

ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

DEPARTEMENT OF BIOLOGY

HUMAN -WILDLIFE CONFLICT WITH SPECIAL EMPHASIS ON PEST PRIMATE

**IN AND AROUND GENDO GURATIRIGNI FOREST, GIDA AYANA DISTRICT,
WESTERN ETHIOPIA.**

BY BELAY WORKU

**A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF
ADDISABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN
BIOLOGY**

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September, 2016

Addis Ababa, Ethiopia

ACKNOWLEDGEMENTS

First, I would like to express my deep gratitude and appreciation to my advisor, Dr.Habte Jebessa for his encouragement, constructive criticism, consistent academic guidance, starting from proposal design up to the final production of this thesis, provision of reference materials and for his enthusiastic advice for the accomplishment of this research work. I am grateful to Addis Ababa University specially the Department of Biology for providing financial support to carry out the present study.

I am also grateful to local people and Developmental Agents for their cooperation and help during the field work and collecting data. In addition, I would like to thank the kebele administrators for their cooperation and Hinde Preparatory School director for computer support.

Last but not least, I would like to express my gratitude to all the people who have helped me in any way to make this thesis possible, especially my family and colleagues.

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ACRONYMS AND ABBREVIATIONS

AF-Adult Female

AM-Adult Male

DA-Development Agents

F/M-Female to Male sex ratio

GPS-Global Positioning System

HWC-Human-Wildlife Conflict

IUCN-International Union for Conservation of Nature

SAF-Sub-Adult Female

SAM-Sub-Adult Male

URT-United Republic of Tanzania

WWF-World Wide Fund of nature

SPSS-Statistical Package for Social Science

ABSTRACT

This study was conducted to assess human wildlife conflict with special emphasis on pest primate around Gendo Gura Tirigni forest, Gida Ayana district, Western Ethiopia from September 2015 to July 2016. The main objective of the study was to identify the cause and effect of human wildlife conflicts, to estimate the population of primate pest in the study site, to estimate the amount of crops destroyed by pest primate, to identify the major human pest primate in the study sites. Based on the information obtained from the preliminary survey, data was collected by field observation, questionnaires and interview. Field observation using line transect was used to estimate the crop loss due to pest primates and to estimate the population size of pest primates. Structured questionnaires and interview were used for gathering information about crop loss by pest primates. The collected data was analyzed by SPSS and Chi-square test was used to compare number of Anubis baboon counted during dry and wet season. From the study site three pest species were identified, namely vervet monkey (*Chlorocebus aethiops*), Colobus gureza (*Colobus abyssinicus*) and anubis baboon (*Papio anubis*). 33.28% of maize was damaged by these pest primates from the total estimated maize plant (48,208) and most maize damages were noticed during the tassle and ripen stages. Serious damage was seen in wet season compared with to dry season. Respondents reported habitat disturbance, proximity of natural forest, increased subsistence agriculture and increased of wild animals' population as causes of HWC. As Gendo Gura Tirigni forest was surrounded by extensive farmlands, the area needs a close follow up and detailed studies to identify current human-wildlife conflict in the area.

Key words: Gendo Gura Tirigni Forest, *Papio anubis*, Colobus monkey, crop raiding,

Human-wildlife conflict

1. INTRODUCTION

Human-wildlife conflicts were started since the beginning of the emergence of human beings. During the time people lived in caves there is a conflict between wild animals and human being. Slowly, with technological advancement it is man who invented traditional sharp materials such as hand axes during Stone Age and Iron Ages to protect themselves from wild animals. Later on, human beings began to hunt wild animals for food and protection (Eltringham, 1979). The numerous cases reported from countries all over the world demonstrate the severity of human-wildlife conflict and suggest an in depth analysis to understand the problem and support the conservation prospects of threatened and potentially endangered species (Hill, 2000).

Human-wildlife conflict is a growing global problem which is not restricted to a particular geographical region or climatic condition but common to all areas where wildlife and human Population coexist and share limited resources .Dense human population in close vicinity to nature reserve seems to pose the greatest challenge in many countries. Conflict becomes more intense where livestock holdings and agriculture are important parts of livelihoods. Competition between rural communities and wild animals over natural resources is more in developing countries where local human population tend to suffer highly (Ogada *et al.*, 2003)

Conflicts over use of natural resources by large, originate from egocentric attitudes and lack of knowledge on resource use rights contends that conflict is a common feature of any resource use system (Mutiru, 2000). Conflicts have shown the way to reduced risk management strategies such as income diversification including cultivation of arable land food storage (Abound *et al.*, 1996). Human-wildlife conflict is more intense in developing countries where livestock holdings and agriculture are important parts of rural people's livelihoods and income .In these regions, competition between local communities with wild animals for the use of natural resources is

particularly intense and direct. As a result resident human populations or wild life is vulnerable (Messmer, 2000).The relative impact of wildlife damage on farm production and household income varies greatly according to the amount of land owned and peoples economic dependence on rural activities (Messmer, 2000).Crop raiding is a cause of much conflict between farmers and wildlife throughout the world (Hill *et al.*, 2002). At present, crop damage and livestock depredation by wildlife are major sources of economic losses. As a result, local communities have in turn threatened protected areas by poaching and by causing habitat loss through encroachment of farms into protected areas .The pressure and conflicts between pastoralists and wildlife are likely to increase as long as there is lack of incentive (economic or otherwise) for pastoralists to invest in wild life conservation (Weladji and Tchamba, 2003).

The utilization and management of natural resources in Africa is often associated with conflicts over the benefits provided by the resources. Crop damage is a wide spread and common problem across the sub-Saharan region (Maples *et al.*, 1976). Crop damage in Africa by potentially life threatening species such as hippopotamus, warthogs, vervet monkeys and anubis baboons results in unique dilemma (Naughton, 1998).They also damage commercial plantations such as tea and coffee cultivation, hydro dams and power generation that brought millions of people to economic crisis (Myers *et al.*, 2000).

Baboon's raid gardens, food in lodges, crops and can cause an immense nuisance in small urban settlements if left unchecked. On the Zimbabwean side of the Zambezi valley, Baboons are major dangerous animals in bush camps and small towns such as Chirundu and Victoria falls and in wildlife camps and lodges where they are not actively controlled (Conover *et al.*, 1995). They pull thatch from thatched-roof buildings to steal food directly from the tables they occupy (Gaynor, 2000 and Kansky, 2002). In Ethiopia large herbivore mammals cause damage to

agricultural crops and plantations (Shibru Tadla, 1995). The extent of damage varies depending on the species of the pest mammal in different parts of the country (Kingdon, 1971). There are wide varieties of pest mammalian species such as hippopotamus, baboons and monkeys. These mammals cause serious damage to agricultural crops wonji sugar plantation (Serekebirhan, 2006). Rapid increase of population growth, investments in forest area, deforestation, wetland draining for cropland areas and using of forest edge for coffee plantations is more experienced in western Ethiopia. These pose pressure on land resources and reduce the area of core habitat for wild animals and eliminate corridors for migration and increase the probability of contact and possibly create conflict between farmers and wild life (Quirin, 2005). As majority of the Gendo kebele land is once covered by natural forest, now a days it is shrinking in size due to increasing in agriculture and investment in forest area (Quirin, 2005). This phenomenon was once and again disturbing the habitat of wild animals, can force wild animals to contact with human being which resulted in conflict (Strum, 2010).

However, as in other parts of the world, in Ethiopia, large herbivore mammals have been causing damage to agricultural crops and plantations. There are wide varieties of pest herbivores, primates and small mammals. These mammals cause serious damage to agricultural crops in different parts of the country (Demeke Datiko and Afework Bekele, 2011). Nevertheless, in Ethiopia only few studies were carried out on human-wildlife conflict in some specific regions of the country (Tewodros Kumsa and Afework Bekele, 2008). The same holds true in Gendo kebele around Gura Tirigni forest, western Ethiopia, in that there was no study carried out about human-wild animal conflict.

1.1. Statement of the problem

The people living in developing countries of Africa and Asia are suffering from the negative impact of human-wildlife conflict. Crop raiding by baboons, elephants and other herbivores seriously affect poor farmers. Across the globe, primates are the most frequently identified crop raiding animals. This is because of the renowned crop raiding behavior of the species (Sillero and Switzer, 2001). The extent of damage caused by large mammals is insignificant when it is considered at the global level compared to the damage caused by invertebrates and rodents. However, in areas where more pest animals found a major part of the crop may be lost in a single night (Naughton, 1997).

In Kenya crops such as maize, cassava, beans, wheat, potatoes and fruits are the target for animals such as elephant, baboons, zebra and buffalo. Wildlife damage to crops varies considerably from site to site and farmers have unequal capacity for preventing such losses. The change in the vegetation structure closer to the protected areas may attract wild herbivores (Kimega, 2003).

Crop raiding has most likely been occurring since humans first settled down and started practicing agriculture. Different types of food items are targeted by wild animals from cereals to fruits and from vegetables to trees (Sillero and Switzer, 2001). The current study area, food items such as maize, sorghum, teff, wheat, barley, beans and potatoes are damaged by wildlife animals like baboon and vervet monkey. However, still the issue of human-wildlife conflict on primate is remaining not assessed in the study area so far and adequate development enhancing information is lacking. Therefore, this study was designed to generate basic scientific information about human-wildlife conflict with emphases to pest primate on crop damage.

1.2. Significance of the study

Different species and subspecies of primates occur in Ethiopia. Some primates are very successful crop raiders and they are particularly problematic across different part of the country, especially in rural area where subsistence farmers role. In the study area the majority of the land is covered with forest and farmers who are near the forest are the main victims of this crop damage. Most of their agricultural products are exposed to the damage by pest primate and their seasonal or yearly yields from their agriculture are less when compared with that of secured farmers (Melese Yihune, 2006).

The significance of the study is to maximize the understanding of people towards the primate conservation. To plan appropriate conservation strategy, and indicates future research areas for those who would like to conduct researches on wildlife. Moreover, the data may be used as secondary data for researchers who working in the study area. It is also used to assess the causes of human-wildlife conflicts with special to pest primate in this study site. The negative perception wildlife animals' damage to crop varieties considerable from area to area. Hence this study is paramount importance in identifying type of primate and method of minimizing the human primate conflict in the area.

Research questions

1. What are the animals species most involved in HWC?
2. What are causes of HWC problem in the study area?
3. What type of crop is most consumed by pest primate in the study area?
4. What is the extent of crop damage?

2. LITERATURE REVIEW

2.1. Definition

Different scholars define Human-wildlife conflict (HWC) in different ways. The World Wide Fund of Nature (WWF, 2005) defined HWC as “any interaction between human and wildlife that results in negative impact on human social, economic, on conservation of wildlife population or on the environment”. The International Union for Conservation of Nature (IUCN, 2005) defines HWC as a conflict occurring “When human population requirements overlap with those of wildlife, resulting in costs to both residents and wild animals.” HWC is the term commonly used to conservationists to describe friction between wild animals and people. The conflict emergence when wildlife and human requirement overlap with consequential costs to humans and wild animals, destruction of property by wildlife and killing of wildlife by people (Osei-Owusu, 2008). The term Pest is typically defined as any animal that consumes crops during any stage of the agricultural cycle, from planting to post harvest storage (Naughton-Treves, and Treves, 2005).

