



Human-wildlife conflict with special emphasis on pest primates in Sembo Kejo Kebele, East Wollega zone, Western Ethiopia

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A research paper submitted to the Department of Biology, College of Natural Sciences and School of Graduate Studies, Jimma University in partial fulfillment for the requirements for the degree of Master of Science in Biology (Ecological and systematic zoology).

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## **Declaration**

I, hereby declare that this thesis is my inventive work, that is the documentation of work carried out by me and it has not been submitted in any previous application for a higher degree. I announce that I have developed and written the enclosed master thesis completely by myself and have not used source or means without declaration in the text. Any thought from others or literal questions are clearly marked. The thesis was not used in the same or in a similar version to achieve an academic grading. This has been submitted in partial fulfillment of the requirement for Msc. Degree at Jimma University. I declare this thesis is not submitted to any other institutions anywhere for the award of the academic degree. However, the contributions of others are involved and every effort are made to indicate this clearly, with due to reference to the literature and acknowledgment.

Name: Biset Tesfaw

Signature \_\_\_\_\_

Date \_\_\_\_\_

Jimma University

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## **ACRONYMS AND ABBREVIATIONS**

AF: Adult female

EMA: Ethiopia meteorological Agency

AM: Adult male

ANVA: Analysis of variance

BARC: Bako Agricultural Research Center

DA: Developmental Agency

FGD: Focus Group Discussion

GPS: Global Position System

HWC: Human wildlife conflict

IUCN: International Union for Conservation of Nature

SAF: Sub adult female

SAM: Sub adult male

SD: Standard deviation

SPP: Species

U.R.T: United Republic of Tanzania

WWF: World wide fund of nature

## ***ABSTRACT***

*This study was conducted to assess human wildlife conflict with special emphasis on pest primate in Sembo kejo kebele, East Wollega, Ethiopia, from February to September 2014. The main objective of the study was to identify the cause and effect of human wildlife conflicts, to estimate the amount of crops destroyed by primate pest and to estimate the population of primate pest in the study sites. Based on the information obtained from preliminary survey, a structured questionnaire was developed based on applicability to the objectives of the study for gathering information by questionnaires, interview and field observation. Field observation using line transect was used, to estimate the population size of pest primates and estimate crop loss due to pest primates. Structured questionnaires and interview were used for gathering information about crop loss by pest primates. From the study site, three pest species were identified, namely anubis baboon (*Papio anubis*), Colobus monkey (*Colobus abyssinicus*) and Vervet monkey (*Chlorocebus aethiops*). The number of adult females was significantly higher than the number of adult males ( $X^2 = 1.1065, p < 0.05$ ). Over twenty seven percent of maize was damaged by pest primates from the total estimated maize plant (42,220) and most maize damages were noticed during the tassle and ripen stages. Serious damage was seen in wet season than dry season. Guarding, chasing with dogs and placing the model of man were traditional methods to minimize loss. The people in the study area depended on the forest for different resources such as fire wood, farmland, grazing land and fodder; such activities lead to the degradation of the natural habitat that may drive wildlife to be crop pests. However to reduce the dependency of the local people on the forest, it is better to encourage the local people to given education not to be dependent on clearing forest for means of farmland, instead they should be organize with others and participate in activities like coffee plants and specie cultivation, which is dual benefits in the coming generation for youngster to engage on forest management.*

**Key words:** Sembo kejo, East Wollega, *Papio anubis*, *Chlorocebus aethiops*, *Colobus monkey* and HWC

# 1. INTRODUCTION

## 1.1. Background of the study

Human - wildlife conflicts was started since the beginning of the emergence of human beings. During the time people live in the cave, there was a conflict between wild animals and human being. 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 animals as food and protection (Eltringham, 1979). The numerous cases reported from countries all over the world demonstrate the severity of human-wildlife conflict and suggest an in-depth analysis to understand the problem and support the conservation prospects of threatened and potentially endangered species (Hill, 2000).

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

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

Conflicts over use of natural resources, by large, originate from egocentric attitudes and lack of knowledge on resource use rights contends that conflict is a common feature of any resource use system (Mutiru, 2000). Conflicts have shown the way to reduced risk management strategies, such as income diversification, including cultivation of arable land, and food storage (Aboud *et al.*, 1996). While livestock support the land holder's, livelihood, and game is regarded by the

landholder as either a threat or a competitor for the same available resources. This conflict has been intensified by two opposing and seemingly mutually exclusive groups such as the pro-game group and the pro-livestock group (Mwangi and Zulberti, 1986).

In Ethiopia, large herbivore mammals cause damage to agricultural crops and plantations (Shibru, 1995). The extent of damage varies depending on the species of the pest mammal in different parts of the country (Kingdon, 1971). There are wide varieties of pest mammalian species such as hippopotamus, baboons and monkeys. These mammals cause serious damage to agricultural crops Wonji sugar plantation (Serekebirhan, 2006). The current study is aimed to assess the conflict of wild animals and human being with emphasis to pest primate around Bako agricultural forest.

## **1.2. Statement of the problem**

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

In Kenya, crops such as maize, cassava, beans, potatoes, and fruits are the target for animals like elephant, baboons, zebra and buffalo (Sillero-Zubiri and Switzer, 2001). Wildlife damage to crops varies considerably from site to site and farmers have unequal capacity for preventing such losses. The change in the vegetation structure closer to the protected areas may attract wild herbivores (Kimega, 2003). Crop raiding has most likely been occurring since humans first settled down and started practicing agriculture. Different types of food items are targeted by wild animals, from cereals to fruits and from vegetables to trees (Sillero and Switzer, 2001). In the present study area crops such as maize, sorghum, sugar cane, teff and tomato are damaged by wild animals like baboon and vervet monkey. However, still the human-wildlife conflict in the study area remaining unstudied and adequate development enhancing information is lacking.

Therefore, this study was designed to generate basic information about human wildlife conflict with special emphases of pest primate on the basis of crop damage.

## **1.3. Objective of the study**

### **1.3.1 General objective**

The general objective of this study was to assess the cause and effect of human- wildlife conflict, with special emphasis to pest primate in Sembo kejo kebele, Eastern Wollega zone, western Ethiopia.

### **1.3.2. Specific objective**

- To identify the cause and effect of human wildlife conflicts
- To estimate the amount of crops destroyed by primate pest
- To estimate the population of primate pest in the study sites



#### **1.4. Significance of the study**

Different species and subspecies of primates occur in Ethiopia. Some primates are very successful crop raiders and they are particularly problem across different part of the countries, especially in rural area where subsistence farmers living and farming near the forest. In the study area, majority of the land is covered with forest and farmers who are near the forest are the main victims of this crop damage. Most their agricultural products are exposed to the damage by pest primate and their seasonal or yearly yields from their agriculture are less when compared with that of secured farmer (Melese, 2007).

The significance of this study is to maximize the understanding of people towards the primate conservation, to plan appropriate conservation strategy, and indicate future research areas for those who would like to conduct researches on wild animals. Moreover, the data may be used as secondary data for researchers and any interested parties working in the study area. Hence, this study is paramount or vita significant in identifying type of primate and method of minimizing the human primate conflict.

