

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF ZOOLOGICAL SCIENCE



Human-wildlife conflict with special emphasis on pest primates in and around Chato forest, Horro woreda, Western Ethiopia

Asebe Regasa Werkinch

A thesis submitted to the school of graduate studies, Addis Ababa University, in partial fulfillment of the requirements for the degree of Masters of Science in Biology (M.Sc)

September, 2017

Addis Ababa, Ethiopia

ACKNOWLEDGEMENT

I would like to express my sincere appreciation to all who supported me while I am working on my thesis. First of all I would like to forward my warm gratitude to my advisor Dr. Habte Jebessa for his help in identifying the topic, his consistent and stimulating advice, valuable suggestions and insightful academic assistance for the completion of the thesis in reading the manuscript in time and providing constructive comments.

I am grateful thanks to the staff of Bone-Abuna and Gudina-Abuna kebeles administration for their coordination, organizing the community and helping me in data collection and development agents working on Gudina-Abuna kebele for their unrestricted provision of information and help. My heartfelt thanks also go to my beloved wife Burtukan Mulugeta for her emotional and moral support throughout the years of my study. My father Regasa warkina and my mother Rabitu Abdena also deserve special thanks for my today's success is rooted in their unreserved support. Last but not least, I would like to thank Fincha Preparatory school director for providing materials to conduct this study.

Table of Contents

Contents	page
ACKNOWLEDGEMENT	i
List of Tables	v
List of Figures.....	vi
List of Plates	vii
List of acronyms	viii
ABSTRACT	ix
CHAPTER: ONE.....	1
1. Introduction	1
1.1. Background of the study	1
1.2 Statement of the problem	3
1.3 Objectives of the study.....	4
1.3.1 General objectives.....	4
1.3.2 Specific objectives:	4
1.4 Research questions.....	5
1.5 Significance of the study	5
1.6 Scope of the study	5
CHAPTER: TWO.....	6
2. LITERATURE REVIEW	6
2.1 Concept and definition of Human Wildlife conflict	6
2.2. Human- Wildlife Conflict	6
2.2.1 The Human Primate Conflict	7
2.3 Causes of human wildlife conflict (HWC).....	8
2.3.1 Human Factors	9
2.3.1.1 The requirement of human development	9
2.3.2 The Habitat Factor	10
2.4 Changes in agricultural methods and techniques.....	11

2.5. Type of crops most affected and extent of damage by wild animals	11
2.6. Attitudes of local people towards primates	12
2.7 Attitude of peoples towards other Animals	13
2.8. Factors that influence abundances of primates	13
CHAPTER THREE: MATERIALS AND METHODS	15
3. 1.Description of study site.....	15
3.1.1 Location	15
3.1.2 Climate.....	16
3.1.3 Soil and Topography	19
3.1.4 Population and Land use	19
3.2 Materials	19
3.3 Methods	20
3.3.1 Sample size and sampling design	20
3.3.2 Preliminary survey	21
3.3.3 Pilot survey.....	21
3.3.4 Data collection	21
3.3.5 Data analysis.....	24
CHAPTER FOUR: RESULTS	25
4. Results	25
4.1. Background characteristics of the respondents in the study area.	25
4.2. Economic activity and social interaction of the respondents.	27
4.3 Type of crops most affected and extent of damage by animals	28
4.4 Pest primate species most involved in crop raiding.....	32
4.5. Causes of Human wildlife conflict	32
4.6 Wild animals involved in crop damage	35
4.7 Population estimation of crop raiders.....	36
4.7.1 Population estimation of Anubis baboon.....	36
4.7.2 Population estimation of Vervet monkey.	38
4.8 Amount of crops damaged by crop raiders.....	40
4.8.1 Amount of crop damaged by Anubis baboon and vervet monkey	40
4.8.2. Amount of crop damaged by other wild animals.....	41
4.10 Livestock depredation	44

5. DISCUSSION.....	46
6. CONCLUSION AND RECOMMENDATION	49
6.1 CONCLUSION.....	49
6.2 RECOMMENDATION	51
7. REFERENCES	52
8. APPENDICES	57

List of Tables

Table 1. Number and percentage of respondents who cultivate crops in the study area	28
Table 2. Ranking of crops in the order of destruction by crop raider	29
Table 3. Percentage of trend of crop damage by crop raiders based on respondents reply	29
Table 4. percentage of the respondent about extent of crop damage by wild animals	29
Table 5. Crop damaging wild animals, crop type , stage damaged and time	31
Table 6. Listed of wild animals found in the study area as revealed by respondents	32
Table7. Lists of crop raiding wild animals and ranked based on the extent they damaged crops.	35
Table8. N/ Baboons counted in the sampled forest during dry and wet season in the study sites.	37
Table 9. Number of Vervet monkeys counted in the sampled forest during dry and wet season.	40
Table 10. Amount of maize damaged by pest primate in the sampled areas.....	41
Table 11. Amount of maize damaged by other wild animals	41

List of Figures

Figure 1. Map of the study area.....	16
Figure 2. Climate diagram for Chato Forest-Shambu Town..	18
Figure 3. Gender of respondents	25
Figure 4. Age of respondent	26
Figure 5. Education backgrounds of respondents	26
Figure 6. Percentage of farmland owned by respondents.	27
Figure 7. Size of farmland owned by respondents.	27
Figure 8. Severity of crop damage on bases of season.....	28
Figure 9. Percentage of livelihood activities of the respondents	31
Figure 10. percentage of respondents those faced different conflict by wild animals	33
Figure 11 . Causes of human wild animals conflict as revealed by respondents	35
Figure 12. The distance of the farmland from the forest edge.	36
Figure 13. percentage of maize damaged by Anubis baboon, Vervet monkey and other wild animals.	42
Figure 14. Different traditional methods to defend crop raider from crops.....	43
Figure 15. percentage of respondents used different traditional methods.....	44
Figure 16. Loss of goat and sheep by Anubis baboon between January 2015 & 2017 according to the respondents.....	45

List of Plates

Plate 1. Habitat disturbances due to inappropriate site selection of investment (A & B and increased subsistence agriculture to forest edge(C & D).	34
Plate 2. A photograph showing Anubis baboon in the study area.	38
Plate 3. A photograph showing Vervet monkey in the study area.....	39

List of acronyms

CSA	Central Statistical Authority
DA	Development Agents
EFAP	Ethiopia Forestry Action Plan
EMA	Ethiopia Mapping Agency
EMSA	Ethiopia Meteorological Services Agency
FAO	Food and Agricultural Organization of the United Nations
FGD	Focused Group Discussion
GPS	Global Positioning System
H.W.R.D.O	Horro Woreda Rural Development Office
Ha	Hectares
HH	House Hold
HWC	Human-wildlife conflict
IUCN	International Union for the Conservation of Nature and Natural Resources
NFPA	National Forest Priority Areas
SPSS	Statistical Package for Social Science

ABSTRACT

*This study was conducted to assess human wildlife conflict with special emphasis on pest primates around Chato forest, Horo district, Western Ethiopia. The study was carried out from September 2016 to June 2017. The main objective of the study was to identify the cause and effect of human wildlife conflicts, to estimate the loss of crops destroyed by pest primate and to estimate the population size of primate pest in the study sites. The data for this study was collected via structured questionnaires, Focus Group Discussion, direct observation and secondary sources. Field observation using line transect was used to estimate the population size of pest primates and to estimate the crop loss due to pest primates. The collected data was analyzed by Statistical Package for Social Science. Chi-square test was employed to compare number of Anubis baboon and Vervet monkey counted during dry and wet season and also was employed to compare traditional methods used by the respondents. The result of the respondents should 66.1% and 12.4% existence of Human wildlife conflict manifested via crop damage and livestock predation respectively. The findings also showed that there was significantly different on the number of Anubis Baboon in dry and wet season ($p < 0.05$). The response of respondents report that habitat disturbance, increased subsistence agriculture, deforestation as causes of Human wildlife conflict. Anubis Baboon, Vervet monkey, Wild pig, Warthog, Porcupine and Civet cat were identified as damage causing wild animals. Most raided crops were maize (*Zea mays*) in the production season. About 28.1% of maize was damaged by crop raiders from the total estimated maize plant. A total of 265 and 295 Anubis baboon and 168 and 206 Vervet monkey were estimated in the sampled forest in dry and wet season respectively. Respondents used guarding, making scarecrow, chasing and smoking to defend crop raiders. There was significant difference between the respondents ($P < 0.05$) in using those traditional methods in which about 70% of them used guarding and 4.1% of them used smoking which was the highest and lowest methods used by respondents respectively. The present study identifies the major causes of Human wildlife conflict in Horro district, western Ethiopia and manifested through crop damage and livestock predation, wild animals habitat disturbance and increased subsistence agriculture. Therefore, based on the finding of this study, it is recommended palatable and nutritive crops should not be grown near the forest edge, educate the local community about a benefit, wildlife conservation, conservation education is paramount and cooperatively keep their crop.*

Key words: Human wildlife conflict, crop raiders, pest, habitat disturbance

CHAPTER: ONE

1. Introduction

1.1. Background of the study

Human wild life conflicts have started since the beginning of the emergence of human beings. During this time, people lived in the caves where there was a conflict between human being and wild animals. Slowly, with technological advancement, it was 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 animal as food and protection (Eltringham, 1979). The transformation of global landscapes from predominantly wild to predominantly anthropogenic over the last centuries has create competition between humans and wildlife for space and resources and it reached on unprecedented level (Hanks, 2006; Kate , 2012). As wildlife habitat becomes more and more fragmented and wildlife gets confined into smaller pockets of suitable habitat, human and wildlife are increasingly coming in to contact with each other (Madden, 2008; Lamarque et al., 2009).

Human wildlife conflict is defined as any interaction between humans and wildlife that results in negative impacts on human social, economic or cultural life, on the conservation of wildlife population, or on the environment. It occurs when human or wildlife is having an adverse impact upon the other. Conflicts between humans and wildlife have occurred since the dawn of humanity. They occur on all continents, in developed as well as developing countries (Lamarque et al., 2009). For examples, dense human population is close vicinity to nature reserve that seems to pose the greatest challenge in many countries. Conflict becomes more intense where livestock holding and agriculture are important part of livelihoods. A wide variety of wildlife comes into conflict with farming activities for searching of resource which causes crop damage and wildlife mortality (Madden, 2008). According to World Wide Fund for Nature (2005) as human population expands and natural habitats shrink, people and animals are increasingly coming into conflict over living space and food. The relative impact of wild life damage on farm production and how sold income varies greatly according to the amount of land owned and people's economic dependence on rural activities (Messmer, 2000). However, primates are highly

significant pests in tropic area, where local people are mainly subsistence farmers (Hill, 1997; Priston, 2005). Primates are among the pests that damage crops particularly in African and Asian reserves, accounting for over 70% of the crop damage and 50% of the area damaged (Naughton-Treves, 1998). Because of their intelligence, adaptability and manipulative abilities, some species can easily turn to crop foraging and make formidable crop raiders.

Human wildlife conflict is rapidly becoming one of the most important threats to the survival of many wildlife species and is an increasingly significant obstacle to the conservation of wildlife (Madden, 2008). It is a serious issue in Africa and other developing areas of the world where rapidly growing human populations and expanding settlements are reducing the areas left for wildlife habitat and increasing the interaction between humans and animals (Blair, 2008). Crop damaged by wildlife is not only affecting a farmer's ability to feed his family, but it also reduces income and has consequence for health, nutrition, education and ultimately development (Naughton et al., 1998). The conflict now also poses one of the greatest threats to the persistence and survival for many species (Dickman, 2010). Crop damage in Africa potentially life threatening species such as warthogs, Vervet monkeys and Anubis baboons results in unique dilemma (Naughton Treves, 1998).

Ethiopia is a large and ecological diverse country with unique environmental conditions (Afework Bekele et al., 2011). Moreover, its vegetation has been deforested for various purposes (Demeke Datiko and Afework Bekele, 2011). As a result, wild animals resources of the country are now largely restricted to a few protected areas (Tewodros Kumssa and Afework Bekele, 2008). Agricultural activities are expanding that leads to forest encroachment, habitat destruction and further to human wildlife conflict which in turn lead the farmers have increasingly lost crops to pests/problem causing animals (Joseline, 2010). 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 Horro land is once covered by natural forest, now a day it is shrinking in size due to increasing in agriculture and investment in forest area. 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).

This is the predominant problem among the small holder, like Ethiopian farmers. However, as other parts of the world, in Ethiopia, large herbivore mammals have been causing damage to agricultural crop 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, 2010). Nevertheless, in Ethiopia only few studies were carried out on human-wildlife conflict in some specific regions of the country (Tewodros Kumssa and Afework Bekele, 2008). The problem becomes serious specifically when it comes to the farmers in Horro District where the tropical rainforest remnant, harboring primates as their dominant fauna. They raid crops like maize, bean, teff, wheat and barley, but they prefer maize more than other crops, because it is the main crop cultivated in the study area. Therefore, the present study was conducted to assess Human wildlife conflict with emphasis to pest primate around Chato forest in Horro District.

1.2 Statement of the problem

Human wildlife conflict is becoming a serious threat to the survival of many pest primates in the world. It is not restricted to geographical regions, but it is common to all areas where wildlife and human population coexist and share limited resources. The people living in developing countries of Africa and Asia are suffering from the negative impact of human wildlife conflict, such as crop damage and livestock predation (Taylor, 1984). Likewise, study conducted in Ethiopia describes the presence of pest primates which damage crops and cause various economic losses. Primate are the worst pests of crop due to their adaptability, intelligence and high levels of socialization and cooperation, so they are one of the causes for yield loss of farmers from time to time. Crop raiding can be simply defined as wild animals moving from their natural habitat into agricultural land to feed on the crops that humans grow for their own consumption and destruction of domesticated plant life within the designated region (Hill, 1997). Across the globe, primates are most frequently identified as crop raiding animals. This is because of the renowned crop raiding behavior of the species (Sillero and Switzer, 2001). Wildlife damage to crops varies considerably from site to site and farmers have unequal capacity for

preventing such losses. Farmers have increasingly lost crops to problem animals, hence increased human wildlife conflict. This has increased competition for forest resources by both humans and wild animals, due to destruction of wildlife habitats which leads to competition for food, among other forest resources and increased the food shortage problem within the area. The reason why this topic has been selected that most of the developing countries economy is based on agricultural products and Ethiopia is a country with about 85% of the people are farmers and the economic policy of the country is mainly agriculture based. So to carry out the stated policy, agricultural products especially crops should be protected; the wildlife which damage crops should be addressed and stakeholders should search possible solution. In Horro district there was no research conducted on Human-wildlife conflict before. Therefore, this study was focused on the cause and the effect of Human-wildlife conflict with emphasis on pest primate on crop damage. Different type of food items are targeted by wild animals from cereal crops to fruits and from vegetables to trees (Sillero and Switzer, 2001). In the study area food items such as maize, barely, wheat, teff and potatoes are affected by wildlife animals like Anubis baboon, wild pig, warthog, porcupine and Vervet monkey. Thus, the present study was conducted to estimate crop loss as the major source of Human Wildlife conflict in Horro district. In this district the problem become a serious due to the presence of remnant tropic rainforest that harboring primates as their dominant fauna.

