ADDIS ABABA UNIVERSITY

COLLEGE OF NATURAL AND COMPUTIONAL SCIENCES

DEPARTEMENT OF ZOOLOGICAL SCIENCE

Assessment of Human-Wildlife Conflict in Gimbo Woreda, Kafa Zone Southern Nations Nationalities and Peoples Region (SNNPR), Ethiopia

Habtamu Debalke

A thesis submitted to the School of Graduate Studies, Addis Ababa University in partial fulfillment of the Degree of Master of Science in Biology.

Addis Ababa

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DECLARATION

I, the undersigned, hereby declare that this thesis is my original work: it has not been presented in other University, College or Institution. All sources of material used for the thesis have been duly acknowledged.

Name: Habtamu Debalke

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ACRONYMS

CBD	Convention on Biological Diversity
CITES	Convention of International Trade in Endangered Species
FGD	Focus Group Discussion
GPS	Global Positioning System
HEC	Human-elephant conflict
HH	Household
HWC	Human-wildlife conflict
IUCN	International Union for the Conservation of Nature
NABU	Nature and Biodiversity Conservation Union
NTFP	Non-timber forest product
PFM	Participatory Forest Management
SPSS	Statistical Package for Social Science
SNNPR	Southern Nations Nationalities and Peoples Region

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ABSTRACT

This study tries to assess human-wildlife conflict in Gimbo Woreda, Kafa Zone (SNNPR), Southern Ethiopia. The study was conducted from February 2016 to July 2016. The methods employed were field observation, to estimate the population size of pest primates using total count in the entire study area and to observe and estimate crop loss due to crop raiders, structured questionnaires and interview for gathering information about crop loss by wild animals. Total count was used to estimate population of most common wild animals in the sampled forest. One way ANOVA was used to analyze the amount of crop lost in the study area, and Chi-square test was used to analyze association of HWC, number of Anubis baboon and vervet monkey between dry and wet season and damage events registered between sites. From the study, four primate species were identified: namely Anubis baboon, vervet monkey, Black and white colobus and blue monkey. Of these Anubis baboon and vervet monkey were known as the worst pest primates of all. In addition, bush pig, porcupine, warthog and rodents were identified as damage- causing wild animals. The present study also revealed that a total count of 332 and 293 Anubis baboon and 332 and 372 vervet monkey population occurred in the study area during the dry and wet season respectively. Thirty-nine percent of maize was damaged by Anubis baboon and vervet monkey from the total estimated maize plant (22,183), and 6% was damaged by other pest primates such as bush pig, warthog, porcupine and rodents. Most damages occurred during the flowering and Fruiting stages and serious damage was seen in the wet season. The response of the respondents showed statistically significant difference for each type of conflict; namely, crop damage only, both crop damage and livestock predation, destruction of traditional beehives and destruction of huts and disturbing of humans respectively are the main troubles in the study area $x^2=83.122$, $P<0.05$ (0.0001). Deforestation, agricultural expansion, wild animal population growth, human population growth and distance from village to farmland were identified as causes of human wildlife conflict. Traditional methods such as guarding, chasing by dog, scarecrow and trapping were used by local people to protect their crops from wild animals. To reduce the conflict, they keep their crop cooperatively and changing their means of farming to cash crops such as chat, coffee and spices.

Key words: Crop raiding, deforestation, Anubis baboon

1. INTRODUCTION

1.1 Background

Human-wildlife conflicts is not a new phenomenon, it has started since the beginning of the human era. Human-wildlife has occurred throughout man's prehistory and recorded history. Among the early forms of the ancestors of prehistoric man were predated by a number of predators of the Miocene such as Saber-toothed cats, leopards, spotted hyenas amongst others (Smile and Shaun, 2002). The advent of farming and animal husbandry of the Neolithic Revolution increased the scope of conflict between humans and animals. The crops and the produced formed an abundant and easily obtained food source for wild animals (Parker *et al*. 2007). Gradually, with technological development, man invented weapons such as axe and iron during stone and iron ages to frighten wild animals, initially. In the last few decades with increasing human population, with resulted pressure on land under cultivation has increased the degree of conflicts between man and wildlife. Rapid increase of population growth, investment in forested area, deforestation, wetland draining for cropland areas, and usage of forest edge for coffee plantations is more experienced in south western Ethiopia. These posed pressures on land reduce the area of core habitat for wild animals and eliminate corridors for migration and increase the probability of contact, and possibly created conflict between animals, farmers, and wild animals (Quirin, 2005). Human-wildlife conflicts are a global problem, and are occurring in many countries where human and wildlife requirements overlapping (Dickman, 2010; Hoffman and O'Riain, 2012). Conflicts between people and wildlife are encountered by a diverse group of communities, particularly those residing close to protected areas containing large to very large herbivores and large carnivores (Newmark *et al*. 1994).

Human-wildlife conflicts can take various forms, including carnivores attacking and killing livestock or humans, species raiding crops, competition for game and /or resources, disease exchange between livestock and wildlife, carcass poisoning, and retaliation killing (Thirgood *et al.* 2005; Madden 2008). Crop raiding is a widespread and common example of the human wildlife conflict, which directly influences local people's perception of support for conservation of wildlife (Hill, 1998).

Many animal species raid agricultural crops. Insects, rodents, birds and antelope are those most frequently cited in many literatures, due to the impact they have on cash crops and intensive agriculture. However, primates are highly significant pests in tropic areas, where local people are mainly subsistence farmers (Hill, 1997; Priston, 2005). With their extensive repertoire of cooperative behaviors, opportunistic life-style, and non-specialized and omnivorous dietary tendencies, certain primates are highly successful crop raiders, such as baboons, Vervet monkeys and macaques (Pirta *et al*., 1997). Their highly adaptable nature, along with their ability to learn very rapidly and change their behavior accordingly, makes them very successful and potentially troublesome when living close to humans (Else, 1991). Due to this regard the conflict may affect human welfare, health and safety, and have economic costs. The conflict also poses negative social impacts such as withdrawal and absence of children from school, absence from work, additional labor costs for crop guards, loss of sleep, fear and restriction of travels (Hoar, 1992). In Africa, antagonistic relationships between human and nonhuman primates have been exacerbated by the increasing amount of land under cultivation with crops that are very attractive to primates (Hill, 2000).

When the issue is evaluated from the angle of small holder subsistence farmers who are living adjacent to forest or protected areas, crop depredation by primates becomes life threatening problem (Tweheyo *et al.*, 2005). Primates such as baboons **(***Papio anubis)* exhibit unrivalled levels of contact with humans (Strum, 2010; Swedell, 2011). They are considered the most troublesome nonhuman primate genus and reported as pests in Uganda and other African counties (Hill, 2000). The conflict now also poses one of the greatest threats to the persistence and survival for many species (Dickman, 2010). At the same time finding ways to manage and resolve these conflicts is vital for their long-term conservation (Heydon *et al.*, 2010). A multitude of traditional and contemporary methods are being employed to reduce human–wildlife conflict including the management of animal numbers (culling and translocation) and the separation of wildlife from humans using a host of deterrents (electric fences, herders) (Dickman, 2010).

But with their adaptability, intelligence, agility, dexterity, and high levels of socialization and cooperation, nonhuman primates present one of the greatest and most complex challenges to human–wildlife conflict mitigation (Else, 1991; Swedell, 2011).

Gimbo woreda where the tropical rainforest remnants, harboring primates as their dominant fauna. Primates, bush pigs and others are the worst crop raiders in this area. They raid crops such as maize, sorghum, teff, haricot bean, coffee, enset and vegetables. But they prefer maize more than other crops. So maize, sorghum and haricot bean are selected for this study, because these are the main crops cultivated in the study area, and the most preferred crops by primates and other wild animals. But of these crops, maize is simple to count for sampling.

Therefore, the present study was conducted to assess the major causes of human-wildlife conflict with emphasis to crop raiding species, and traditional practices to alleviate the problem in Gimbo woreda.

1.2. Statement of the problem

Human-wildlife conflict is fast becoming a serious threat to the survival of many endangered species in the world and a global problem that is experienced especially in areas where wildlife and human population co-exist and share limited resources (Musimbi, 2013), and also share boundaries (Eniang *et al*.,2011). The people living in developing countries like Africa and Asia are suffering from the negative impacts of human-wildlife conflict, such as crop damage and livestock predation (Hill, 2000). Likewise, studies have been conducted in Ethiopia described the presence of pest animals which damage crops, attack domestic animals and cause various economic loss (Mesele Yihune, 2007; Mussa Adem, 2009). Primates are the worst pests of crop due to their adaptability, intelligence, agility, dexterity, and high levels of socialization and cooperation. So they are one of the causes for yield loss of farmers from time to time. If these conditions proceed without mitigation there was a great problem on every part of the society. Thus, the present study was conducted to estimate crop loss as the major source of human-wildlife conflict in Gimbo woreda. The reason why this topic was selected that most of the developing countries where agriculture is a major of livelihood for rural people and economy is based on agricultural products (Musimbi, 2013).

So Ethiopia is a country with about 85% of people is farmers and the economic policy of the country is mainly agriculture based. So agricultural products especially crops should be protected; the wildlife which damage crops should be addressed and concerned bodies/stake holders/should search possible solutions. To accomplish all the above activities the problem should be searched scientifically and opened for the one who concern on it. In Gimbo woreda there was no research conducted on human-wildlife conflict before. So this study was designed to generate basic scientific information about human-wildlife conflict on the bases of crop damage.

1.3. Purpose

The purpose of this study is to provide a better understanding of the causes of human-wildlife conflict and to promote community-based solutions.

1.4. Research Questions

The guiding question of this study was:-

1. What types of conflict does the community encounter by wild animals and to what extent?
2. How do the various wildlife species contribute to human-wildlife conflict?
3. Which species of animals are most frequently involved in human-wildlife conflict?
4. What type of traditional method does the community use to alleviate the problem?

1.5. Objectives

1.5.1. General objective:

To evaluate the current status of human-wildlife conflict in Gimbo woreda, Kafa Zone, South west Ethiopia in some selected kebeles.

1.5.2. Specific objectives

1. To identify causes of human-wildlife conflicts and major crop raiding wild animals.
2. To estimate the population size of the top ranked crop raiding wild animals in the selected sites.
3. To estimate the level of loss of crops caused by crop raiders.
4. To estimate the number of domestic animals predated by wild animals.
5. To assess the traditional methods used to alleviate human-wildlife conflict.

1.6. Significance of the study

This study focuses on estimating crop loss as the major source of human-wildlife conflict with a variety of wild animals come in contact with farming activities and particular problem across much of Africa and Asia, especially for rural, subsistence farmers living and farming at buffer zone. Likewise in Gimbo woreda there is tropical rainforest that facilitate ways for wild animals to damage crops at the buffer zone and elsewhere. In this woreda, majority of the land is covered with forest and farmers who are nearer to the forest are in a great problem. Most of their agricultural products are exposed and damaged by wild animals, due to these farmers seasonally or yearly yields are less when compared with that of secured farmers. Therefore, this study provides information about the species mostly destroyed by specific species of wild animals and crops mostly damaged by it. In addition to this, it expresses the problems that farmers face due to the conflict in regard to agricultural yield loss and damage of other valuable materials. Furthermore it express the seasons associated with sever crop damage the farmers whose crops are most vulnerable to such damage.

