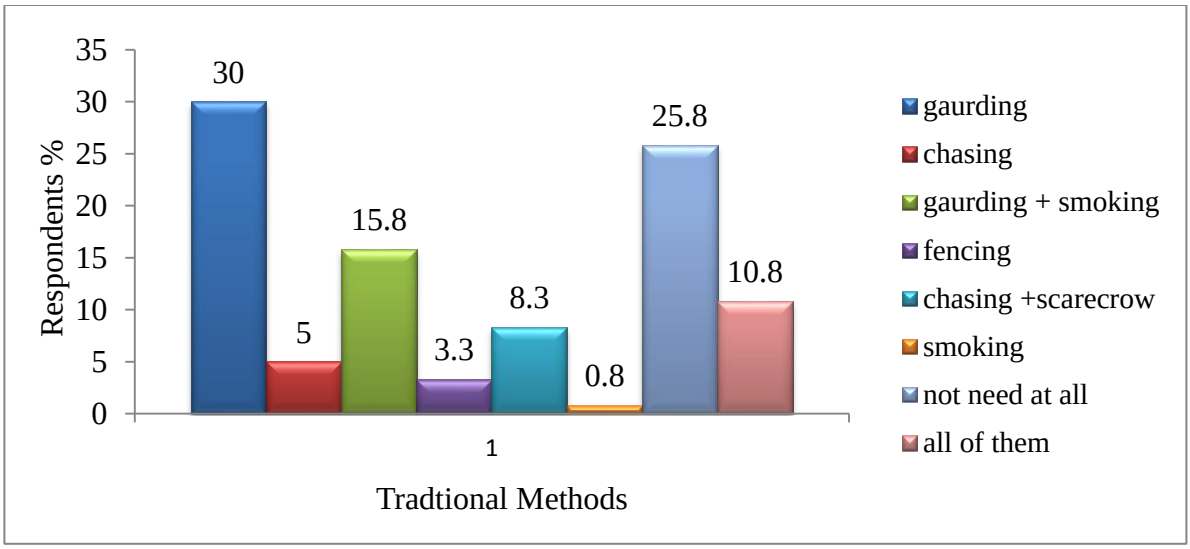

Figure 4 .Percentage of respondents thus used different traditional methods.