1.3 Objectives of the study

1.3.1 General objectives

The general objective of this study is to assess the cause and effect of human wildlife conflict with special emphasis on pest primates in and around Chato forest, Horro district, Western Ethiopia

1.3.2 Specific objectives:

- ❖ To identify the causes and effect of human wildlife conflicts.
- ❖ To estimate the loss of crops destroyed by pest primates.
- ❖ To estimate the population size of pest primates in the study sites.
- ❖ To recommend possible solutions to mitigate the problems caused by pest primates

1.4 Research questions

Based on the specific objectives indicated above the following guiding questions of this research was:

- ✚ What are the causes of the problems of human wildlife conflict in the study area?
- ✚ How much of the crops are damaged by crop raiders?
- ✚ What is the primate species most involved in human wildlife conflict in the study area?
- ✚ What are the possible solutions to mitigate problems caused by pest primates?

1.5 Significance of the study

The present study focused 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 particularly problematic across different part of the country , especially in rural area where subsistence farmers living and farming at buffer zone. In the study area, majority of the land is covered with forest and farmers who are near to the forest are the more victims of this crop damage. 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, the present study can provide information about the specific species of wild animals and crops mostly damaged by it. The present study was to maximize the understanding of people towards the primate conservation and also show how to bring the conservation and socio-economic stability of the farmers who are suffering from the attack of wild animals. Moreover, the data may be used as secondary sources for researchers who are working in the study area and also provides baseline data on human wildlife conflict. Hence, this study can paramount important in identifying type of primate and method of minimizing the human wildlife conflict in the study area.

1.6 Scope of the study

The present study was delimited to the representative area: that is in and around Chato forest in Horro district, western Ethiopia. The study focuses on two kebeles (i.e. Gudina Abuna and Bone Abuna), the sample size for each selected farmers kebele was determined according to the proportion of total number of their household heads for the study.

CHAPTER: TWO

2. LITERATURE REVIEW

2.1 Concept and definition of Human Wildlife conflict

Conflict is difference or in compatibilities in interests or perception (Yasmi et al., 2010). Human wildlife conflict is interaction between humans and wild animals where there are costs borne by humans (Blair, 2008). According to World Wide Fund for Nature (2005) defines HWC as “any interaction between human and wildlife that results in negative impacts on human social, economic or cultural life, on the conservation of wildlife population 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 population, 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 human and the wild animals (Osei-owusu and Bakker, 2008). Crop raiding by wildlife is a problem of most rural Africa which has led to incidences of loss of human life, destruction of crops and farm infrastructure (Hill, 1997).

2.2. Human- Wildlife Conflict

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

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

(Blair, 2008). 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).

2.2.1 The Human Primate Conflict

Primates are one of the most frequently cite crop pests (Naught on-Treves, 1998; Hill, 2000) so primates and humans are always in potential conflict over crops. Pest primates often destroy unharnessed farms causing economic losses to farmers. Crop damage is becoming serious for many residents around protected areas. Most primate population 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 (Cowlshaw and Dunbar,2000). Africa has largest primate fauna in the world. There are 175 species and subspecies of primate listed in Africa (Grubb, 2006), Even though there are 12 species and subspecies of primates occur in Ethiopia such as Anubis baboon, Columbus monkey, and Vervet monkey (Kingdon, 1997). Large mammals cause crop loss near protected areas among agriculturalists in many parts of Africa and Asia. The extent of damage is almost insignificant when it is considered at the global level as compared to the damage caused by invertebrates and rodents. However, in the area where large number of animals occurs, the whole season production may be lost in a single night (Naughton-Treves, 1997). Wildlife damage varies considerably from site to site and farmers have unequal capacity for preventing losses. Farmers themselves are sometimes, the causes for crop loss because they continuously change the vegetation structure of the land closer to the protected areas. This changed vegetation probably becomes attractive to wild herbivores. Cultivated plants having characteristics of increased yield, rapid growth and resistance to disease may be vulnerable to the herb ivory of locally overabundant wildlife population (Messmer, 2000). According to Kimega (2003), in Kenya, food items such as maize, cassava, beans, potatoes, and fruit trees are the target for the

hungry such as elephants, baboons, zebra, buffalo and wild pigs. Among those common agricultural pests (primates, rodents, birds or insects), the damage caused by elephants is often far greater (Hoare, 2000). This is because elephant raids are unpredictable and can cause more damage per raid. Almost all countries in Africa including Ethiopia reported problems with elephant crop raiding (Yirmed Demeke, 1997). Subsistence agriculture is the sector more exposed to elephant damage than other crop pests. Generally, it is difficult to alleviate the conflict between herbivores and human. But it is possible to minimize it using different conservation measure. According to Treves et al. (2003), placing pasture around vegetated water ways may promote sheep predation by wolf. The occasional killing of livestock by wild predators can cause inevitable problems. The problem of livestock predation is prominent in a given area where extensive livestock husbandry is practiced (Oli et al., 1994). The presence of few numbers of wild preys may promote livestock predation. Many large carnivore species are adapted for ungulate predation but some individuals readily kill domesticated ungulates when they get the chance (Treves and Karanth, 2003).

2.3 Causes of human wildlife conflict (HWC)

No single factor or cause explains HWC across the continent (Naughton-Treves and Treves, 2005). 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 (Lamarque et al., 2009). 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 (Tchamba, 1996). According to Hill (2000) reasons like, the distance between the farm and the forest boundaries and the number of neighboring farms is highly likely to affect vulnerability to crop-raiding by wildlife. Additionally, farmers are not equally exposed to human-wildlife conflict situations; age, gender, farm location, ethnicity, cultural rules, crop assemblages, and the behavioral and ecological characteristic of wildlife can all influence vulnerability to crop damage by wildlife (Hill, 2004). The extent and intensity of damage also vary depending on the cropping patterns, wildlife population density and behavior, and food availability in wild habitats (Sekhar, 1998). 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, 2004). Certain species may cause more damage than others. For instance, primates and elephants can have a significant impact on crop yields due to the extreme agility of many primate species and to the large size and nocturnal/crepuscular activity of elephants (Osborn and Hill, 2004). 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,

2.3.1 Human Factors

2.3.1.1 The requirement of human development

The main cause of human wildlife conflict worldwide is the competition between growing human population and wildlife for the same declining living spaces and resources (Madden, 2008). HWC arises mainly due to the loss, degradation and fragmentation of habitats by human activities such as logging, agricultural expansion and development projects (Fernando et al., 2005). Since 1950 most of the increasing demand for food in the developed world has been met through intensified agriculture and husbandry rather than increased production areas (Joseline, 2010). So far, the increase in production in sub-Saharan Africa cannot be secured by greater productivity because technical progress does not match the rate of demographic increase. Continued expansion of agriculture and husbandry areas will have various impacts on habitats and biodiversity: at this stage, rural development in sub-Saharan Africa inevitably involves accelerated transformation of natural landscapes at the expense of wilderness that sustains biodiversity and finally resulted in HWC (Madden, 2008).

2.3.1.2 Increasing wild Animals and Human Populations

The major causes of human wildlife conflict could be attributed to many factors ranging from wild animals population increase to human population increase (Edward and Frank, 2012). More peoples means more cultivated land and hence a greater interface between people and wildlife. The world population is predicted to grow by over 50% in the next fifty years, from six billion in 2000 to over nine billion in 2050 and the increment in both wildlife and human population create competitions in fixed natural resource which leads to conflict (Sillero-zubiri and Switzer, 2001).

2.3.2 The Habitat Factor

The gradual loss of habitat has led to increasing conflict between humans and wildlife (Edward and Frank, 2012). As wildlife habitat becomes more and more fragmented and wildlife is confined in to smaller pockets of suitable habitat. And humans and wildlife are increasingly coming in to contact and in conflict with each other (Sillero-zubiri and Switzer, 2001; Lamarque et al., 2009). Competition for space, resources and the reduction of habitat may be a powerful factor which threatening wild lives. If habitats are converted to agricultural or pastoral land, HWC are bound to increase (Hill, 2000). Human carnivore conflicts have intensified in most African countries in recent decades. The greater majority of cases of human carnivore conflict through degradation of domestic animals reflect some type of imbalance in the local ecosystem, if the influence of human on the habitat decreases these animals to tend to avoid man and his domestic animals (Treves and Karanth, 2005). A common consequence of human occupation of wild life habitat is the development of negative perceptions of wild life. Human-carnivore conflicts have intensified in most African countries in recent decades. These is due to exponential human population growth and economic activities (Conover, 2002 cited by Demeke Datiko and Afework Bekele, 2013). Several factors can contribute to the modification of the quantity or quality of wildlife habitats.

2.3.2.1. Natural Factors

Droughts, bush fires, climatic changes and other unpredictable natural hazards can contribute to a decrease in suitable wild animals' habitat and therefore affect the occurrence and extent of Human- wild animals' conflict. Similarly the seasonal modification of habitats due to rainfall can also have an impact on Human- wild animals' conflict. One of the main consequences of the loss of habitats is the decrease in natural resources available for wildlife. The destruction of natural vegetation and in some cases the total disappearance of buffer zones force herbivore species to feed in cultivated fields. This phenomenon is on the increase because the growth rate of cultivated areas is high at the edge of protected areas and forest areas (Lamarque et al., 2009). As the human population keeps expanding, there is an increasing demand for land for agriculture, expansion of cultivated land into previous wildlife habitat, and natural resources for industry, leading to increased contact opportunities for wildlife and people, crop raiding is becoming one

of the most common conflicts antagonizing human-wildlife relationships and resulting in conflict (Sillero-Zubiri and Switzer, 2001; Eyebe et al., 2012).

Human activities such as husbandry, agriculture, fishing, the development of infrastructure or even of tourism or wildlife protection itself, can dramatically modify wildlife habitats either directly or indirectly (Kate, 2012). Baboons have been eradicated from some areas of South Africa and Zimbabwe, particularly where they interfered with commercial agriculture. Because of this the extent of the current distribution range of baboons is largely restricted to areas that are not used for commercial cropping and horticulture. Baboons are now concentrated instead in areas where subsistence agriculture is practiced, where they can raid crops grown by subsistence farmers (Lamarque et al., 2009).

2.4 Changes in agricultural methods and techniques

In recent decades there has been a significant shift towards the intensification of agriculture, and the resulting large monoculture can be very attractive to animals. Some animals are naturally pre-adapted to take advantage of these opportunities. Omnivorous species like Anubis baboons will take a wide range and diversity of foods, including many crop species and often utilize several different parts of these plants, rendering them vulnerable throughout their life cycle (Sillero-Zubiri and Switzer, 2001).

2.5. Type of crops most affected and extent of damage by wild animals

An important consideration is how crop damage is distributed. The damage occurs seasonally or year round. Anubis baboon are likely to visit fields all round, Thus farmers, whose farms are close to the forest boundary, are potentially at risk of losing stable crops year round. A point to notice is that crop raiding activity, especially by Anubis baboon occurs at day, so fields have to be protected at day (Hill, 2000). Crop raiding is not a new phenomenon; it has most likely been occurring since humans started practicing agriculture. Many different crops are targeted by animals, these includes cereals, fruits and vegetables and trees (Sillero-zubiri, 2001). Crop raiding may be greatest during harvest season, but it does occur throughout the year. In particular maize seems to be targeted and damaged throughout its growing cycle, from the newly sown seed to the time the cobs are mature. Damage sustained at any stage can cause severe crop losses, but these are most serious when crops are mature (Sillero-zubiri, 2001).

2.6. 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 al., 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 pests, sharing household 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 (Hill, 2000; and Naughton-Treves, 1997). 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.

2.7 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). 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). 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, 1998). 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).

2.8. 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 (Patterson, 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 Columbus 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.

2.9. Traditional methods used by the local people to prevent crop damage from pest primate

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 methods. 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).

CHAPTER THREE: MATERIALS AND METHODS

3. 1.Description of study site

3.1.1 Location

The present study was conducted in and around Chato forest in Gudina-Abuna and Bone-Abuna kebele, Horro district which is located in Horo Guduru Wollega Zone of Oromia Regional state, Western Ethiopia. The physical distance of this kebele from Addis Ababa is about 314km and 30km from the zonal town Shambu. Geographically, the location of the study area lies between $9^{\circ}39'30''\text{N}$ - $9^{\circ}47'00''\text{N}$ latitudes and $36^{\circ}58'30''\text{E}$ - $37^{\circ}6'30''\text{E}$ longitudes and it has a total area of 6, 675.6 hectares. The district borders of this study area, Jarte-Jardaga in North, Gudaya-Billa in south, and Horro in East and Abe-Dongoro in the west. The forest is located along between altitudinal ranges of 1700 and 2350 meters above sea level and covers an area of about 42,000 hectares, of this 1,800ha is the natural forest (EMA, 1996, GPS reading by Asebe Regasa, 2017) (Figure1.)

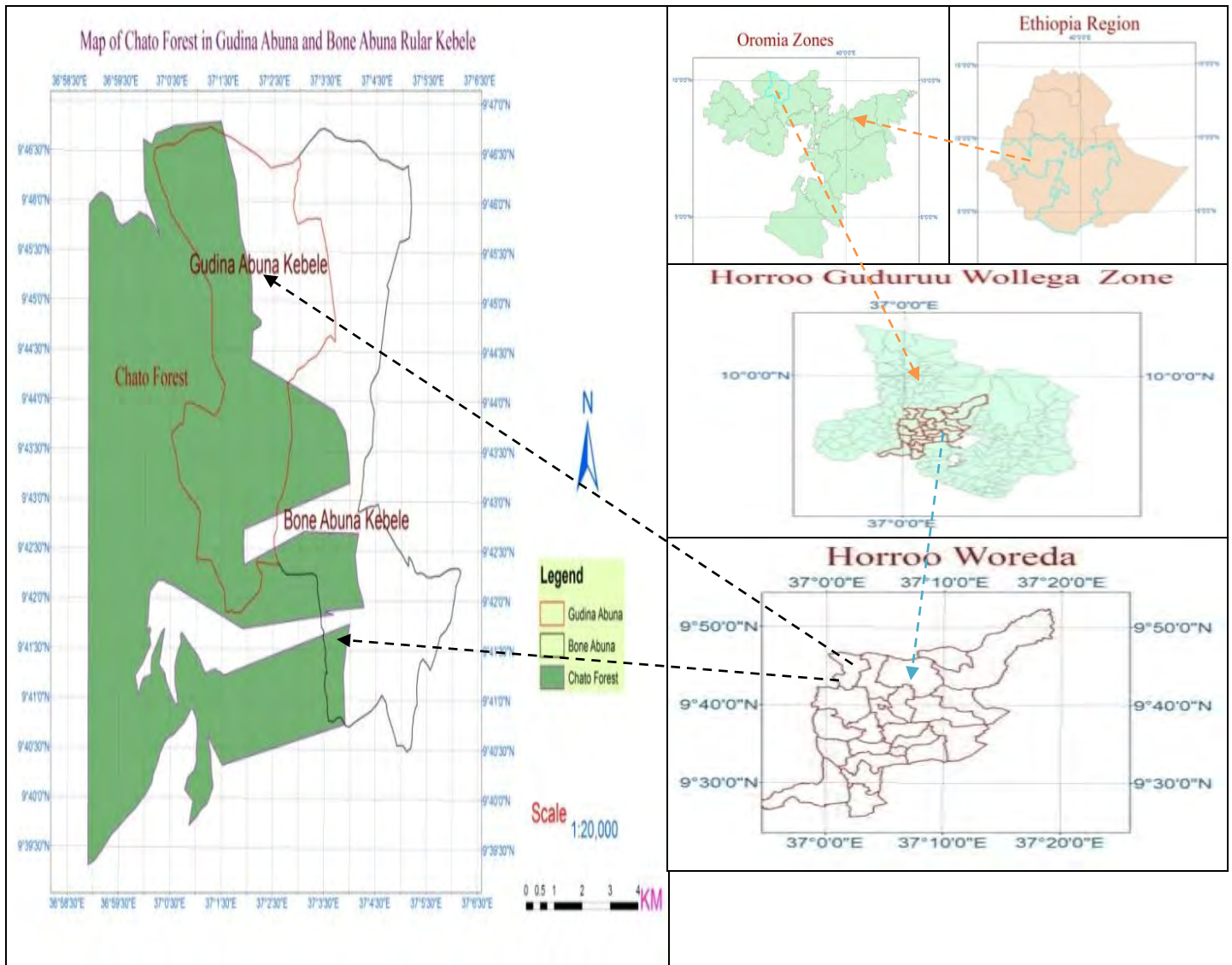


Figure 1. Map of study area. Source: From GIS satellite by Eng. Aboma Tolasa.