This documentary evidence was show how to bring the conservation and socio-economic stability of the farmers who are suffering from the attack of wild animals and it's beneficial for affected farmers by screening out the stage of damage in crops and other associated problems for concerned bodies to mitigating them and assists the country. So it gives ways to local, national and international agencies that may develop appropriate measures to control wild animals and also provides baseline data on human-wildlife conflicts.

2. LITERATURE REVIEW

2.1. Definition and Nature of Human-Wildlife Conflict

Different scholars define human-wildlife conflict (HWC) in different ways. The World Wide Fund for Nature (WWF, 2005) defines HWC as "any interaction between humans and wildlife that results in negative impacts on human social, economic or cultural life, on the conservation of wildlife populations, or on the environment". The International Union for Conservation of Nature (IUCN, 2005) defines HWC as a conflict occurring "when wildlife requirements encroach on those of human populations, with costs both to residents and wild animals". HWC is a term commonly used by conservationists to describe friction between wild animals and people. The conflict emerges when wildlife and human requirements overlap with consequential costs to humans and/or the wild animals (Osei-Owusu and Bakker, 2008). In extreme situations injuries and fatalities are caused to humans and livestock (Tchamba, 1995). The commonest type of HWC seems to be crop raiding by wild animals, especially large mammals and birds outside their refugee. HWC is a complex mix of characteristics, which include instances of raiding, wildlife-livestock disease transmission, livestock depredation, destruction of property by wildlife, killing of wildlife by people who experience or perceive actual or potential wildlife threats to themselves, family members or their property (Madden, 2006). For instance Human-elephant conflict (HEC) is a specific HWC that involves humans and elephants. It occurs where competition for resources and landscapes between humans and elephants results in actual or perceived damage to humans, wildlife or property (Balmford *et al.*, 2001).

Human-wildlife conflict occurs when the needs and behavior of wildlife impact negatively on the goals of humans or when the goals of humans negatively impact the needs of wildlife. These conflicts may result when wildlife damage crops, injure or kill domestic animals, threaten or kill people (IUCN, 2003). HWC occurs worldwide, however it is intense in the tropics and in developing countries where livestock rearing and agriculture are important parts of rural people's livelihoods and income. The relative impact of wildlife damage on farm production and house hold income varies greatly according to the amount of land owned and people's economic dependence on rural activities (Messmer, 2000).

Wildlife damage to agriculture has increased over the last 30 years (Decker, 1991).There are several reasons why crop damage may be on the increase, some of the reasons are the following: In recent decades, there has been a large move towards the intensification of agriculture, and the resulting large monoculture can be very attractive to animals. A set of global trends has contributed to the escalation of HWC world-wide. These can be due to human population growth, land use transformation, habitat loss, degradation and fragmentation. In addition to these 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). In Africa, human population growth has led to encroachment into wildlife habitat constriction leaving species into marginal habitat patches and direct competition with local communities (Siex and Struhsaker, 1999). Crop damage is a widespread and common problem across the sub Saharan region. Crop damage in Africa by potentially life threatening species such as hippopotamus, buffalo, rhino, warthog, and elephant has resulted in unique dilemma (Naughton-Treves, 1998a).

In Kenya, in many areas with abundant wildlife, conflict is intensified by land use fragmentation and the development of small-scale farming (Hill, 2000). In various parts of Africa different species of animals cause crop damages. For instance in the Lilongwe area of Malawi, about 80% crop damage was mainly caused by elephants, bush-pigs, baboons, grivet monkeys, eland and kudu, together with elephants and bush-pigs accounting for the total damage. In Zambia, the main wild animal pests are monkeys, warthogs, baboons, elephants, and hippopotamus (Decker, 1991). Some animals are naturally pre-adapted to take advantage of these opportunities, for instance, cereal crops are a target for birds that are primarily seed eaters, and root vegetables area prime target for species of porcupine and pigs that are specialist tuber diggers. Although there is a general concern over declining wildlife populations, particularly in tropical ecosystems, some species may actually be increasing in numbers. 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.

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 agricultural, and natural resources for industry, leading to increased contact opportunities for wild life and people, resulting in conflict (Naughton-Treves, 1998a).

Nowadays human-wildlife conflict exists in one form or another all over the world as wildlife requirements encroach on those of human populations and involves 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- wildlife conflict is rapidly becoming one 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 increasing demand for land to be cultivated means that in many areas use marginal land leading to farming right up to the boundary of wilderness and protected areas. Pest species are likely to flourish along the edges of natural habitat and agricultural lands, where they can eat both the food available in undisturbed habitats and the crops growing in the adjoining farmland (Sillero-Zubiri and Switzer, 2001). And also pest animal that consumes crops during any stage of the agricultural cycle, from planting to post-harvest storage (Naughton-Treves and Treves, 2005). As wilderness gets converted to agricultural use, protected areas such as national parks, reserves, and hunting blocks, rapidly become "islands" in a sea of farmland. Wildlife populations are thus effectively cut-off from populations in other patches of natural habitat. These fragmented areas differ from the original, undisturbed ranges in two ways. First, the edge size in relation to the fragment size is high, and second, the center of each fragment is closer to an edge. As a consequence, the probability of wildlife-human contact increases resulting in the likelihood of conflicts such as crop raiding, because potential crop raiders have to travel shorter distances to access crops (Hill, 2000).

Children who were supposed to guard their parent's fields against crop raiding animals would not attend school. After completing their studies many of them was not return to their original places instead find employment in other towns and cities (Makomb, 1993). These factors which have been facilitating crop damage are most important in the developing world at the present time.

A study around the Budongo Forest Reserve in Uganda found that the cost of crop raiding and guarding varied from 96-519 dollars per household per year (Hill, 1997). This is a huge amount if we consider the average local salaries in this area, 25-30 dollars per month. With the mitigation of crop raiding losses, compensation is rarely available, and where it is present, it often implies a lengthy procedure with the claim going through several layers of bureaucracy.

2.2. Causes of human- wildlife conflict

2.2.1. Rise in Human Population and Wild animals

More peoples means more cultivated land and, hence a greater interface between people and wildlife. Due to this 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). 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). In Africa, human population growth has led to encroachment into wildlife habitats, constriction of species into marginal habitat patches and direct competition with local communities (Siex *et al*., 1999).

According to Musyoki (2007), almost all human societies lived by hunting and gathering around ten thousand years ago. Co-existence between humans and animals was never strained as natural resources were abundant in terms of quality and quantity. When people started cultivating land for agricultural purposes and tamed animals, reliable food resource base was gained throughout the year but this faced new threats of crop damage by wild animals. Humans have suffered losses in crops and livestock ever since there has been agriculture (Naughton-Treves, 1998a). In Africa a large percentage of the population depend on nature for their source of livelihoods.

2.2.2. Deforestation

Clearing of the forest areas for food and crop production destroys the natural habitats of wildlife are the main cause of human-wildlife conflict worldwide is the competition between growing human populations and wildlife for the same declining living spaces and resource (Madden, 2008; Kumara *et al*., 2012). The transformation of forest, savannah and other ecosystems in to 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). Wildlife attack humans during such clearings as humans encroach into their territories. The encroachment of people into the forests of the Democratic Republic of Congo (DRC) has led to the cutting down of hardwood trees to make charcoal and cause conflict with mountain gorillas that live in the forest (Anderson. C, 2008).

In addition to this the human population surrounding the Kakum Conservation Area in Ghana has increased dramatically during the past 30 years in the 1970s farmers migrated in large numbers from other regions of the country to take advantage of the ideal cocoa-growing conditions at the

edge of the forest this contributed the gradual loss of habitat and led to increasing conflicts between humans and wildlife.

2.2.3. Habitat factors resulting to human-wildlife conflict

A set of global trends relating to human populations, habitat evolution and animal distribution and behavior has contributed to the escalation of human-wildlife conflict worldwide. HWC arises mainly due to the loss of forest and degradation is mostly caused by the expansion of agricultural land, the intensive harvesting of timber for fuel and other forest products, as well as over-grazing and fragmentation of habitats by human activities such as, logging, animal husbandry, and development of infrastructure can dramatically modify wildlife habitats either directly or indirectly (Fernando *et al.,* 2005, Kate, 2012).

As habitat gets fragmented, the length of 'edge' for the interface between humans and wildlife increases, while the animal populations become compressed in insular refuges. Consequently, it leads to greater contact and conflict with humans as wild animals seek to fulfill their nutritional, ecological and behavioral needs (Sukumar, 1990). Conflict has characterized the relationship between humans and wildlife throughout history **(**Heydon *et al.,* 2010).

However, the transformation of global landscapes from predominantly wild to predominantly anthropogenic over the last three centuries (Ellis *et al.,* 2010) has seen competition between humans and wildlife for space and resources reach unprecedented levels (Siex and Struhsaker, 1999, Woodroffe *et al.,* 2005, Hoffman, 2011). The nature of conflict shows an increasing tendency between humans and wildlife over the use of natural resources mainly land, forests and water. Conflicts are manifested when people are killed or injured by wild animals, loss of livestock

through predation, competition for pasture, wildlife invasion of crops in farms and inadequate or lack of compensation for losses (Musimbi, 2013).

2.3. Factors affecting levels crop raiding by wild animals

2.3.1. Distance from the farm and the forest boundaries

Distance of field boundaries from the forest and other habitats is an important factor in determining the likelihood of incursion by wild animals (Hill, 1997, 2000, Hoare, 1999, Rugunda, 2004; Sitati *et al*., 2005). Conflict between wildlife and people, particularly those who share the immediate boundaries with protected areas in to adjacent crop fields, are common phenomenon all over the world (Musimbi, 2013, Eniang *et al*., 2011).

However, close proximity between farms and the forest ecosystem resulting in high level of conflict and the forest edge were most frequently raided by wild boar, pig-tailed macaque and porcupine individually and all species combined (Hill, 2000).

2.3.2. Crop species grown

Many crops are damaged by crop raiders at specific stages of development, for example at germination, seedling, flowering, harvesting and fruiting stage due to this the extent and intensity of damage also vary depending on the cropping pattern and crop available (Sillero-Zibiri, 2001).

There are a number of factors, including the stage at which a crop raided and the diversity of species that feed on it. Hill (1997) reported that maize is attacked at all stages in its development from the newly sown seed to the time when the cobs are mature. While, raiding sustained at any stage can cause severe crop losses.

The most serious time is when a mature crop sustains substantial losses which are potentially the case with maize. Certain crops such as maize, bananas and passion fruits are favored foods of primate's crop raiders while other such as cassava and sweet potatoes are mainly raided by such bush pig and rodents (Sitati *et al*., 2005). Crops that are less susceptible to raiding include ground nuts, bean and coffee. Crop-damage depends also on the species that are involved in this activity. Indeed, different species may specialize on different types of crop and different plant parts or development stages (Osborn and Hill, 2005).

2.3.3. Season

Seasonal variation of crop raiding incidence is mostly attributed to forage availability. In Kenya seasonal changes in rainfall are directly correlated with predation intensity. According to Patterson *et al*, (2004) in Zimbabwe, in proximity to the Sengwa Wildlife Research Area, the correlation between seasonal changes and intensity of livestock depredation is also found to be strong.