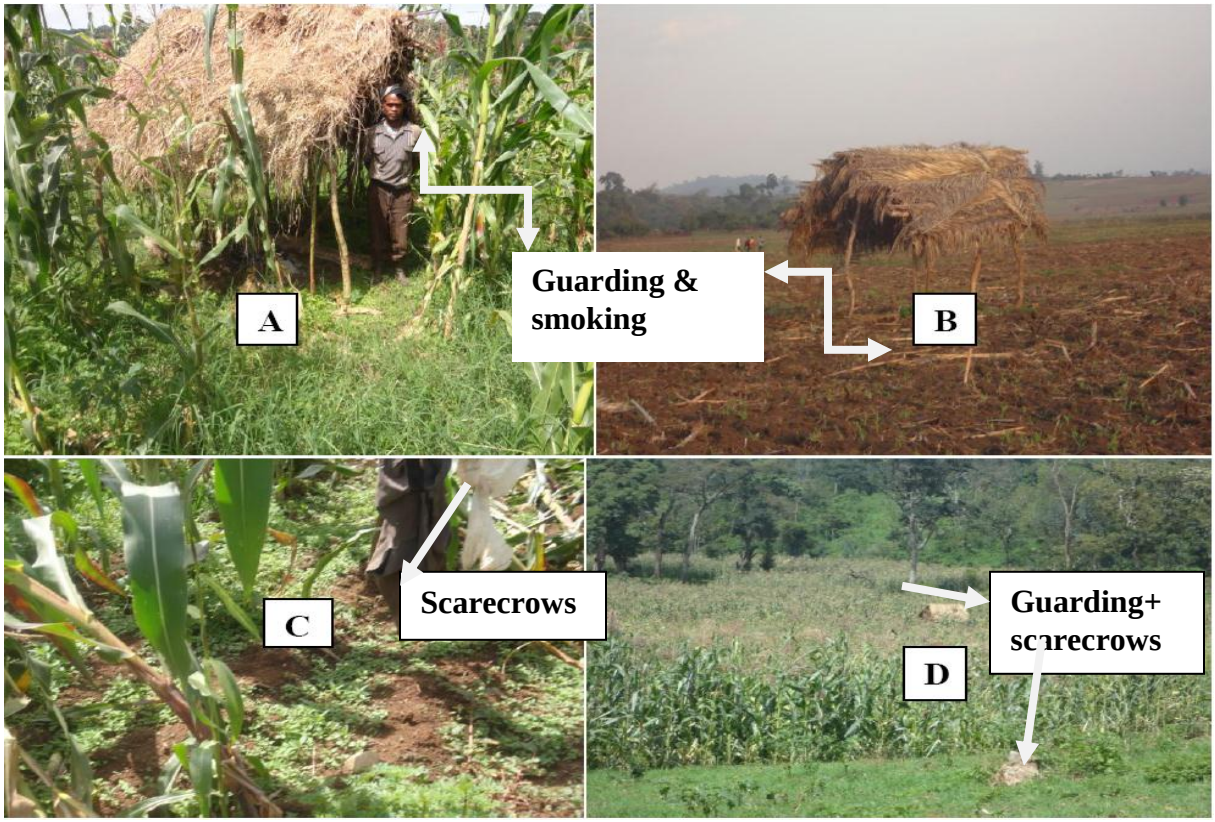

Figure 5.Traditional method used by local farmers to defend crop raider

On sampled site based, 52.6% of the respondents from Bonche, 47.6% from Wanja, 40 % from Chala, 10.5% from Seke and 30 % from Gado stated that guarding was the most and effective protective method to minimize the loss of their crop from crop raider. This indicates that as the farm land close to the edge of forest, it needs strict fellow up to reduce crop depredation. Respondents from all sample villages except Agalo used other methods as supplementary, but respondents from Agalo reported that there is no need of crop keeping method hence there was no crop raider in their area (Table 14).

Table 14.Method of crop protection against crop raider in each study site

Village	No	Guarding	Chasing	Guarding & smoking	Live fencing	Chasing & scarecrow	Smoking	no t at all	all
Bonche	19	10	0	5	0	0	0	0	4
Chala	20	8	3	4	1	1	0	0	3
Seke	19	2	3	0	0	4	0	10	0
Wanja	21	10	0	4	1	3	0	0	3
Gado	20	6	0	5	2	3	1	0	3
Agalo	21	0	0	0	0	0	0	21	0
Total	120	36	6	18	4	11	1	31	13

Sampled respondents in the study area proposed different management options to overcome crop damage caused by crop raiders. There were significant difference ($\chi 2 = 29.4$, df = 5, $P < 0.05$ (0.000) among respondents on their proposed mechanisms to overcome crop damage. Of the total household interviewed on average about 30.8 % of the respondents suggested it is better to use traditional methods like guarding, chasing, live fencing, scarecrow, and smoking. While 20.8% of the respondents suggest keeping wild animals' habitat intact whereas 16.8% of them suggested compensation of the damaged crop from the government and investors who invest in forest land around the study area. Then they planned to change their farming system to perennial crops. About 10.9% of them proposed reducing their number by killing as a solution and the remaining 4% of the respondents reply not have any response (Table 15).