3.1.2 Climate

3.1.2.1. Rainfall

The rainfall data for this study were obtained from Ethiopian National Meteorological Service Agency, from 2002-2016 (EMSA, 2017). Shambu station is located at $9^{\circ}34'N$ latitudes and $37^{\circ}06'E$ longitudes with altitudes of 2430 m.a.s.l. The rainfall in the study area is unimodal,

characterized by a prolonged wet season from June to the end of September (big rain) and a short dry spell showers from mid February to April. There is a long dry period from October to the end of February (H.W.R.D.O., 2017). From the 15 years data (2002-2016), the mean annual rainfall in the study area is about 1566mm, rainfall peak period between May to October and decreasing in November and December with little or no rainfall in January and February (Figure.2A).

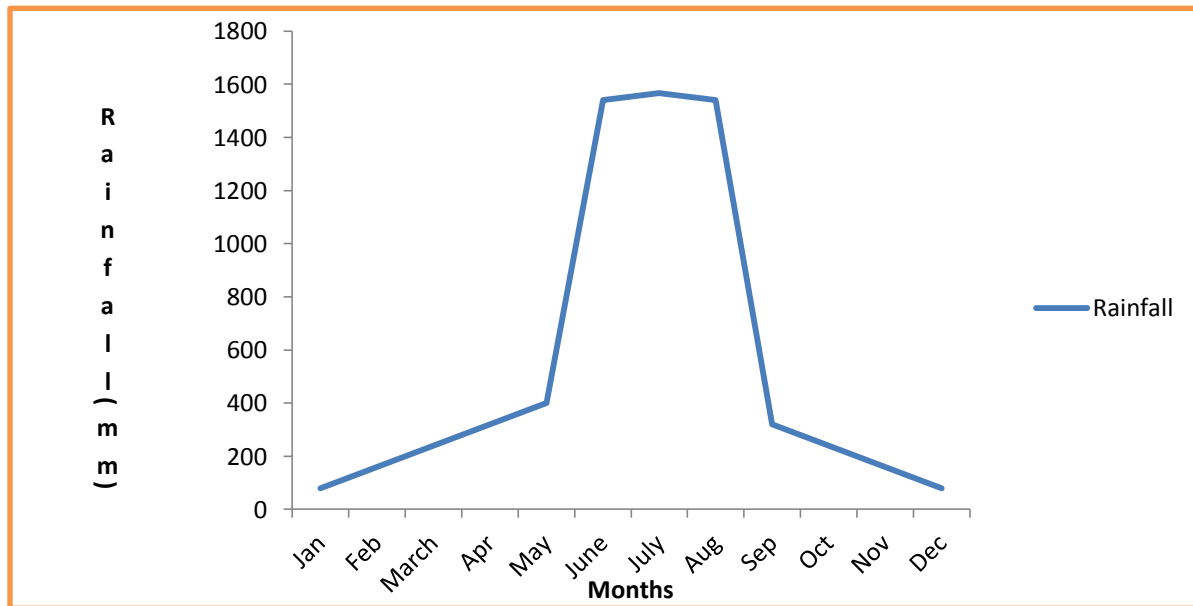


Figure.2A. he rainfall in the study area. Source: Ethiopia National Meteorological service Agency, 2017

3.1.2.2 Temperature

The temperature data for this study were obtained from Ethiopian National Meteorological Service Agency. The mean annual temperature is about 16.6⁰c and the mean minimum temperature is 10.78⁰c where as the mean maximum temperatures is 22.32⁰c. The hottest months are from February to May maximum temperature recorded is about 24.6⁰c and the coldest months are from July to December with mean minimum temperature 9.8⁰c. Based on altitudinal variations, Horo District has three agro climatic zones which correspond to the traditional classification system 43% temperate (Dega) 2300-3300m, 55% sub-tropical (Weina Dega) 1500-2300m and 1.24% tropical (Kolla) 500-1500m(EFAP,1994)(Horo District Agricultural office,2017).

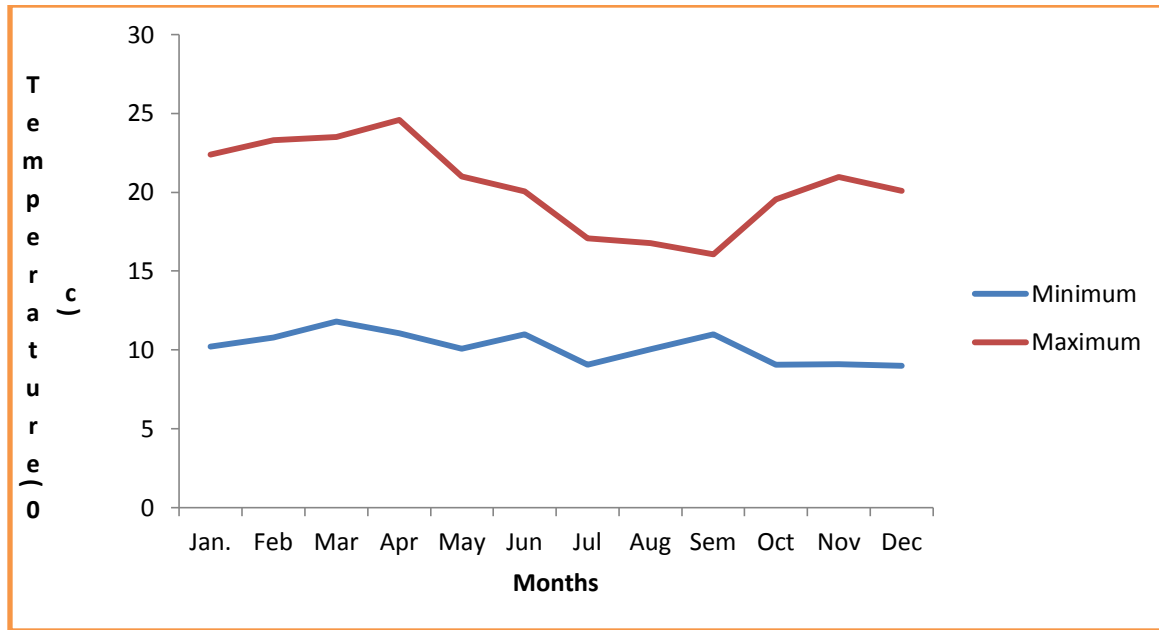


Figure 2B .The temperature in the study area. Source: EMSA (Ethiopia National Meteorological Service Agency, 2017).

3.1.2.2. Vegetation and wildlife

Chato Natural forest which is located in the Horo Guduru Wollega zone of Oromia National Regional state, Ethiopia .The main species of plants found in this forest vegetation include broad-leaved and evergreen with important tree species such as *Podocarpous falcatus*, *Teclea nobilis*, *Allophylus abyssinicum*, *Albiza gummifera*, *Diosspyros abyssica*, *Cordia Africana* and *Syzygium guieense subspecies*. Although, Chato natural forest has been designated as a part of National Forest Priority Areas (NFPA) and has been known by the name Chato Sangi-Dangab forest in the country (EFAP, 1994). Little conservation attention was given. Apparently new settlers, who settled there from other parts of the country, cleared the forest for other types of land uses, particularly at marginal area of the forest. This is one of the existing threats the forest vegetation by expansion of farmland surrounding the forest and illegal logging.

The vegetation of Chato natural forest also contains a variety of wildlife including Columbus monkey, wild pig, various species of birds and mammals and reptiles. Some of the common wildlife includes Anubis Baboon, Vervet monkey, porcupine, Warthog, Africana civet cat, Leopard, common bushbuck and spotted hyena. Thus, the forest is rich in fauna diversity.

3.1.3 Soil and Topography

The geology and soil of Ethiopia fall within the geological structural units of the horn of Africa (Mohr, 1971). Most common forest soils in Ethiopia are red or brownish ferrisols derived from volcanic parent material (Friis, 1992). According to (H.W.R.D.O., 2017) the type of soil in the district is sandy loam type. However, as visually observed the soils of the forest area are darker-reddish in color with concentrated humus as there is no strong eroding forces along vegetation cover. Topographically, it is generally characterized by rough topography with undulating plain, hills, slopes, deep valley, gorges and dissected plateaus.

3.1.4 Population and Land use

According to population and housing census reported by the CSA (2007), the total population of Horro district was 78,262 people, of these 56,762 and 21,500 were rural and urban population respectively. Similarly, 35,584 are females and 42,678 are males in district. In each, 29,854 are males and 26,908 are female in rural, whereas 12,824 are males and 8,676 are females in urban area. The majority of population of the study area earns its livelihood mainly from mixed cultivation of livestock rearing and crop production is practiced. Subsistence agriculture is the main economy development of the community (H.W.R.D.O., 2017). The land cover categories of the district include about 45% account for potential arable land including land under crops ,land reserved 12% goes for pasture land/grazing land and 11.05% accounted for forest land,2% of for swampy land and 29% for other purpose (H.W.R.D.O.,2017). Major crops grown in this woreda are cereal crops (maize, wheat, barley, and teff), pulses (peas and beans) and oil crops (nug and rape seed). During the 2014-2016 E.C livestock population in the district were 262,507cattle, 108,839 sheep,30,345 goats,98,557 poultry,27,546 horses,2,453 mules and 24,543 donkeys as reported by (H.W.R.D.O.,2017)

3.2 Materials

The materials used during this study were field binocular (7x 50mm), Geographic positioning system (GPS), digital camera, and stationary materials.

3.3 Methods

3.3.1 Sample size and sampling design

The study district was purposively selected as the area represents on the highest case scenarios in Human wildlife conflict. Out of 13 kebeles found in Horro district two kebeles namely Gudina-Abuna and Bone-Abuna were selected for this study. In the second stage, each village found in the selected kebeles were categorized into three groups based on their proximity towards to forest edge as near, medium and far. The total villages from each kebeles were two and the study covers a total of four villages from the two kebeles. Based on distance of farmland they have from forest egged households were selected from each village for structured questionnaires. The sample frame was all household head living in the two kebeles. The total numbers of household head living in both kebeles was 985. This data was taken from the kebeles administration offices. After getting the total number of household heads living in each selected kebeles, the last step was determining total sample size of household head. Total sample size was determined by using

probability of sampling technique (Cochran, 1977).
$$n_1 = \frac{no}{1 + \frac{no}{N}}$$

Where: no= desired sample size Cochran's (1977) when population greater than 10,000.

n_1 = finite population correction factors (Cochran's formula, 1977) less than 10,000.

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

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

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

d = is degree of accuracy desired (0.05).

N= total population of households (985).

$$\text{➤ } n_1 = \frac{138.29}{1 + \frac{138.29}{985}} = 121$$

Based on Cochran (1977) population correction factors, a total of 121 sample household were selected using simple random sampling techniques from the total population of 985. Allocations of the number of sample households to each kebeles was proportional to the number of household heads living in each selected kebeles, accordingly 57 Household from Gudina- Abuna and 64 Household from Bone-Abuna were selected for this study.

3.3.2 Preliminary survey

Preliminary survey was conducted to gather basic information about temperature, rainfall, vegetation and wildlife of the study. The physical environments of the study area were assessed and also networks were established with governmental office experts and local kebele leaders. This information helps to determine the study sites and severity of crop damage. Information was also gathered on cause of Human wildlife conflict, the prevalence of crop damage and livestock depredation.

3.3.3 Pilot survey

Pilot survey was conducted in the selected kebeles based on the information gathered during the preliminary survey. During the pilot survey 30 households were randomly selected and interviewed. The main purpose of the pilot survey was to evaluate the questionnaire and to check whether it is applicable and suitable in the study area. It is also used to check the question was understood by the respondents and also used to identify the period and the occurrence of human wild animals" conflict. In addition, it is used to identify the cause of HWC in the study area. Then based on the result from the pilot survey, the questionnaire was revised and developed.

3.3.4 Data collection

To achieve the objectives of the present study, three complementary data collection methods namely household survey, direct observation of the crops damaged and focus group discussions were used during present study. Data collection was conducted between September 2016 and June 2017.

Household survey

Questionnaire survey were used to acquire information on the various aspects of the study about the different variables with the question being both open and close ended. It helps to get information from respondents regarding socio-demographic data (such as age, sex and educational status), crops grown, damage caused to crops and livestock, species of wild animals" responsible for damage, type of crop more damaged, type of crop raiding wild animals" that causes more damaged, protection measures practiced, perceived wild animals" population

tendency and causes of HWC (Appendix I). A structured questionnaire were prepared in English language and translated into Afan Oromo because the majority of the respondents were Afan Oromo speakers.

Focus group discussion

This method helps to acquire useful and detailed information. Focus group Discussion was carried out to collect qualitative information from the selected two kebeles. Discussions were made with randomly selected 8-12 respondent in each kebeles under the guidance of a moderator. This technique was enabled to explore what they know or think about the research problem that the questions would cover. Checklists were prepared to guide topics for open-ended discussion with group of farmers (Appendix II).

Direct observation

Direct survey was another method used to collect primary data and carry out through systematic observation. The observation was conducted in the selected sample kebeles of the district during the study. It was used to obtain data on distance between forest and farmlands, the damaged crops, estimating crop lost by crop raider, type, diversity and number of the damage causing pest primates. 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.

3.3.4.1 Estimation of crops damage by pest primates

Totally four study sites were used to estimate crop loss due to pest primate, field visit and direct observation of crop damaged by wild animals, From all sites, crop land having areas of 20,000 m² (2 hectares) which have equal distance from forest edge were randomly selected from Bareda, Wabo, Bone and Wana. Five plots of 4m x 4m were placed randomly within the crop stands of four farms in each sites and observed three times a week to count the crop damage from 0.5ha of the four farmers in each sites and to identify the types of crops damaged. The seedlings of the maize in each five plots were counted from total area of the farm to extrapolate the total number of plants in the measured farm. On the selected farmlands, maize crop was selected because it is main cultivated crop compared with other types of crops. The percentage crop losses for each farm, taking into account the number of stands planted was estimated. For each cultivated land,

the type of crop grown, condition of the crop before damage, area of damaged portion, part of the crop eaten and type of crop species eaten were recorded (Appendix III). In dry and wet season, the observation was conducted starting from September 2016 to January 2017. During the seedling stage for eight days direct observation was carried out in each study site. But during the flowering and maturation stage more emphasis was made. In each of these stages three times a week observation was accomplished. Ten data collectors were participated during the time of direct observation in each trip and their steps forward were supervised by development agents (DAs). At the end of each developmental stage, damaged plants were added up and estimated. Following Rugunda (2004) method the area of the crops damaged by wild animals was measured. After yield obtained from one hectare was obtained from district agricultural office for maize, the amount of yield loss was estimated per hectare. For nocturnal wild animals do not damage crops during the day time, therefore, it requires using its marks left such as dung, feeding style, foot prints and others physical remains. Local farmers were useful in helping to identify the signs of crop raiding damage on crops.