2.3.4. Competition for resources between people and wildlife

The continuous decline and fragmenting of ecosystem through increased pressure by human expansion often results in conservation ecosystems that are small, isolated and fenced (Bissonette and Adair, 2008). This restricts wildlife populations and can result in local over population of a particular species, amongst other problems (Van Aarde and Jackson, 2007). The continuous loss of habitat emphasizes the importance of ecosystem conservation and the understanding of how wild life uses ecosystem (Dougles-Hamilton *et al*., 2005). Many studies have shown that animals adapt their ranging and foraging behavior, or their daily movement rhythms, to avoid human-induced disturbance and unexplored or unknown areas (Burke *et al*., 2008).

Once a conservation area is expanded, the response of wildlife can give wildlife managers and conservation planners' good insight into these animals welfare and their perception of both the existing and new area. Crop raiding is on the increase and people are competing with wildlife resources. The development of small scale farming in areas that have historically been known to be prime wildlife habitats, or migration corridors, in Kenya for instance, the remarkable transition from semi nomadism to semi agricultural and settlement. Most natural wildlife buffer zones have led to competition for food, water, habitats, and space for both humans and wildlife hence resulting in a conflict for survival (Kagiri, 2000).

2.4. Effects of human wildlife conflict

Crop losses to wildlife may have various impacts on farming households. They include high guarding investment, disruption of schooling for children who have to help guard fields, increased risk of injury from wildlife and increased risk of contracting diseases and loss of life, threats to economic security, reduced food security and livelihood opportunities (Hill, 2004).

2.5. Attitude towards primates

Different counties have varied perception on primates and other wild animals. One fundamental influence on perceptions of primates is the general cultural attitude of people towards primates. Levels of tolerance, acceptance and even demand for interactions vary with cultural context (Gautier and Biquand, 1994; Burton, 2002). Cultural perceptions of primates vary enormously and have shifted over time. Historically, primates were revered as guardians of human settlements, as spirits of ancestors, or as an embodiment of sexuality, wisdom, and fortune in areas as widespread as Cameroon to Tibet (Cormier, 2002).

Monkeys and apes are kept as pets, sharing household areas and food, acting societies, monkeys may even be incorporated in to the kinship or cosmological belief as surrogate infants or dolls for young girls, or exploited for their entertainment value (Knight, 1999). The crop losses due to primates were considered acceptable or normal within general crop yields, perceptions of the significance of the "monkey" problem might rank relatively low in the general context of pests. A cash economy also promotes a need for crop surpluses that can be sold, exacerbating the "cost" of reduced yields.

It can be suggested that a Euro-centric attitude to wildlife, which veers from extreme forms of animal control to passionate advocacy of animal rights, is often at odds with indigenous attitudes. In particular, the pest-control mentality associated with agri-business and a market economy has been exported along with the plantations. This, at least potentially, promotes contexts for negative perceptions and increases the potential for conflict (Fuentes, 2002).

2.5.1. Primates as a pest

Crop damage is the most prevalent form of human-wildlife conflict across the African continent particularly in rural areas. Crop damage is an increasing source of economic loss and local frustration in subsistence agriculture settings and also promotes negative attitudes towards species of conservation value. Crop losses to primates can be as much as 70% of an individual farm and average losses of certain crops at other sites have been measured at 19–25% of the annual crop. Because of the intelligence, opportunism, adaptability and manipulative abilities many primate species easily turn to crop foraging and make formidable crop raiders (Lee and Priston, 2005).

A variety of vertebrates animals come in conflict with farming activities in Africa. These include birds, rodents, primates, antelopes, buffalos, hippopotamuses, bush pigs and elephants (Parker *et al*, 2007). Elephants in particular are identified to be the greatest threat to African farmers. The elephants have cause severe and extensive damage to crops in Zimbabwe, Ghana, Benin Republic, Mozambique, Malawi etc. and the elephants are considered a threat to food security. Crops raided during the planting season include maize, millet and sorghum and do break into storage bins and steal grains (Parker *et al*, 2007).

3. Materials and Methods

3.1. Description of the study area

3.1.1. Location

The present study is carried out in Gimbo woreda which is located between 7°-23′ and 7°-47′North, and 36°-00′ and 36°-47′ East in the northern central part of the Kafa Zone, in Ethiopia. The woreda is divided in to three municipalities (Ufa, WushWush and Gojeb) and 32 kebeles. Ufa, the administrative center of Gimbo woreda is found 18 km Bonga, the centere of the zone, Ufa is 460 km far from706 km from Hawassa, and 706 km far from Addis Ababa. Gimbo has a total area of 832.5 km^2 which is 7.85% of the total land mass of the regional state. The woreda is bordered by Oromia region in the North, Decha woreda in the South, Chena and Gewata woreda in the West and Menjwo woreda in the East. The altitude of the area ranges between 1001 to 2000 masl (Ayele Kebede, 2011). According to the 2007 census, the woreda has a population of 90,816 people and a total area of 832.5 km^2. Out of the total population is Gimbo woreda 81,211 (89.42%) are estimated to be rural in habitants, while 9,605 (10.42%) are urban (Ayele Kebede, 2011). In Gimbo woreda there is no industry as such which would create ample off farm job opportunity for the people living in the area. Hence the major occupation in the woreda is agriculture, though people are also engaged in homestead husbandry.

The main agricultural crops cultivated in the woreda are maize (*Zea mays*), sorghum, and teff (*Eragrostis*) and haricot bean. Cattle, sheep, goats, poultry, donkeys, horses and mules are the major livestock kept by the farmers. Non-timber forest products (NTFPs) such as honey, false cardamom (*Afromomum corrorima*) and wild pepper (*Piper capense*) are important means of income.

Furthermore, the forests are a source of fuel wood, charcoal and timber (Ensermu Kelbessa. and Teshome Soromessa, 2004). The major land cover of Gimbo woreda is forest and agriculture associated with human settlement. The forests found in the study area are among the remnant forests in Ethiopia where, different kinds of mammals and birds dwell. Hence, the Nature and Biodiversity Conservation Union (NABU) project is working on forest conservation: Participatory Forest Management (PMF), reforestation, agro-forestry and enrichment planting are under implementation in order to increase carbon capture and storage capacity of forest and to secure the conservation of the valuable forests. Planting of fast growing community plantations for multi-purpose uses has been started and involved local communities to ensure their livelihood and fire wood supplies, reforestation and motivating the community to conserve the forest and avoid deforestation (Sisay,2007).

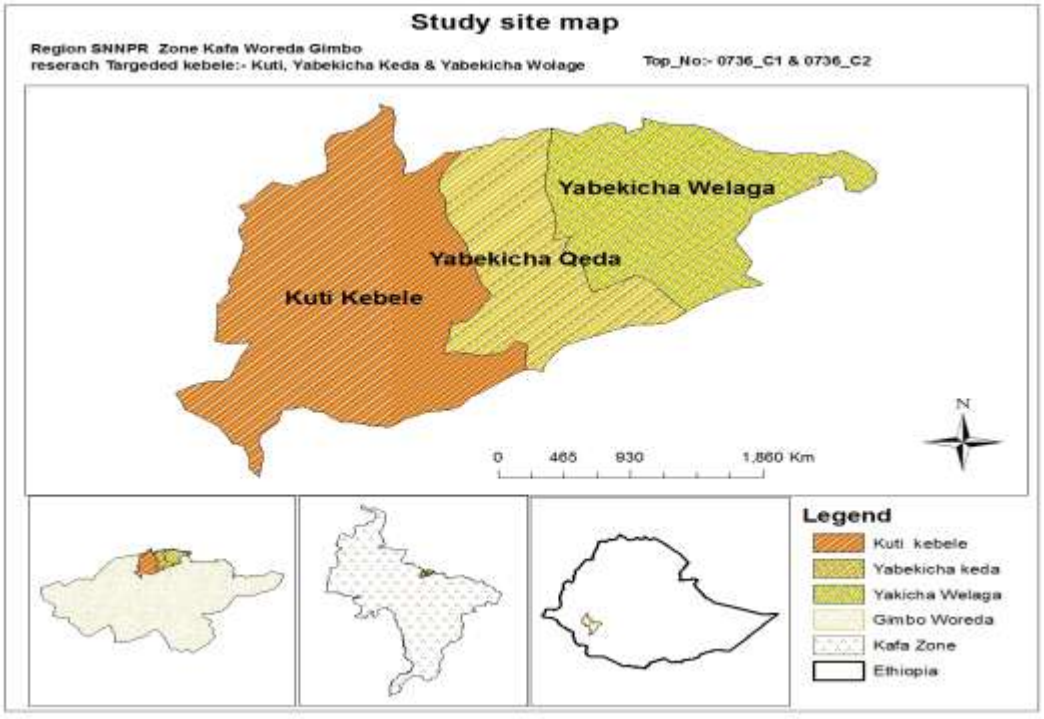

Figure 1. Map of the study area in Gimbo woreda and its relative location in Ethiopia.

3.1.2. Climate

3.1.2.1. Temperature

The mean annual temperature ranging between 15.1^0C and 22.5^0C.The warmest months are February, March and April while temperature drops during the peak rainy months due to the effect of cloud cover (Ayele Kebede, 2011).

3.1.2.2. Rainfall

Gimbo woreda is one of the parts of the southwest Ethiopia highlands which receive the highest amount of rainfall in Ethiopia. This is attributable to the presence of evergreen forest cover on top of the windward location to the moist monsoon wind. The annual rainfall of the woreda is between 1401-2000 mm. The largest amount of rain occurs between May and September. The peak rainy months are June, July and August while December, February, March and April are relatively the drier months (Ayele Kebede, 2011).

3.2. Methods

3.2.1. Sampling Design

Gimbo woreda was purposively selected for this study as the area entertains one of the well-known human-wildlife conflict in the area. Among 32 kebeles found in Gimbo woreda, three kebeles, namely Kuxi, Yabekicha Qeda and Yabekicha Welega were selected through stratified random sampling for this study.

Each village found in the selected kebeles was categorized into three groups based on their proximity to forest edge as near, medium and far. Following this, two villages from each group were selected. The study covers a total of six villages from the three kebeles.

Based on distance of farmland, from forest edged households were selected from each village for formal interview. In the case of interview, three indigenous persons from each kebele who were born and have lived there for a minimum of twenty years or from the time of birth and have been conversant with events happening in the villages were interviewed about the general features of crop damage in the past and now. The interview was conducted with each of the assigned persons one by one. 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 three kebeles and finally the selection sample household was proportional to each stratification which based on farmland distance from forests to keep uniformity. Accordingly, the total numbers of household head living in the selected kebeles were 994 from kebeles administration. After getting the total number of household heads living in each kebeles, the fourth step was determining the 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).

$$n_o = \frac{Z^2 * (P)(q)}{d2} \quad \rightarrow \quad n_1 = \frac{no}{(1+\frac{no}{N})}$$

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 than 10000

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 the above calculation 121 respondents was sampled. After the sample size determined simple random sampling techniques were used to select the respondents from the total population of 994 (409 from Yabekicha Qeda, 314 Yabekicha Welega and 271 from Kuxi). Allocations of the number of sample households to each kebeles was proportional to the number of household head living in each of the selected kebeles, accordingly 38 HH from Kuxi, 40 HH from Yabekicha Welega and 43 HH from Yabekicha Qeda were selected for this study.