Table 15.Management options proposed by respondents' to overcome resource damage by wild animals

Sampled Villages	Suggested mechanisms by respondents and number of HH respond (%)					
	using traditional methods	keep habitat intact	compensations	changing farming system	reducing their no	no response
Bonche	26.3	21	21.1	10.5	15.8	5
Chala	30	15	25	15	10	5
Seke	36.8	21	15.8	15.8	10.5	0
Wanja	23.8	19	9.5	23.8	14.3	9.5
Gado	30	20	20	15	10	5
Agalo	38	28.6	9.5	19	4.8	0
Mean	30.8	20.8	16.8	16.5	10.9	4

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

Conflict between human and wild animals existed since the dawn of humanity and is an increasing concern in all parts of the world particularly in developing nation where peoples depend on agriculture. It is becoming more frequent and severe over recent years. Human population growth and activities such as deforestation, inappropriate site selection for investment in forested areas and expansion of agricultural activities together have led to increased human encroachment on previously wild and uninhabited areas.

The present study investigated the prevalence of HWC in Gera south western Ethiopia and manifested through crop damage and livestock predation. The cause of human wild animals' conflict were wild animals' habitat disturbance, increased subsistence agriculture around forest edge, proximity to natural forest, increased plantation forest coverage, nature of the area hence it is forest area and the contribution of all mentioned causes. Crop raiders responsible for the occurrences of human wild animals through crop raiding and domestic animals depredation were Olive Baboon, Bush pig, Warthog, Grivet Monkey and Porcupine. Olive Baboons was the most commonly reported crop raiders and domestic animals depredation causing wild animals. Bush Pig was the second problematic animals on crop depredation followed by Warthog, Grivet Monkey and Porcupine in the study area.

Crop raiders cause significant loss on farmers' production. Maize was the highest vulnerable crop to damage whereas chickens, goat and sheep were the most vulnerable livestock. The trend of crop damage was increasing from time to time. On bases of direct observation the present study identified Olive Baboon and Bush Pig as the main damage causing wild animals. Olive Baboon was cause damage day time whereas Bush Pig caused damage in the night time. Even though not series as Olive Baboon and Bush Pig; Warthog, Grivet Monkey and Porcupine were caused considerable damage.

In all sampled sites damage events were caused by the listed crop raiders. Olive Baboon caused the greatest damage events. Crop raiders more frequently visit farm near to the forest. On the bases of sample land taken for direct observation, of the total expected yield about 6.04% was lost due to crop raiding wild animals. Result of discussion with FGD and key informant was confirmed the response of formal interview in that, there was human wild animals conflict in almost all selected site except Agalo site which is far from forest and it. The key crop raider protection methods in the study area were guarding and chasing. Farmer's also used fencing, scarecrow and smoking to defend crop raiders from their crop.

5.2. Recommendations

In light of the results and conclusions, the following recommendations are suggested to minimize the problem of HWC:

- Encouraging farmers as they keep wild animal's habitat intact and should cooperatively keep their crop farm from crop raiders to minimize yield.
- Farmers should sow uniform crop at uniform time alongside of their farm to take the advantage of uniformly keeping the farm to minimize the loss of crop to crop raiders.
- Encouraging farmer as they scale up live stock raring and bee farm than crop cultivation.
- Crops damaged by wild animals depend on the taste of cereal crop plants. Those the food habits of the wildlife should be systematically studied and local communities should be encouraged to grow unpalatable crops to wild animals.
- Potential of ecotourism should be studied to encourage development of ecotourism in the area.
- Appropriate assessment of wild animals' resource in the forest area to decide on carrying capacity of the forest of wild animals should be needed.
- Making appropriate site selection for investment to reduce habitat disturbance.
- Encouraging the development of ecotourism which benefits local resident and wild animals without harming one another.

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APPENDIX

Appendix I: Semi- structured survey questionnaire for formal interview

Households survey on Assessment of Human-wild animals conflict status and its management strategy in Gera, South Western Ethiopia**.**

1. General information

Household code number_____ Name of interviewer_____ sign _____Date of interviewee day _____ month _____ year _____