3.3.4.2. Estimation of population size of pest primates.

To determine population of Anubis Baboon and Vervet Monkey, preliminary survey supported by farmers. Line transect method was used to count of the population of pest primates by moving on foot throughout the whole study sites which were divided in blocks to precede the counting of population. Four days each in dry and wet season count was under taken in the sampled forest and finally the average of the four day count was used to estimate the population. Before estimating the population in the area, the total numbers of the troops in each sample forest were identified from well knowing farmers of the area hence they are familiar. Two habitat type sites were observed, 24 transect lines systematically established in the study area. The total area of the entire sampled forest was 800 hectares (8 square kilometers), of which the dense forest habitat was 480 ha (4.8 square kilometers) and 320 ha (3.2 km²) was fragmented forest habitat. The dense forest was divided in 16 blocks and each block was sampled by line transects that has a length of 2km and widths of 150m, then counting of pest primates seen from the transect continue and the animal seen in the transect recorded. The fragmented forest were divided in 8 blocks and each block was sampled by line transects with length 2km and width 200m, and then

counting of pest primate in transect line continue. Population of Anubis baboon and Vervet Monkey were categorized into three age groups namely adult male and female, sub-adult male & female, and juvenile(infant) (Appendix IV). Body size was used in age determination. The Adult males are considerably bigger than the females. Sub-adult male and females were identified by their body size. 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 were taken by means of digital camera and census was 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.). The population density is calculated by the following formula. The areas of the forest were taken from district agricultural office: $D = N/A$, Where: $D =$ density of population per km^2

$N =$ number of individual counted in the entire sampled forest.

$A =$ Area of the sample forest in km^2

3.3.5 Data analysis.

Data were organized into different topics by following the objectives of the study and coded according to the topics already described. The collected data were analyzed using the Statistical Package for Social Sciences (SPSS) Computer software program. The questionnaire was coded and run to SPSS .Chi-square test were used to see whether there is a significant association of number of Anubis baboon and Vervet monkey counted between dry and wet season and also traditional methods used by the respondents. The significance is determined at p-value less than 0.05. For descriptive part of the research, in a form of percentage and frequency were used.

CHAPTER FOUR: RESULTS

4. Results

4.1. Background characteristics of the respondents in the study area.

The general information about the demographic data obtained from the respondents which include the gender, age and education level was identified before conducting the research. Figure.3 indicates gender of respondents where by 83.47% (n=101) of the responses were received from males while 16.53% (n=20) of the response were from females.

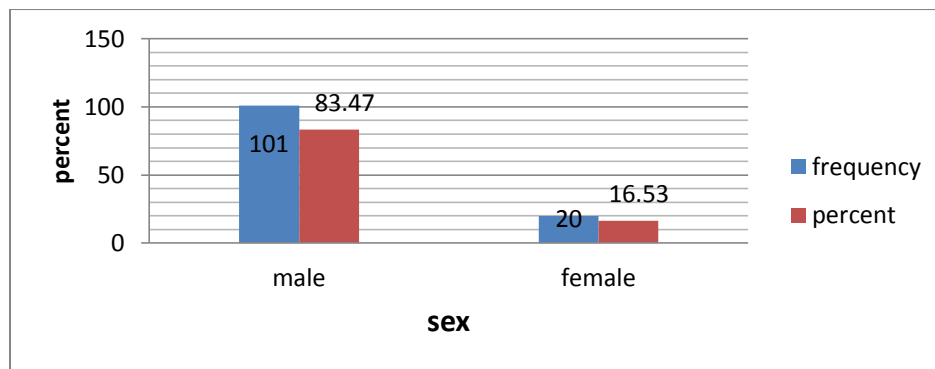


Figure 3 . Gender of respondents

Figure.4 shows the age groups of respondents whose responses were mainly got from persons of ages between 15-35 years with 38 (31.41%), 36-45 years with 51 (42.15%), 46-55 years with 24 (19.83%) and above 56 years with 8 (6.61%), as they are the majority living along the forest edge. Respondent farmers for the administered questionnaire survey were in the maturity age and they had an experience in agricultural activities and also trained in the challenges and crop raiding activities.

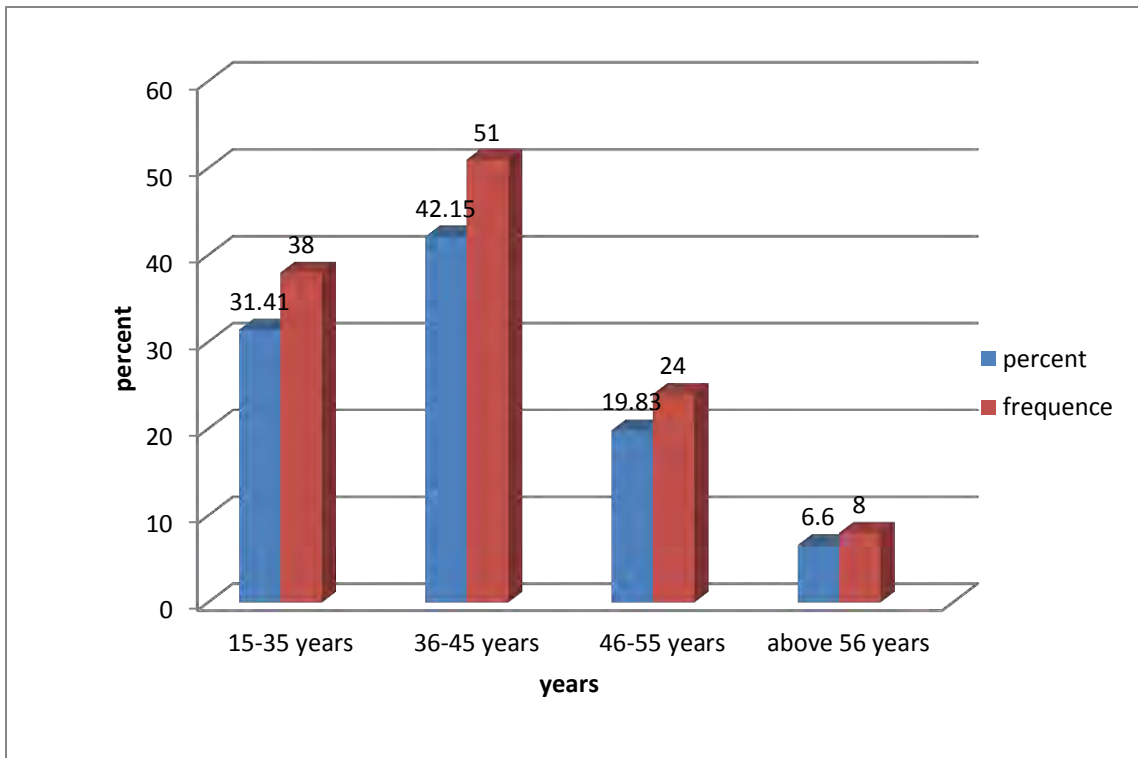


Figure 4. Age of respondents

Educational background of the respondents of the study area were 25(20.66%) illiterate, 57(47.11%) were able to read and write, 20 (16.53%) attended primary level (1-8) and 19 (15.70%) those who had attended secondary level (9-12). Education would have a great influence for the awareness of farmers regarding human wildlife conflict issues (figures 5).

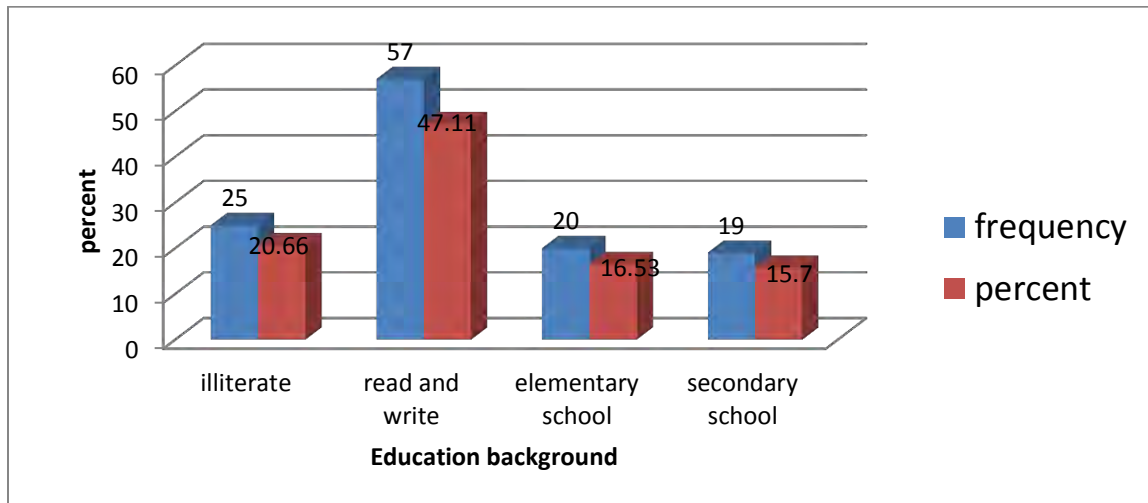


Figure 5. Education backgrounds of respondents

4.2. Economic activity and social interaction of the respondents.

According to the response of the respondents, the possession of own farmland in their study area, among these 112 (93 %) reported that they possess their own farmlands whereas 9 (7 %) reported that they have no own farmlands (figures 6).

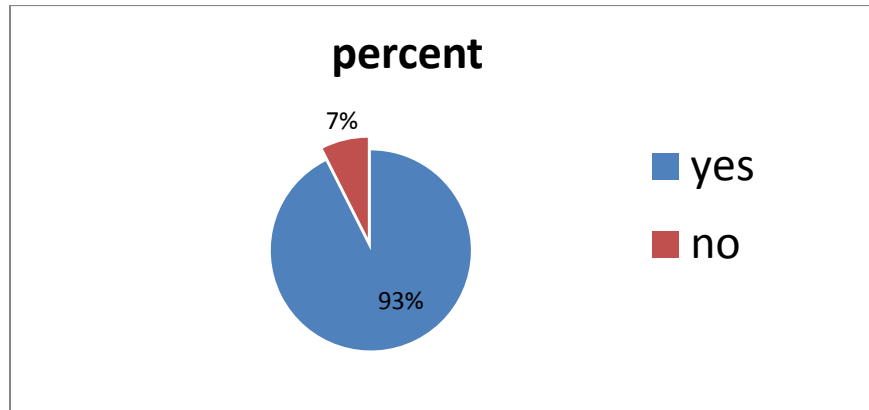


Figure 6 Percentage of farmland owned by respondents.

Figure .7 shows that the respondents own farmland with different size ranging from 0.5ha up to greater than 5 ha; 56 (46 %) of the respondents owned 0.5-1ha, 36 (30 %) of the respondents owned 2-3ha, 19 (16 %) of the respondents owned 4-5ha and 10(8 %) of the respondents owned greater than 5 ha farmland.

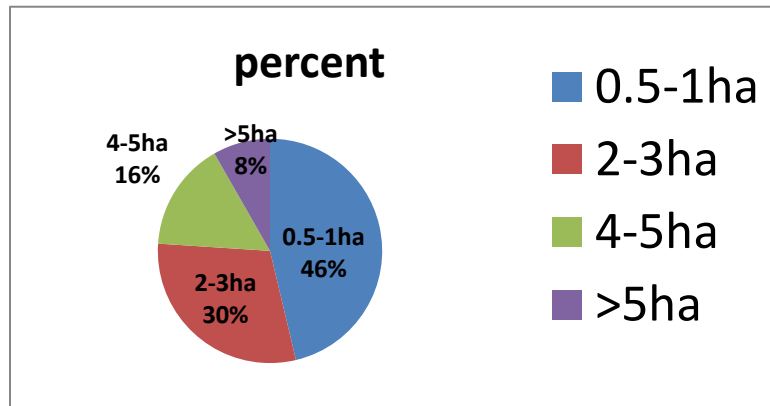


Figure 7 Size of farmland owned by respondents.

From the total respondents 70% revealed as the damage of the crop was sever in wet season,8% revealed that it was sever in dry season and 22% of the respondents that occur in both wet and dry season (figure 8).

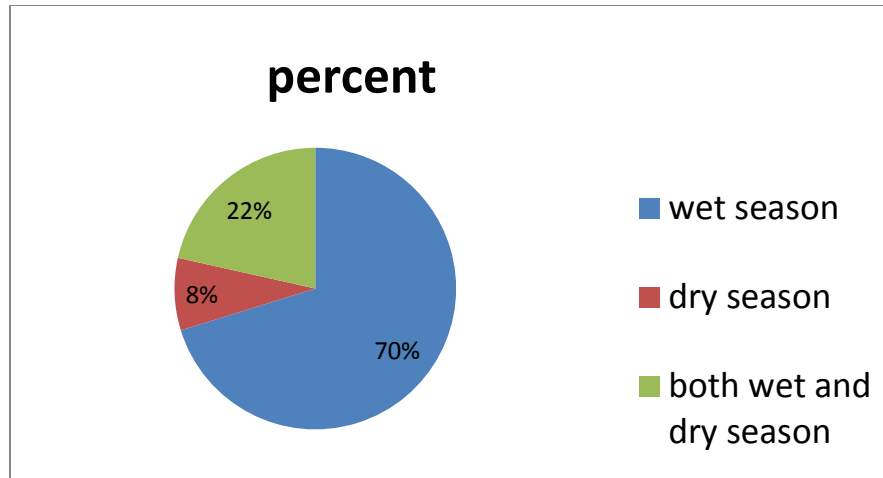


Figure 8 Severity of crop damage on bases of season.

Agriculture was the main activity of people around the study area. The main crop grown during wet season from June to August. There is also crop grown during dry season from December to February based on type of crops. The crops include Maize and potatoes were grown in wetland areas. In the study areas: maize, wheat, barley, Teff and others cereal crops were the major crop grown and they were the most important cultivated by many farmers. Out of the total respondents cultivated maize were 46.87%, and followed by 28.09% cultivate Teff, 14.87% cultivate wheat, 8.27% cultivate barley and the remaining 2.47% produced other crops (table 1).

Table 1 Number and percentage of respondents who cultivate crops in the study area

Type of crops	Number of respondents	Percentage
Maize	56	46.87
Wheat	18	14.87
Teff	34	28.09
Barley	10	8.27
Others	3	2.47
Total	121	100

4.3 Type of crops most affected and extent of damage by wild animals

The response of respondents result showed that not all crops were equally affected by crop raiders. About 80.99% of the respondents claimed that maize was the most vulnerable crop to

crop raiders followed by 55.37% wheat, and 50.41% barley. Teff was the least (46.28%) vulnerable crops to damage caused by wild animals. (Table2.)

Table 2 Ranking of crops in the order of destruction by crop raider

Type of crop	Frequency	percent	Rank
Maize	98	80.99	1
Wheat	67	55.37	2
Barley	61	50.41	3
Teff	56	46.28	4

All of the respondents from Wabo, Bone, Bareda and Wana reported that there was an increase of crop damage by crop raider from time to time. However few respondents from Bareda gave unknown response on trends of crop damage. But none of the respondent reported that crop damage by crop raider was decreased. About 98.5% of the respondent reported that it is increasing whereas 1.5% of them said it is unknown and finally no one reported that the trend of crop raiding was decreasing (table 3.)