The respondents who can read and write answered the questionnaire by themselves and those who cannot read and write was assisted by trained field workers. The questionnaire was translated to the native language of the society (kafinoono) for easily understanding and responding. Before distributing the questionnaire survey the aim of the study was explained.

3.2.2. Data Collection Methods

3.2.2.1. Preliminary survey

A preliminary survey was conducted for ten days before the actual data collection. During this period field observation was made and basic information about the study sites was obtained, and the physical environment of the study area was assessed. This information helped to determine the study sites which were more associated with wild animals and where the severity of crop damage is very high. In this period all the necessary information of the study area was gathered properly. The kind of human wildlife conflicts and the types of wild animals were assessed.

The stages of crop damage were examined. Following the procedure of Mesele Yihune *et al* (2008), information was gathered on the cause of HWC and the prevalence of crop damage and livestock depredation since locals are aware of the problem. In addition to this, information about the living condition of the society was gather from concerned bodies such as local people living around the study area, from agricultural and rural development office. Finally, to incorporate the obtained information to questioner, pilot survey was carried out.

3.2.2.2. Pilot survey

A pilot survey was conducted in the selected kebeles from September 2015 end to October 2015 based on the information gathered during the preliminary survey. During the pilot survey 25 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 result from the pilot survey, the questionnaire was revised and developed as used by Mesele Yihune *et al*. (2008) and Fairet *et al*. (2012).

To achieve the objectives of the study four complementary data collection methods namely house hold survey (individual interviews), direct observations, focus group discussion, key informant interviews 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

Semi-structured questionnaires was employed with closed and open-ended question for gathering information from respondents regarding demographic data (such as age, sex, religion, marital status, family size and educational status), crop loss by crop raiders, other problems caused by crop raiders other than crop damage, traditional methods by the local people to alleviate crop raiders from their crops, the relative importance of wild animal species in relation to crop damage.

Key informant interview

Oral interview is used to strengthen the information collected using questionnaire and to have a detailed in sight about HWC in the area, in-depth interviews and discussion covering about causes, consequences, type, density and history of top ranked damage causing wild animals, farming system and cropping season of the study area were held and the interviews were conducted within the respondent's territory and interviewing atmosphere by translating questionnaire to their local language.

Figure 2. Data collection through interview

Focus group discussion

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, traditional method to prevent crop damage from crop raider and population trends of top ranked damage causing wild animals and cause of human-wildlife conflict. Discussions were made with randomly selected 6-10 respondents in each kebeles.

Direct observation on crop damage by wildlife

Direct observation was another method used to collect primary data and carry out through systematic observation. Due to this the purpose of direct observation on crop damage by wild animal's six study sites namely Mender-4, Wegashunit, Merabet, Goshuka, Telwot and Edget were selected randomly and an area of 30,000 m^2 covering cultivated land were selected randomly. In turn, which divided in to each study sites of which has 5,000 m^2.

On the selected farm lands, four crops namely maize, sorghum, haricot bean and teff were sawn in the production season of 2015/2016. For each cultivated land, the type of crop grown, condition of the crop before damage, area of the damaged portion, part of the crop eaten and type of crop species eaten were recorded (Naught on-Treves, 1997).

To assess the degree of crop damage, three quadrats of 4 m by 4 m, from each affected crop stand were laid. Quadrats were placed randomly within the crop stand of four farmers in each village and observed two times a week to check if there were crop damage. The proportion of damaged crops was derived from calculating the number of damaged or missing plants or plant parts, divided by the total crop population planted in the garden.

The mean of the three quadrat values for each damaged stand is a measure of the proportion of crop damage sustained in any sample (Rugunda, 2004). 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.

Thirteen data collectors participated to assist in data collection during the time of direct observation and thus a total of ten day (12 hours each) direct observation was conducted in each study site during each trip. Observation was conducted starting from the time of seedling (February, 2016 up to the time of maturation June, 2016). During the time of germination (seedling) four days of observation for eight hours was carried out. But during flowering time and maturation more emphases was made. In each of these two stages six days of observation for eight hours were accomplished.

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

3.3. Population estimation of crop raiding wild animals

To determine population of Anubis baboon and vervet monkey, preliminary survey was done at well-known habitats of Anubis Baboons' and vervet monkey and their place of rest overnight was undertaken and identified.

Once their day time and overnight habitat were identified, (three day each in dry and wet season) counts were made 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- experienced farmers in the area. The study sites were also categorized into two habitat types namely the dense forest and sparse forest. Counting was carried out using unaided eyes while on foot, twice during the dry season and twice during the wet season. All information about the animals was listed in the data sheet. Accordingly, when the animal was encountered, all information about the animal (the species name, number of individuals, age, sex and location of the place) were recorded. Their population was categorized into three age groups, namely adult male, adult female and juvenile. Body size was used in age and sex determination.

Male Anubis baboon with visible manes and overall body size about twice that of females were considered as adult males. Males similar in size with adult females with the beginning of the manes were considered as sub-adult males. Sub-adult and adult females were identified by their body size. Vervet monkeys were differentiated by their body size (Mussa Adem, 2009). All other individuals are considered as juvenile based on their body size hence they are small in size than the others. Photograph of the primates was taken by using digital camera (resolution) and census were conducted when the primates were most active and with good visibility in the morning (8:00-11:00 a.m.) and the afternoon (2:00-5:00 p.m.). Each total count was completed within 2-3 hours in a day with the help of three well-trained and responsible field workers.

3.4. Data analysis Techniques

Data was analyzed using SPSS version 20 software. Accordingly, descriptive statistics in a form of percentage and frequency were used to analyze socioeconomic profile of the respondents, type of crop cultivated, traditional methods used by the respondents and damage causing animals in terms of ranking. One-way ANOVA was used to analyze amount of crops lost, and crop cultivated in the study area. Chi-square test was used to analyze association of HWC, number of Anubis baboon and Vervet monkey between wet and dry season and damage events registered between site and crop raiders and cause of HWC. Qualitative techniques on the other hand were employed in the computation of statistical table, bar graphs charts as well as map.

4. RESULTS AND DISCUSSIONS

4.1 Results of the Questionnaire Survey

4.1.1. Background of the respondent

Data was collected from a total of 121 respondents, 38 (31.4%) from Kuxi, 43 (35.53%) from Yabekicha Qeda and 40 (33%) from Yabekicha Welega kebeles. Of the respondents 108 (89%) were males and 13 (11%) were females. Most of the respondents were in age range of 44 (31-40) followed by age group 37 (41-50), 15 (51-60), 13 (20-30), 12 (61 and above) respectively. Farmers participated in the study were adults, thus having an experience in practicing agriculture and all its underlying challenges, crop raiding inclusive. Majority of the respondents 96 (79.34%) were born and lived in the study area for more than 20 years, 19 (15.7%), and lived in range of 16-20 years, whereas the rest 6 (4.96%) lived for less than 5 years, 11-15 years and 5-10 years, respectively.

4.1.2. Economic activity and Social interaction of the respondents

Farmers in the study area cultivate different types of crops, such as maize, sorghum, teff, haricot bean, enset, coffee and others, and these are the most important crops cultivated by many farmers in terms of coverage on farmland in the cropping year of 2015/2016. The study sought to identify 96 (79.3%) of the respondents to have their own farmland with different sizes ranging from 0.5 to above 5 hectare, and the remaining 25 (20.7%) did not have their own farmland. The frequency of respondents who owned 0.5-1 hectare was 18, for 1.1-2.99 hectare it was 23, for 3.0-4.99 hectare it was 45, and for > 5 hectare it was 10.

According to the χ^2 test of association applied between size of farmland owned against the respondents' year of living in the area, co-operation of farmers with neighboring farmers, and type of crops cultivated, gives a χ^2 value of 72.092, (P-value < 0.0001), χ^2 = 42.556, (P-Value <0.0001) and χ^2= 20.893, (P-value = 0.011), respectively. Hence, there is statistically significant association between the size of farmland and the three variables.

4.2. Factors that aggravate damaged by wild animals

4.2.1. Lack of cooperation of farmers in adjacent fields

The study sought to establish the main causes of human-wildlife conflict in the area. Of the total respondents interviewed, about 81% had no cooperation during their farming activities, while 19 % responded that they had cooperation with their neighbors. From the findings, respondents indicated that the local communities have no cooperation (team work) during their farming activity but the majority of the respondents indicated that farming was the main economic activity. In the data, 55.4% respondents reported that due to the absence of cooperation, the majority of their crops were destroyed by pest primates and other wildlife, whereas 10.74% reported that they lack support and their crops were damaged, 6.6% reported they faced problems of support, damage of crops and shortage of information and 4% reported that they had faced problems including crop damage and lack of update information and the rest 23% of the respondents did not give response.

Based on the respondents the absence of collaboration (team work) was one of the reasons for increased conflict between human and crop raiders in the study area.

It was seen that farmers cultivate crops in separated (unconnected) land in opposite directions one from the other and such type of disparity affected each of the farmers and the society at large by opening several opportunities for pest primates, and other pests damage the crop in all directions. Due to this reason most of the farmers were minimizing cultivating crops and shift to cattle rearing and other activities.

The result agrees with finding of Lamarque (2009) who reported that small-scale farmers in Africa face problems such as receiving poor extension services, poor access to information, lack of training and knowledge and wild life menace. But the present study is contradictory with Kate (2012) who stated that people in Uganda work cooperatively, helping to chase away wild animals from their gardens as well as from their neighbor's fields and also there is a significant positive correlation between monthly investment in guarding and monthly frequencies of crop raiding events by all diurnal species.

4.2.2. Competition for resource between people

The study sought to find out the knowledge and practice of respondents on HWC. From the participants, 43.8% responded that they used forest for farmland, grazing field, fire wood and fodder wood, 32% responded as they used it for fire wood, grazing field and fodder wood, but 7.4% of them farm land, fire wood and fodder wood. Likewise, 6.6% responded as they used the forest for fire wood and fodder wood and 5.8% used for farm land and fire wood, 4% of them implied that they used it for fire wood and grazing field.

Resource competition was one of the causes for the conflict. The farmers in the study area use the forest for different purposes by distracting the habitat of wild animals.

This practice forces the wild animals to engage in crop damage and distraction of other valuable materials. Similar studies conducted in and around the Simien Mountains National Park and in Indato forest, Eastern Arsi reveal that destroying forest for the purpose of fire wood, grazing and other benefits engages primates to raid crop (Mesele, 2006).

4.3 Crop Raiding Wild Animals and Causes of HWC

Of the total respondents interviewed, about 41.3% implied that primates had conflict with humans, 48% responded primates and other pest, and 10.7% of them responded other pests only had conflict. We found that, 41.32% of participants responded that the cause of the conflict was both predation of domestic animals and crop damage and , 23.14% of them responded that the cause were crop damage only, 15.7% of them responded that they face problem of wild animals causes distraction of traditional beehives, 11.6% of them reported that distraction of huts and disturbing of human and only 8.26% of the respondents from Mender-4 and Goshuka they did not face any conflict caused by wild animals respectively (Table 1).