## **2. LITERATURE REVIEW**

### **2.1 Definition**

Different scholars define HWC in different ways. The world wide fund of nature (WWF, 2005) defined HWC as “any interaction between human and wildlife that results in negative impact on human social, economic, on the conservation of wildlife population or on the environment”. The International Union for Conservation of Nature (IUCN, 2005) define HWC as a conflict occurring “ When wildlife requirements encroach on those of human population, with cost both to residents and wild animals.” HWC is a term commonly used to conservationist to describe friction between wild animals and people. The conflict emergence when wild life and human requirement overlap with consequential costs to humans and wild animals (Osei-Owusu, 2008).

### **2.2 Human wildlife Conflict**

#### **2.2.1 The human-primate conflict**

In many parts of the world people and non-human primates have co-existed for thousands of years. Over the past 50 years, there has been growing concern that increasing populations. The changing needs of humans have endangered our ability to live in close association with non-human primates. The conflicts between humans and other primates, crop-raiding is one that has received the most attention to date (Strum 1994; Hill, 2000)

Pest primates often destroy unharvested farms, causing economic losses to farmers. Crop damage is becoming serious for many residents around protected areas. Due to this reason, in developing countries intervention in the name of conservation can generate considerable resentment and hostility in local communities. Establishment of protected areas is a major form of government intervention with local people as it leads to conflict with wildlife. Sometimes people around protected areas are forced to keep their farm uncultivated due to fear of crop raiders. Most primate populations’ today face on going habitat disturbance, but not all primate species respond to disturbance in the same way. While many primate species experience declines in population density when their habitats are disturbed, several primate species are not threatened and these species will generally require less conservation attention (Cowlshaw and Dunbar, 2000). Hoffman, (2011) reported that, habitat had the greatest influence on baboon occurrence,

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

Africa has the largest primate fauna in the world. There are 175 species and sub-species of primates listed in Africa (Grubb, 2006). Even though there are 12 species and subspecies of primates occur in Ethiopia such as anubis baboon (*Papio anubis*), Colobus monkey (*Colobus abyssinicus*), vervet monkey (*Chlorocebus aethiops*), Wild pig (*Sus scrofa*), Hayne (*Curacuta curacuta*), Hippopotamus (*Hippopotamus amphiblius*), Hamadryas baboon, Warthog (*Phacochoerus africanus*), Plain zebra (*Equus quagga*) and Lion (*Panthera leo*) (Kingdon, 1997). These, primate population indirectly conflict with livestock that forage on similar resource. The impact of livestock on terrestrial vegetation has been proposed as a significant competitive pressure on primate populations as diverse as Barbary yellow baboons (Altmann, 1974), anubis baboons (Strum and Western, 1982), and vervet monkeys (Struhsaker, 1973). Where people increase stocking rates in relation to natural vegetation availability, to enhance returns of meat, milk and other animal products, primates may be squeezed out or suffer reduced reproductive rates by the far more effective off take of human-managed livestock movements through the area. While the human herders may not have a perception of monkeys as pests, the indirect competition can drive monkeys into habitats, such as forests or plantations (Ciani *et al.*, 2001).

Habitat domination by humans, and the associated compression, fragmentation and conversion of primate habitats (Strum, 2010), are the driving forces behind human-primate conflict and one of the greatest threats to primate survival. The use of space has thus become a central theme in primate studies, with conservationists relying on patterns of habitat use and minimum resource requirements for the effective conservation and management of various primate populations (Arrowood *et al.*, 2003). This is particularly true for those inhabiting small, isolated and fragmented habitats. Within primates, baboon (*Papio anubis*) are among the species exhibiting the greatest degree of spatial overlap with humans (Hill, 2005). This success is attributed to their

agility, dexterity, high levels of sociality and co-operation, combined with dietary and behavioral flexibility (Swedell, 2011).

### **2.2.2 Human herbivores conflict**

In Africa, conflicts between agriculturalists and primate herbivores have always existed (Tylor, 1982). At the periphery of protected area, large wild animals wander in close proximity to human settlements. This poses serious problem in terms of crop damage. In such areas, the integration of conservation with other land uses has become difficult. However, the intensity of crop raiding around protected areas is different depending on factors such as human population density, distance of the farmland from protected area boundary and season of the year and the animal's behavior (Lee, 1987). Various animals are featured in varying degrees of crop raiding. Not all crop raiding animals come from protected areas only; some are resident outside protected areas. They live in suitable habitats in different gardens within the community. Crop damage by wild animals may vary from season to season as the type of farming during wet seasons and dry seasons. The behavior of the animal is also another factor, which has an influence on the extent of crop raiding. Information from wildlife managers and field observations in Zimbabwe have suggested that crop raiding may be learned by young elephants from older bulls (Kagoro-Rugnda, 2004).

Across the globe, primates are the most frequently identified crop-raiding animals. This is because of the renowned crop raiding behavior of the species (Sillero-Zubiri and Switzer, 2001). The extent of damage caused by large mammals is insignificant when it is considered at the global level compared to the damage caused by invertebrates and rodents. However, in areas where more animals occur, a major part of the crop may be lost in a single night (Naughton-Treves, 1997). In Africa, baboons (*Papio* spp.) and vervets (*Chlorocebus* spp.) top the list of crop-raiding primates (King and Lee 1987; Sillero-Zubiri and Switzer, 2001). According to (Kimega, 2003), in Kenya, food items such as maize, cassava, beans, potatoes, and fruits are the target for animals like elephant, baboons, zebra and buffalo. Wildlife damage to crops varies considerably from site to site.

Increasing interaction between people and wildlife and the resulting conflicts are the main challenges facing wildlife conservation in developing countries. Encroachment of wild habitats

by subsistence farmers in Africa leads to conflict. Crop raiding by baboons, elephants and other herbivores seriously affect poor farmers. The change in the vegetation structure of lands closer to the protected areas may attract wild herbivores. Cultivated plants have characteristics of increased yield, rapid growth and resistance to disease, making them vulnerable to the herbivores of locally abundant wildlife populations (Messmer, 2000). Crop raiding has most likely been occurring since humans first settled down and started practicing agriculture. Different types of food items are targeted by wild animals, from cereals to fruits and from vegetables to trees (Sillero-Zubiri and Switzer, 2001).

Conflicts between wildlife and local people are major concerns for wildlife management and rural development initiatives across Africa. Typically, the main conflict involves crop damage by wild herbivores, and thus solutions should set within a policy and legislative framework that attempt to address both wildlife management issues and rural development objectives. Many initiatives have been designed to address crop loss because this can undermine the success of other programs related to agriculture or wild land conservation (Tylor, 1982). Crop damage affects farmers directly through loss of their primary food and cash resources, and indirectly through a variety of social costs such as costs for school and hospital. Due to these losses, rural people express their fear, or even sabotage development projects that deal with wildlife conservation (Hill *et al.*, 2000 and Horrocks, 1994).