2.2. Human-wildlife conflict

Human-wildlife conflict has been in existence for as long as humans have existed and wild animals and people have shared the same land scapes and resources. Human-wildlife conflict or negative interaction between people and wildlife has recently become one of the fundamental aspects of wildlife management as it represents the most wide spread and complex challenge currently being faced by conservationists around the world. It arises mainly because of the loss, degradation and fragmentation of habitats through human activities such as logging, animal husbandry, agricultural expansion and developmental projects (Fernando *et al.*, 2005).

Human-wildlife conflict is increasing across Africa. As human populations and demands for land increase throughout the continent, human-wildlife conflict will continue to increase (Browne and Jonker, 2008). Human-wildlife conflict has been the cause of serious damage to both humans and wild animals for years (Raini, 2009). It occurs as a result of occurrence of both parties in close proximity. The conflict usually starts when wild animals consume resources meant for human Consumption; crops by herbivores and livestock by carnivores. In addition wild animals that have Massif body size like elephants, rhinos and hippos cause structural damage to fences, electric posts and water pipes as they raid within settlement areas. In addition such large animals could cause significant damage to crops by trampling (Dudley *et al.*, 2008).

2.2.1. The Human-primate conflict

Primates are one of the most frequently cited crop pests (Naughton-Treves, 1998; Hill, 2000). So primates and humans are always in potential conflict over crops. The genera *Papio* and *Cercopithecus*, particularly, baboons and vervet monkeys are one of the most serious crop raiders because of their aggression, adaptability, wide dietary range, complex social organization and intelligence of the animal to recognize the absence of guards and the immediately rushes into the plantation fields forming different groups in different direction (Sillero-Zubiri and Switzer, 2001).

Pest primates often destroy unharvested farms causing economic losses to farmers. Crop damage is becoming serious for many residents around protected areas. Due to this reason in developing countries intervention in the name of conservation can generate considerable resentment and hostility in local communities. Establishments of protected areas are a major form of government intervention with local people as it leads to conflict with wildlife. Sometimes people around

protected areas are forced to keep their farm uncultivated due to fear of crop raiders. Most primate populations today face on going habitat disturbance, but not all primate species respond to disturbance in the same way while many primate species experience declines in population density when their habitats are disturbed, several primate species are not threatened and these species will generally require less conservation attention (Cowlshaw and Dunbar, 2000). Hoffman, (2011) reported that, habitat had the greatest influence on baboon occurrence, followed by distance from water, slope and the altitude.

Among the topographic variables the probability of baboon occurrence increased significantly with increasing distance from water, increasing slope and decreasing altitude (O’Riain, 2010). Within the habitat predictor variable and relative to natural habitat, the probability of baboon occurrence increased significantly in agricultural habitat and decreased in urban habitat. The greatest difference between the two models was the magnitude of the coefficient estimate for urban habitat (O’Riain, 2010).

Africa has largest primate fauna in the world. There are 175 species and subspecies of primates listed in Africa (Grubb, 2006). even though there are 12 species, subspecies of primates occur in Ethiopia such as anubis baboon(*Papio anubis*), colobus monkey(*Colobus abyssinicus*),vervet monkey(*Chlorocebus aethiops*),wild pig(*Sus scrofa*),Spottedhayna(*Crocuta crocuta*),hippopotamus(*Hippopotamus amphibius*),hamadryas baboon(*Papio hamadryas*),warthog(*Phacochoerus africanus*),plain zebra(*Equus quagga*) and lion(*Panthera leo*) (Kingdon, 1997). A more general conservation issue for primate populations relates to the potential for indirect conflict between primates and livestock that forage on similar resources, where people increase stocking rates in relation to natural vegetation availability, to enhance returns of meat, milk and other animal products, primates may be squeezed out or suffer reduced

reproductive rates by the far more effective off take of human managed livestock movements through the area. While the human herders may not have a perception of monkeys as pests the indirect competition can drive monkeys into habitats such as forests or plantation (Ciano *et al.*, 2001) where they cause significant damage and become pests. Habitat domination by humans and the associated compression, fragmentation and conversion of primate habitats (Strum, 2010), are the driving forces behind human primate conflict and one of the greatest threats to primate survival.

The use of space has thus become a central theme in primate studies, with conservationists relying on patterns of habitat use and minimum resource requirements for the effective conservation and management of various primate populations (Arrowood *et al.*, 2003). This is particularly true for those inhabiting small, isolated and fragmented habitats. Within primates, baboon (*Papio anubis*) are among the species exhibiting the greatest degree of spatial overlap with humans (Hill, 2005). This success is attributed to their agility, dexterity, high levels of sociality and co-operation, combined with dietary and behavioral flexibility (Swedell, 2011).

2.2.2. Human herbivores conflict

In Africa, conflict between agriculturalists and primate herbivores have always existed (Tylor, 1982). At the periphery of protected area large wild animals wander in closer proximity to human settlements. This poses serious problem in terms of crop damage. In such areas the integration of Conservation with other land uses has become difficult. However, the intensity of crop raiding around protected areas is different depending on factors such as human population density, distance of the farm land from protected area boundary and season of the year and the animals' behavior (Lee, 1987). Various animals are featured in varying degrees of crop raiding.

Not all crop raiding animals come from protected areas only. Some are residents outside protected areas. They live in suitable habitats in different gardens within the community. Crop damage by wild animals may vary from season to season as the type farming during wet seasons and dry seasons. The behavior of the animal is also another factor which has an influence on the extent of crop raiding. Information from wildlife managers field observations in Zimbabwe have suggested that crop raiding may be learned by young elephants from older bulls (Kagoro Rugunda, 2004).

Across the globe, primates are the most frequently identified crop-raiding animals. This is because of the renowned crop raiding behavior of the species (Sillero-Zubiri and Switzer, 2001). The extent of damage caused by large mammals is significant when it is considered at the global level compared to the damage caused by invertebrates and rodents. However, In Africa, baboons (*Papio anubis*) and vervets (*Chlorocebus* spp.) the top list of crop-raiding primates (King and Lee 1987; Sillero-Zubiri and Switzer, 2001). According to (Kimega, 2003) in Kenya, food items such as maize, cassava, beans, potatoes and fruits are target for animals like elephant, baboons, zebra and buffalo. Wildlife damage to crops varies considerably from site to site. Increasing interaction between people and wildlife and the resulting conflicts are the main challenges facing wildlife conservation in developing countries.

Encroachment of wild habitats by subsistence farmers in Africa leads to conflict. Crop raiding by baboon, elephants and other herbivores seriously affect poor farmers. The change in the vegetation structure of lands closer to the protected areas may attract wild herbivores. Cultivated plants have characteristics of increased yield, rapid growth and resistance to disease, making them vulnerable to the herbivores of locally abundant wildlife populations (Messmer, 2000). Crop raiding has the most likely been occurring since humans first settled down and started

practicing agriculture. Conflicts between wildlife and local people are the major concerns for wildlife management and rural development initiatives across Africa. Typically, the main conflict involves crop damage by wild herbivores and thus solutions should set within a policy and legislative framework that attempt to address both wildlife management issues and rural development objectives. Many initiatives have been designed to address crop loss because this can undermine the success of other programs related to agriculture (Tylor, 1982). Crop damage affects farmers directly through loss of their primary food and cash resources, and indirectly through a variety of social costs such as costs for school and hospital. Due to these losses, rural people express their fear or even sabotage development projects that deal with wildlife conservation (Hill *et al.*, 2000).

Crop-raiding by wild animals is increasingly known to be a source of conflict between the animals and humans, perhaps especially so along as, the boundaries of protected areas (Strum 1994 and Naughton-Treves, 1998). The losses incurred by farmers may make communities living close to protected areas antagonistic and in tolerant towards wildlife which can undermine and impede conservation strategies (Nyhus *et al.*, 2000). Because farmers in developing countries often have limited access to cash and are rarely compensated for their losses, the individual economic losses suffered from crop-raiding can be relatively high (Nyhus *et al.*, 2005). Furthermore farmers' inability to mitigate crop-raiding adequately and the absence of compensation scheme may lead to retaliatory killing of problem species (Jackson and Wangchuk, 2001). Several studies have found that proximity of a farm to the forest edge and the presence or absence of neighboring farms best explains the likelihood of any farm sustaining crop damage (Hill, 2002). Hence, it seems that farmers that reside close to the border of protected forest reserves or that cultivate crops within the park boundaries are especially vulnerable to crop

raiding (Priston, 2001). In most primate range countries the major threats to populations are due to the extensive conversion of primate habitat into areas of human use (Lee *et al.*, 1986). Human-wildlife interaction is now recognized as a major issue in conservation (IUCN, 2005). Crop raiding is a wide spread and common example of human-wildlife conflict and crop damage directly influences local peoples' perception of, and support for conservation initiatives (Conover, 1991 and Hill, 1998). The encroachment of wild habitats by subsistence farmers in Africa as a result of increased population is on the rise and this calls for concern. Crop raiding by wild animals is one of the major causes of human-wildlife conflict. Crop raiding can be simply defined as wild animals moving from their natural habitat onto agricultural land to feed on the produce that humans grow for their own consumption (Ojo *et al.*, 2010). Crop damage affects farmers directly through a variety of ways, due to these losses; rural people express their fear or interfere with development projects that deal with wildlife conservation (Hill, 2000).

Survey on crop damage by wild animals have many practical application from agricultural and wildlife point of view. They are useful to document the extent of a suspected wildlife damage problem, the timing of the problem and, in some cases the particular species responsible for the problem. They also can be used to compare trends among geographic regions or between time periods. Surveys on the problem of crop raiding also are useful to detect changes in tolerance to wildlife damage. Moreover, surveys on crop damage can be used to identify current methods used to control wild animals' damage and to design management programs that address stakeholder needs .Results from surveys on wildlife damage are useful in developing management plans that will be acceptable to farmers and address their problems and concerns (Craven *et al.*, 1992). Therefore ,it is crucial to document the different wildlife that cause crop

damage, the amount of losses they cause, the place where they cause the damage and the different strategies used by the local people to prevent the damage in different parts of the world.

2.2.3. Human carnivore conflict

Across the globe, the frequency and extent of economic cost of conflict between human and carnivores is increasing due to the expansion and growth of human population (Karanth *et al.*, 1999). Besides, their large space requirements and position at the top of the food chain results in conflict with expanding human populations and domestic livestock (Myers and Bazely, 2005). Under a variety of demographic, economic and social pressure, human alteration of carnivore habitat or expansion of carnivores has led to escalated conflicts (Naughton-Treves *et al.*, 2003).