1. Name of household head_____
2. Sex 1) Male 2) Female
3. District_____
4. Keble's _____
5. Marital status 1) married 2) single 3) divorced 4) widowed
6. What your ethnicity 1) Oromo 2)Tigre 3)Amhara 4) kaficho 5) others
7. Level of education 1) illiterate 2) Read only 3) 1-4 grade 4) 5-9 grade 6) grade 10 and above
8. Family composition of the Respondents 1) 1-3 2) 3-5 3)5-7 4) more than 7
9. What is the nature of your land security from wild animal pest? 1) secured2) not secured3) others specify
10. How much is the distance of your cultivation land from forest edge? 1) near 2) medium 3) far 4)
11. What are your livelihood activities? (multiple choice is possible) 1) Crop production2) Livestock keeping3) mixed Farming (Farming and livestock keeping) 4) Crop production and other income 5) other (mention)
12. What type of crops you grow in your farm land 2012/2013? Put in order to know which one is the most 1) maize 2) Tiff 3) sorghum 4) wheat 5) barely 6) potato 7) others
13. Do wild animals cause damage to your crops? Yes/ No**.**
14. What is the cause for the happening of HWC in your area?
    1. .....
    2. .....
    3. .....

15. Which pest wild animals are more responsible for crop damage? 1) Columbus monkey, 2) Grivet Monkey, 3) Olive Baboon 4) wild pig, 5) Warthog 6) Porcupine 7) others
16. Which wild animals are more responsible for crop damage during day time? ---------
17. Which pest wild animals are more responsible for crop damage during night time? ---------
    ---
18. If yes for Q .13 above in what time more cause damage? 1) night2) day 3) both day and night 4) others
19. Which type of crop is more attacked by pest wild animals? 1) Maize 2) Teff 3) sorghum 4) wheat 5) barely 6) potato 7) no damage in general
20. Which type of crop is least attacked by pest wild animals?1) Maize 2) Teff 3) sorghum 4) wheat 5) barely 6) potato7) no damage in general
21. At which stage pest wild animals more attack crops 1) seedling 2) early maturation 3) matured 4) others
22. In what season do you experience the most wildlife damage? Circle one 1.Dry season 2. Wet season 3others specifies----------
23. What do you feel on the population of wildlife in the natural forest in your surrounding? 1) Increasing 2) decreasing 3) No idea
24. What solution you put to manage the existing conflict in your area? ----------
25. What control measures have been taken to safeguard your crops from pests?
    1. .....
    2. .....
    3. .....

26. Which of the techniques are most effective?
    1.....
    2.....
27. Which of the techniques are least effective?
    1. .....
    2. .....
    3. .....
28. What you suggest to reduce the effect of crop damage by wild animals?
    1. .....

2. .....
3. .....
4. ……....

29. Do you have livestock? If yes, type and number of livestock:

Cattle----------goat----------sheep----------horse----------Donkey---------Mule---
------- other----------

30. Which animals are the most problematic in terms of livestock predation?

1…….
2…….
3……..
4……..

31. Have you lost any livestock to wild animals in the past three years? Yes/No
32. Have you lost any small ruminant to wild animals in the past three years? Yes/No
33. Have you lost any chickens to wild animals in the past three years? Yes/No

34. If yes for Q 31 to 33 above please put type and numbers of domestic animals you lost in the last three years

Cattle----------
Goat (1) Adult male---------
(2) Adult female--------
(3) Young -------
Sheep (1) Adult male---------
(2) Adult female--------
(3) Young -------
Hen (chicken) ----------
Horse----------Donkey---------Mule---------- other----------

Appendix .II Check lists for Focus Group Discussion (farmers)

Discus in the following points in context to your farm plot or locality

1. Is there any Human wild animals' conflict in your area?
2. Which pest wild animals is more cause crop damage?
3. What is the main deriving cause of HWC in your area?
4. In which season the crop damage is serious and what is the reason behind?
5. How farmers protect pest wild animals from their property and how much it is effective?
6. Is there any organization participate on solving the problem of crop raiding pest wild animals?
7. Is there a shortage of farm land in your area; if yes how solve the problem?
8. Is habitat of wild animals is fragmented due to human and natural causes in your area?
9. Is there any protected forest area in your residence?
10. Is there the option of expanding farm land from forest boundary to overcome shortage of farm land?