Table 3 Percentage of trend of crop damage by crop raiders based on respondents reply (N=121).

Villages	Frequency	Trends of crop damage (%)		
		Increased %	Decreased %	unknown %
Wana	29	100	0.0	0.0
Bareda	32	94	0.0	6
Bone	31	100	0.0	0.0
Wabo	29	100	0.0	0.0
Mean		98.5	0.0	1.5

The majority of respondents replied that the tendency of crop damage is increasing from time to time. Moreover, most of the respondents replied that the extent of crop damage by wildlife was high (79.34%, n=96), medium (13.22%, n=16) and (7.44%, n=9) of the respondents considered the extent of crop damage by wildlife was low (table 4.)

Table 4 percentage of the respondent about extent of crop damage by wild animals

	Level	Frequency	Percent
Extent of crop damage by wild animals	High	96	79.34
	Medium	16	13.22
	Low	9	7.44
Total		121	100

In the study area, several type of crops were grown namely Maize, Teff, Wheat, Barley and others crops in the production season of 2016/2017.

Anubis baboon, Vervet monkey, Wild pig, Warthog, Civet cat and Porcupine were observed when they damage crop directly and indirectly. Anubis baboon and Vervet monkey damaged crop during day time whereas Wild pig, warthog, Civet cat and porcupine damaged crop during night time (nocturnal). Anubis baboon was the most problematic wild animals for farmers around the study area. The study showed that food crops are the most raided by wild animals .Although wild animals affect crops, there is a variation in specific plant part eaten or the age of the crop when eaten. Anubis baboons feed on maize throughout its life cycle i.e. seedlings, flowering, harvesting and fruiting while vervet monkeys destroyed maize near maturation stage, Wild pig were observed causing damage on crops in all stages from the time of germination to the time of harvest whereas warthog affects crop early in the seedling and also porcupine mainly destroyed maize near maturation stage (table 5.)

Table 5 Crop damaging animals, crop type and stage damaged, and time as revealed by respondents.

Crop damaging Animals	Type of crops	Stage of crop damaged	Time of day
Anubis baboon	Maize Wheat Barley Teff	All parts Grain, matured Grain, flowering Grain	Day
Vervet monkey	Maize	Near maturation stages	Day
Wild pig Warthog Porcupine Civet cat	Maize Maize Maize Maize	All parts Flowering to harvesting Maize cobs Near maturation stage	Night Night Night Night

Majority 83 (68.60%) of the respondents earn their income by crop production and animal rearing. The remaining 23(19.01%) depends only on crop production and 15(12.39%) of respondents depend only on crop production and other income sources. Regarding the household incomes, low incomes from agricultural activities since a significant fraction of the crops grown are destroyed by the crop raiders (figures 9).

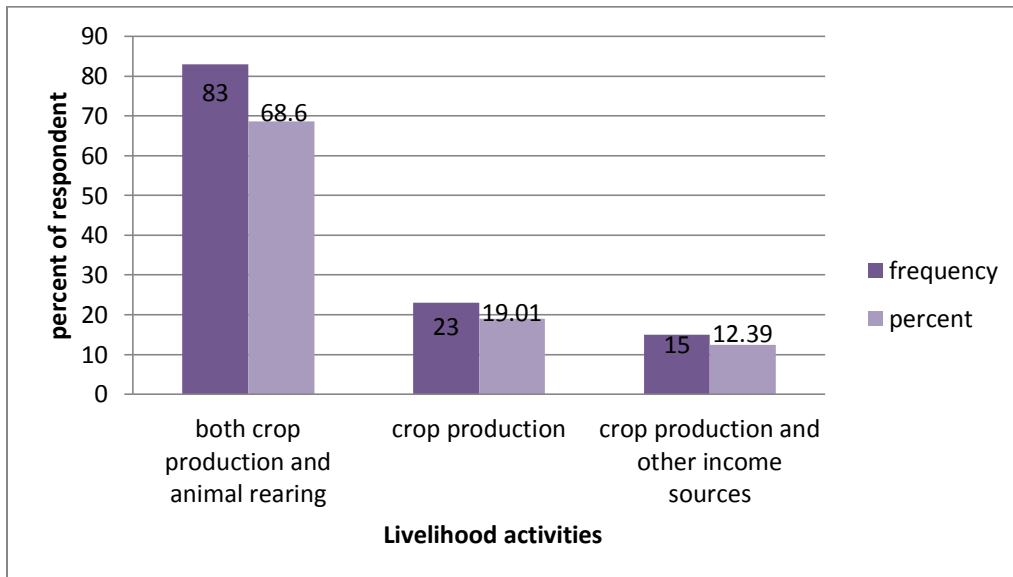


Figure 9 Percentage of livelihood activities of the respondents

4.4 Pest primate species most involved in crop raiding.

Respondents listed 10 major wild animals in the study area. Respondents also listed only six wild animals cause crop damage: namely Anubis baboon, Vervet monkey, wild pig, warthog, Civet cat and porcupine (tables 6).

Table 6 Listed of wild animals found in the study area as revealed by respondents

Local name	Common name	Scientific name	Number of respondents
Jaldeessa	Anubis baboon	<i>Papio anubis</i>	121
Qamalee	Vervet monkey	<i>Chlorocebus aethiops</i>	121
Weenni	Colobus monkey	<i>Colobus abyssinicus</i>	121
Xaddee	Crested porcupine	<i>Hystrix cristata</i>	68
Karkaroo	Warthog	<i>Phacochoerus africanus</i>	71
Xirinyii	Africana civet cat	<i>Civettictis civetta</i>	64
Booyyee	Wild pig	<i>Sus scrofa</i>	88
Qeeransa	Leopard	<i>Panthera pardus</i>	47
Leenca	Lion	<i>Panthera leo</i>	39
Waraabessa	Spotted Hyena	<i>Crocuta crocuta</i>	80

4.5. Causes of Human wildlife conflict

The existence of Human wildlife conflict in all sites, 66.1% of them reported that there was both the problem of crop damage and livestock predation by wild animals, 17.4% of them reported that they face problem of wild animals causes crop damage only, 12.4% of them reported that they face problem of wild animals causes livestock predation only and 4.1% of them reported other's. Result of focused group discussion summarizes that the existence of human wildlife conflict in all sites. The response of respondents from each site were not significantly different on different types of conflict namely crop damage, livestock predation caused by wild animals in the study area ($p > 0.05$). Respondents from Wabo, Bone, Bareda and Wana were reported the existence of both crop damage and livestock predation particularly goat and sheep (Figures 10).

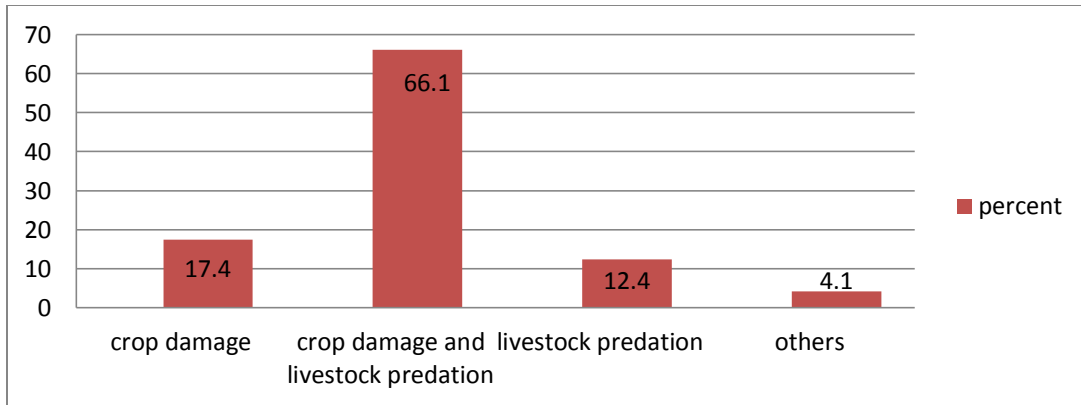


Figure 10 Percentage of respondents those faced different conflict by wild animals

The discussion with FGD and interviewed households showed that the causes of human wild animal's conflict were expansion of subsistence agriculture around forest edge, wild animal's habitat disturbance, increment of wild animal's population and deforestation the contribution of all mentioned causes. The listed causes compared on the bases of reaction of respondent of the four villages. 64.5% of the respondents reported were disturbances of wild animals' habitat and followed by 23.1%, 6.6% and 5.8% subsistence agriculture around forest edge, deforestation and increment of wild animal's population respectively were reported as main cause of Human wildlife conflicts.

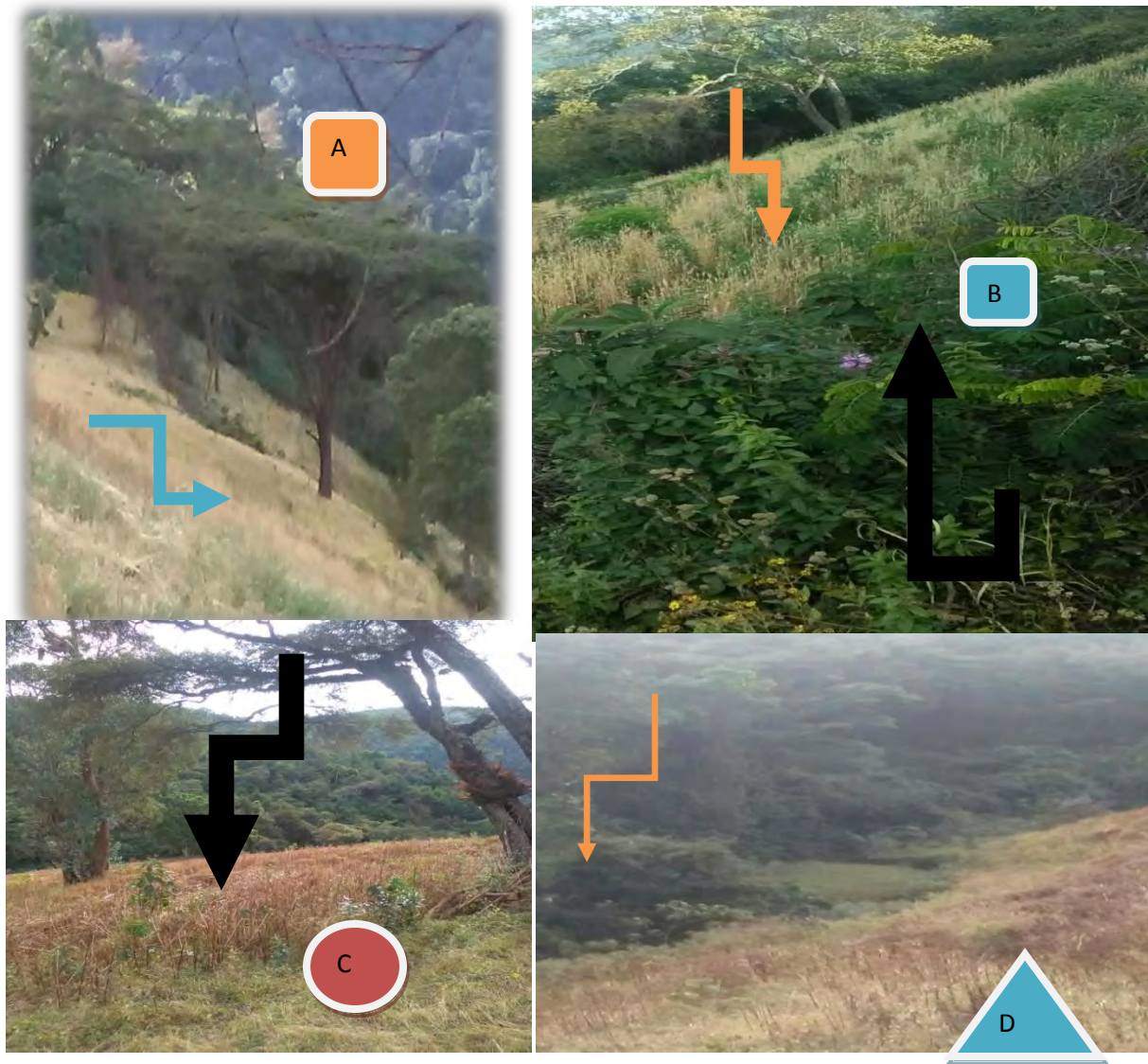


Plate 1. Habitat disturbances due to inappropriate site selection of investment (A & B and increased subsistence agriculture to forest edge(C & D) .Source: field survey, 2017.

The highest cause for Human wildlife conflict for Wabo, Bone and Bareda were disturbances of wild animals’ habitats while in Wana the main cause of conflict was expansion of subsistence agriculture to forest edge. Of the mentioned causes, increment of wild animals’ population was listed as less cause of conflict on villages of Wana, Wabo, Bone and Bareda (Figures 11).

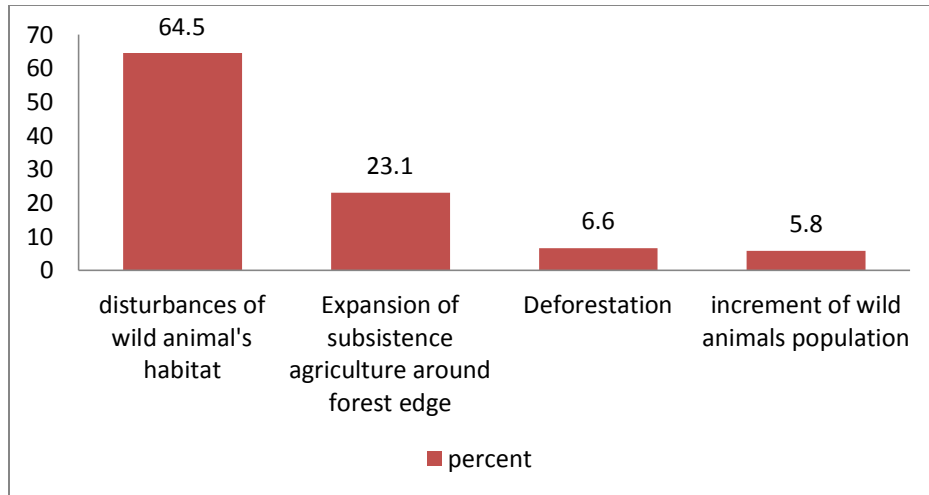


Figure 11 .Causes of human wild animals' conflict as revealed by respondents

4.6 Wild animals involved in crop damage

The response of the respondents indicate that six wild animals were identified from the studies area, namely Anubis baboon, Vervet monkey, wild pig, warthog, Civet cat and crested porcupine were causes crop raiding in different degrees. Farmers ranked crop raiding wild animals from the one causing most damage to the one that cause the least damage. Anubis baboon was the most commonly reported crop raiders which cause more damage and ranked first. They damage crops early in the morning and evening when people are absent near farmlands. Respondents put Vervet monkey as second crop raiders and wild pig was the third crop raiders followed by crested porcupine, Warthog and Civet cat (table 7).

Table 7 Lists of crop raiding wild animals and ranked based on the extent they damaged crops.

Wild animals	No. of respondent	Rank based on the damage crop
Anubis Baboon	121	1
Vervet Monkey	104	2
Wild pig	72	3
Crested porcupine	57	4
Warthog	45	5
Africana civet cat	31	6

Depending on the response of the respondents, the distance from their farmland to the forest edge, 65.3% of the respondent's lives near the forest, 22.3% and 12.4% of the respondents not very far and far from the forest edge respectively. The majority of the respondents replied that the damage of crop was the highest to those living near the forest edge. This finding shows most of the respondents close to the forest and they conflict with pest primate in the forest (figure 12).