Humans can also allow the recovery of carnivores. Land use practices exemplified by the regrowth of forests in many regions of the United States are providing room for potential recolonization by previously extirpated carnivores (Mladenoff *et al.*, 1997). The greater majority of cases of human carnivore conflict through depredation of domestic animals reflect some type of imbalance in the local ecosystem. If the habitats in which they live consist of areas large enough to support them, with sufficient food resources and if the influence of human on the habitat decreases, these animals tend to avoid man and his domestic animals (Treves and Karanth, 2005). As a group, carnivores exert a profound influence on biological communities via predation and inter specific competition carnivores often regulate or limit the number of their prey, thereby; altering the structure and function of the entire ecosystems. Their extirpation or rarity can result in a change in the communities of the habitat (Berger *et al.*, 2001).

2.3. Impact of human-wild animals' conflict on humans

Human-wild animals' conflict is a growing problem in today's crowded world, and can have significant impacts on human population. As human population and the extent of landscape transformation increase the probability of competition for resource between human being and wild animals also increase (Dickman, 2008). As the need and behavior of wildlife and human being become close to each other, it impact negatively the goals of human and finally create conflict between them. Wild animals can have very significant impacts up on human directly and indirectly these impacts range from clear cut economic hard ship to less tangible effects such as increased opportunity costs and decreased quality of life. Living along side of wild animals can incur variety of additional costs aside from the direct impact of depredation (Distefano, 2010).

2.4. Attitudes of local people towards primates

One fundamental influence on perceptions of local people towards primates is the general cultural attitude. Levels of tolerance acceptance and even demand for interaction vary with cultural context (Biquand *et at.*, 1992; Gautier and Biquand, 1994). Cultural perceptions towards primates vary enormously and have shifted over time. Historically; primates were as sacred as guardians of human settlements, as spirits of ancestors or as an embodiment of sexuality, wisdom and fortune in some areas. In some societies, monkeys may even be incorporated into the kinship or cosmological belief system (Cormier, 2002). Monkeys and apes are kept as pets, sharing house hold areas and food, and acting as surrogate infants or dolls or exploited for their entertainment value. This may be a converse of the human companion animal relationship (Serpell, 1981).

Crop losses due to primates were considered acceptable or normal within general crop yields. Perceptions of the significance of the primate problem might rank relatively low in the general context of pests. The relative suggestions that even minor losses can assume a major perceptual importance when farmers become engaged in a market economy. Primates are pests in a huge variety of contexts in fields, tourist lodges, reserves, roadsides, temples or towns. One key issue is increasing competition between primates and humans with the spread of agriculture and human activity into areas that previously sustained primates. There is little quantitative work on the socio-economics of pest primates and the importance of loss of subsistence as opposed to cash crops is unknown, either in terms of the economics of the losses or in relation to changing perceptions. However, primates dominate amongst pests that damage crops, particularly around African and Asian reserves, being responsible for over 70% of the damage events and 50% of the area of farms damaged (Naughton-Treves, 1998).

Almost all primate families have been identified as crop-raiders, although species differ in their ability to cope with encroaching human settlement. Rainfall, season, crop variety and characteristics, food availability, distance from forest, nearest farm or village and farm protection methods will have an impact on raiding (Biquand *et al.*, 1992; Hill, 1998; Naughton-Treves, 1998). The raiding frequency and intensity influence the attitude of local people towards primates.

Local peoples' perception of conflict does not always correspond to reality; in some cases negative impact is only perceived and may result from confusing ecological factors by socio-economic variables (Siex and Struhsaker, 1999). Generally negative attitudes are functions of degree of contact with primates as pest and to a lesser extent with the risks perceived to result from direct primate-human contacts. Brief contact with monkeys in the absence of crop damage

tends to promote positive attitudes (King and Lee, 1987; Knight, 1999), while even minimal experience of raiding leads to an attribution of blame that may greatly outweigh the extent of the damage (Naughton-Treves, 1997; Chalise, 2000, Hill, 2000; Chalise and Johnson, 2001). It should be noted that societal expectations like myth, religious belief, and economic or political contexts establish initial principles for how humans are expected to behave towards monkeys. The subsequent experience of those people with monkeys is thus layered on a series of beliefs and expectations to produce perceptions of monkeys.

2.4.1. Attitude of peoples towards other Animals

Local people use the local fauna for different purposes like for medicine and food. The direct use of animals suggests that there might be little awareness regarding the negative consequences for animals. The most common attitude of people towards animals is the utilitarian one, with little consideration of the consequences. In South Africa, for example, some species of reptiles are more intensively used by traditional healers (Smart *et al.*, 2005). Birds can be important for seed dispersal, biological control of pests and aesthetic values; which leads to positive attitude towards some bird species. Concerning snakes, the majority local people showed low knowledge in believing that most snakes are non-poisonous, so local people perceived snakes as being dangerous animals (Lopez-del-Toro *et al.*, 2009). For non-flying mammals, attitudes were in general different. However, the perception of local people has been positive towards those species used as food and negative towards those species that cause some level of damage. Negative attitudes also revealed towards rodents that damage crops. In Indonesia and India costs associated with wildlife have a negative impact on local perceptions, while the benefits have positive effects (Sekhar, 2007). The negative perceptions towards bats are possibly linked to the damage that these animals may cause to livestock, for example, vampire Bats. However, the

damage or benefit obtained from a group of animals is not the only factor shaping the attitude of local people. For example some bird species can cause damage to their crops and yet their attitudes towards birds in general were overwhelmingly positive (Lopez-del-Toro *et al.*, 2009). Animals that cause higher levels of damage are disliked and when the damage is small or moderate, the attitudes of people are more positive (Kaltenbornet *et al.*, 2006). Thus, in the case of bats and to some extent also in the case of snakes and others, many of the negative perceptions and attitudes can probably be attributed to lack of knowledge and the prevalence of culturally inherited beliefs. Generally, the attitude and perceptions of local people are positive for birds, intermediate for non-flying mammals and lower for snakes, rodents, pest insects and bats (Lopez-del-Toro *et al.*, 2009).

2.5. Factors that influence abundances of primates

In the case of Africa, antagonistic relationships between human and non-human primates have been exacerbated by the increasing amount of land under cultivation with crops that are very attractive to primates (Struhsaker, 1978; Hill, 2000). Humans and non-human primates have had a long association and in many instances, have antagonistic relationships (Fuentes, 2006). This antagonism is often due to nutritional reliance on similar foods (Paterson, 2005). However, with increasing conversion of forest to agriculture, crops have become vital supplements to the diet of many non-human primates and will be important for their conservation (Estrada, 2006). Subsistence farmers living adjacent to protected areas have borne the bulk of the crop depredation associated with primates (Tweheyo, 2005). Such negative interactions between people and animals from protected areas hinder both conservation area protection and wildlife management (Naughton-Treves, 1998). As a result understanding what primates' crop-raiding is

critical to devise means of improving people-parks interaction and effective protected area management (Lee, 2010).

The goals of primate conservation in areas where there are conflicts can be summarized as developing strategies to reduce conflict where it is a genuine problem. This requires an assessment both of the magnitude of the problem and an understanding of how attitudes relate to perceptions and reality. For example, the feeding strategy of the Zanzibar red colobus monkey in plantation may actually increase the trees' productivity. Making farmers aware that the monkeys either have a limited damaging effect or even a potentially beneficial one, could be a major route to enhancing positive perceptions about the presence of primates in plantation area (Siex and Struhsaker, 1999). Creating education programs to promote an awareness of the significance of primates, of their conservation status and how humans can help protect them.

2.6 .Traditional methods used by the local people to prevent crop damage

People can prevent crop damage by using different methods such as guarding, chasing, strange scents, fencing, scarecrows and trapping to control their crop damage. Guarding was the most familiar method. Most farmers guarded their crops especially during the harvest season. Chasing and fencing were also the second and the third important methods, respectively. Yelling and throwing stones were the other methods used to chase wild animals away from the farmland (Musa Adem, 2009). They are also forced by wild animals to change their cropping patterns to escape crop damage. Moreover, they spend additional labour, time and expenditure to protect their crop against wild herbivores (Sekhar, 1998).

3. OBJECTIVES

3.1. General objective

The general objective of this study was to assess the cause and effect of human-wildlife conflict with special emphases on pest primates in and around Gendo Gura Tirigni forest.

3.2. Specific objectives

- To identify the cause and effect of human wildlife conflicts;
- To estimate the amount of crops loss by pest primates;
- To estimate the population sizes of pest primates in the study sites
- To recommend possible solutions to mitigate the problems caused by pest primates.

4. THE STUDY AREA

4.1. LOCATION

The present study was conducted in and around Gura Tirigni forest of Gendo kebele, Gida Ayana District, East Wollega zone of Oromia Regional State, Western Ethiopia. The physical distance of this kebele from Addis Ababa is about 436 km to the West. The location of the study area lies between latitude 9°49.5'-9°59.6 N and 36°40'-36°43'E longitude. The forest has a total area of 57 hectares (including 10-16 hectares community plantation on east south edges) and the total area of the kebele is about 1100 ha (GAARDO, 2009). The forest is located along Nekemte-Bure Bahirdar road, between altitudinal ranges of 2183 and 2268 m.a.sl (Ethiopian Mapping Agency, 1994; Encarta 2006; GPS reading during field survey, 2016). The kebele borders of this study area, Gombo in North, Lalise Birbirsia in south and Gattira in East and Lebu in the west.

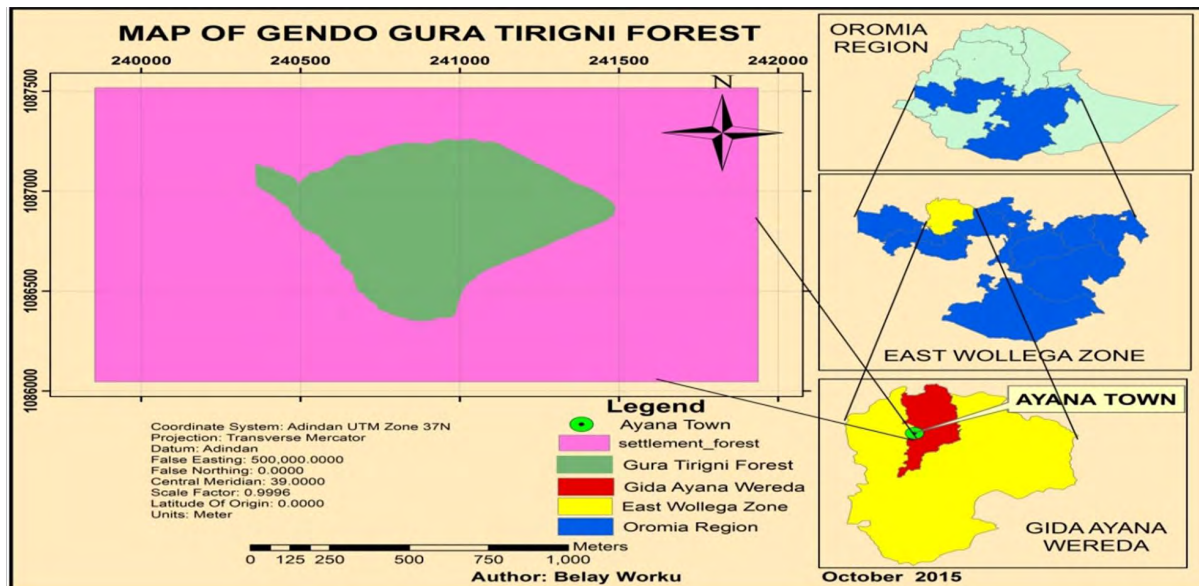


Figure 1. Map of the study area indicating Gendo Gura Tirigni Forest and its relative location in Ethiopia.