Crop-raiding by wild animals is increasingly known to be a source of conflict between the animals and humans, perhaps especially so along the boundaries of protected areas (Strum 1994 and Naughton- Treves, 1998). The losses incurred by farmers may make communities living close to protected areas antagonistic and intolerant towards wildlife, which can undermine and impede conservation strategies (Nyhus *et al.*, 2000). Because farmers in developing countries often have limited access to cash and are rarely compensated for their losses, the individual economic losses suffered from crop-raiding can be relatively high (Nyhus *et al.*, 2005). Furthermore, farmers' inability to mitigate crop-raiding adequately and the absence of compensation schemes may lead to retaliatory killing of problem species (Jackson and Wangchuk, 2001).

Several studies have found that proximity of a farm to the forest edge and the presence or absence of neighboring farms best explains the likelihood of any farm sustaining crop damage

(Hill, 2002). Hence, it seems that farmers that reside close to the border of protected forest reserves or that cultivate crops within the park boundaries are especially vulnerable to crop-raiding (Priston, 2001). In most primate range countries, the major threats to populations are due to the extensive conversion of primate habitat into areas of human use (Lee *et al.*, 1986). Human–wildlife interaction is now recognized as a major issue in conservation (IUCN, 2005). Crop raiding is a widespread and common example of human–wildlife conflict and crop damage directly influences local people perception of, and support for, conservation initiatives (Conover, 1991 and Hill, 1998).

### **2.2.3 Human carnivore conflict**

Across the globe, the frequency and extent of economic cost of conflict between human and carnivores is increasing due to the expansion and growth of human populations (Karanth *et al.*, 1999). Besides, their large space requirements and position at the top of the food chain results in conflict with expanding human populations and domestic livestock (Myers and Bazery, 2005). Under a variety of demographic, economic and social pressures, human alteration of carnivore habitat or expansion of carnivores has led to escalated conflicts (Naughton-Treves *et al.*, 2003). Humans can also allow the recovery of carnivores. Land use practices exemplified by the regrowth of forests in many regions of the United States are providing room for potential recolonization by previously extirpated carnivores (Mladenoff *et al.*, 1997). The greater majority of cases of human- carnivore conflict through depredation of domestic animals reflect some type of imbalance in the local ecosystem. If the habitat in which they live consists of areas large enough to support them, with sufficient food resources and if the influence of human on their habitat decreases, these animals tend to avoid man and his domestic animals. (Treves and Karanth, 1995).

As a group, carnivores exert a profound influence on biological communities via predation and interspecific competition. Carnivores often regulate or limit the number of their prey, thereby, altering the structure and function of the entire ecosystems (Ester *et al.*, 1998). They can function not only as flagship species, which conserve a raft of other species along with them, but some are keystone species. Their extirpation or rarity can result in a change in the communities of the habitat (Berger *et al.*, 2001).

### **2.3 Factors that influence abundances of primates**

In the case of Africa, antagonistic relationships between human and nonhuman primates have been exacerbated by the increasing amount of land under cultivation with crops that are very attractive to primates (Struhsaker, 1978; Hill, 2000). Humans and nonhuman primates have had a long association and, in many instances, have antagonistic relationships (Fuentes, 2006). This antagonism is often due to nutritional reliance on similar foods (Paterson, 2005). However, with increasing conversion of forest to agriculture, crops have become vital supplements to the diet of many nonhuman primates and will be important for their conservation (Esrade, 2006). Subsistence farmers living adjacent to protected areas have borne the bulk of the crop depredation associated with primates (Twehyo, 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 interactions 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 plantations 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). Create education programs to promote an awareness of the significance of primates, of their conservation status and how humans can help protect them. Showing an interest in the animals themselves can promote an interest from local residents. Such strategies have worked with the Diani Columbus Project in Kenya and appear effective especially with children (Lee, 1987).

### **2.4 Traditional methods used by the local people to prevent crop damage**

People can prevent crop damage by using different methods such as guarding, chasing, strange scents, fencing 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 the farmland (Musa, 2009). They are also forced wild animals to change their cropping patterns to escape crop damage. Moreover, they spend additional labor, time and expenditure to protect their crop against wild herbivores (Sekhar, 1998).



### **3. THE STUDY AREA AND METHODS**

#### **3.1 The study area**

The present study was carried out in Sembo Kejo Kebele, East Wollega zone of the Oromia Regional State, Western Ethiopia. The distance of this kebele is 250 km West of Addis Ababa. The location of the study area is between 9° 06' and 9° 08'N latitude and between 37° 03' and of 37° 09' E longitude. The kebele has a total area of about 33 km<sup>2</sup>. The district borders Sibul Sire in the West, Horroguduru Wollega in North, and Chaliya district in the East and Biloboshe district in the south.