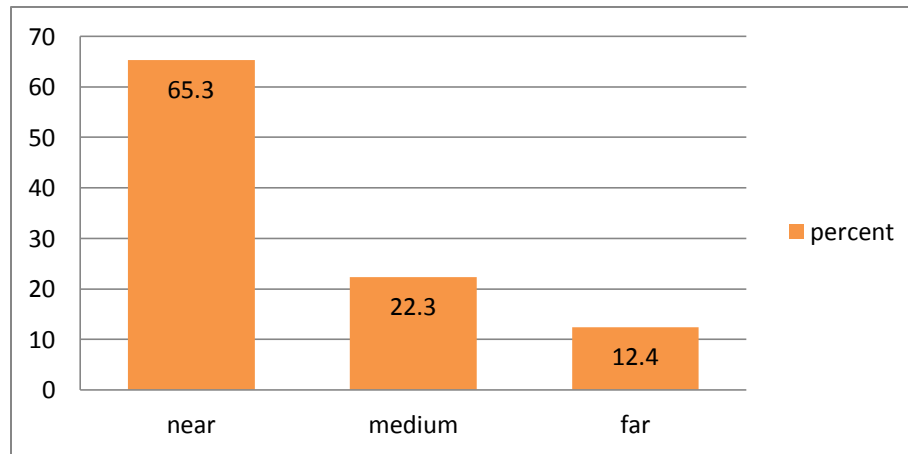


Figure 12 The distance of the farmland from the forest edge.

4.7 Population estimation of crop raiders.

Six wild animals were identified as crop raiders during present study and include Anubis baboon, Vervet monkey, wild pig, warthog, Civet cat and porcupine in order of problem they caused in the study area. Only population of Anubis baboon and Vervet monkey were estimated during present study area.

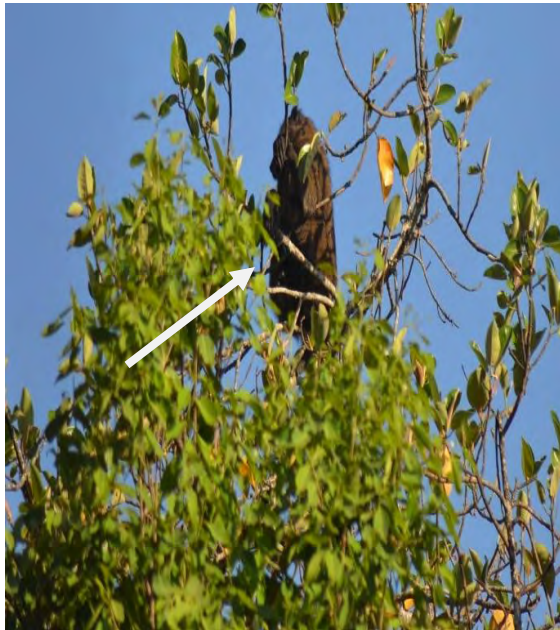
4.7.1 Population estimation of Anubis baboon

A total of 451 and 523 Anubis baboons were counted in the entire sampled forest area during dry and wet season respectively. The population size of Anubis baboon in Gudina-Abuna sampled forest was 284 and 322 in dry and wet respectively whereas 167 and 201 Anubis baboon in dry and wet season respectively in Bone-Abuna samples forest. Statistically there was significantly difference between number of Anubis Baboon counted in dry and wet season ($p < 0.05$ (0.002)). The density of Anubis baboon population in Gudina-Abuna sampled forest was 36 Anubis baboons per km^2 and 40 Anubis baboon per km^2 in dry and wet respectively whereas 21 Anubis baboons per km^2 and 25 Anubis baboons per km^2 in dry and wet season respectively in Bone Abuna sampled forest. A total of 4 and 5 troops of Anubis baboons were counted in Gudina-

Abuna sampled forest in dry and wet season respectively whereas a total of 2 and 3 troops of Anubis baboons were counted in Bone-Abuna sampled forest. On the average troop's size ranged from 30-65 individual. During the wet season count, there was 365 sub-adult male & female (69.78%), 80 adult male and female (15.29%), and 78 the number of juvenile (14.91%) were recorded. During the dry season count, there was 320 sub-adult male and females (70.95%), 61 adult male and female (13.52%) and 64 the number of juvenile (14.19%). There was a significant difference in the number of Anubis baboon among habitats ($P < 0.05(0.001)$) (table 8).

Table 8 Number of Anubis Baboon counted in the sampled forest during dry and wet season in the study sites.

Habitat	Species with Respect to Age class	Number of Anubis Baboon counted in dry and wet season in two sites			
		On Gudina-Abuna		On Bone-Abuna	
		Dry season	Wet season	Dry season	Wet season
Dense forest	Adult male and female	16	18	12	16
	Sub-adult male and female	92	102	49	60
	Juveniles	15	19	11	13
	Total	123	139	72	89
Fragment forest	Adult male and female	19	23	14	23
	Sub-adult male and females	119	131	60	72
	Juveniles	23	29	15	17
	Total	161	183	95	112



late 2. A Photographs showing Anubis baboons in the study area.

4.7.2 Population estimation of Vervet monkey.

A total of 318 and 387 Vervet monkey were counted in the entire sampled forest area during dry and wet season respectively. The population size of Vervet monkey in Gudina-Abuna sampled forest was 134 and 172 in dry and wet season respectively whereas in Bone Abuna sampled forest was 184 and 215 in dry and wet season respectively. Statistically there was significant difference between number of Vervet monkey in dry and wet season ($p < 0.05(0.001)$). There was a significant difference in the number vervet monkeys among habitats ($P < 0.05$). The density of Vervet monkey in Gudina Abuna sampled forest was 17 vervet monkeys per km^2 and 21 vervet

monkey per km² in dry and wet respectively whereas 23 Vervet monkey per km² and 27 Vervet monkey per km² in dry and wet season respectively in Bone-Abuna sampled forest. A total of 3 and 4 troops of Vervet monkey were counted in Bone-Abuna sampled forest in dry and wet season respectively whereas 2 and 3 troops in Gudina-Abuna sampled forest were counted in dry and wet season. On the average, troop's size ranged from 28-50 individual. During the wet season count, there was 238 sub-adult male & female (61.5%), 78 adult male and female (20.1%) and 60 the number of juvenile (18.86%) were recorded. During the dry season count, there was 199 sub-adult & female (62.57%), 59 adult male (18.5%) and 71 the number of juveniles (18.34%) (Table 9).



Plate 3 . a photographs showing Vervet monkey in the study area.

Table 9 Number of Vervet monkey counted in the sampled forest during dry and wet season

Habitat	Species with Respect to Age class	Number of Vervet Monkey counted in dry and wet season in two sites			
		On Gudina-Abuna		On Bone-Abuna	
		Dry season	Wet season	Dry season	Wet season
Dense forest	Adult male and female	11	13	16	23
	Sub-adult male and females	37	49	58	63
	Juveniles	13	17	15	16
	Total	61	79	89	102
Fragment forest	Adult male and female	13	17	19	25
	Sub-adult male and female	44	57	60	69
	Juveniles	16	19	16	19
	Total	73	93	95	113

4.8 Amount of crops damaged by crop raiders. ►

Maize was damaged by all the five crop raiders throughout its growth stages. ▲

4.8.1 Amount of crop damaged by Anubis baboon and vervet monkey

The damage caused by Anubis baboon and Vervet monkeys on maize plant starting from the stage of seedlings to maturation were recorded in the study area. Out of the total of 56,400 maize plants, 9568 (16.96%) were damaged by Anubis baboon whereas 4923 (8.72%) were damaged by Vervet monkeys at all stages. The highest damaged recorded by Anubis baboon were 4480 (7.94%) at ripened stage whereas Vervet monkey were 2981 (5.29%) at the flowering stages. The least damage recorded by Anubis baboon were 1862 (3.3%) at seedling stage whereas Vervet monkey were 645 (1.14%) during seedling stage. As calculated based on quadrant sampling, from 20,000m²(2 hectares) maize, sample taken farmland, about 78 quintals (7,800kg)

maize yield were expected. The estimated yield loss of maize due to crop raiding wild animals was about 22 quintals (2,200 kg). The losses cover 28.1% of the total annual production of the total sampled area of the maize crops. In monetary term, the overall loss to farmers in the sampled area was estimated to be 11,000ETB per sampled farmland of maize. In the study area, Anubis baboon and Vervet monkey was the top worst pest in villages. This two pest primates account about 20 quintal (2000 kg) from the total damaged maize plant and in terms of money it was estimated to be 10,000ETB (table 10).

Table 10 Amount of maize damaged by Anubis baboon and Vervet monkey in the sampled areas.

Crop raiders	The developmental stage of maize and the damaged recorded					
	Seedling		Flowering		Ripened	
	Number	%	Number	%	Number	%
Anubis baboon	1862	3.3	3226	5.72	4480	7.94
Vervet monkey	645	1.14	2981	5.29	1297	2.29
Total	2507	4.44	6207	11.01	5777	10.23

4.8.2. Amount of crop damaged by other wild animals

Maize was damaged by other pest animals throughout its growth stage. From the total 20 plots of 4m width by 4m length damages caused by other pest animals such as wild pig, crested porcupines and warthog were counted and recorded at different growth stages. Out of the total of 56,400 maize plants, 1367 were damaged by other wild animals. The highest damage was observed and registered during the ripening stage with 627(1.11%) maize plant damage followed by flowering stage with 412 (0.73%) and seedling stages with 328 (0.58%). The highest damage was recorded by wild pig with 734 (1.3%) whereas the least damage was recorded by crested porcupine with 220 (0.39%). The estimated yield loss of maize due to this other primates about 2 quintal (200kg) from the total damaged maize plant and in terms of money it was estimated to be 1000ETB (Table11).

Table 11 Amount of maize damaged by other wild animals

Crop raiders	The developmental stage of maize and damaged recorded					
	Seedling		Flowering		Ripened	
	Number	%	number	%	Number	%
Wild pig	179	0.32	215	0.38	340	0.6
Warthog	103	0.18	129	0.23	181	0.32
Porcupine	46	0.08	68	0.12	106	0.19
Total	328	0.58	412	0.73	627	1.11

Out of the total 56,400 maize plant grown in sampled area, 15,858 (28.1%) were damaged. From this total amount 9568 (16.96%) were damaged by Anubis baboons, 4923(8.72%) were damaged by Vervet monkeys and 1367 (2.42%) by other wild animals. The loss covers 28.1% of the total annual production of maize. The estimated yield losses of maize due to crop raiding wild animals were about 2,200kg (22 quintals) and in terms of money it was estimated to be 11000ETB (figure 13).

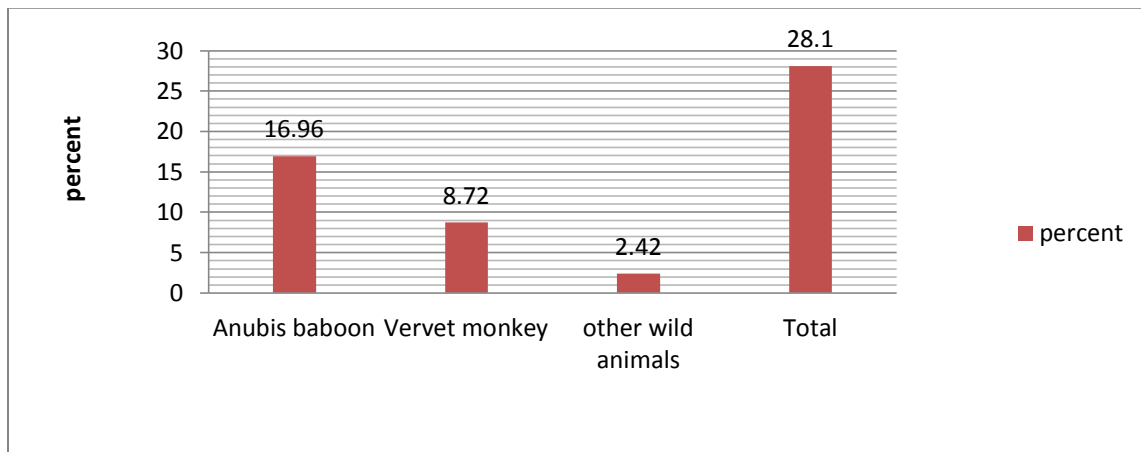


Figure 13 percentage of maize damaged by Anubis baboon, Vervet monkey and other wild animals.

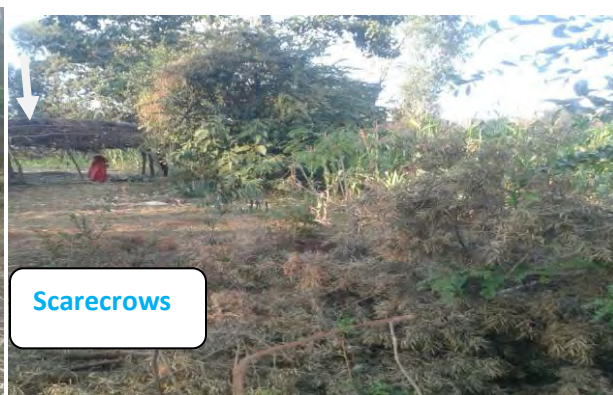
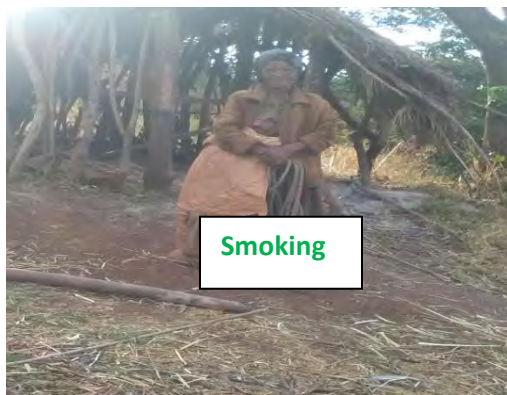


Figure 14 Different traditional methods to defend crop raider from crops (photos by Asebe Regasa in field survey, 2017)

4.9 Traditional methods used by farmers to defend crop raiders from their crops.

During the present study respondents used different methods to defend crop raider from their crop it's include making scarecrow, chasing, guarding and smoking. There was significant difference between respondents ($p < 0.05$ (0.003). About 92 (76%) of respondents reported that as they guarded their crops throughout crop growing season, 13(10.7%) of respondents chasing by dogs or stones are other methods used, 11 (9.1%) of respondents making scarecrow was also used to as supplementary and 5 (4.1%) of respondents were used smoking to repeal the crop raiders from their crop mostly in the night time. Guarding was the most and effective protective method to minimize the loss of their crop from crop raider (figures 15).