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

Cause of conflict	Frequency of respondents by village					
	Mender-4	Wegashunit	Merabet	Goshuka	Telwot	Edget
Crop damage only	6	0	10	12	0	0
Both crop damage and Livestock depredation	7	11	8	2	12	10
Destruction of traditional beehives	3	5	4	0	5	2
Destruction of huts and Disturbing humans	0	2	1	0	4	7
No conflict at all	4	0	0	6	0	0
Total	20	18	23	20	21	19

The respondents at each site indicated strong conflict between wild animals and the local farmers in the study area. The test of association by chi-square tests for independence, resulted in χ^2 = 83.122, (df= 4, P<0.05(0.0001)) therefore, the response of respondents from each site were statistically significant on different types of conflict such as crop damage, both crop damage and livestock predation, destruction of traditional beehives, and destruction of hut between those study sites. A study conducted in Jalukbari Kamrup Assum (India) reported that monkeys not only attack humans, but also they destroy and damage valuable human properties (Sunanda and Saikia, 2008). During the study period all of the interviewed persons discussed about the presence of crop damaging animals in their locality and expressed that Anubis baboon, vervet monkey, bush pig, warthog, porcupine and rodent are the major crop raiding wild animals and cause crop raiding in different degrees in the study area.

Among the respondents about the relative importance of crop raider wild animals and all of them implied Anubis baboon was a primate which destroys large mass of crop within a single visit and they ranked it in the first place. They ranked bush pig in the second stage in the study area mostly at night time. Vervet monkey was the third important crop raider followed by porcupine, rodent and warthog (Table 2).

Table 2. Problem causing animals in terms of ranking

Wild animals	Scientific name	Local name	Frequency	Rank
Anubis baboon	*Papio anubis*	Sheexo	96	1
Bush pig	*Potamochoerus larvatus*	Gudino	84	2
Vervet monkey	*Cercopithecus aethiops*	Shakke	63	3
Porcupine	*Hystrix crstata*	Caayi	47	4
Rodent	Unidentified	Eecee	39	5
Warthog	*Phacochoerus atricanus*	Tichoo	17	6

The result agrees with finding of Demeke Datiko and Afework Bekele (2013) who reported that Baboons are the most destructive crop raiding animals in Chebera Churchura National Park, Ethiopia, and Kate (2012) who reported that baboons were ranked number one crop raiders in Uganda. Tweheyo (2011) also reported that baboons and Bush pig were ranked as first and second crop raider in Uganda, respectively.

The interviewed households reported that causes of human wild animal conflict were the rapid increase of human population from time to time and some of the land less youngster clears the forest illegally for settlement and crop production, whereas some of them destroy forest for lumber production, inappropriate site selection for investment in forest area.

In addition to this fire wood collectors destroy huge trees and transport to town for sale. On the other side: they expressed that cattle rearing is one of the common agricultural activity in all the study sites and farmers use forest as a source of food for their cattle and the contribution of all causes (Table 3).

The highest cause for human-wildlife conflict in Edget, Merabet and Mender-4 were deforestation while in Wegashunit and Telwot the main cause of conflict were distance from village to farm. In Goshuka increase human population growth was the main cause of human-wildlife conflict. Of the mentioned causes, settlement was listed as less cause of conflict on villages of Wegashunit, Edget and Telwot.

Table 3. Causes for wild animals' conflict among sampled villages

Cause	Frequency of respondents by village						
	Mender-4	Wegashunit	Merabet	Goshuka	Telwot	Edget	Mean
Deforestation	5	4	7	3	4	7	5
Agricultural expansion	4	3	3	3	4	4	3.5
Settlement	4	2	4	4	3	2	3.17
Human population growth	5	2	4	8	3	2	4
Distance from village to farm	2	7	5	2	7	4	4.5

This result was in agreement with Jones (2012) reported that habitat destruction and fragmentation was the main causes of human-wildlife conflict in Indonesia. Priston *et al*. (2012) reported anthropogenic habitat alteration cause crop raiding in southeast Sulawesi, Indonesia by primates**.**

4.4. Population Estimation of prevailing wild animals

In the present study, four species of primates, porcupine, bush pig, warthog and rodents were identified in an effort of four days survey in each of all the six study sites during both dry and wet season. The four primate species identified were Anubis baboon, vervet monkey, colobus monkey and blue monkey. Among these primate species, Anubis baboon and vervet monkey were the known pests and the rest two were not considered as problematic pests in the study area.

But due to the complexity of the forest, the behavior of nocturnal wild animals, and 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. Total count was carried out for the two pest primates species (Anubis baboon and vervet monkey).

Table 4. Number of Anubis baboon counted in the sampled forest during dry and wet season

Age structure	Season	Wegashunit	Edget	Telwot	Total
Adult males	Dry	16	20	12	48
	Wet	11	18	10	39
Adult females	Dry	60	64	51	175
	Wet	57	62	42	161
Juveniles	Dry	38	40	31	109
	Wet	34	37	22	93
Total	Dry	114	124	94	332
	Wet	102	117	74	293

4.4.1. Population census of Anubis baboon

A total of 332 and 293 Anubis baboons were counted in the three study sites during the dry and wet season, respectively (Table 4). There was no significant difference between dry and wet season count (χ^2 = .367, p = 0.996 > 0.05) among the sex groups of Anubis baboon (Table 4).

By applying chi-square test of association, it was found that, no significant association in number of Anubis baboon between sites in dry and wet season (χ^2 = .115, p = .944> 0.05). During dry season count (February-April, 2016), Edget site had large population 124(37.35%) followed by Wegashunit 114(34.34%) and Telwot 94(28.31%) respectively.

In wet season count there were 39(13.31%) adult males, 161(54.95%) adult females and 93(31.74%) juveniles. Like that of dry season, in wet season, greater number of Anubis baboon (117) was counted in Edget site (Figure 4).

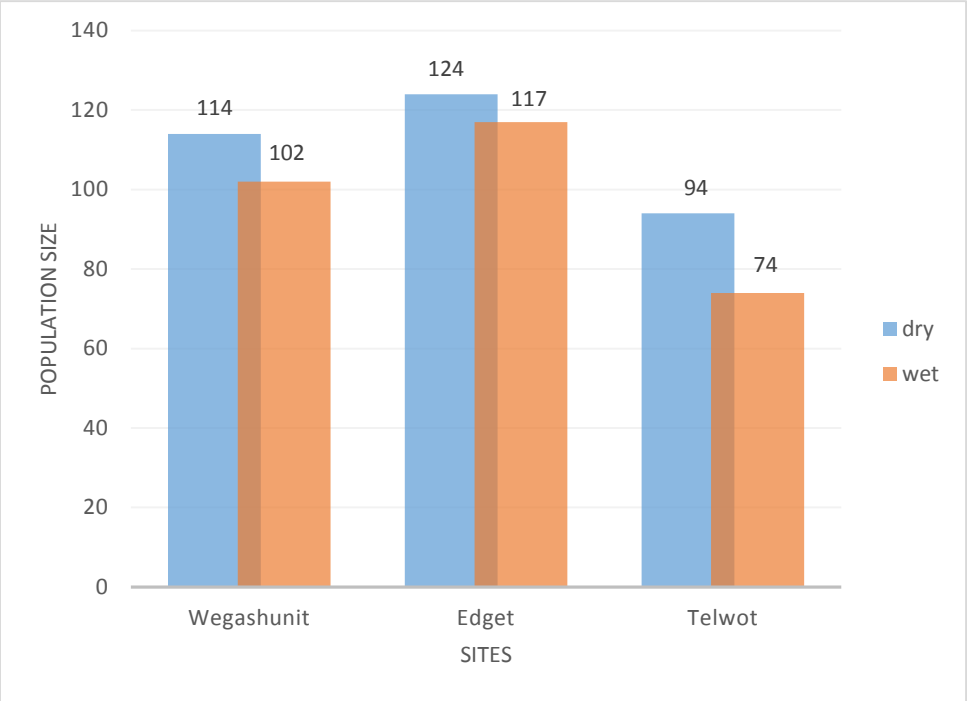

Figure 3. Population of Anubis baboon in dry and wet season in the study area.

4.4.2. Population census of vervet monkey

The counted vervet monkeys were categorized in dry and wet seasons in each site and there was variation of population in dry and wet seasons. In all sites the number of vervet monkeys was increased in the wet season (Table 5).

Table 5. Number of vervet monkey estimated in the sampled forest during dry and wet season

Age structure	Season	Wegashunit	Edget	Telwot	Total
Adult male	Dry	18	20	16	54
	Wet	20	24	18	62
Adult female	Dry	65	71	50	186
	Wet	70	77	60	207
Juveniles	Dry	30	36	26	92
	Wet	33	38	32	103
Total	Dry	113	127	92	332
	Wet	123	139	110	372

A total of 332 and 372 vervet monkeys were counted in all the study sites during the dry and wet season respectively. According to the conducted count in dry season there were 113 in Wegashunit, 127 in Edget and 92 in Telwot site respectively (Table 5). There was no significant difference on the population of vervet monkeys counted in the two seasons by sex groups (χ^2 = .032, p-value> 0.05). But, there was a significant difference in vervet monkey among different site groups in dry and wet season (χ^2 = 7.841, p-value < 0.05).

The abundance of the two pest primates (Anubis baboon and vervet monkey) varied between seasons and the study sites. The presence of large number of the pest primates (Anubis baboon and vervet monkey) in the farmlands during the wet season can be attributed to suitable condition in the wet season than dry season.

Farmlands around the forest are attractive and provide plenty of food sources for these primates, but during the dry season food becomes scarce in the farms and thus some of Anubis baboon and vervet monkeys might have temporarily migrated to the forest or other places where they can get food. The result of this study is in agreement with the study conducted by Mesele Yihune (2007) in Wonji-Shoa, Central Ethiopia that indicated the number of grivet monkey population in farmlands increased in wet season compared to the dry season.

As indicated in the current finding, the sex ratio in the two pest primate species is not 1:1 ratio. This variation in sex ratio provided suitable conditions for the male individuals to find mates during the time of reproduction and pass their genes to the next generation. The result of the present study is similar to the result obtained with the study conducted in Wonji-Shoa Central Ethiopia among grivet monkey population that the female to male ratio was not match (Mussa Adem, 2009).

4.5. Magnitude of crop loss

The respondents indicated that different kinds of crops including maize, teff, sorghum, haricot enset and different kinds of vegetables, coffee and other species are grown in their farm land but due to the cause of various human activities crops mainly affected by crop raiders. In the study area showed that not all crops were equally affected by crop raider.

From the findings, 121 (100%) indicated that maize was the most preferred crop and thus the most damaged while sorghum was the second most affected crop but other crops that experienced damage by wild animals were haricot bean, teff, and enset, was the least crop damage caused by wild animals. Generally, the respondents responded that wild animals were influencing them damaging their agricultural production in different amount in the study area. Therefore, this condition intensified negative interaction between human and wild life in and around the farm land (Table 6).