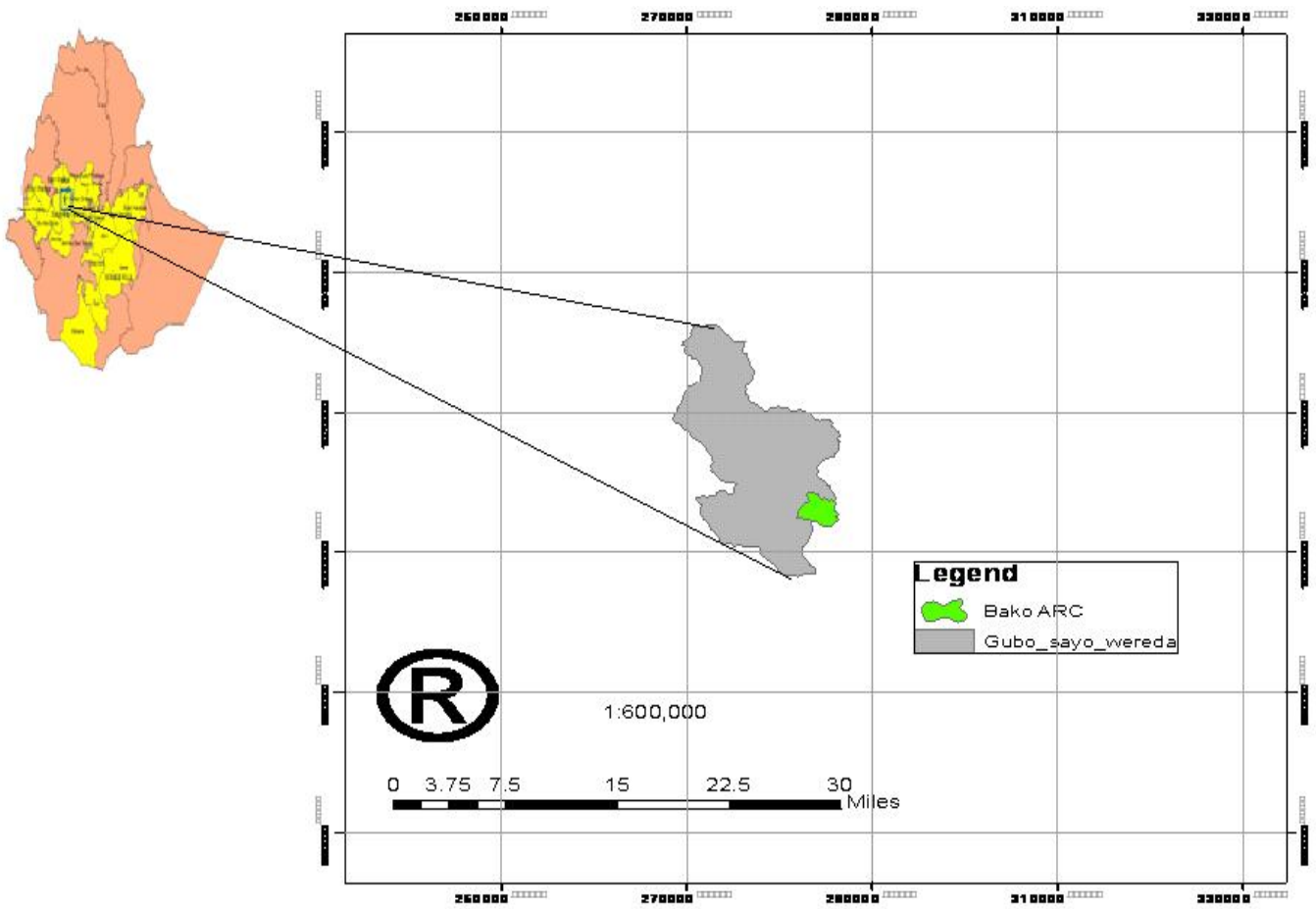
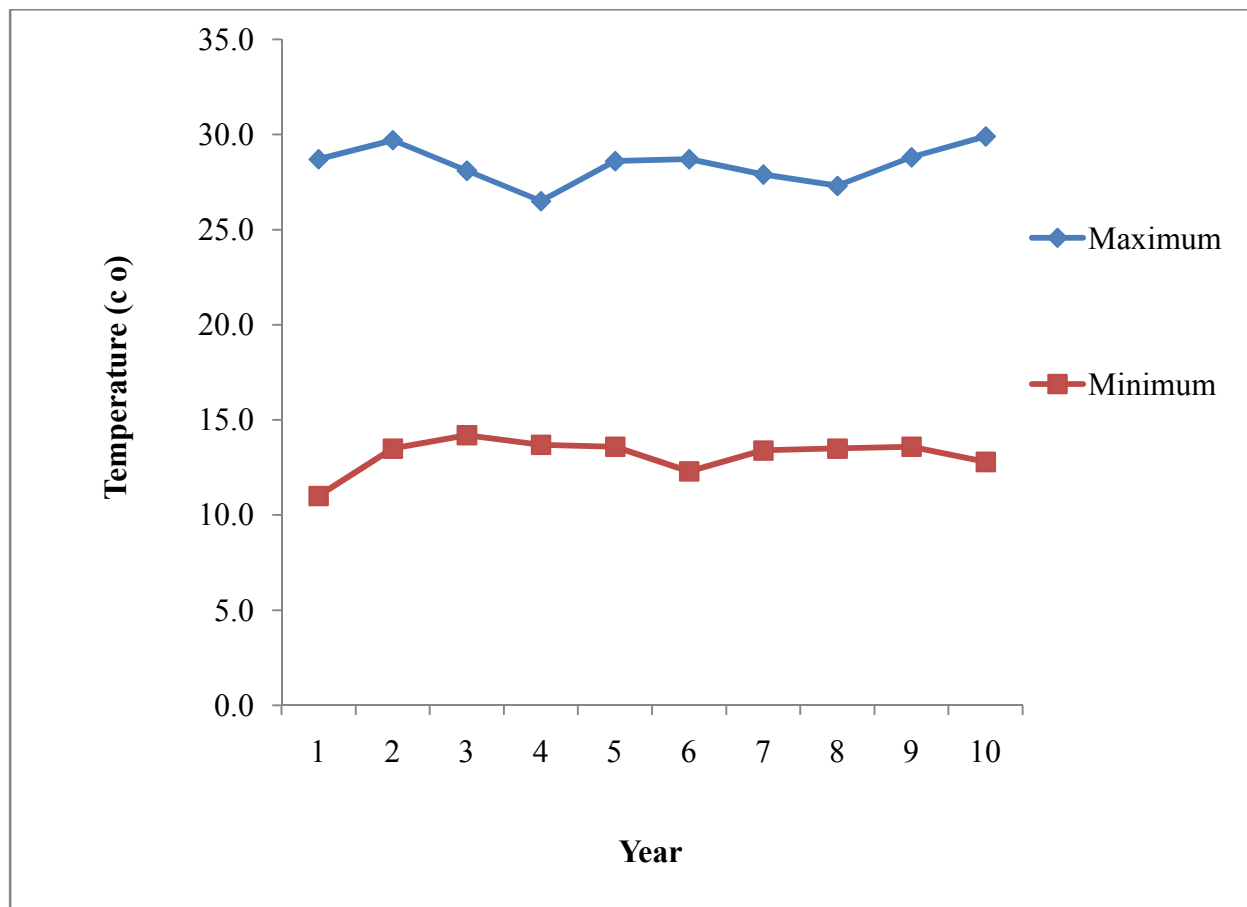


Figure1. The map of study area

## 3.2. Climate

### 3.2.1. Temperature

Ten years (between 2004 to 2013) of rainfall and temperature data obtained from Bako agricultural research center was used to describe the climate of the study area. The mean annual minimum and mean maximum is 11.0 and 29.9 C<sup>0</sup> respectively (Figure 2). The warmest months are January, February and March.



Key: 1= 2004, 2= 2005, 3= 2006, 4= 2007, 5= 2008, 6 = 2009, 7= 2010, 8= 2011, 9= 2012, 10=2013

Figure 2. The mean minimum and mean maximum of temperature of the study area (BARC, 2013).

### 3.2.2. Rainfall

The rainfall in the study area is bimodal. The wet season is from June to September, and the short rainy season occurs between January and April. The average annual rainfall of the study area is 1207.5 mm ranging between 886.50 and 1527.60 mm (Figure 3).