4.2. Climate

4.2.1. Temperature

As Gendo Gura Tirigni forest has a relatively broad ranges of altitude (2183-2268 m.a.sl.), it has relatively broad ranges of annual. From the ten years data (2006-2015) the mean monthly minimum temperature ranges from 13.00°C-15.65°C while the maximum temperature ranges 20.69°C-28.36°C (Fig.2). The mean monthly minimum temperature was 13.00°C, recorded in January and the maximum was 15.65°C, recorded in March. This means the coldest month is January and the hottest month of the year is March.

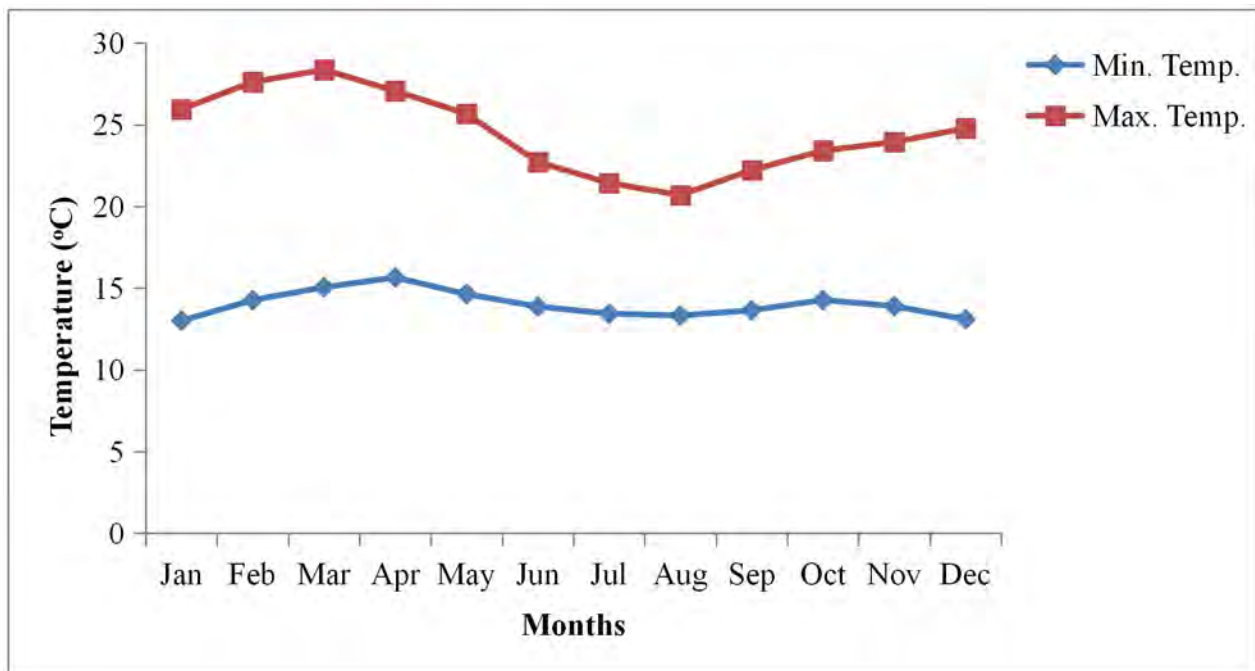


Figure 2. Mean monthly Temperature 2005-2016 of Gida Ayana

(Source: Ethiopian National Meteorological Service Agency, 2006-2015)

4.2.2. Rainfall

The rainfall in the study area is unimodal. The first wet season mostly occurs from June to the end of September, while the second short rainy season occurs between Februarys to April. The average annual rainfall of the study area is 1572 mm ranging between 1397 mm-1748 mm (Figure3).

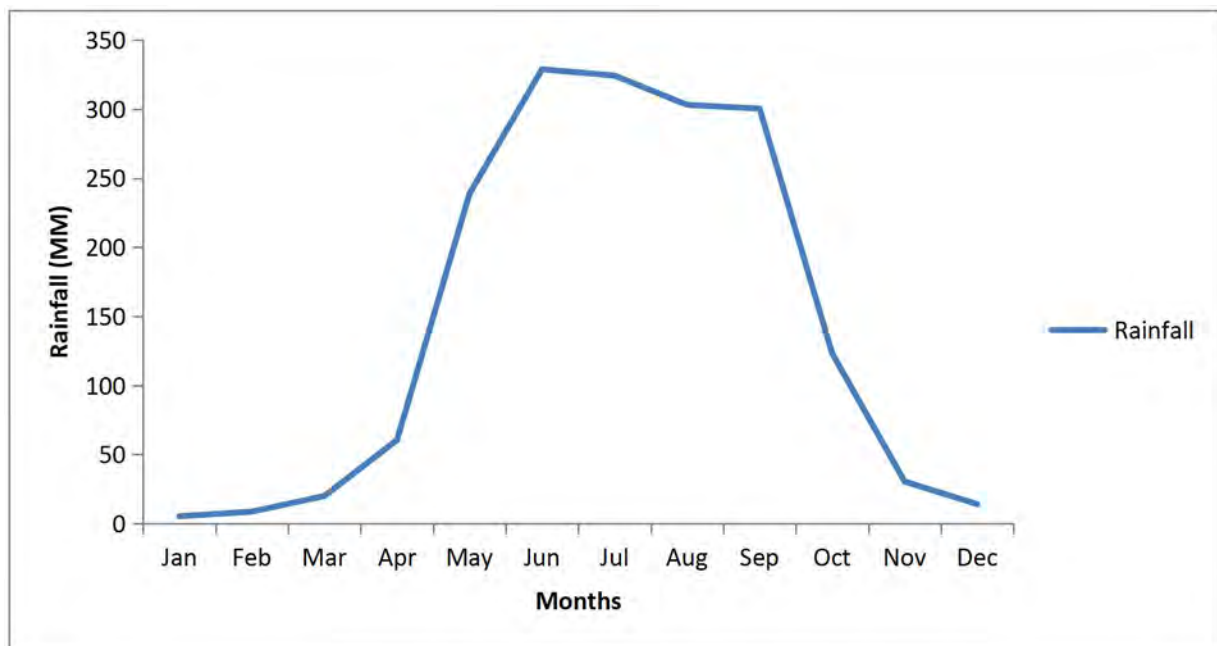


Figure 3. The mean monthly rainfall 2006-2015 for Gida Ayana

(Source: Ethiopian National Meteorological Service Agency, 2006-2015)

4.2.3. Flora and Fauna

Gendo Gura Tirigni forest vegetation is one of the moist montane forests found in East Wollega Zone, western Ethiopia. The forest is containing diverse animals and plant species. It consists of about 100 species of vascular plants. Some of the vascular plants are: *Cordia africana*, *Ficus sur*, *Juniperus procera*, *Teclea nobilis* and *Grevillea robusta*. According to basic data of Gida Ayana Agriculture and Rural Development Office, about 12,265.27 hectares of land is flat, 101,325.77 hectares is hill slope, 6,319.5 hectares is gentle gorge, 7,322.55 hectares is swamps and 1,830.64 hectares is other land forms (GAARDO, 2016). The soil of the study area is pale brown to dark reddish and red in color, clay and clay-loam in texture (Murphy, 1959). The topography, geology, soil of the study area fits with that of Weyina Dega agro climatic zone. The forest also harbors different species of mammals, birds and especially crop raiding wild animals such as Anubis baboon, vervet monkeys, warthogs, hippopotamus, spotted hyena, wild pig, porcupine and hare.

4.3. METHODS AND MATERIALS

4.3.1. Material

The materials used during this study were field binocular (7x50mm), Geographic positioning system (GPS), digital camera resolution, compass and stationery (Solomon, 2008).

4.3.2. Methods

4.3.2.1. Preliminary survey

A preliminary survey was conducted to gather basic information about temperature, vegetation, and fauna of the study area. The physical environment of the study area was observed and also net works were established with the developmental agents' experts of the study area and local kebele leaders. Following the procedure of (Melese Yihune *et al.*, 2008) information was gathered on cause of Human-wildlife conflict and prevalence of crop damage since locals are aware of the problem. Finally incorporate the obtained information to questionnaire. Secondary data which obtained from written documents, internet and books were also used to collect detailed information on human-wild animal conflict.

4.3.2.2. Methods of data collection

Data collection was conducted between September, 2015 and July, 2016. from September, 2015 to December, 2015 I conduct preliminary survey and writing proposal. It was conducted during dry season and wet season. The dry season included January to February, 2016 and wet season study included June to July, 2016. Based on the information obtained from preliminary survey, a structured questionnaire was developed based on applicability to the objectives of the study for gathering information by questionnaires and one to one interview. Field observation was

conducted for census of population size of pest primate and determining the crop damaged by pest primate using plots in selected crop lands starting from January to July 2016 in wetland agriculture. A semi-structured questionnaire was prepared in English language and translated into Afan Oromo. Then enumerators were recruited from the study area and trained on methods of data collection and interviewing techniques. Interviewing of the respondents was needed to get more information on the issue.

4.3.2.3. Population size of pest primates

In the study site, counting of the population of pest primates was carried out by walking on foot throughout the whole study sites which were divided in blocks to precede the counting of population. The total area of the Gura Tirigni forest was 57 ha. of which the dense forest habitat was 42 ha and the remaining 15 ha was fragmented forest habitat. Primate in the dense forest were counted by dividing the forest in 14 blocks and each block was sampled by line transects that has a length of 1km and width of 100 m. Then the counting of pest primates seen from the transect continue and the animal seen in it was recorded (Plumper and Reynolds, 1994). The fragmented forest were divided in 5 blocks and each block was sampled by line transects with length 2 km and width 150 m. The counting of pest primate in transect line continue. Counting was carried out using direct observation while moving on foot. During dry and wet season, the pest primate's census was carried out two times a week during dry (January and February) and wet (June to July).