Table 6. Ranks of crops in the order of destruction by crop raider (N=121)

Crop	Frequency	Percentage (%)	Rank
Maize	121	100	1
Sorghum	95	78.5	2
Haricot bean	93	77	3
Teff	85	70	4
Enset	65	54	5
Pea	58	48	6

The present study showed that maize (*Zea mays*) was the type of crop mainly damaged by pest primates. The reason might be maize is not difficult to handle, effortlessness to raid and sweet to feed. Furthermore these pests raid it through all of its growth stages, starting from seedling up to the matured cobs. But in case of other crops like sorghum, haricot bean, teff etc almost damage occurs at the stage of maturation.

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 and similarly study conducted in Uganda also reported that baboons appear to concentrate their crop-raiding activities on maize throughout the year when the crop is present in the fields (Hill, 2000).

4.6. Crop raiding by wild animals based on the distance from the forest

The result of this study suggest that the distance of a farm land from the forest area is an important factor in determine the extent of crop raiding by wild animals. So our result show that with respect to farm location, 110(91%) of the respondents responded that damage is more sever around the buffer zone, 3(2.5%) responded at center and 8(6.6%) responded it was equal both at buffer zone and in the central village. Distance from the forest and trend in crop damage by presented in (Table

7). The respondents noted that, in all study villages crop damage has been increased during the last three years. 87.6 % of the respondents responded as the trend increasing.

Only, 7.438% of the respondents noted as the trend is decreasing and finally 6.613 % of the respondents reported that the trend of crop raiding was unknown. So people who live close/near the forest generally faced many problems than those living far above 2 km of the forest.

According to the chi-square test of association applied on the association between trend of crop damage by wild animals and village of the respondents near to the forests, since the P-value was found to be less than the level of significance (P-value = 0.0001< α = 0.05), there is statistically significant association between them (Table 7).

Table 7. Approximate distance of farmland from the forest, trend of crop damage by crop raider based on respondents reply.

Village	N (121)	Distance from forest	Increased	Decreased	Unknown
Mender-4	20	0.5-1 km	20	0	0
Wegashunit	18	0.25-0.5 km	18	0	0
Merabet	23	1-1.5 km	15	0	8
Goshuka	20	1.5-2 km	11	9	0
Telwot	21	0.5-1 km	21	0	0
Edget	19	0.25-0.5 km	19	0	0
Total	121		104	9	8

The current finding showed that damage of crop was more sever around buffer zone than person settled far from the forest (central zone). People at buffer zone face great problems in crop damage and other associated problems than people far from the forest. This is because of the buffer zone is near to the habitat of primates and other wild life, so primates and others visit the buffer zone more frequent than the central zone.

Such types of problems were observed in Jigme Singye Wangchuck National Park (JSWNP) more people reported crop damage in the buffer zone is higher than in the inner zone. Settlements located near forested core areas in Uganda and Tibet suffered higher damage from wild animals, especially wild pigs and primates (Sonam *et al*., 2006).

4.7. Estimate of crop damage by crop raiders

Maize (*Zea mays*) damage by Anubis baboons, vervet monkeys and other animals occurred through all its growth stages: seedling, flowering and maturation in the six study sites Mender-4, Wegashunit, Merabet, Goshuka, Edget and Telwot.

The extent of damage varied depending upon the growth stages and the type of animal that actually caused the damage. As showed in table 8, large amount of damage occurred during the flowering stage (tassel) by vervet monkey and during the matured (ripen) stage by Anubis baboon. The least amount of damage was observed during the seedling stages. In all sites large amount of damage was caused by Anubis baboon, vervet monkeys and other wild animals respectively (Table 8).

Table 8. The amount of maize damage by Anubis baboon and vervet monkey in study site during each developmental stage

Village	Anubis baboon					Vervet monkey				
	S	F	M	Total	Mean	S	F	M	Total	Mean
Mender-4	61	210	278	549	183	41	275	193	509	170
Wegashunit	147	423	596	1,166	389	81	308	221	610	203
Merabet	128	387	320	835	278	60	172	124	356	119
Goshuka	14	187	137	338	113	37	240	175	452	151
Edget	241	450	631	1,322	441	91	403	291	785	262
Telwot	141	411	503	1,055	352	70	296	175	541	180
Total	732	2,068	2,465	5,265		380	1,694	1,179	3,253	
Mean	122	345	411	876		63	282	197	542	

Key: - S= seedling F= Flowering M= Matured

Damage caused by Anubis baboon on maize plant was recorded in each site and each stage of development. From all of the study sites 732 (14%) of seedling, 2,068(39.3%) of flowering (tassel) and 2,465 (47%) of matured (cobs) were damaged by Anubis baboon.

There was significant difference among different stages of maize damaged by Anubis baboon ($F = 7.128$, $P = 0.007$). But also there was no significant difference among sites on damage of maize by Anubis baboon ($F = 1.749$, $P = 0.198$). So the damage in mender-4 sites was 61, 210 and 278 counted /measured farmland (50m by 50m) during seedling, flowering and matured stage respectively. The damages counted in Wegashunit sites were 147 (2.8%) in seedling stage, 423 (8%) in flowering stage and 596 (11%) during the matured stage and the maize crop damaged by Anubis baboon in Telwot site were 141 (2.7%) in seedling stage, 411 (7.8%) in flowering stage

and 503 (9.6%) during ripen stage. Large amount of damage by Anubis baboon was seen in Edget site followed by Wegashunit, Telwot, Merabet, Menerr-4 and Goshuka sites respectively.

Anubis baboons damage the maize plant through all of its developmental stages and visit the farmland rarely in seedling stages but frequently in flowering and ripened stage. In addition to these, damaging the stem before flowering is common to them. These primates damage large amount of maize plant within single visit due to their capability of holding and feeding large amount of cobs at a time.

From the total 22,183 estimated maize plants 5,265(24%) was damaged by these primates in mender-4, Wegashunit, Merabet, Goshuka, Edget and Telwot sites as compared with 3,253 (14.7%) of vervet monkey. They caused large amount of damages during the flowering stage in Edget, Wegashunit and Telwot. But in average large amount of damage was seen in matured stage. In all sites the least damage was recorded during the seedling stage.

4.7.1. Estimation of crop damage by vervet monkey

Damage on maize plant by vervet monkey was 380, 1,694 and 1,179 per measured farm land during its developmental stages (seedling, flowering and matured) respectively in all study sites.

There was high significant difference among stages of maize damaged by vervet monkeys ($F=23.085$, $P = .0001 < 0.05$).

The total damage caused by vervet monkey was recorded and it was 509(15.6%) in Mender-4, 610(18.7%), in Wegashunit, 356(11%) in Goshuka, (14%) in Merabet, 785(24%) and 541(16.6%) in Telwot. There was no significant difference between the study sites on damage of maize by vervet monkey ($F = 0.545$, $P = .739 > 0.05$).

In addition to these the damage caused in each stage was counted and recorded in each site. The damage in Mender-4 site was 41(1.3%) in seedling, 275(8.5%) in flowering and 193(6%) in ripen stage per measured farm land. Likewise 81(2.5%), 308(9.5%) and 221(6.8%) was damage caused by vervet monkey on maize plant in its seedling, flowering and mature stage in Wegashunit site. The damage in Goshuka site was 37(1.1%), 240(7.4%) and 175(5.4%) during seedling, flowering and matured stage respectively. 60(1.8%), 172(5.3%) and 124(3.8%) was the amount of damage in Merabet-1 site and 91(2.8%), 403(12.4%), and 291(8.9%) in Edget site and 70(2.2%), 296(9%) and 175(5.4%) was the amount of damage in Telwot site. In all sites, the highest amount of damage was recorded in flowering and the least was in seedling. Large amount of damage was seen in Edget site followed by Wegashunit, Telwot, Mender-4, Merabet and Goshuka respectively.

Vervet monkey visits the crop frequently and causes considerable amount of damage. It is difficult to control the vervet monkey during the flowering and ripen stages.

Especially the adult males hide themselves in the maize plant and proceed damaging in advance. In addition to this they have social organization and intelligence to recognize the absence of guards and then immediately rush in to the farm land forming different groups in different directions. This kind of social organization makes the damage incidence high, because it is difficult to chase them away since they come to the farm land in different directions in large numbers.

Vervet monkeys affect the maize plant by feeding on its different parts: root with endosperm at seedling time, stem, unmarred cobs and matured cobs. The damage by vervet monkey was chronic in flowering stage, followed by ripened and seedling stages respectively.

4.7.2. Estimation of crop damage by other animals

Damage caused by other animals such as bush pig, porcupine, warthog and rodent were counted and recorded in each site in all developmental stages. In case of total damage 699 in seedling 228 in flowering and 425 in matured stage was recorded. There was significant difference among different stages of maize damaged by other pest animals (F=5.916, P= 0.013). In addition to this the damage in each site was recorded. The damage was 201 in Edget, 177, in Wegashunit, 103 in Telwot, 82 in Mender-4, 74 in Merabet and 62 in Goshuka.

There was no significant difference among the study sites on maize damage by other pests (F=1.732, P = 0.202). The damage 6% was smaller when compared to the damage caused by Anubis baboon (24%) and vervet monkey (14.7%) that of the total estimated maize plant. Except wild pig others cause small damage. This is because they can stay for a long time with one cob but bush pig damaged more within a single visit (Table 9).

Table 9. Amount of maize damaged by other animals (m^2)

Village	Seedling	Flowering	Matured	Total
Mender-4	82	20	58	160
Wegashunit	177	46	95	318
Merabet	74	35	40	149
Goshuka	62	27	32	121
Edget	201	57	121	379
Telwot	103	43	79	225
Total	699	228	425	1,352

As presented in Table 9 great amount of damage by other animals occurred during the seedling stage followed by matured and flowering stage. More damage was seen in Edget site and least damage was seen in Goshuka site. Among the pest primates, Anubis baboon was the one that caused more damage on maize plants in all sites.

From a total of 22,183 plants estimated in six sites 5265 (24%) was damaged by Anubis baboon, 3253 (14.7%) was damaged by vervet monkeys and 1352(6%) was damaged by other pest animals. Large number of respondents described that maize yield loss by crop raider was above 30% per hectare and interviewed persons expressed about 30-45% of maize damaged by crop raider per hectare. These results were almost similar with the result of direct observation (44.7%).

The current study is comparable with the study conducted in Nigeria that, about 30% of loss was caused on commercial farms, but less than from damage caused in peasant's maize fields (up to 70%) by monkeys moving in groups (Ofor, *et al*., 2009).