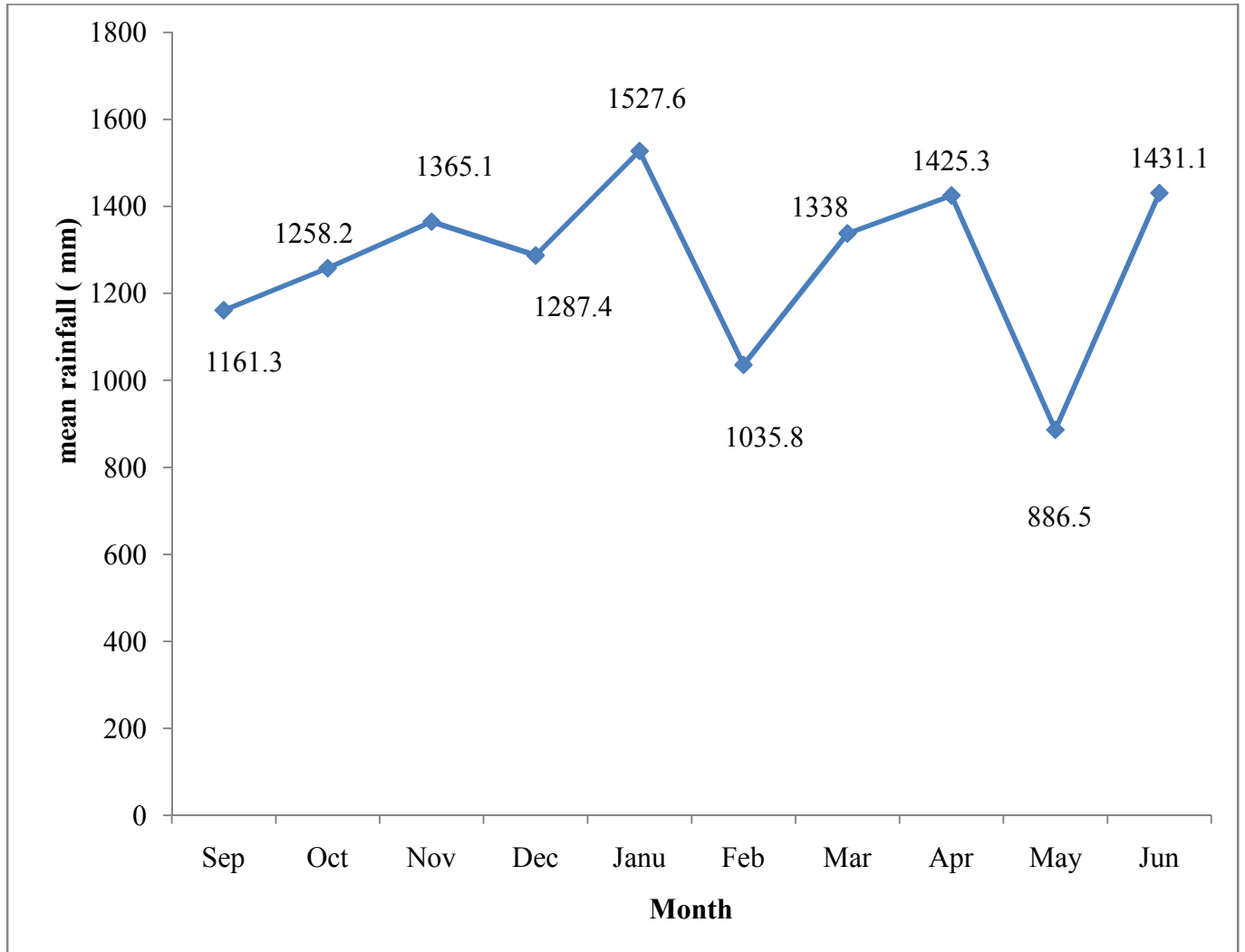


Figure3 . The mean annual rain falls of the study area (Source: EMA Bako branch, 2013) .Ten years average rainfall data of western shoa zone report.

### **3.3. METHODS AND MATERIALS**

#### **3.3.1 Materials**

The materials used during this study were binoculars (7x50mm), Geographic Positioning System (GPS), digital camera, field guides for identification of medium and large sized animals (Solomon, 2008) and stationary materials.

#### **3.3.2 Methods**

##### **3.3.2.1 Preliminary Survey**

A preliminary survey was conducted to gather basic information about the study area. The physical environment of the study area was observed and also networks were established with the governmental office experts and local kebele leaders. In addition to this, information about the living environment of the society or farmers was identified from concerned bodies such as local people living around the study area, the research center and governmental office.

##### **3.3.2.2 Methods of data collection**

Based on the information obtained from preliminary survey, a structured questionnaire was developed based on applicability to the objectives of the study for gathering information by questionnaires and interview. Field observation was conducted and used for estimation the population size of pest primate. A semi-structured questionnaire was prepared in English language and translated into Afan Oromo. Then, the enumerators were recruited from the study area and made acquainted with the questions, trained on methods of data collection and interviewing techniques. Interviewing of the sample respondents were needed for getting more information about the objective of the study. The researcher adequately administered and supervised the data collection process and checked the quality of the returns to avoid bias and errors.

##### **3.3.2.3. Population size of pest primates**

In the study site, counting of the population of pest primates were carried out by moving on foot throughout the whole study sites which were divided in blocks to precede the counting of

population. The total habitat of the study area was 33km<sup>2</sup> of which dense forest habitat was 9.9 km<sup>2</sup> and the remaining 23.1km<sup>2</sup> was fragmented forest habitat. The dense forest was divided in 3 blocks and each block was sampled by 3 line transects that has a length of 1km and width of 100m. The fragmented forest were divided in 7 blocks and each block was sampled by 3 line transects with length 2km and width 140m while count the pest primate in each line transects and the distance between each line transect was 800m-1000m distant each other. Counting was carried out using direct observation while moving on foot. During dry and wet season, the pest primate's census was carried out two times during dry (January and February) and wet (June to September) season per week. The animal species observed were recorded.

The pest primate population was categorized in to different age groups, namely adult, sub adult and infant (juvenile). Body size was used in age determination. Photograph of the primates were taken by means of digital camera and position at which they were counted was taken using Global position System (GPS Garmin 72). Censes was conducted when the primates were most active and with good visibility in the morning (8:00-11:00a.m) and in the afternoon (14:00-17:00p.m).

#### **3.3.2.4. Estimation of crop damage by pest primates**

To estimate crop loss due to pest primate and assess the traditional methods used by the local people to alleviate pest primates from their crops in fields such as direct observation of crops damaged at field, questionnaire and interviews were carried out. Direct observations to estimate crop loss due to pest primate, in sembo kejo kebele three farmlands were selected by purposive sampling and each farmer owned one hectare. The reason is, because of the land was nearer to the forest and based on the information of severity of the human primate conflict.

For the purpose of direct observation on crop damage by primates, three study sites were selected purposive sampling. For each site, three corresponding cultivated land covering an area of 30,000 m<sup>2</sup> were selected purposively. In turn, each of the three cultivated lands was divided into six plots each of which has 5,000 m<sup>2</sup>. Crop damage by large mammals was recorded in meter directly to estimate the average losses. In addition to the researcher, two forest guards have participated during the time of direct observation and direct observation was conducted in each study site in each trip (Stuart, 1994).

The maize crop was selected, because it is main cultivated crop compared with another types of crops in this particular study area. In wet and dry season, the observation was conducted starting from February to September, 2014. In each these stages five days of observation for six hours were accomplished. During the time of visit all the damaged crop was recorded on actual days. The photograph of the event was taken by using digital camera. At the end of each developmental stage, damaged plants were added up and estimated. Finally, total yield loss of each site was added up and summarized. For nocturnal animal (wild pig) marks left such as dung, feeding, foot prints and diggings were used (Stuart, 1994).