The pest primate population was categorized into different age groups, namely adult, sub adult and infant (Juvenile); body size was used in age determination. Photograph of the primates were taken by means of digital camera, and the position at which they were counted was taken. Census

was conducted when the primates were most active and with good visibility during mid-day (12:00-13:00 am) and in the early afternoon 5:00-7:00 pm at watering site).

4.3.2.4. Estimation of crop damage by pest primates

To estimate crop loss due to pest primate, field visit and direct observation of crop damaged were mainly used to confirm the respondent's responses so that accurate and reliable information would be collected since farmers have a tendency to exaggerate the issues. Direct observation was also important in identifying the particular problem, animal species responsible for the damage through assessing the teeth marks left on the damaged plants and foot marks of the animals. Four plots of 6mx6m were placed randomly within the crop stands of 8 farmers in the village (Melese Yihune, 2006) and observed two times a week to count the crop damage from 0.5 ha of the eight farmers and to identify the type of animal that caused the damage. The reason is, because the farmland was nearer to the forest and based on information of severity of the human primate conflict. The seedlings of the maize in each four plot were counted from total area of the farm to extrapolate the total number of plants in the measured farm (Strum, 1994).

The maize crop was selected because it is main cultivated crop compared with other types of crops in this particular study area. In dry and wet season, the observation was conducted starting from September, 2015 to July, 2016. During the germination (seedling) stage for 12 hours observation was carried out. But more emphases were made in time of flowering and maturation. In each of these stages two times a week observation were accomplished. During the time of visit all the damaged crop was recorded on the same day. The photograph of the event was taken by using digital camera. At the end of each developmental stage, damaged plants were added up and estimated. Finally total yield loss of each site was added up and summarized. For nocturnal

animal (wild pig) marks left such as teeth marks, dung, feeding, foot prints and diggings were used (Strum, 1994).

4.3.2.5. Questionnaire survey and Interview

To conduct this research total population of 331 household were selected randomly in the area. The samples were collected through questionnaire, direct observation and interview. The households were identified through a simple random sampling technique by Cochran formula i.e. among 331 households of the Gendo Kebele 140 study participant was selected.

$n =$ where $n_o =$

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

$n =$ total sample size

$d =$ degree of accuracy desired (0.05)

$N =$ total number of the population

$p =$ proportion of the population

$q = 1 - p$ (i.e. (0.8))

$N_o =$ marginal line

$\alpha =$ level of significance

$d = 0.05, p = 0.2 \quad \alpha = 0 \quad q = 1 - p$

Therefore $n_o = 245$

$= 140$

Based on Cochran (1977) population correction factor, a total of 140 sample household were selected using simple random sampling technique from the total population of 331. So that the

information about the damage of crops by pest primates were collected by structured Questionnaire and interview. The selected householders were asked by using structured Questionnaires which is pre-tested and translated into Afan Oromo. The questionnaire contain the survey of crop damage and other related activities prepared for local respondents. In case of interview, ten (10) indigenous persons from the present study site who have lived there for a minimum of 40 were interviewed about the general features of crop damage in the past and now, about the number of primates (increasing or decreasing), the situation of primates versus human familiarity in the past and now was discussed while basic information gathered. The interview was conducted with each of the assigned person one by one.

4.4. Data Analysis

The collected data was analyzed by using Statistical Package for Social Sciences (SPSS) version 20. The questionnaire was coded and run to SPSS and the data was organized by Microsoft Office Excel 2007. Chi-square test was used to analyze association of pest primate counted during dry and wet season and association of habitat with sex of pest primate. The results of the study were expressed in tables and figures.

5. RESULTS

5.1 Primate pest species

In the present study, three species of primate and four other pest wild animals were identified from the study area during both dry and wet seasons. Among the primate species, Anubis baboon and vervet monkey were known as common crop raiders (Table 1).

Table 1. List of wildlife in the study area

Local name	Common name	Scientific name
Jaldeesa	Anubis baboon	<i>Papio anubis</i> (Lesson)
Qamalee	Vervet monkey	<i>Chlorocebus aethiops</i> (Linnaeus)
Weenni	Colobus gureza	<i>Colobus abyssinicus</i> (Ruppel)
Xaddee	Crested porcupine	<i>Hystrix cristata</i> (Linnaeus)
Booyye	Bush pig	<i>Sus scrofa</i> (Linnaeus)
Roobii	Hippopotamus	<i>Hippopotamus amphibious</i>
Karkaroo	Warthog	<i>Phacochoerus africanus</i> (Gmelin)

5.1.1. Population Size of Anubis baboon

These counts are categorized into two for dense and fragmented forests. A total of 319 and 467 Anubis baboons were counted during the dry and wet seasons respectively (Table 2 and 3).

Table2. Number of Anubis baboon counted in each counting blocks during dry season.

Habitat	AM	AF	SAM	SAF	JV	Total
Dense forest	11	36	21	51	19	138
Fragmented forest	15	46	25	57	38	181
Total	26	82	46	108	57	319

Table3. Number of Anubis baboons counted during the wet season in the sampling blocks

Habitat	AM	AF	SAM	SAF	JV	Total
Dense forest	19	49	33	70	31	202
Fragment forest	23	70	42	86	44	265
Total	42	119	75	156	75	467

Keys: DS=Dry season, WS=Wet season, AM=Adult male, AF=Adult female, SAM=Sub adult male, SAF=Sub adult female, JV=Juvenile

A total of 6 and 9 groups were counted in the dry and wet seasons respectively. On the average, group size ranged from 50-60 individuals. With respect to the age structure and sex ratio, 82 adult female (25.7%), 26 adult male (8.1%), 108 sub-adult female (33.8%), 46 sub-adult male (14.4%) were recorded during the dry season. The sex ratio for the two seasons F/M=1:3 for Anubis baboons. Chi-square test showed that the association between sex of Anubis baboon with respect to habitat are statistically insignificant ($\chi^2 = 3.11$, $df=4$, $p>0.05$). During the wet season count, there was 119 adult female (25.5%), 42 adult male (8.9%), 156 sub-adult female (33.4%) and 75 sub-adult male (16%); the number of female was statistically significant than the number

of male ($t=1.27$, $df=5$, $p < 0.05$). The proportion of juveniles during dry and wet seasons was 17.8% and 16.1% of the total population, respectively.

5.1.2. Population Size of vervet monkey

The number of vervet monkeys were counted in dense and fragment forests was 81 and 106 respectively during the dry season. During the wet season, the number was 135 in dense and 190 in fragmented forest during wet season. Among the counted vervet monkeys, 8 and 12 adult males were count in dense and fragment, 26 and 29 adult females count in dense and fragment, 9 and 13 sub adult males count in dense and fragment, 16 and 21 sub adult females count in dense and fragment and Juvenile were 22 and 31 respectively in dense and fragment habitat (Table4).

Table 4. Number of vervet monkey counted during the dry season.

Number of counts						
Habitat	AM	AF	SAM	SAF	JV	Total
Dense forest	8	26	9	16	22	81
Fragment forest	12	29	13	21	31	106
Total	20	55	22	37	53	187

Table 5 .Number of vervet monkey counted during wet season

Number of counts						
Habitat	AM	AF	SAM	SAF	JV	Total
Dense forest	14	35	16	32	38	135
Fragment forest	21	46	23	48	52	190
Total	35	81	39	80	90	325

Keys: DS=Dry season, WS=Wet season, AM=Adult male, AF=Adult female, SAM=Sub adult m

A total of 5 and 8 groups were counted in the dry and wet season respectively. On the average, group size ranged from 20-40 individual. The number of Anubis baboon and vervet monkey counted during the wet season was significantly higher than the dry season=62.44, df=8, p<0.05).

5.2 Amount of crop damaged by pest primates

Maize (*Zea mays*) damaged by Anubis baboons and vervet monkeys throughout its growth stages seedling, flowering (tassle) and maturation (ripen) were recorded. The extent of damage varied depending up on the growth stages of crop and the type of animals that causes the damage. The highest damage recorded for Anubis baboon was 3880 (8.05%) at ripened stage and for vervet monkey were 2842 (5.89%), at the tassle stages (Table 6).

The damage caused by Anubis baboon and vervet monkeys on maize plant starting from the stage of seedlings to maturation was recorded in the study site. Out of the total of 48,208 maize plants, 5943 (12.32%) were damaged by vervet monkey as compared to 7611 (15.78%) by Anubis baboon at all stages. Maize damaged during seedling, flowering and maturation by Anubis baboon were 1652 (3.43%), 2079 (4.31%) and 3880 (8.05%) respectively.

Table6. Amount of damaged by Anubis baboons and vervet monkeys in the sampled areas.

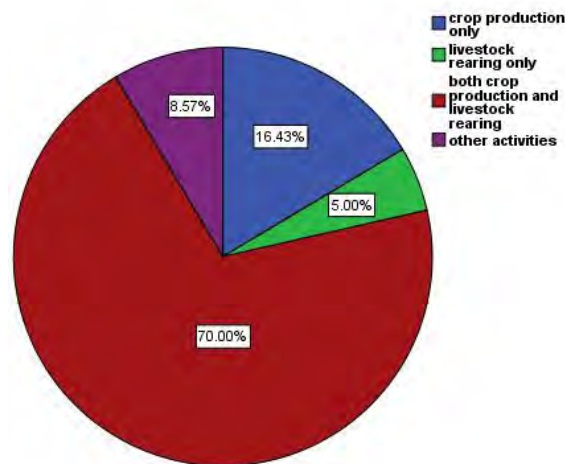
Stage	Anubis baboon		Vervet monkey	
	No of plants	%	No of plants	%
Seedling	1652	3.43	763	1.58
Tassle	2079	4.31	2842	5.89
Ripen	3880	8.05	2338	4.80
Total	7611	15.78	5943	12.32



Photo of Anubis baboon and vervet monkey in the study area.

Figure4 .Percentage of livelihood activities of the respondents

The major livelihood activity of the people living in the study area is subsistence agriculture that includes crop production and livestock rearing. Most (70%) of respondents depend on crop farming and livestock rearing and few (5%) depend only in livestock rearing. The major livestock reared by the community in the area are cattle, sheep, goat, pack animals (horse, donkey). Also (16.43%) and (8.57%) of respondents depend only on crop production and other activities respectively (Figure 4).



5.2.1. Amount of crop damaged by non-primate pests

From the total 32 plots of 6mx6m, damages caused by other animals such as wild pig (*Sus scrofa*), crested porcupines (*Hystrix cristata*) and hippopotamus (*Hippopotamus amphibius*) were counted and recorded at different developmental stages (Table 7). A lot of damage was observed during the ripening stage with 910 (1.88%) maize plants damaged followed by seedling 817

(1.69%) and flowering stage 671 (1.39%) and more damage was recorded by wild pig 1132 plants (2.35%) and least damage was recorded for hippopotamus 535 (1.11%) (Table7).