Appendix III .Check lists for key informant interview (development agent's, District MoA experts, and better-informed farmers)

1. Name _____ Date _____Sign _____

2. Education status _____ your profession_____

3. How long have you stayed in the area? _____

4. What efforts have done by government, NGO, community and specially district MoA office with regard to Human wild animals' conflict?

5**.** How do you perceive about the following in your district in general and the study area in particular?

- The major factors causing Human wild animals conflict
- The perception of farmers towards forest degradation problems and Human wild animals conflict
- The consequences of Human wild animals conflict on : environment ,social, economic aspects

6. Which types of crop do you think that most prone to pest wild animals damage in your area and? Why?

7. What are the major factors that cause Human wild animals conflict in the study area /district?

8. How do you see the participation and attitude of local communities in wild animal's conservation in particular and natural resource management in general?

9. Why farmers are in your area face Human wild animals' conflict?

10. What are the gaps between farmers and development actors in addressing Human wild animals' conflict?

11. What general option do you have to improve the current efforts towards solving Human wild animals' conflict?

Appendix .IV Olive Baboon and Grivet Monkey census form

Name of data collector---------- Date----------
District----------
Kebeles----------
Quadrant number----------

Quadrant. No	Season		Age category and their respective number			Remark
	Wet	Dry	Adult male	Adult female and Sub-adult	juvenile	

Appendix V Data collection sheet for direct observation of crop damage by wild animals

Kebeles_____ Site_____
Trips _____Stages of crop development_____
Stratification_____ Name of data collector_____

Month and Date	Species observed					Type of crop damaged			Part of crop damaged			Size of damaged Area in (m^2)			Time of observation (day or night)		
	Olive Baboon	Bush Pig	Warthog	Grivet monkey	Porcupine	maize	Teff	sorghum	maize	Teff	sorghum	maize	Teff	sorghum	maize	Teff	sorghum

Appendix VI Tables and Figures for result

Appendix Table 1.Income sources of House hold of (120)

Income source	No. of family head	Percentage
Crop farming alone	20	16.7
Crop farming and animal rearing	84	70
Crop farming, animal rearing and Other income sources	16	13.3
Total	120	100

Appendix Table 2.Lists of wild animals found in the study area as revealed by respondents.

Common Name	**Scientific Name**	**No. Responses**
Olive Baboon	*Papio anubis*	120
Guereza	*Colobus Monkey*	120
Grivet Monkey	*Chlorocebus aethiops*	120
Bush Pig	*Potamochoerus Larvatus*	110
Warthog	*Phacochoerus africanus*	100
Bush duiker	*Sylvicapra grimmia*	95
Common Jackal	*Canis aureuse*	80
Giant forest Hog	*Hylochoerus meinertzhageni*	76
Leopard	*Panthera Pardus*	75
Spotted Hyaena	*Crocuta Crocuta*	74
Buffalo	*Syncerus caffer*	68
Porcupine	*Hystrix Cristata*	60
Lion	*Panthera Leo*	58
Blue monkey	*Cercopithecus mitis*	50

Appendix Table 3 .Crop damaging animals, crop type and stage damaged, time and site seen damaging crops

Damaging animals	Type of crop	Stage of crop damaged	Time they often seen in the crop field	Sampled site
Olive Baboon	Maize	seedling, steam, cop	day	in all sites
	Teff	grain		
	Sorghum	tassel, grain		
Bush Pig	Maize	cop	night	in all sites
	Teff	grain	early in the morning	
	Sorghum	tassel, grain		
Warthog	Maize	all parts	night	in all sites
	Teff	seedling &grain	occasionally early in the morning	
	Sorghum	seedling		
Grivet Monkey	Maize	seedling, cop	day	in all sites
	Sorghum	tassel, grain		
Porcupine	Maize	cop	night	in all sites

Appendix Figure 1.Forest disturbance or clear cutting with few trees remaining for coffee farm