### 3.3.2.5 Questionnaire survey and Interview

To conduct this research among 315 households of the Sembo Kejo kebele, 172 study participants were selected using the formula of (Cochran, 1977).

$$n = \frac{n_0}{1 + \frac{n_0}{N}} \quad \text{where, } n_0 = \frac{Z_{\alpha/2}^2 P(1-P)^2}{d^2} \quad (\text{Cochran, 1977})$$

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

n=total sample size

d=margin of error

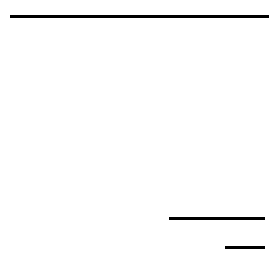
N=total number of the population

P=proportion of the population

n<sub>0</sub>= Marginal line

α=level of significance

d=0.05, p=0.5, and α=0.0





Proceeding to the actual survey, 172 sample sizes were determined using simple random sampling techniques. So that the information about the damage of crops by pest primates were collected by structured questionnaire and interview. The selected householders were interviewed by using structured questionnaires which is pre –tested and translated in to Afan Oromo.

The questionnaire contain three parts, part one contain the demographic information of respondents, part two considered ideas which are related with crop cultivated in the study area and associated issues and part three contain the knowledge and practice about human pest primate conflict . In case of interview, eight indigenous persons from the present study site who has lived there for a minimum of fifteen years and have been happening in the village were interviewed about the general features of crop damage in the past and now, about the number of primates (increasing or decreasing), the situation of primates versus human familiarity in the past and now was discussed while basic information gathered. The interview was conducted with each of the assigned person's one by one.

### **3.4. Data Analysis**

The collected data was analyzed by means of the Statistical Package for Social Sciences (SPSS); version 16.0. Software package, by using chi square test and data was organized by using Microsoft office excel 2007. The results of the study were expressed using descriptive statistics such as tables and figures.

## 4. RESULT

### 4.1 Primate pest species

In the present study, three primate species and three other pest wild animals were identified from the study area during both dry and wet seasons. Among the primate species anubis baboon and vervet monkey were known pests (Table 1).

Table1. List of animals in the study area

Local name	Common name	Scientific name
Jaldesa	Anubis baboon	<i>Papio anubis</i>
Qamale	Vervet monkey	<i>Chlorocebus aethiops</i>
Wenni	Colobus monkey	<i>Colobus abyssinicus</i>
Tede	Crested Porcupine	<i>Hystrix cristata</i>
Boye	Wild pig	<i>Sus scrofa</i>
Robi	Hippopotamus	<i>Hippopotamus amphiblius</i>

#### 4.1.1 Population estimation of anubis baboon

A total of 129 and 167 anubis baboon were counted in dry and wet seasons respectively in the dense forest. In the fragmented forest 160 and 203 anubis baboon were counted in dry and wet seasons respectively. During wet season count, there was 35 AM, 78 AF, 27 SAM, 38 SAF and 25 Juvenile in fragment forest. The number of females was significantly higher than the number of males ( $X^2 = 0.8301$ ,  $p < 0.05$ ) table 2.

Table 2. Number of anubis baboon counted during the study period and in the two habitat types

Habitat	Season	Category						Total	Mean $\pm$ SD
		AM	AF	SAM	SAF	JV			
Dense forest	DS	22	42	21	26	18	129	25.8 $\pm$ 1.79	
	WS	30	55	28	34	20	167	33.4 $\pm$ 4.14	
Fragment forest	DS	28	57	25	31	19	160	32.0 $\pm$ 5.38	
	WS	35	78	27	38	25	203	40.6 $\pm$ 9.19	

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

#### 4.1.2 Population estimation of vervet monkey

A total of 111 and 159 vervet monkeys were counted in dry and wet seasons respectively in dense forest. Furthermore 143 and 187 vervet monkeys were counted during the dry and wet seasons respectively in fragmented forest. The number of adult females was significantly higher than the number of adult males ( $X^2 = 1.1065$ ,  $p < 0.05$ ) (Table 3). Among the counted vervet monkeys, adult males were 29 and 43 during dry and wet season, adult females were 20 and 56 during dry and wet seasons, sub adult males were 23 and 28 during dry and wet season, sub adult females were 19 and 25 in dry and wet season and Juvenile were 32 and 35 in dry and wet seasons, respectively (Table 3).

Table 3. Age structure of vervet monkey per season and habitat types

Habitat	Season	Category						Total	Mean $\pm$ SD
		AM	AF	SAM	SAF	JV			
Dense forest	DS	25	38	13	12	23	111	22.20 $\pm$ 3.86	
	WS	36	48	27	20	28	159	31.80 $\pm$ 2.88	
Fragment forest	DS	29	40	23	19	32	143	28.60 $\pm$ 1.85	
	WS	43	56	28	25	35	187	37.40 $\pm$ 3.34	

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

## 4.2 Estimation of crop damage by pest primates

Maize (*zea mays*) damaged by anubis baboon and vervet monkeys throughout its growth stages; seedling, flowering (tassle) and maturation (ripen) were recorded. The extent of damage varied depending up on the growth stages of crop and the type of animals that causes the damage. The highest damage recorded for vervet monkeys and anubis baboon were 2970 (56.73%) and 2480 (50.0%) respectively at the tassle stages (Table 4).

The damage caused by anubis baboon and vervet monkeys on maize plant starting from the stage of seedlings to maturation was recorded in the study site. Out of the total of 42,220 maize plants, 4,910 (11.63%) were damaged by anubis baboon as compared to 5,230 (12.4%) by vervet monkey at all stages. Large amount of damage was caused during flowering or tassel stages (7.03%), and least damage was recorded during the seedling stage (1.28%). Maize damaged during seedling, flowering and maturation by vervet monkeys were 920(2.18%), 2970(7.03%) and 1340 (3.17%) respectively (Table 4).

Table 4. Maize damage by anubis baboon and vervet monkeys

Stage	Damage of maize plant			
	Anubis baboon	%	Vervet monkeys	%
Seedling	540	1.28	920	2.18
Tassle	2480	5.87	2970	7.03
Ripen	1890	4.47	1340	3.17
Total	4910	11.63	5230	12.38



plate1. Anubis baboon in the study area

Date: 21/06/2006 By: Biset Tesfaw



plate2. Forest found around Bako

Date: 19/06/2006 By: Biset Tesfaw



plate3.Vervet monkey in study area

Date: 12/07/2006

By: Biset Tesfaw

#### 4.2.1 Estimation of crop damage by other animal

From the 50m by 50m maize damages caused by other animals such as wild pigs (*Sus scrofa*), crested porcupines (*Hystrix cristata*) and hippopotamus (*Hippopotamus amphiblius*) were counted and recorded at different developmental stages (table 5). A great amount of damage was observed during the ripening stage with 589 (1.38%) maize plant damage, followed by seedling 490(1.15%) and flowering stage 360(0.85%) and more damage was recorded by wild pig 590(1.39%) and least damage was recorded by hippopotamus 365(0.86%) table 5.