Table 7.Amount of maize damaged by non-primate pests

Animal	The developmental stage of maize						Total	
	Seedling		Flowering		Ripened		Nu	%
	Number	%	Number	%	Number	%		
wild pig	188	0.38	296	0.61	646	1.34	1132	2.35
porcupine	290	0.33	224	0.46	447	0.93	831	1.72
hippopotamus	177	0.41	107	0.22	231	0.47	535	1.11
Total	817	1.69	671	1.39	910	1.88	2498	5.18

Out of the total 48,208 maize plant grown, the maize crop damaged in the study area 15.78% of maize was damaged by Anubis baboon, 12.32 % of maize was damaged by vervet monkey and 5.18 % by other wildlife (Fig.5).

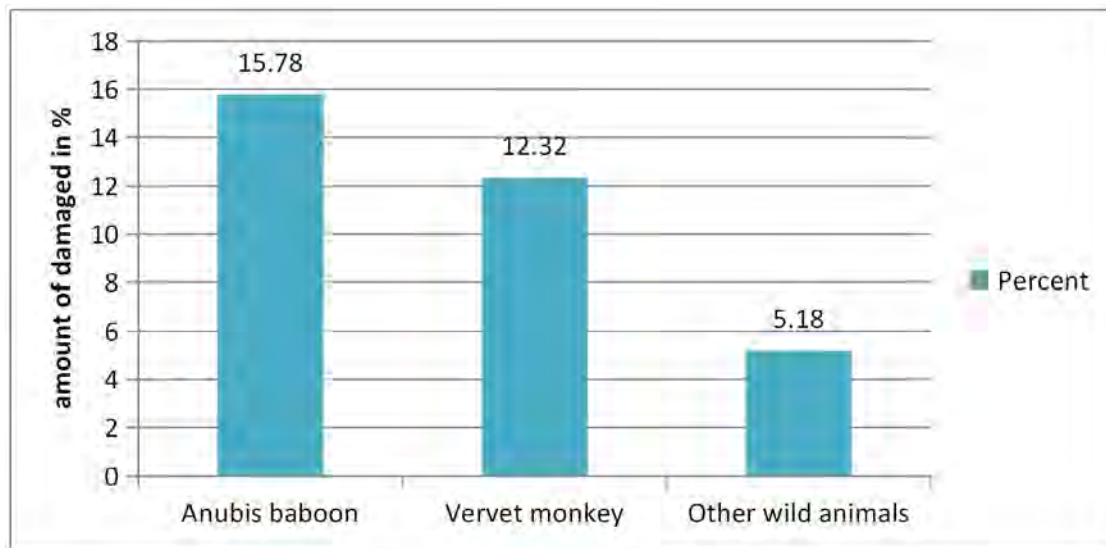


Figure5. Percentage of maize damaged by primates and non-primate pests

5.3. Supplementary results from questionnaire survey'

5.3.1. Background of the respondents

Among the respondents, 90 (64.28%) were males and 50 (35.72%) were females. Respondent farmers for the administered questionnaire survey were in the maturity age and also they had an experience in agricultural activities and trained in the challenges and crop raiding activities. Regarding educational background of the respondents, 43 (30.72%) were illiterate, 21 (15.00%) were read and write 46 (32.85%) completed elementary school, 30 (21.43%) had attended high school (table 8).

Table 8.Socio-demographic characteristics of respondents

Socio-demographic characteristics		Respondents	Percentage (%)
Sex	Male	90	64.28
	Female	50	35.72
Age range	20-30	44	31.43
	31-4	62	44.28
	41-50	19	13.57
	51-60	8	5.71
	>61	7	5.00
Education	Illiterate	43	30.72
Background	Read and write	21	15.00
	Elementary	46	32.85
	High school	30	21.43

Out of the total respondents, (44.29%) were married, (27.86%) were single and the rest 11.43% and 16.43% were divorced and widowed, respectively.

5.3.2. Economic activity and social interaction of the respondents

All the respondents own farmland with different size ranging from 0.5 hectare to greater than 4.0 hectare. 20 (14.29%) of the respondents owned 0.5 hectare, 51 (36.43%) of the respondents owned 0.6-2.0 hectare, 33 (23.57%) of the respondents owned 2.1-3.0 hectare, 24 (17.14%) of the respondents owned 3.1-4.0 hectare and 12 (8.57%) of the respondents owned greater than 4 hectare farmland. The detailed information is indicated in the following (figure 6).

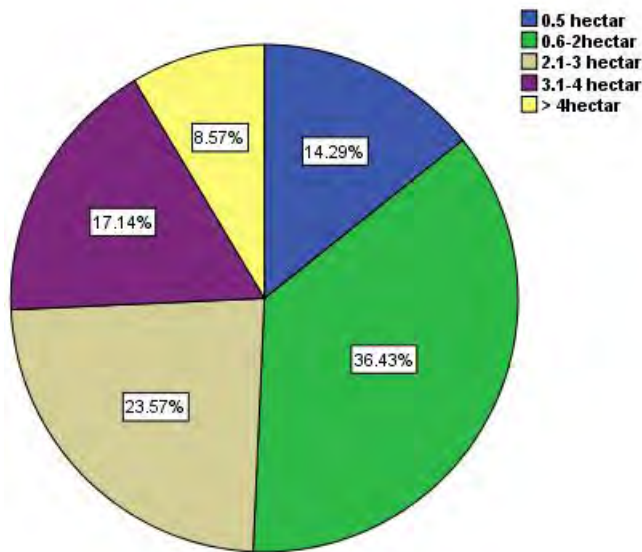


Fig.6. Size of farmland owned by respondent

Agriculture was the main activity of people around the study area. The main crop growing months were May to December. A survey conducted in the village, maize and teff was the major

crop. Farmers in the study area cultivate different type of crops, such as maize, teff, potato, sorghum, beans, wheat and barley. Most 59 (42.14%) of the respondents cultivate maize and teff, 34 (24.29%) cultivate teff, 18 (12.25%) cultivates barley, 16 (11.43%) of them cultivate Sorghum and maize and remaining 13 (9.29%) produced other cereal crops (table 9).

Table 9. Type of crops cultivated in study area.

Type of crop cultivated	Number of respondents	Percent (%)
Maize and Teff	59	42.14
Sorghum and maize	16	11.43
Teff	34	24.29
Barley	18	12.85
other	13	9.29
Total	140	100

5.3.3. Knowledge and practice of respondents on human primate conflict

All the respondents were asked about their yield in their farmland per hectare, accordingly 78 (55.71%) of them responded <10 quintals, 27 (19.29%) of them 11-15 quintals, 15 (10.71%) of them 16-20 quintals, 8 (5.72%) of them 21-25 quintals, 6 (4.29%) of them 26-30 quintals, 6 (4.29%) of the >31 quintals. (Table10).

Table10. Annual crop yield of respondent in quintal in 2015/2016

Yield in quintal	Number of respondents	Percent
<10	78	55.71
11-15	27	19.29
16-20	15	10.71
21-25	8	5.71
26-30	6	4.29
>31	6	4.29

Regarding the presence of forest in the study area, all the responds agree with its presence. Among these 44 (31.43%) used for fodder and fire wood, 73 (52.14%) used for fire wood and house construction and the remaining 23 (16.43%) of them used the forest for other uses (fig. 7).

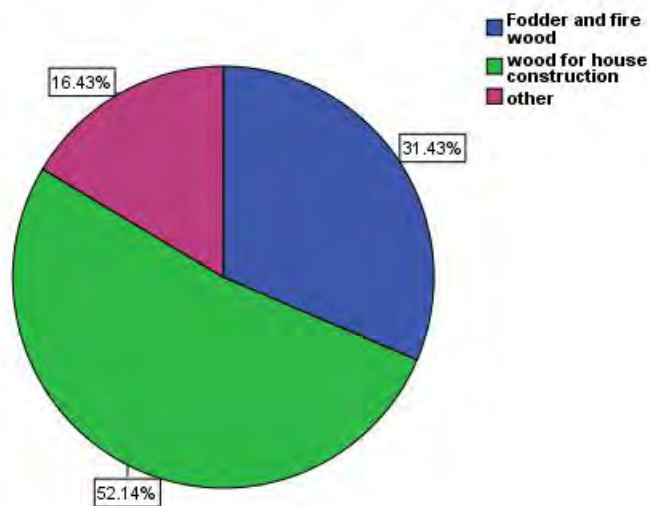


Figure 7. People used forest for different purpose

Regarding the distance from their farmland to the forest 20 (14.73%) of the respondents live very close to the forest up to(1 km), most respondents 52 (37.21%) 1.1 km-2 km far apart, 28 (20.16%) 2.1 km-3km far apart, 21 (15.50%) 3.1 km-4 km far apart and 17 (12.40%) above 4.1 km far apart from the forest. In general a total of (87.6%) of the respondents live up to 4 km away from the forest. because the forest found at the center of the kebele. This finding shows most of respondents close to forest and they conflict with pest primate in the forest (figure 8).

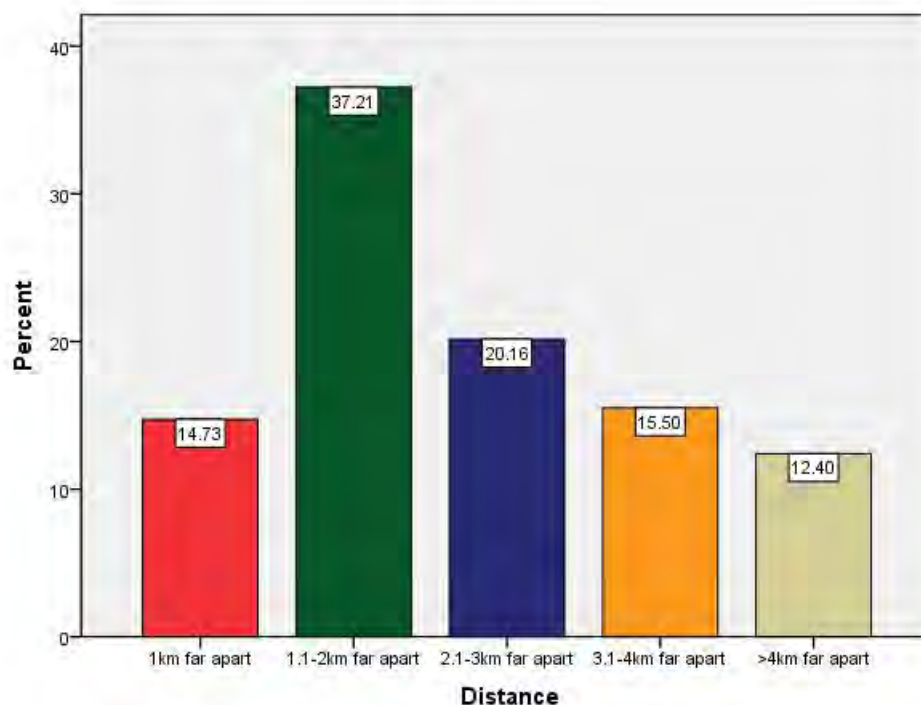


Figure8. Approximate distance of the farm land from the forest in kilometer

As shown in table 11 below, majority of the respondents replied that the tendency of crop damage is increasing from time to time (93.57%, n=131) while 2.86%, n=4) of the respondents replied that the extent of crop damage was decreasing. Moreover, most of the respondents replied that the extent of crop damage by wildlife was much (69.29%, n=97) whereas (9.28%, n=13) of the respondents considered the extent of crop damage by wildlife was very little. Most respondents additionally replied that the damage of crop was the highest near the forest zone (76.43%, n=107) table 11.