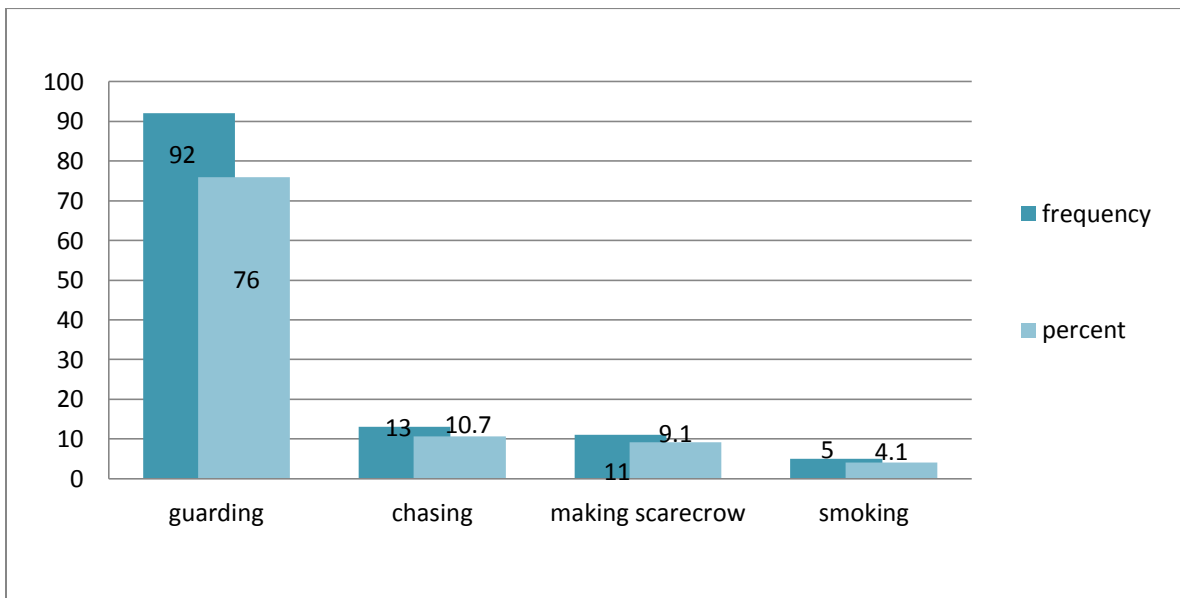


Figure 15 percentage of respondents used different traditional methods.

4.10 Livestock depredation

A very large number (96%) of respondents said that livestock loss by carnivores was not as such a big problem in the study area. The most predators on small ruminant such as goat and sheep during the present study were Anubis Baboons. Based on respondent's response the killed goat and sheep's between January 2015 and 2017 were 62. Out of the total kills caused by Anubis baboon in the last two years, about 35 (56.45%) were on goat whereas 27 (43.55%) were on sheep (figures 16).

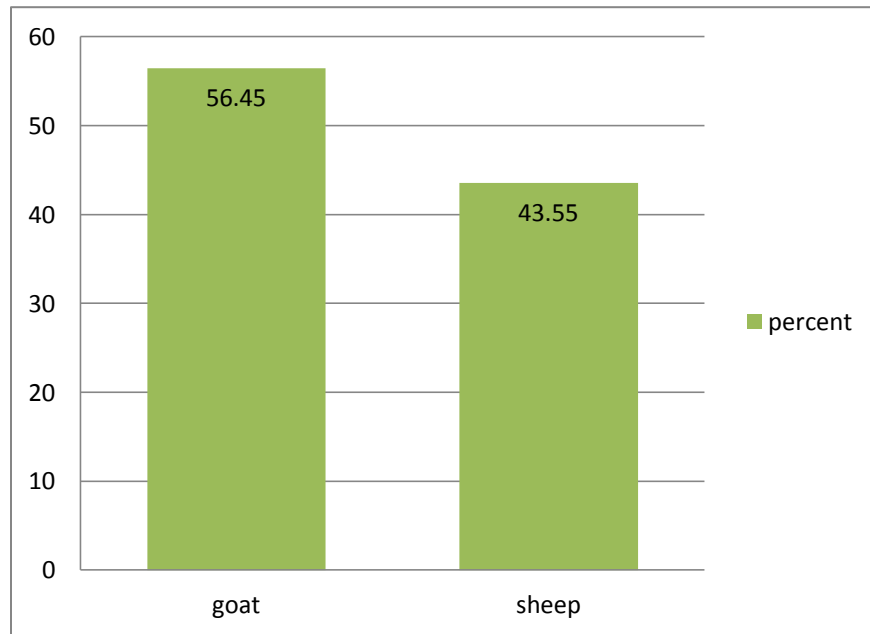


Figure 16 Losses of goat and sheep by Anubis baboon between January 2015 and 2017 according to the respondents.

5. DISCUSSION

Human population expansion and habitats shrinks, local people and wildlife are increasingly coming into conflict over living space, food and other economic resources. The result of this study have shown that there was a strong conflict between wild animals and farmers living in and around the Chato natural forest, especially in villages like Wana, Wabo, Bone and Bareda. Based on respondents list, six major wild animals namely, Anubis baboon, Vervet monkey, wild pig, warthog, Civet cat and crested porcupine were identified in the study area as they cause crop damage. Similar result was reported in different parts of Africa which revealed that wild animals posed major threat on crops (Hill, 1997; Rugunda, 2004).

Anubis baboon and Vervet monkey were the known pest primates. Primates are the most frequently identified crop raiding animals. Anubis baboon was the most commonly reported crop raiders and ranked first followed by Vervet monkeys. Similar result has been reported by Kate (2012) who reported that baboon were ranked number one crop raiders in Uganda; Tweheyo (2011) also reported that Anubis baboon was ranked as first and Vervet monkey as second crop raiders. Both studies agree with the present study. The conflict between wild animals and farmer's around Chato forest involved crop raiding and livestock predation, hundred percent of the respondents reported problems with wildlife. Of that discussion with focused group discussion and interviewed households who reported problems caused by wildlife: 65% reported both crop damage and loss of livestock to wildlife, 22.5% reported crop damage; only 12.5% reported the loss of livestock. Similar findings were observed from the study conducted in Tanzania on the conflict between wildlife and farmers Joseline (2010) and Edward (2012).

All crops were not equally affected by crop raiders. Maize was the most vulnerable crop to crop raiders, because of easy handling of maize cobs than other crops. The result was agreed with finding of Warren (2008) who reported that maize was the most frequently eaten crop by crop raiding in West Africa. In particular maize seems to be targeted and damaged by Anubis baboons, vervet monkeys, wild pigs and porcupines. The competitions for resources cause conflict between wild animals and local people, this was in agreement with the study of Hill (2000) who reported that the wild animals increasing year to year which is due to competitions for resources between wild animal and human population. Pest primate population in the study area was high during the wet season than the dry season because the maize farmlands around the

forest become attractive and provide a plenty of food sources for those primates. During the dry season food were become scarce in the farmland, thus the Anubis baboon and Vervet monkeys might temporally move from forest to forest in different area. This result was similar with the study conducted by Mesele Yihune (2007) who reported that more pest primate population was recorded during the wet season than the dry season in Wonji shoa. Based on the present findings, about 95% of the respondents reported the trend of crop damage by crop raiders was increased from time to time and about 5% of them said it is unknown. This result was similar with the study conducted by Leta Gobosho (2014) who reported that the trend of crop damage by crop raider in Gera district. The study showed that the analysis of data collected through direct observation have shown more or less the same result with that of structured questionnaire survey and the species observed damaging crops were the same as those species listed under questionnaire survey.

On the basis of samples taken for direct observation, out of the total expected yield; 28.1% was lost due to crop raiding by wild animals. This result showed that during direct observation, maize was damaged by Anubis baboon 16.96%, Vervet monkey 8.72% and other wild animals 2.42%. Therefore, the result of this study showed that there was strong conflict between them. Anubis baboon and Vervet monkey damaged crop during day time whereas wild pig, warthog, Civet cat and porcupine damaged crop during night time (nocturnal). Anubis baboon was causing damage on crops in all stages from the time of germination to the harvest whereas Vervet monkey affect crops at flowering stages. Many crops are damaged by crop raiders at specific stages of development, for example at germination, seedling, flowering, harvesting and fruiting stages. Regarding the variation of damage in the developmental stages of maize, the highest amount of damage was recorded during the ripened stage by Anubis baboon and during the flowering stage by Vervet monkey, the least amount were recorded during seedling stages by both pest primates in the study sites. This result was agreement with finding of Warren (2008) 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 Nigeria. As reported by Naughton Treves et al (1998), primates were the most often identified problem in crop raiding in many African parks.

The result of the study shows that the causes of human wild animals'' conflict were expansion of subsistence agriculture around forest edge, wild animals'' habitat disturbance, deforestation and increment of wild animal''s population. Habitat destruction is through fragmentation of natural

habitats, cultivation and settlement near primate habitat. This has resulted in human wildlife conflicts around Chato forest. 64.5% of the respondents reported were habitat disturbance. This result was similar with Joseline (2010) and Edward and Frank (2012) who reported increased habitat disturbance as major causes of HWC in Uganda and Priston et al.,(2012) who reported deforestation was the main causes of HWC in Indonesia.

Regarding the major problematic predators in the all study sites, 56.45% of the respondents reported goat loss by Anubis baboon whereas 43.55% of the respondents reported sheep loss by Baboon in the last two years .This result agreed with finding of Oli et al .,(1994) who reported that Anubis baboon to kill livestock in most parts of its range. The study showed that farmers developed different strategies to defend crop raider from crop damage. Guarding was a most method used by large number of farmers in protecting their crop from damage by crop raiders and also guarding was common especially during the harvest season, during this time, farmers guard crops even during the morning and night time. This result agreed with the finding of Sillero-Zubiri and Swetzer (2001) in different parts of Africa. Also making scarecrow, chasing and smoking was common methods which were used in the study area.

6. CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

Conflict between human and wild animals exist in different forms all over the world, particularly in developing country where peoples depend on agriculture. The effect of human wildlife conflicts are negative and impacts negatively on both human and wildlife as showed in the present study. The present study was investigated the cause and effect of human wildlife conflict with special emphasis to pest primate in and around Chato forest in Horro district, Western Ethiopia to estimate crops damaged and livestock depredation. The causes of human wild animals" conflict were wild animals habitat disturbance, increased subsistence agriculture around forest edge, deforestation, unfavorable situation in the forest and increment of wild animal population all mentioned causes.

The six wild animals responsible for the most damage to crops were determined to be: Anubis baboon, Vervet monkey, Wild pig, Warthog, Africana civet cat and porcupine were identified in the study area. Maize is the most crops which were cultivated by most of the farmers in the study area and it was the highest vulnerable crop damage. The highest crops damaged was caused by Anubis baboon and it was the most commonly reported crop raiders and livestock depredation causing wild animals. Vervet monkey was the second problematic animals on crops damaged followed by wild pig, warthog and porcupine in the study area. Out of total expected yield of maize planted 28.1% was lost due to crop raiding wild animals. Most of the damage was recorded during flowering stage by Vervet monkey and in matured stage by Anubis baboon. The tendency of crop damage was increased from time to time. Anubis baboon and Vervet monkey were damage day time whereas wild pig, warthog, Africana civet cat and porcupine caused damage in the night time.

The crop raider protection methods in the study area were guarding, chasing, making scarecrow and smoking to defend crop raiders from their crop. Guarding in the field was indicated to be the primary and most effective means of guarding against pests. During guarding the aim was to kill the wild animal using stone or other harmful instruments. This indicated that there is an

immediate need for sweeping wildlife conservation educate program to educate farmers living in Horro district about the purpose and benefit of wildlife conservation, the causes of human wildlife conflict and methods for reducing various forms of this conflict. Therefore, Human wildlife conflict issues must be treated with concern and placed in the context of local farmers. Farmers need to take responsibility for protecting their own crops.

6.2 RECOMMENDATION

Based on the obtained results of the present study, the following points are recommended to mitigate the human wildlife conflict in the study area:

- ❖ To avoid heavy losses, highly palatable seasonal crops such as maize, sweet potatoes should not be grown near the forest edge. This is because these crops seem more attractive to crop raiders than wild foods, thus farmers should be encouraged to concentrate on crops which are unpalatable to wild animals. This will help to minimize crop loss to wildlife.
- ❖ To reduce the dependency of local community on the forest, it's better to encourage the local community to plant trees for their different utilization.
- ❖ Stakeholders should reduce illegal human settlements around the forest, expansion of farmland and cattle grazing in the forest.
- ❖ Educating the community around Chato forest regarding the purpose and benefit of wildlife conservation, the causes of human wildlife conflict and method for reducing or eliminating various forms of this conflict.
- ❖ Making appropriate site selection for investment to reduce habitat disturbance.
- ❖ Encouraging farmers as they keep cooperatively their crop farm from crop raiders to minimize crop loss by using the most effective methods in the area.
- ❖ Farmers should sow similar crop at uniform time along side of their farm to take the advantages of uniformly keeping the farm to minimize the loss of crop to crop raiders.

7. REFERENCES

- Afewerk Bekele, (2011). Population estimation of Menelik's (*Tragelaphus scriptus meneliki*, Neumann, 1902) from denkoro forest proposed National park, Northern Ethiopia. *International Journal of Ecology and Environmental Science* 37(1):1-13, Addis Ababa university department of Biology, Ethiopia.
- Biquand, S., Biquand, V., Biong, A and Gautier, J.P.(1992). The distribution of Papio Hamadryads in Saudi Arabia: *ecological correlates and human influence*. *Int.J.Primatol.*13:223-243.
- Blair, A. (2008). *Human-wildlife conflict in Laikipia north, Kenya: comparing official reports with the experience of Maasai pastoralists* a thesis submitted to McGill University in partial fulfillment of the requirements of the degree of master of science. Department of Geography McGill University ,Montreal.
- Cochran, W. G. (1977). *Sampling techniques* (3rded). John Wiley and Sons New York USA.74-76 pp.
- Conover, M. 2002. Resolving human wildlife conflicts the science of wildlife damage management, *Lewis Publishers*, New York, 418 p.
- Cormier, L.(2002). *Monkey as Food, Monkey as child: Guajá symbolic cannibalism*. Primates face to face. Cambridge, UK: Cambridge University Press. 63-84pp.
- Cowlshaw, G. and Dunbar, R. (2000). *Primate conservation Biology*. University of Chicago Press, Chicago, 134-143pp.
- Central Statistical Authority (CSA,2007). The population and housing census of Ethiopia result for Oromia Region, Addis Ababa.
- Demeke Datiko and Afework Bekele, (2011). Population status and human impact on the endangered Swayne's hartebeest (*Alcelaphus buselaphus swaynei*) in Nechisar plains, Nechisar national park, Ethiopia. *Afr. J. Ecol.*, 49:311-319..
- Dickman, A.J (2010). Review on Complexities of conflict: the importance of considering social factor for effectively resolving human-wildlife conflict. Department of Zoology, Wildlife conservation research unit the Reanati Kaplan center , University of Oxford, Tubney, Oxford shire, UK.
- Edward, D.W and Frank, S. A.(2012) .Victims Perspectives of Lowe's Monkeys'' (Cercopithecus Campbell Lowei) crop raiding events in Ghana: A case of Boabeng-Fiema Monkey Sanctuary. *Journal of Biodiversity and Environmental Sciences (JBES)*, ISSN: 2220-6663 (Print) 2222-3045 (Online) Vol. 2, No. 2, p. 1-8, <http://www.innspub.net>.
- Eltringham, S . (1979). *The Ecology and Conservation of Large African Mammals*. The Macmillan Press, London.103-109Pp.