Table 5. Estimation of maize damage by other pest animals

Animal	The stage of maize						Total	
	Seedling		Flowering		Ripened		N <sub>0</sub>	%
	N <sub>0</sub>	%	N <sub>0</sub>	%	N <sub>0</sub>	%		
Wild pig	210	0.49	160	0.38	220	0.52	590	1.39
Porcupine	170	0.40	112	0.27	204	0.48	486	1.15
Hippopotamus	110	0.26	90	0.21	165	0.39	365	0.86
Total	490	1.15	360	0.85	589	1.38	1441	3.4



Out of the total crop damaged in the study area, 12.4 % of maize was damaged by vervet monkey, 11.63% of maize was damaged by anubis baboon and 3.4 % of maize damaged by wildlife (figure4).

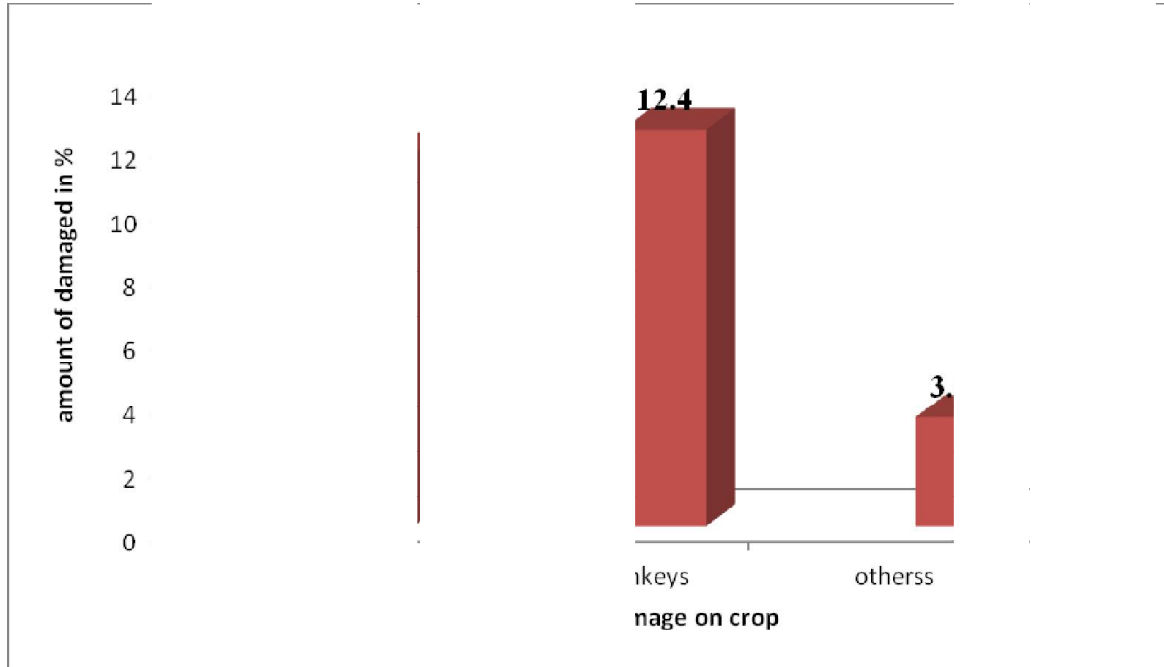


Figure 4. Percentage of damaged on maize by primates and other pests

### 4.3 Results of the questionnaire survey

#### 4.3.1. Background of the respondents

Among the respondents, 105 (61.05%) were males and 67 (38.95%) were females. Respondent farmers for the administered questionnaire survey were in the maturity age and also they had an experience in agricultural activities, and trained in the challenges and crop raiding activities. Regarding educational background of the respondents, 47(27.33%) were illiterate, 34(19.77%) were read and write, 47(27.33%) completed elementary school, 44(25.58%) had attended high school.

Table 6.Socio-demographic characteristics of the respondents

Socio-demographic characteristics		Respondents	Percentage (%)
Sex	Male	105	61.05
	Female	67	38.95
Age range of the respondents	23-30	55	31.98
	31-40	79	45.93
	41-50	20	11.63
	51-60	9	5.23
	Above 61	9	5.23
Educational background	Illiterate	47	27.33
	Read and write	34	19.77
	Elementary	47	27.33
	High school	44	25.58

### 4.3.2 Economic activity and social interaction of the respondents

All the respondents own farmland with different size ranging from 0.5 hectare to 4.0 hectare.65 (36.63%) of the respondents owned 0.5 hectare, 20 (12.71%) of the respondents owned 0.6 – 2.0 hectare, 30 (17.44%) of the respondents owned 2.1 – 3.0 hectare, 35 (20.34%) of the respondents owned 3.1 – 4.0 hectare and 22 (12.79%) of the respondents owned 4.1hactare farmland. The detail information is indicated in the following figure 5.