Table 11. Response of the respondents about the tendency, extent and season of crop damage with respect to forest location.

Human effect	Measurement	Number of respondents	%
Tendency of crop damage	Increasing	131	93.57
	Decreasing	4	2.86
	No idea	5	3.57
Damage of crop with respect To forest location	Forest zone	107	76.43
	Center	11	7.86
	Both	22	15.71

According to the respondents, the knowledge of crop damage other than primates was listed in table 12. In the study area wild pig (32.86%, n=46) highly affect crops and warthog (5.00%, n=7) was least influence on the crops other than primates (table 12).

Table 12. Response of respondent about animals those raid crop other than primates

Animal	Number of respondents	Percent
crested porcupine	12	8.57
wild pig	46	32.86
hippopotamus	10	7.14
Warthog	7	5.00
All	15	10.71
wild pig and porcupine	26	18.57
wild pig and warthog	16	11.43
Porcupine and hippopotamus	8	5.71

From the total respondents, 108 (77.14%) replied as the damage of the crop was sever in wet, 9 (6.43) replied that it was sever in dry and 23 (16.43%) responded that occur in both seasons (figure 9).

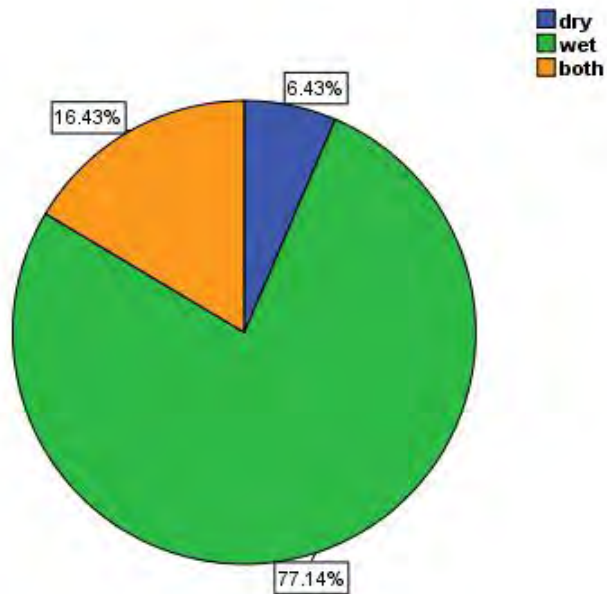


Figure9. Respondents view on Severity of crop damage on bases of season the study area

According to the respondents, severity of crop damage varies in different reasons. 61 (43.57%) responded that the reason was the presence of plenty food in the farm, 39 (27.86%) responded due to the attractiveness of farm crops, 27 (19.29%) responded it was due to shortage of food in the forest, 13 (9.28%) responded due to unfavorable condition (figure10).

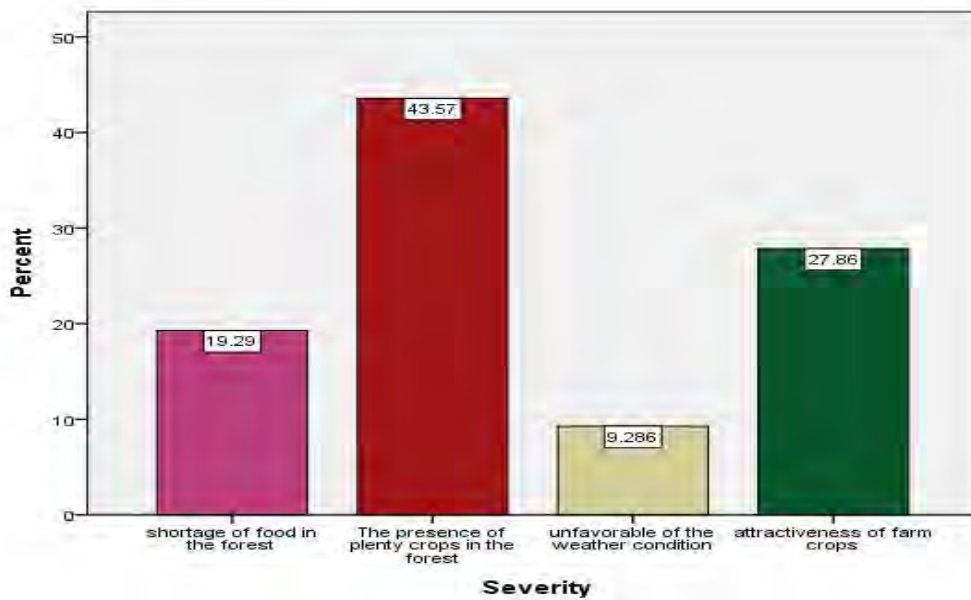


Figure10. Reason of crop damage in specific season

According to the responses of the respondents, several of animals were involved in different degree of crop raiding. Most of the respondents reported some degree of crop losses as a result of damage by wildlife and a total of six wild mammal species were reported to raid crops around the study area. According to the respondents, Anubis baboon was the most commonly reported crop raider on the farmland causing much damage. They damage crops early in the morning and evening when people are absent near farmlands. Farmers ranked pest animals from the one causing most damage to that causing the least damage (Table 13).

Table13. Rank of animals based on the extent of damage cost on crops

Name of animals	Number of respondents	Rank
anubis baboon	140	1
vervet monkey	131	2
wild pig	93	3
Porcupine	76	4

A 77 (55%) more of respondents responded that the crop was guarded by children and few of the respondents replied that it was guarded by women 28 (20%) Table14).

Table 14. Response of respondent about guards protecting the crops

List of guarding	Number of respondents	Percent
Men	35	25
Women	28	20
Children	77	55
Total	140	100

Regarding control measure used to prevent wild animals from crops, 66 (47.14%) permanent guarding, 41 (29.29%) chasing by dogs, 19 (13.57% making scarecrow and 14 (10.00%) hunting (Table 15). Guarding was the most familiar methods. Most of the respondents reported that they guarded their crops especially during the harvest season. Chasing by stones are other methods used.

Table 15. Methods of respondents use to protect crops from crop raiders.

Method of guarding	Number of respondents	Percent
Permanent guarding	66	47.14
Chasing by dog	41	29.29
Scarecrow	19	13.57
Hunting	14	10.00
Total	140	100

5.4 Supplementary information from interviews

The interviewed persons from the study site indicated that, most of the farmers cultivate crop such as maize, teff, sorghum, barley, potato, wheat and beans. But some of the farmers were restricted to produce only two up to three types of crops due to the small size of their farmland. According to their idea maize, teff, barley, wheat and potato were commonly cultivated by each farmer in the present study area. The interview was also conducted to realize the presence of forest and the benefit obtained from the forest. The entire ten (10) of the explained the existence of the forest in the villages especially around Gura Tirigni forest of Gendo kebele. Most of the society gets from the forest fire wood, fodder, for their cattle grazing and charcoal seller also destroyed the forest.



Photo of interviewer person in the study area

All of the interviewed persons discussed about the presence of primates and types of wild animals in their locality and expressed that Anubis baboon, vervet monkey, wild pig and

porcupine were identified around their village and Anubis baboon and vervet monkey were the common pest primates. they were interviewed about the relative important of pest primate and all of them implied anubis baboon was a primate which destroy large mass of crop with in single visit and they ranked it in the first place while vervet monkey in the second stage and the third stage ranked pigs. Also the person interviewed in Gendo kebele estimated that average yield lost was 25-40% of maize, 16-26% of teff, 24-32% of wheat, 10-18% of Barley and 22-31% of Potato per hectare caused by pest primate every year, especially by Anubis baboon, vervet monkey and porcupine. The other point is raised for the interviewed person was about problems caused by pest primate other than crop damage and those persons from the study site, explained that anubis baboon creates great problems like predation of domestic animals such as sheep ,goat ,hen and attaching humans especially children. They also explained that the problems that because conflict is the production of crops close to forest edge, center of forest and destruction of wildlife habitat for subsistence agriculture and the increase in human population from time to time. As human population increases, encroachment to the wildlife habitat becomes decrease resulting in resource depletion.

6. DISCUSSION

Data collected through the questionnaire survey pointed out that wild animals found around the study area often destroyed standing crops and caused economic loss to farmers in the study area. Similar studies in different parts of Africa revealed that wild animals posed major threats on crops (Hill, 1997; Kagoro-Rugunda, 2004; Okello, 2005). Anubis baboon (*Papio anubis*), Colobus monkey (*Colobus abyssinicus*), crested porcupine (*Hystrix cristata*), wild pig (*Sus scrofa*), hippopotamus (*Hippopotamus amphibius*) and vervet monkey (*Chlorocebus aethiops*) were identified in the study area.

Among these Anubis baboon and vervet monkey were the known pest primates. Farmers ranked that Anubis baboon is the leading crop raider followed by vervet monkeys. The analysis of data collected through direct observation also has shown more or less the same result with that of questionnaire survey. Species observed damaging crops were the same as those species listed under questionnaire survey. In case of direct observation Anubis baboon (15.78%), vervet monkey (12.32%) and other wild animals (5.18%) destroy farmers' crops. The result of this study showed that there was a strong conflict between these animals and the local people. The conflict between these animals and the local people was high during the wet season where the animals get enough resources for the survival of the species. The competitions for resources cause conflict between wild animals and people. This result is in line with the study of Hill (2000) and Quirin (2005) who reported that the wild animals increasing year to year which is due to competitions for resources between wild animals and human populations. Because of the destruction of natural habitat of the animal by human activities the natural diet of the animals was lost in the area. As a result animals move to the farmland in search of food and caused

damage. This result was in agreement (Priston *et al.*, 2001) reported that habitat destruction and fragmentation was the main cause of human primate conflict in Indonesia.

The study showed that the population of wild animals in the study area varied from season to season. Relatively more pest population was recorded during the wet season than the dry season because the maize farmland across the forest will become attractive and will provide a plenty of food sources for these primates. During the dry season food will become scarce in the farmland, thus the Anubis baboons and vervet monkeys might temporally migrate from forest to forest in different area. In addition the ability of vervet monkeys to exploit different varieties of food enables them to Survive and have large number of population in the area. This result is similar to the study conducted by (Melese Yihune, 2007) who reported that more pest population was recorded during the wet season than the dry season in wonji shoa.