- EMSA (Ethiopian Mapping Service Agency, 1996). *Topographic map of Ethiopia: 1:50,000*.EMA. Addis Ababa, Ethiopia.
- EFAP (Ethiopia Forestry Action Program, volume III.1994).The challenge for development. Ministry of Natural Resources, Addis Ababa.
- Estrada, A. (2006). Human and non-human primate co-existence in the Neotropics: A Preliminary View of some agricultural practices as a complement for primate conservation Ecological and Environmental Anthropology.2:17- 29.
- Eyebe, A., Dkamela,G and Endamana,D.(2012). Overview of Human wildlife conflict in, poverty and Conservation learning group discussion paper.
- Fernando, P, Wikramanayake, E., Weerakoon, D, Jayasinghe, A. K, Guana wardene, M and Janaka, K. H, (2005). *Perceptions and patterns of human elephant conflict in and New settlements in srilanka; Insights for mitigate and management*.Biodiver.Conserv.14:2465-2481
- Friis, B.(1992). Forest and Forest trees of Northeast Tropical Africa: Their natural habitats and distribution pattern in Ethiopia, Djibouti and Somalia. Kew. Bull. Add.Ser.15,396pp.
- Fuentes,A.(2006). Human-non human primate interconnections and their relevance to functions,Trop. conserv.sci.2:299-318.
- Gautier, J. and Biquand, S. (1994). *Primate commensalism*. Rev Ecol TerreVie.49:210-212.
- Grubb, P. (2006). Geo-species and Super-species in the African primates'fauna. Primate conserve.20: 75- 78.
- Hanks, J.(2006). Mitigation of human–elephant conflict in the Katanga-Zambezi Transfrontier Conservation Area, with particular reference to the use of chili peppers. Cape Town: *Conservation International*.
- H.W.R.D.O. (Horo Woreda and Rural Development Office, 2017). Socioeconomic profile of Horo woreda, Shambu.
- Hill, C. M.(1997). *Crop raiding by wild vertebrates: the farmer's perspective in an agriculture Community in Western Uganda*. International Journal of pest management 43:77-84.
- Hill, C. (1998). Conflicting attitudes towards elephants around the Budongo Forest Reserve, Uganda. Environ.Conserv.25:244-250.
- Hill, C. (2000). Conflict of interests between people and baboons: Crop raiding in Uganda. International. Journal. Primatol 21; 299-315.
- Hill, C.(2004). *Farmers' perspectives of conflict at the wildlife-agriculture boundary: some lessons learned from African subsistence farmers*. Hum. Dimen.Wildl. 9:279-286.
- Hoare, R.E.(2000).Projects of Human Elephant conflict Task Force (HETF). Result and Recommendation, pachyderm 28:68-72.

- IUCN. (2005). Benefits beyond Boundaries. Proceedings of the 5th IUCN World Parks Congress .IUCN, Gland, Switzerland and Cambridge, UK.Ix. 306pp.
- Joseline, M. (2010). The impact of crop raiding by wild animals from Bugoma forest reserve on farmers'' Livelihoods . A research thesis submitted to Maker ere University Institute of Environment and Natural Resource (MUIENR) in partial fulfillment of the requirement for the award of the degree of Master of Science in Environment and Natural Resource of Makerere university.
- Kate, K. (2012). Possible strategies/practices in reducing wild animal (Primate Crop raids) in unprotected areas in Hoima District, Uganda.21pp.
- Kimega, G.(2003). Unresolved Human Wildlife conflict in Kenya The Source of Misery and poverty.
- King, F.A. and Lee , P.C (1987) . A brief survey of *human attitudes to a pest species of primate*. Cercopithecus aethiops.Prim.Conserv.8:82-84.
- Kingdon, J.(1997). The Kingdon Field Guide to African Mammals. Academic Press, London . UK. 476pp.
- Knight , J. (1999). Monkeys of the move: the natural symbolism of people-macaque conflict in Japan. J. Asia Stud. 58:622-647.
- Lamarque, F., Anderson, J., Fergusson, R., Lagrange, M., Osei Owusu, Y and Bakker, L. (2009). *Human wildlife conflict in Africa cause, consequences and management strategies*.
- Lee, P. and Priston, N. (2005). *Human attitudes to primates: perceptions of pests, conflict and consequences for primate conservation*. In Paterson JD, Wallis J. Commensalism and conflict: the primate human interface, American Society of Primatologists, Norman, OK,1-23pp.
- Lee, P., (2010). Sharing space: Can ethnoprimateology contribute to the survival of nonhuman primates in human dominated globalized landscapes. American Journal of primate.72:925-934.
- Leta Gobosho (2014). Assessment of human wild animals'' conflict and Management strategy in Gera District, south western Ethiopia, Jimma.
- Lopez-del-Toro, P., Andresen, E., Barraza, L. and Estrada, A. (2009). Attitudes and knowledge of Shade Coffee farmers towards vertebrates and their ecological functions. Trop.conserv.Sci 2:299-318.
- Madden, F.(2004).Creating coexistence between human and wildlife, global perspectives on local efforts to address human-wildlife conflict, *Human dimensions of Wildlife*, 9:247-257, 2004.
- Madden, F.(2008). The growing conflict between humans and wildlife: law and policy as Contributing and mitigating factors. *Journal of International Wildlife Law & Policy*, 11: 189-206.
- Mesele Yihune, Afework Bekele and Zelealem Tefera,(2008) . Human Gelada baboon conflict in and around the Semien Mountains National Park, Ethiopia, Department of Biology, Addis Ababa University. *Ethiopia and Afro-alpine Ecosystem Conservation Project*, FZS, PO Box IOI428, Addis Ababa, Ethiopia.
- Messmer, T (2000). The emergence of Human Wildlife Conflict Management: turning challenges into opportunities. International Biodegradation 45:97-102.

- Mohr, p.(1971). *The Geology of Ethiopia*. HIS university press, Addis Ababa.
- Mussa, A. (2009). Population status of Gelada Baboon and human- wildlife Conflict In and around denkoro forest. Msc. thesis, Addis Ababa University, Ethiopia p44-83.
- Naughton-Treves, L. (1997). Farming the forest edge vulnerable places and people around Kibale national Park, Uganda .The Geographical Review 87 (I): 27-46, January 1997.
- Naughton- Treves, L. (1998). Predicting patterns o f crop damage by wildlife around Kibale National Park, Uganda.Conserv. Biol. 12:156–168.
- Naughton Treves, N and Treves, A. (2005).Socio-ecological factors shaping local support for wildlife: crop-raiding by Elephants and other wildlife in Africa.
- Oli, M.K, Taylor, I.R.and Rogers, M.E. (1994).Snow leopard panther unica predation of livestock: an assessment of local perception in the Annapurna conservation area, Nepal. Biological Conservation 68:63-68.
- Osborn , F. and Hill, C. (2005). *Techniques to reduce crop loss: human and technical dimensions in Africa*. In: People and Wildlife: Conflict or Coexistence? R. Woodroffe. Thyroid and A. Rabinowitz (eds.), Cambridge University Press, Cambridge, UK. 72– 85pp.
- Osei-Owusu, Y. and Bakker, L. (2008).Human–WildlifeConflict.FAO Elephant Technical Manual. 45pp.
- Patterson, J. (2005). Residents and immigrants: perceptions of crop raiding in Masindi District, Uganda. In commensalism and conflict: the human primate Interface. Paterson, J. and Wallis, J, American Society of Primatology, Norman, Oklahoma.
- Priston, N. E., Wyper, R.W and Lee, P.C.2012.Buton Macaques (*Macaca ochreata brunnescens*): Crops, conflict and behavior on farms. Department of Anthropology and Geography, Oxford Brookes University, Oxford, United Kingdom, *Behaviour and Evolution Research Group*, School of Natural Sciences, University of Stirling, Stirling, United Kingdom. *American Journal of Primatology* 74:29–36.
- Quirin, C.(2005). Crop raiding by wild vertebrates in the Illubabor zone, Ethiopia, A report submitted in partial fulfilment of the post graduate Diploma in wildlife management, University of Otago, Department of zoology. New Zealand, *recommendation, pachyderm* 28; 68-72.
- Rugunda . G. K.2004. Crop raiding around lake Mburo National park, Uganda Department of Biology Mbrara University of science and technology Uganda, *African Journal of Ecology*.
- Sekhar. S. (1998). Perception of local people towards conservation of forest resources in Nanda Devi Biosphere Reserve, north- Western Himalaya, India.*Biodivers.conserv.*16:211-222.
- Serpell, J.A. (1981). Duetting in birds and primates“ question of function.*Anim.Behav.*29:963-965

- Siex, K. and Struhsaker, T. (1999). Columbus monkeys and coconuts: a study of perceived human- wildlife conflicts. *J. Appl. Ecol.* 36:1009–1020.
- Sillero - Zubiri, C. and Switzer, D. (2001). Crop raiding primates: searching for alternatives, human Way to Solve conflict with farmers in Africa, People and wildlife initiative, Wildlife conservation research unit, Oxford University, oxford. 123-134pp.
- Smart, R, Whiting, and M. And Twine, W. (2005). D Lizards and landscapes: integrating field surveys and Interviews to assess the impact of human disturbance on lizard Assemblages and selected Reptiles in a savanna in south Africa. *Biol. conserv.* 122:23-31.
- Struhsaker, T. (1978). Food habits of five monkey species in the Kibale Forest, Uganda. In recent Advances in primatology. Chivers, D and Herbert. Academic press, London 225-248pp.
- Strum, S. (1994). Prospects for management of primate pests. *Rev. Ecol. Terre Vie.* 49:295-306.
- Taylor, K. (1984). *Vertebrate Pest Problems in Africa*. In Dubock, A.C. (ed.) Proceeding of a Conference on the Organization and Practice of Vertebrate Pest Control. , Dram rite Printers. Ltd. London. 21-28 pp.
- Tchamba, M. (1996) History and Present Status of the Human-Elephant Conflicts in the Waza Loone Region, Cameroon. *Biol. Conserv.* 75:35-44.
- Treves, A., Naughton-Treves, L, Harper, E.K., Mladeno H, D.J., Rose, R.A., Sickely, T.A., and Wydeven, A.P. (2003). Predicting human carnivore conflict: A spatial model derived from 25 years of data on wolf predation or livestock. *Conservation Biology* 18:114-125
- Treves, A. and Karanth, K (2005). Human-carnivores conflict: local solution with global applications. *Conserv. Biol.* 17;1489-1490.
- Tewodros Kumssa and Afework Bekele, 2008. Human wildlife conflict and population status of Swayne's Hartebeest in (*Alcelaphus buselaphus swaynei*) in Senkele Swayne's Hartebeest sanctuary Master Thesis in Biology (Ecological and Systematic Zoology), Ethiopia.
- Tweheyo, M, Hill, C. and Obua, J. (2005). Patterns of crop raiding by primates around the Budongo Forest Reserve, Uganda. *Wildlife Biology.* 11:237-247
- Warren, Y. (2008). Crop raiding Baboons (*Papio Anubis*) defensive farmers: A West African perspective. School of Human and life sciences, Whiteland College, Roehampton University, Holybourne avenue, London SW15 4JD, *West African Journal of Applied Ecology*, vol. 14:246-249.
- WWF (2005). *Human Wildlife Conflict manual Southern African Regional Programmer* .Office. 30pp.
- Yasmi, Y., Kelley, L and Enters. T, (2010) .Conflict over forests and land in Asia impacts, causes, and management. Email: info@recoftc.org Website: www.recoftc.org.
- Yirmed Demeke, (1997). The status of African Elephant, *Walia* 18:20-26.

8. APPENDICES

APPENDIX: 1 Questionnaire; Structured questionnaire for household's survey on crop damage and other related crop raiding activities by wild animals around Chato forest in Horro district, western Ethiopia.

1. Name _____
2. Sex [A] male [B] female
3. Age: _____
4. Educational back ground [A] Illiterate [B] read and writes only
 [C] Elementary school [D] High school [E] other
5. Do you have your own farmland? [A] Yes [B] No
6. If your answer is „yes“ for question (Q 5) above, how much is its size?
 [A] 0.5-1ha [B] 2-3 [C] 4-5ha [D] Greater than 5ha
7. How much is the distance of your cultivation land from forest edge?
 [A] Near [B] Medium [C] Far
8. What are your most livelihood activities?
 [A] Crop farming [B] both crop farming and livestock rearing
 [C] Crop production and other income source [D] other (mention).
9. What type of crops do you grow in your farm land?
 [A] Maize [B] Barely [C] Teff [D] Wheat [E] Other
10. Which type of crop is more attacked by pest wild animal?
 [A] Maize [B] Barely [C] Wheat [D] Teff
11. To what extent wild animals cause damage to your crops?
 [A] High [B] Medium [C] Low
12. Do wild animal cause damage to your crop? Yes / No.
13. If your answer yes“ for question (Q12) above, in what time more cause damage?
 [A] Night [B] Day [C] both
14. Do you encounter any conflicts with wildlife? Yes or no
15. If your answer is yes for question (Q14), what kind of problems do you face because of wildlife?
 [A] Crop damage only [B] livestock predation only

- [C] Both the crop damage and livestock predation [D] others
16. What is the major cause for the happening of HWC in your area?
 [A] Expansion of subsistence agriculture around forest edge
 [B] Wild animal habitat disturbance [C] Deforestation
 [D] Increment of wild animal's population
17. Which pest wild animal is more responsible for crop damage?
 [A] Columbus Monkey [B] Vervet Monkey [C] Anubis baboon
 [D] Wild pig [E] Warthog [F] Porcupine [G] Civet cat
18. What control measures have been taken to safeguard you crops from pests?
 [A] Guarding [B] Chasing [C] Making scarecrows [D] Smoking [E] Others
19. At what stage pest wild animal more attack crops?
 [A] Seedling [B] early maturation [C] Maturation [D] Other
20. What is the tendency of crop damage from time to time?
 [A] Increasing [B] Decreasing [C] Unknown
21. Have you lost any livestock to wildlife? Yes or no.
22. If your answer is yes for question (Q21), how many? And what is the species involved?
23. Which wild animals are more responsible for crop damage during day time?

24. In what season do you experience the most wildlife damage your crops?
 [A] Dry season [B] wet season [C] Both wet and dry season
25. Which pest wild animal is more responsible for crop damage during night time?

26. Rank crop raiders according to the extent of crop damage.

APPENDIX: II

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

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

1. Is there any Human wildlife conflict in your area?
2. What type of crops do you grow on your land?
3. What is the main deriving cause of HWC in your area?
4. Which pest primate is more cause crop damage?
5. Which wildlife species frequently attack your farm?
6. Do you think the presence of the Chato forest close to your area benefited the society?
if benefited what are they?
7. In which season the crop damage is serious and what is the reason behind?
8. What are the major factors that cause Human wild animals conflict in the study area?
9. Is habitat of wild animal is fragmented due to human and natural causes in your area?
10. Why farmers are in your area face Human wild animals „conflict?

APPENDIX III

Appendix III: Data collection sheet for direct observation of crop damage by pest primates

Name of data collector _____

place _____

season _____

Stages of crop development _____

Distance of the field from the forest boundary _____

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

APPENDIX . IV

Appendix IV: Data collection sheet for population estimate of pest primates.

Name of data collector _____

Date _____

Species _____

Season _____

Place _____

Site _____

Quadrant No	Season		Age structure and their respective number			Remarks
	Dry	Wet	Adult male and female	Sub-adult male and female	Juvenile	
Total						

Appendix figure . 1







Appendix figure.1 interviewer person in the study area, crop damages and use scarecrows for protecting their own crops and expansion agriculture near the forest edge.

Declaration

I, the undersigned, declare that this thesis entitled Human wildlife conflict with special emphasis on pest primates in and around Chato forest in Horro district, western Ethiopia is my original work and has not been presented for a degree in any other university and all that sources of materials used for the thesis have been fully acknowledged.

Student name

Signature

Date

ASEBE REGASA

Advisor's name

Signature

Date

Dr. HABTE JEBESSA