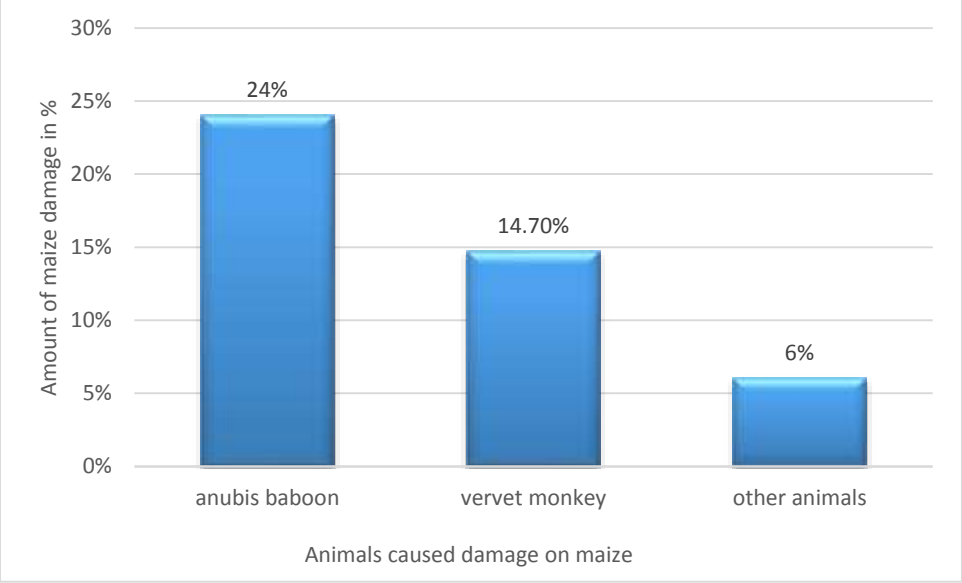

Figure 4. Percentage of damage on maize by different animals

4. 8. Direct observation of crop cultivated in the study sites

During the present study, different types of crops were grown in the study sites, but in terms of coverage on the farm land it mainly focus on maize, sorghum, haricot bean and teff respectively. Maize covered 16,035m^2 (53.45%) of the total cultivated land (30,000m^2) in all the sites. Teff crop covered the smallest portion of the cultivated land, which was 2,900m^2 (9.7%) of the total cultivated land (Table 10).

According to the ANOVA conducted on the data, we founds a statistically significant difference in size of cultivated areas between the four types of crops we have described ($F = 288.898$, $P<0.0001$).

Table 10. Crops and the extent of area (m^2) observed in the sampled sites

	Cultivated area of crops (m^2)				
Village	Maize	Sorghum	Haricot bean	Teff	Total (m^2)
Mender-4	2,410	1,100	840	650	5,000
Wegashunit	2,800	1,050	700	450	5,000
Merabet	2,525	1,000	875	600	5,000
Goshuka	2,550	1,200	700	550	5,000
Edget	3,000	1,050	650	300	5,000
Telwot	2,750	1,150	750	350	5,000
Total (m^2)	16,035	6,550	4,515	2,900	30,000 (m^2)

During the sampled study sites, six species of wild life were involved in crop damage, but out of these six crop damage wildlife as assured from direct observation pest primates caused a great damage on maize crop more than other pests except bush pig. This might be due to their capacity

of handling maize cobs more than other pests, their ability of feeding large amount of maize cobs within a short time, their frequent visiting of farm land and due to their intelligence.

The study conducted in Uganda confirms the result of this study by describing that baboons have potential to cause large amounts of damage locally and raid farms more frequently than other species of wildlife do, cause proportionately greater amounts of damage than all other animals combined, and visit farms throughout most of the year (Hill, 2000). Similar study conducted in and around Denkoro forest, also showed that Gelada baboon caused the greatest damage events than other animals (Melse, 2007). Likewise study conducted in Gashaka Gumt National Park (GGNP Nigeria) reviled similar result with the present study that primates cause more damage of crop than other pests (Eniang *et al*., 2011)

On the data of sample of site by damage of event registered by crop riders, chi-square tests of independence was applied (Table 11). According to this test, since we founds a significant chi-square value of $\chi^2 = 60.175$ than the critical value $\chi^2_{0.05,\,25} = 37.65$, sample site and damage event registered by crop raiders are associated.

Table 11. Damage events caused by crop raiders in the sample site

Village	Anubis baboon	Wild pig	Vervet monkey	Porcupine	Warthog	Rodent	Total	Mean
Mender-4	25	21	25	11	10	12	104	17.3
Wegashunit	81	71	40	19	4	21	236	39.3
Merabet	33	40	11	10	9	10	113	18.8
Goshuka	13	15	10	7	0	12	57	9.5
Telwot	71	40	32	24	11	16	194	32.3
Edget	97	62	51	34	13	20	277	46.2
Total	320	249	169	105	47	91	981	

The extent of crop damage varied depending upon the village and the type of animal that actually cause crop damage. From the total of 10,094 m^2 damaged farm lands was recorded during the time of 981 damage events, out of this, 2,282m^2 (22.6%) was takes place at Edget sites and the lowest damaged area of crop filed was in Goshuka sites followed by Merabet which were 992m^2 (9.8%) and 1,235m^2 (12.2%) respectively. When compared the size of damage area of the four types of crops the highest damage was on maize (Table 12).

Table 12. Total damaged area (m^2) recorded in four crop types

Village	Maize	Sorghum	Haricot bean	Teff	Total
Mender-4	661	441	315	166	1,583
Wegashunit	883	603	474	180	2,140
Merabet	408	418	235	174	1,235
Goshuka	332	321	148	191	992
Edget	926	705	508	143	2,282
Telwot	816	503	411	132	1,862
Total	4,026	2,991	2,091	986	10,094

Among 10,094m^2 total damaged area, maize constituted 4,026 m^2, which was (39.9%) of the total damage fields whereas sorghum, haricot bean and teff constituted 2,991 m^2 (29.6%), 2,091 m^2 (20.7%) and 986 m^2 (9.8%) respectively. Since F-value was found to be 10.911 with a (P- value of 0.0001), the size of damaged area was significantly differed from crop to crop at 0.05 level of significance.

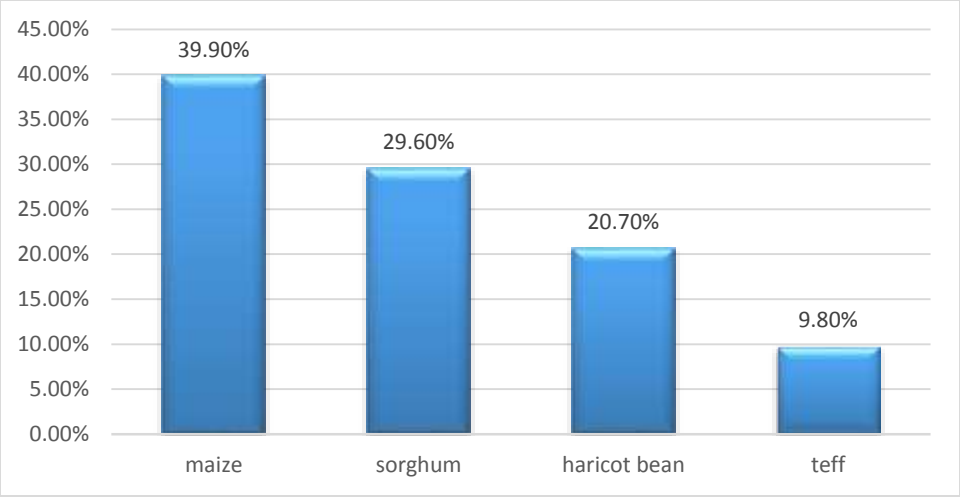

Figure 5. Area damaged (in m^2) for four crop type

Crop loss estimation

The information obtained from the questionnaire was introduced in to the statistical tool to assess the crop loss the following formula was used.

Total crop loss (Kg) = expected yield before crop raid – actual yield after crop raid

Based on these formula the amount of crop loss in (Kg) as estimated through quadrate sample in fields of six randomly selected sites are given the following table (15).

Table 13. Amount of crops in each sample site in kg

Crop loss	Expected yield	Observed Yield	Yield difference	Market Value (Birr/kg)	Annual Monetary Loss (ETB, Birr/kg
Maize	8,818	8,094	724	4.00	2,896
Sorghum	3,410	3,307	103	10.00	1,030
Haricot bean	1,321	1,212	109	5.00	545
Teff	2,515	2,427	88	17.00	1,496

As calculated based on quadrant sampling, from 16,035m^2 maize, 6,550m^2 sorghum, 4515m^2 haricot bean and 2900m^2 sample taken farm land about the above expected yield were expected. The highest yield recorded was in maize while the lowest was on teff. Of all expected yield 1024kg was lost by wild animals during the present study.

The loss covers 6.4% of the total annual production of the sampled area of the four crops.

The maximum loss was registered on maize crop which cover 71% of the total loss occurred. In monetary term, the overall loss of farmers in the sampled area was estimated at birr 5,967 per 3 ha, which was 5.3% of the monetary value of the annual production.

4.9. Livestock Depredation

In the study area, when asked about perception of people on livestock depredation, a very large number 87% of respondents said that livestock loss by carnivores was not as such a big problem. Even though, there were carnivores in the study area (hyena, lion, and common jackal) but according to the respondent reported that there was no damaged livestock by wild animals in the study area.

The other point raised for the interviewed persons was about problems caused by pest primates other than crop damage is that five person from Kuxi kebele, five persons from Yabekicha Qeda and Five persons from Yabekicha wolega explained that Anubis baboon creates great problems like predation of domestic animals such as sheep, goat and hen, damaging of traditional beehives, destruction of huts and attacking humans specially children. The vervet monkey had no much problem as that of Anubis baboon, but sometimes the adult male one tries to attack children when they patrol their crop and destroys small huts.

In addition to this the interviewed persons described the number of sheep and goats eaten by Anubis baboon from their own property and from their village. Thirty two sheep, 23 goats, 17 traditional beehives were damaged from Kuxi , 53 sheep, 33 goats 41 traditional beehives and 14 huts and 56 sheep, 41 goats 33 traditional beehives were destroyed from Yabekicha qeda and Yabekicha wolega from in these three years.

This study is in agreement with the study conducted in and around the Simien Mountain National Park revealed that 6.7% of the respondents reported the loss of sheep and goats to hamadryas baboon among villages, 40% of the respondents from Mecheka-Tikurwuha reported loss of sheep and goats to hamadryas baboon (Mesele, 2006).

Likewise the finding done in GGNP (Nigeria) described that baboon preys on domestic chicken and sometimes baboon will attack women and children even up to their house and sometimes kill fowls (Eniang *et al*., 2011). Mussa Adem (2009) also reported that hamadryas predated on sheep and goats in and around Denkoro forest.

4.10. Traditional methods used by farmers to Defend Crop Raiders from their Crops

During the present study respondents used different method to prevent crop raider from their crops, 68.6% responded permanent guarding, 10% chasing by dogs, 8.3% placing scarecrow, 9.09% trapping, and 4% responded digging trenches round the farm.

The current finding showed that permanent guarding was a method used by large number of farmers in protecting their crop from damage of crop raider. Other like chasing by dogs, placing model of man and other animals, trapping and hunting were also common methods which were used. From all of these methods guarding the crop permanently was the effective method to protect crops from damage of wild animals throughout crop growing season.

Farmers in the study area expressed that, to compete with wild animals the only preferable method was guarding the crop especially maize throughout its developmental stages. When they use methods like chasing Anubis baboon run to forest and frequently turn back and vervet monkey hide themselves in the bush and branches of trees.

Similar result in 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 guarding their fields constant vigilance during crop seasons and guarding and chasing away was ranked first and second in protecting crop raiders from crops.

Of the total respondents 73% responded the crop was guarded (patrolled) by men, women and children, whereas 11.6% respondents responded that it was guarded by men and children.