The variation in the sex ratio provided suitable conditions for male individuals to find mates for reproduction. As a result, the Anubis baboon population is in a good status in the area. This was confirmed by observation and population estimation both during the wet and dry seasons. The finding of the current study shows that the sex ratios (F/M) in the two pest primates were not 1:1. It was 1:3 for Anubis baboons and 1:2.5 for vervet monkey. The number of females counted in the study site is high. This variation in sex ratio provided suitable condition for the male individuals to finding mates during the time of reproduction and posses their gens to the next generation. The result of the present study agrees with Melese Yihune, (2007) who reported that anubis baboon and vervet monkeys of sex ratio is 1:2.5 during the wet and dry season in wonji shoa.

Resource competition was one of the causes for the conflict. The farmers in the study area use the forest for different purposes by destructing the habitat of wildlife animals. This practice forces wild animals to engage in crop damage and distraction of other valuable material. Similar studies was worked by (Melese Yihune, 2006) in Bale and around the Semen Mountains National Park the people destroying forest for the purpose of fire wood, cattle grazing and other benefit engages primate to raid crop.

The result of the study shows these pest primates caused a great damage to maize more than other crops, because of easy handling of maize cobs than other crops. There are a number of reasons for primates raiding crops .Firstly; primates are attracted to maize and other tasty crops because they were more nutritious than the food that a primate would eat in the wild. Secondly, people's destruction of woodland may cause more crop-raiding. Where people clear the forest for agriculture, primates lose forest their habitat and their sources of food, so they may start raiding more crops because their own supply of food has been affected.Thirdly, some primates are become used to people. For example, in Uganda baboons have become used to seeing tourists and so have lost their fear of people. They raid crops in farms at the edge of the forest without fear (Hill, 1998).

On the basis of samples taken for direct observation, 33.28 % was lost due to crop raiding by wild animals. This result was greater than the result reported by Leta 26.9% (2014) in Gera district, western Ethiopia. In addition to this, the result showed that not all crops were equally affected by crop raider during the present study 59 (42.14%) of the respondents claimed that maize and teff was the most vulnerable crop and crop raiders by barley 18 (12.85%). where about 16 (11.43%) respondents responded that sorghum was the last vulnerable crop to damage caused by wild animals in my study area. The result agreed with finding of Warren (2008) who

reported that maize is the most frequently consumed crop by raiding in West Africa. The result was inconsistent with the study of Warren, (2008) who reported that the maximum loss was registered on maize crop which covers 73.4% of the total loss occurred, the loss of sorghum were about 17% from the total loss . This might be caused due to the maize crop was the most frequently eaten crop by crop raiders in West Africa. The work done by Vercamen and Mason (1993) showed that about 8.9% of maize was damaged by hippopotamus during the wet season. Conversely, in the present study area, hippopotamus was repeatedly observed in the farmland of fields (1.11%) and it usually damages maize by grazing on the young shoots of the corn.

Regarding the variation of damage in the developmental stages of maize, large amount of damage was recorded during the flowering stage by vervet monkey and during matured stage by Anubis baboon and the least amount was recorded during the seedling stages by both pest primates in the study sites. In the flowering stage the cob was not matured so that the pests jump from one to another to get the best cob by destroying large amount of maize plants. In matured stage they get fruitful energy content food, which attract them to farm land. On the other hand tassel and ripen stages were suitable for the pests to hide themselves in the farm. The result was agreed with the study of Hill (2000) who reported that during seedling stage the farmland was clear and the guard can control the pest easily by watching them from farm distance in Uganda. Farmers in the study area developed different strategies to prevent their crop against wild animals from crop damage. Guarding was a method used by large number of farmers in protecting their crop from damage by pest primates. Guarding was popular method in different parts of Africa (Sillero-Zubiri and Swetzer, 2001). Making scarecrow, chasing and hunting was also common methods which were used in the study site. From all these methods, guarding crop permanently was the effective method to protect crops from damage of pests. When they use

chasing Anubis baboon run to forest and frequently turn back and vervet monkey hide themselves in the bush and branches of trees. Similar study conducted by Ram and Kandel (2008) who reported that, the most commonly used crop protection strategies in that study area was secured their field constant vigilance during crop season. The finding of the present study indicates successfully guarding required that people be in the fields for long period of the day throughout the seasons when there were vulnerable crop in the most of the year. This study agrees with the study made by Kate (2012) who reported that people had other tasks to complete including attending school, household chores, trading in the local market and employment for local chores.

In these finding men, women and children were the people who guarded the crop to protect from the damage by pest primate and other. Similar study is done by Kate (2012) and Hill (2000) who reported that in Hoima district (Uganda) adults particularly, women were least involved by guard and two-third of all crop guarding was carried out by children. Guarding was common especially during the harvest season. During this time, farmers guard crops even during the morning and night time. Farmers, which had no children to guard their crops, chase wild animals away from the nearby area of the farm at certain interval.

In the present study, both the number of Anubis baboon and vervet monkey was increased during the wet season when compared with that of dry season. Because during the wet season farmers cultivated their farmland all around the forest so that they exist all in all in the forest to raid the crops near to that forest but in dry season population of these primate might temporarily migrate from the forest to other area to search for food. Anubis baboon and vervet monkey damage crops during day time where as wild pig, warthog and porcupine damage crops during night time and warthog affects crops early in the seedling.

7. CONCLUSION AND RECOMMENDATIONS

7.1. Conclusion

The present study tried to investigate the cause and effect of human-wildlife conflict with special emphasis to pest primate in Gendo kebele, Gida Ayana District, western Ethiopia and also tried to estimate amount of crop damage. Human-wildlife conflicts exist in different forms all over the world and experienced more in developing countries. The cause of human-wildlife conflict is disturbance of natural habitats by increased subsistence agriculture around forest edge, shortage of food in the forest, unfavorable situation in the forest.

Farming system in the study area was traditional seasonal type. Crop raiders cause significant loss on farmer's crop production. Maize is the main crop which was cultivated by most of the farmers in the study area and it was the most vulnerable crop raided by wild animals. Farmers in the study area depend on the forest for different resources such as fire wood, fodder and wood for house construction and consequently competition between human and wildlife animals occurred. The major pest primates namely Anubis baboon, vervet monkey, wild pig, and porcupine were identified. The highest crop damage was caused by Anubis baboon followed by vervet monkey in the study area. Most of the damage was recorded at flowering stage by vervet monkey and in matured stage by Anubis baboon. Other wild animals such as wild pig, warthog and porcupine raid crops at all stages.

As respondents explained the number of primate species in the study area and the population number increased from time to time.

7.2. Recommendations

Based on the present study, the following points are recommended to mitigate the human- pest primate conflict in the study area.

- ✓ To reduce the dependency of the local people on the forest, it is better to encourage the local people to plant trees for their various types of utilization.
- ✓ Crop damage depends on the taste of the cereal crop plants. For example in the study area, porcupine totally feeds on potato crops. Therefore, the food habit of wildlife should be systematically studied and encouraged societies to grow less preferable and unpalatable crop to wildlife.
- ✓ Giving awareness among the local people to develop the knowledge about the issue of environmental degradation and its overall impact, as well as sense of ownership of natural resources.
- ✓ Most of landless youngster of the study area uses the forest as better sources of farmland. To solve these problems, the government should encourage and organize youngsters in different organizations for creating job opportunities instead of damaging the forest for agricultural purposes.
- ✓ Stakeholders should reduce human settlements around the forest, expansion of farmland and cattle grazing in the forest.
- ✓ Encouraging farmers to protect their crops farms cooperatively from crop raiders.
- ✓ The local community should protect and conserve the natural habitat of animals.
- ✓ Encouraging the development of ecotourism which benefits local resident and wild animals without harming one another.

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Appendix I

Questionnaire for the survey on crop damage and other related activities.

1. Respondents'

Sex -----

Age-----

2 Educational back ground

A. Illiterate B .Read and write only C. Elementary D. high School

3. Marital status

A. Widowed B. Married C. Divorced D. Single

4. Do you have your own farm land?

A. Yes B. No

5. What is the size of your farmland?

A.0.5ha B.0.6-2ha C.2.1-3ha D. 3.1-4ha E. Greater than 4 ha

6. What type of crop do you cultivate on your farm land?

A. Maize and teff B. sorghum and maize C.teff D. barley E. Others

7. How many kilogram (quintal) yields did you get from all you cultivate last year?

A.1-10 quintal B.11-20 quintal C.21-30 quintal D.31-40 quintal E.41-50 quintal F. >51 quintal

8. is there forest around in your settlement?

A. Yes B.NO

9. Which of the following resources do you use from the forest?

A. Fodder and Fire wood

B. Wood for house construction

C.other

10. How much the distance of your farm land from the forest?

A.1 km far apart B.1.1-2 km far apart C.2.1-3 km far apart D.3.1-4 km far apart E. > 4 km far

11. Are there wild animals around your village?

A. yes B. No

12. In what location of the crops damaged more by primate pest?

A .forest zone B. forest center C. both

13. What is the tendency of crop damage from time to time?

A. Increasing B .Decreasing C. no idea

14. The damage of crop is severing in which season?

A. dry B.wet C. both

15. Which of the following ideas can be the reason why it is sever in specific season or month?

A.shortage of food in the forest B.The presence of plenty crops on the farmland

C. unfavorable of the weather condition D .attractiveness of farm crops

16. What is your livelihood activity?

A. crop production only B.livestock rearing only C.both crop production and livestock rearing

D.other activities.

17. What type of animals raid crops other than primate found in Gendo forest?

18. What methods do you use to prevent crop damage from wild animals?

19. If permanently guarding is the method practiced in your locality, who is the guard?

A. women B. children C .men D. women and children

20. Rank crop raider according to the extent of crop damage

Appendix II

Data collection sheet for direct observation of crop damage by wild animals or pest primate

Name of data collector _____

Place _____

Season _____

Stage of crop development _____

Distance of the field from the forest boundary _____

No	Species Observed	Type of Crop and Amount of damage	Part of crop damage	Time of observation	Traditional method used to control wildlife	Remark
1						
2						
3						
4						
Total						

Appendix III

Data collection sheet for population Estimate of pest primate

Date _____

Species name _____

Season _____

Place _____

Site _____

Name of data collector _____

No	Group type	Age structure			Remark
		Adult	Sub adult	Juvenile	
1					
2					
3					
4					
Total					

Appendix IV

Interview

1. What type of crops do you grow on your land?
2. Can you estimate the amount of yield did you lost from all crop in % every year?
3. Do you think the presence of the Gendo Gura Tirigni close to your area benefited the society?

If benefited what are they?

4. List the primate found in the forest around your village?
5. What is the importance of conserving wild animals present in the forest?
6. What about the number of these primates, is it increasing or decreasing? Explain the reason.
7. What is the problem of wild animals to encourage crop damage?
8. What about the number of human population from time to time?



A. Guarding

B.Scarecrow



C.Guarding by male



D.Chasing by dog

Photo shows different methods people use for protecting their own crops (by Belay Worku)