Table14. Response of respondents about permanently guarding/patrolling person

List of guard	Number of respondents	Percentage (%)
Men	5	4
Women	3	2.5
Children	4	3
Men and women	14	11.6
Men and children	2	2
Men, women and children	88	73
Women and children	5	4
Total	121	100

In this finding, men, women and children were the people who guarded/patrolled the crop to protect from the damage by pest primates and others. The study conducted in Hoima district (Uganda) reported that locally adults, particularly men, were most feared by baboons and two-thirds of all crop guarding was carried out by women and children (Kate,2012).

Similar finding in Uganda described that Children (6-12 years old) carry out nearly a third of all guarding and just over a third is done by women, the remaining third is carried out by men (Hill, 2000). Of the total respondents interviewed about 74.4% reported that absence of meeting and other social relations, absence or withdraw from school and absence from market and other journeys were common problems of persons who guard the crop permanently, 5% of them reported absence from meeting and other social relations was basic problem.

Whereas 17.4% of them reported that absence of meeting, other social relation, absence from market and other journeys were common problems and about 3% of them reported that absence or withdraw from school and absence from market and other journeys were common problems of persons who guard the crop permanently.

The present study revealed that persons who guarded the crop permanently faced problems like: absence from meeting and other social relations, absence or withdraw from school and absence from market and other journeys. This expressed that men, women and children were blocked from performing their activities freely due to the impact imposed by wild animals.

Men and women broke their social relation such as participating in wedding ceremony, visiting sick and sorrow person, participating in meetings and resolved from business activities. Likewise children were inhibited from attending their class properly. Findings indicated that such problems were common in Hioma district (Uganda). Successful guarding required that people be in the fields for long periods of the day throughout the seasons when there were vulnerable crops in the ground which means most of the year.

Obviously, this was not always possible given that had other tasks to complete, including attending school, household chores, taking crops to the grinding mill, trading in the local markets and employment for local chores, and businesses to include taking agricultural produce to markets (Kate,2012). Similar study conducted in LNP (Nepal) also reported that loss of crops, loss of foods, loss of money and loss of time (via time spent guarding fields) were problems associated with crop-raiding by macaques (Ram and Kandel, 2008).

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

Crops including maize, sorghum, teff and haricot bean were common to all farmers of the study area. In addition, beans, peas, potato and enset were crops cultivated according to the size of the owned by the farmers. The farmers in the study area had no integrated (organized) working system with each other on their activities of farming. Most of the farmers responded that due to these practice pest primates and other wildlife gets opportunities to damage crop easily and some farmers were forced to shift from crop production to other activities. Farmers in the study area depended on the forest for different resources such as fire wood, farm land, grazing land and fodder which indicates the presence of resource competition between human and wildlife. In all the study sites, crop damage by pest primates was common.

Four primates namely Anubis baboon, vervet monkey, black and white colobus and blue monkey were identified. From these the most common pest primates in the study area were Anubis baboon and vervet monkey. According to the damage caused, Anubis baboon was placed on top raider, vervet monkey was the second. The sex ratio of these two pest primate species was not 1:1 (more number of females was counted in all of the study sites). There was variation in abundance of these two pest primates (Anubis baboon and vervet monkey) between seasons and the study sites. Large numbers of primates were counted in wet season. More Anubis baboon was recorded in Edget site but vervet monkey were in Goshuka sites. The crop mostly damaged by pest primates was (*Zea mays*). This is because these crops more attractive to crop raider then wild food thus making them more attractive to vermin.

The results obtained from different methods of this study showed the damage of maize by these pests that, 44.7% of damage was recorded in direct observation, 40% and 30%-45% was reported from questionnaire survey and interview respectively. Most of the damage was recorded in flowering stage by vervet monkey and in matured stage by Anubis baboon.

The tendency of crop damage was increasing from time to time in the study area. It was more serious in wet season and in areas located at buffer zone (nearest to the forest). Other pests such which raid crop are bush pig, porcupine, warthog and rodent. In addition to crop raiding, pests primates especially Anubis baboon predate domestic animals such as sheep, goat and sometimes hen. Furthermore Anubis baboon destructs traditional beehives and huts, cause problems of security/creates fear on the society. All of the results gathered by questionnaire and obtained from interview have shown that the presence of high conflict between pest primates (Anubis baboon and vervet monkey) and farmers in all of the study sites.

The data gathered have showed that farmers of the study area protect their crops from damage by wild animals by means of different methods such as permanent guarding, chasing using dogs, placing scarecrow and trapping.

5.2. Recommendations

Based on the findings of the present study, the following recommendations can be made to mitigate the human wildlife conflict in the study area.

- The farmers of the study area do not cooperate with each other during their activity of farming. This promotes wild animals to raid crops easily. Therefore to minimize the crop damage farmers of the study area should cooperate with their neighbors and others on their activity of farming. Because it is one of the best way to reduce the chance of invading of the crop by wild animals in all directions and also it is important for protecting their crops by adjusting plans and programs.
- The people in the study area depended on the forest for different resources such as fire wood, farm land, grazing land and fodder. Such human activities lead to the degradation of the natural habitat and can encourage wild animals to destroy crops. Therefore, to reduce the dependency of the local people on the forest, it is better to encourage the local people to plant trees for different utilization and advise them to reduce the number of cattle and have their own grazing land.
- The stakeholders should also help to change people's perception particularly important because crop raiding can reduce tolerance towards wild life and affect actions taken by local farmers because local people play the key role in generating sustainable solutions and for conserving wild life.
- Farmers should also be encouraged to concentrate on planting unpalatable plants such as red pepper, sisal and spray on the borderline of the crop plantation and highly palatable seasonal crops such as maize, sorghum and enset should not be grown near the forest edge.

- Most of the landless youngsters of the study area use the forest as the best source of farm land. This activity is one of the causes for the destruction of the home of wild animals which push them to damage crops. So to solve such problems youngsters should be given education not be dependent on clearing forest for means of farm land and other activities, instead they should organize with others and participate in activities like coffee planting, beehives management, spices cultivation etc. which has dual benefits means in one side generates income for youngsters, on the other hand assist forest management.
- The stakeholders should encourage and organize youngsters in different organizations for creating job opportunities instead of damaging the forest for agricultural purposes.
- The stakeholder should discuss with farmers about the problem of crop damage and its solutions.
- Further research on the behavior of the most important crop raiding wild animals in Gimbo is needed to devise more reliable solutions than existing ones.

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APPENDEX

Appendix I. Data collection sheet for population estimate pest primates.

Name of data collector_____

Date_____

Species_____

Season_____

Place_____

Site_____

Altitude_____

Table 4:

S. No						
	DRY	WET	AM	AF	Juveniles	Remark
1						
2						
3						
4						
5						
Total						

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

Name of data collector_____

Kebeles_____

Site/got/_____

Season_____

Stages of crop development_____

Distance of the field from the forest boundary_____

Month and Date	Species observed	Type of Crop damage	Parts of Crop damage	Size of damaged Area in (m^2)	Time of observation (day) or (night)	Traditional methods used to control wildlife

APPENDIX III: QUESTIONNAIRE FOR COMMUNITIES

My name is Habtamu Debalke I am a postgraduate student from University of Addis Ababa Department of Zoological Science and carrying out a research study on Human Wildlife Conflict In Gimbo Woreda.

The questionnaires are designed for this research only. You are kindly requested to contribute and fill in the questionnaire which will be used in the study. I assure you that the information gathered will be used for the purpose of this research only and will be treated with strict confidentiality. Thank you in advance for your co-operation.

Part one: General Information for family members

Tick (✔) the appropriate answer to your level best

Gender Male [ ] Female [ ]

Age [ ]

For how long have you been living in the area?

< 5 years [ ] 6-15 years [ ]

16-25 years [ ] >25 years [ ]

Marital status Married [ ] Single [ ]

Separated [ ] Divorced [ ]

Ethnic group Keechi [ ] Oromo [ ] Amhara [ ]

Tigre [ ] Other [ ]

Educational back ground Unable to read and write [ ] Elementary school [ ]

Primary second cycle (5-8) [ ] High school (9-10) [ ]

Others [ ]

Position in household Head of household [ ] Member of household [ ]

Other [ ]

What is your origin Indigenous [ ] Settler [ ]

Moved in [ ]

Part Two: the crop cultivated in the study site and estimated yield obtained

1. Do you have your own farm land?

Yes [ ] No [ ]

2. If your answer is yes for question above, how much is its size.

0.5-1h [ ] 1.1-2.99h [ ] 3.0-4.99h [ ] 5h and above [ ]

3. How much is the distance of your cultivation land from the forest edge?

Near [ ] medium [ ] far [ ]

4. If your answer is no, where you cultivate your crop?

By renting land [ ] by cooperating with other [ ] others----------

---

5. What are your livelihood activities?

Crop production [ ] livestock keeping [ ] mixed farming [ ]

Crop production and other income [ ] other (mention) ----------

---

6. Do you encounter any conflicts with wildlife?

Yes [ ] No [ ]

7. If yes, which one?

Crop damage only [ ]

Both predation of domestic animals and crop damage [ ]

Distraction of traditional beehives [ ]

Distraction of huts and disturbing of humans [ ]

No conflict at all [ ]

8. Which wildlife species frequently attack your farm?

I) ---------- ii) ----------

iii) ---------- iv) ----------

9. Do you grow crops? Yes [ ] No [ ]

10. What type of crops you grow in your farm land 2015/2016?

Maize [ ] enset [ ] teff [ ]

Sorghum [ ] potato [ ] Haricot bean [ ]

Wheat [ ] If others mention them----------

---

11. Which type of crop is more attacked by pest wild animals?

Maize [ ] enset [ ] teff [ ] sorghum [ ]

Potato [ ] Haricot bean [ ]

12. Which pest wild animals are more responsible for crop damage?

Columbus Monkey [ ] Anubis baboon [ ]

Warthog [ ] Rodent [ ]

Grivet monkey [ ] Bush pig [ ]

Porcupine [ ] 0ther [ ]

13. Which stages pest wild animals more attack crops?

Seedling [ ] early maturation [ ] matured [ ]

14. What solution you put to manage the existing conflict in your area?

---

15. If your activity of farming does you have cooperation with farmers of neighboring fields?

Yes [ ] No [ ]

16. If your answer is no for the above question, what problems have you faced through your Practice (experience).

Being helpless [ ] easily damage of the crop by wildlife [ ]

Loss of update information [ ] If any more mention ----------

---

---

17. Which wild animals are more responsible for crop damage during day time? ----------

---

18. Which pest wild animals are more responsible for crop damage during night time?

---

19. In what season do you experience the most wildlife damage?

Dry season [ ] Wet season [ ]

20. What do you feel on the population of wildlife in the natural forest in your surrounding?

Increasing [ ] decreasing [ ] No idea [ ]

21. What control measures have been taken to safeguard your crops from pests?

1----------
2----------
3----------
4----------

22. Which of the techniques are most effective?

1----------

2----------

3----------

23. Which of the techniques are least effective?

1----------

2----------

3----------

24. What you suggest to reduce the effect of crop damage by wild animals?

1----------

2----------

3----------

4----------

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

Cattle **[ ]** goat **[ ]**

Sheep **[ ]** Horse **[ ]**

Donkey **[ ]** Mule **[ ]** other **[ ]**

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

1----------

2----------

3----------

4----------

Part Three: Check lists for Focus Group Discussion

Discuss 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 are the main causes 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