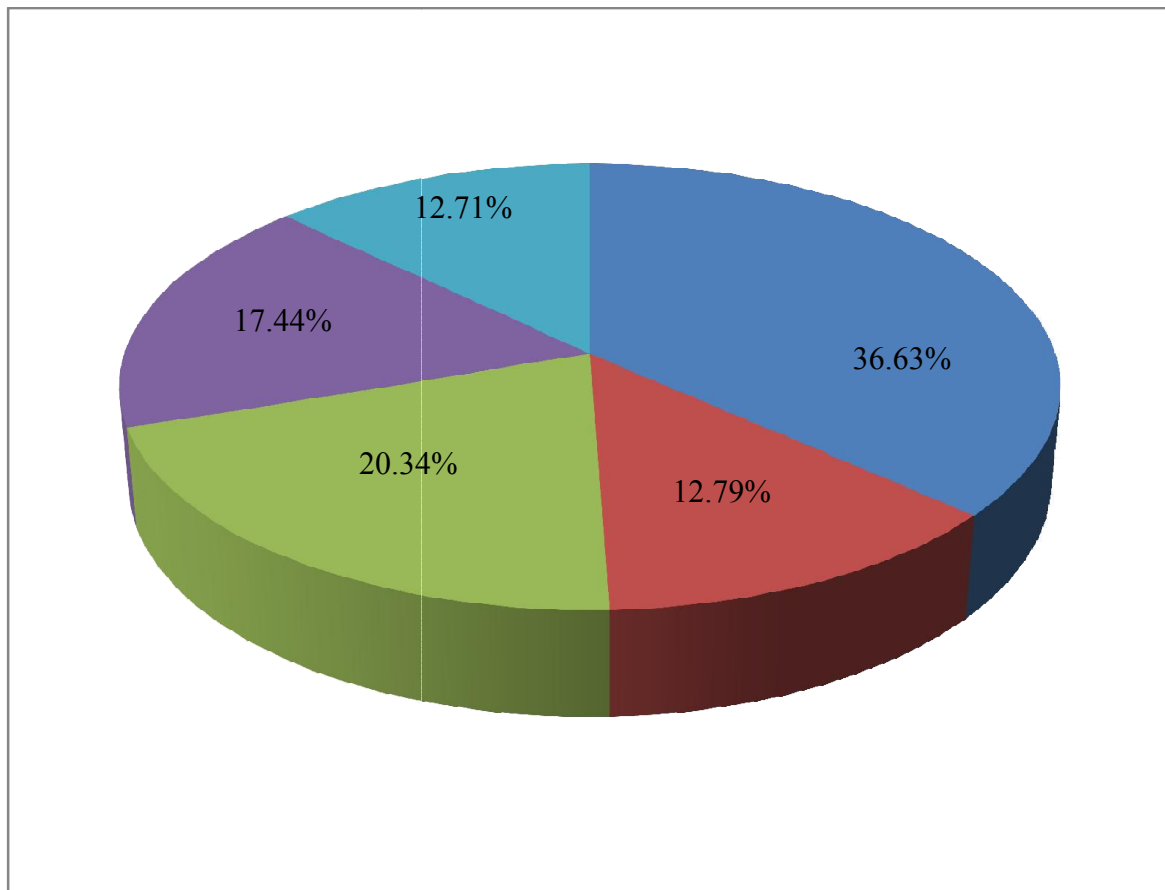


Figure 5. Size of farmland owned by respondent

Farmers in the study area cultivate different type of crops, such as maize, teff, tomato, sorghum and mango. 65(37.79%) of the respondents cultivate maize and teff while 5(2.9%) of them cultivate barley (table7).

Table 7.Type of crops cultivated in study area

Type of crop cultivated	Number of respondent	Percent (%)
Maize and Teff	65	37.79
Sorghum and Teff	36	20.93
Teff	47	27.33
Barley	5	2.9
Other	19	11.05
Total	172	100

#### 4.3.3. Knowledge and practice of respondents on human primate conflict

Regarding the presence of forest in the study area, all the responds agree with its presence. Among these, 55 (31.98%) used for fodder and fire wood, 76(44.19%) used for fire wood and house construction and the remaining 41(23.84%) of them used the forest for other uses.

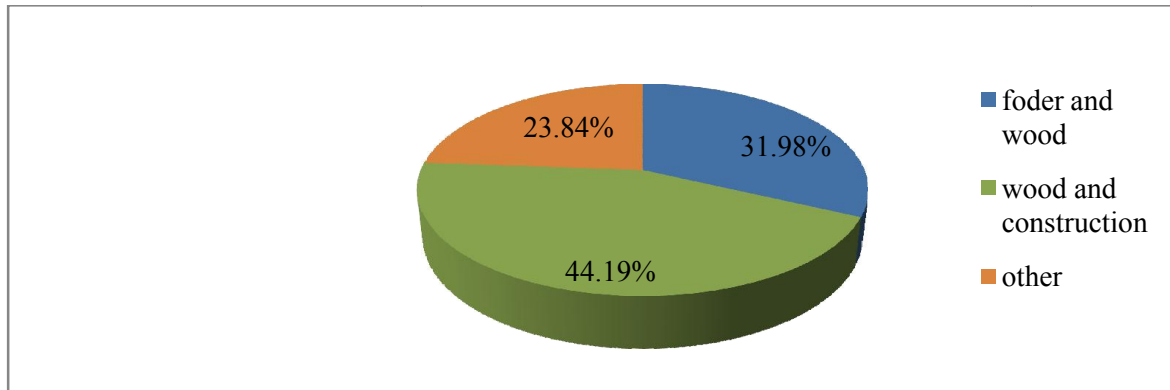


Figure 6. People used forest for different purpose

Regarding the distance from their farmland to the forest, 25(14.53%) of them responded 1km far apart, 55(31.98%) 1.1-2km far apart, 35(20.35%) 2.1-3Kkm far apart, 15(8.72%) 3.1-4Kkm far apart and 15(8.72%) 4.1Kkm far apart from the forest.

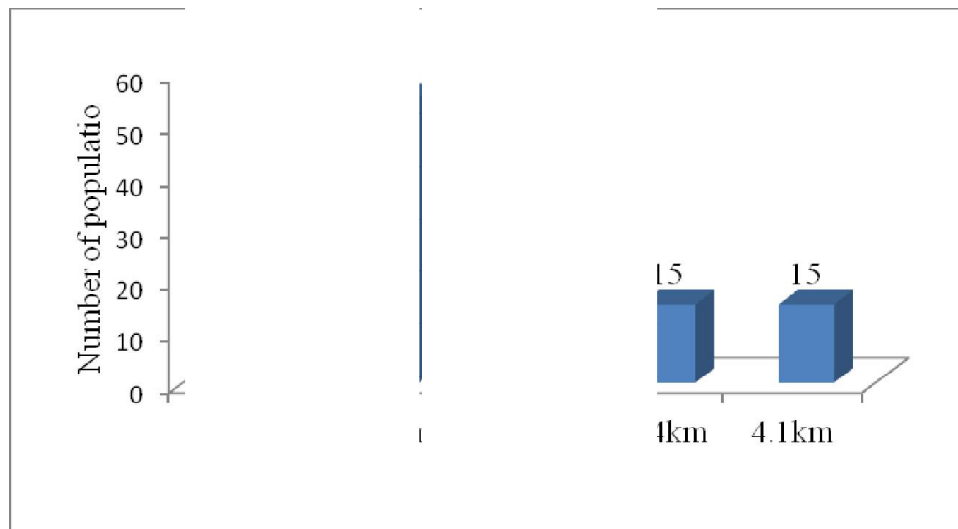


Figure 7. The distance of the farm land from the forest in kilometer

All of the respondents indicated the presence of wildlife in their location. 19(11.05%) reported the presence of crested porcupine (*Hystrix cristata*), 40 (23.25 %) reported the presence of vervet monkey (*Chlorocebus aethiopsis*), 65 (37.79%) reported the presence of anubis monkey (*Papio anubis*), 9(5.23%) reported the presence of warthog (*Phacochoerus africanus*), 24(13.95%) reported the presence of hippopotamus (*Hippopotamus amphiblius*), 7(4.06%) responded the

presence of Columbus monkey (*Colobus abyssinicus*) and 8(4.65%) responded the presence of hyena (*Crocuta crocuta*).

As shown in table 9 below, majority of the respondents replied that the tendency of crop damage is increasing from time to time (95.93%, n= 165) while 1.74% (n= 3) of the respondents replied that the extent of crop damage was decreasing. Moreover, most of the respondents replied that the extent of crop damage by wildlife was much (67.44%, n= 116) whereas 13.95 % (n= 24) of the respondents considered the extent of crop damage by wildlife was very little. Furthermore, the respondents replied that the problem of wildlife occur more during summer season (73.26%, n= 126) than autumn and other seasons. Most respondents additionally replied that the damage of crop was the highest near forest (63.37%, n=109) table 8.

Table 8. Response of the respondents about the tendency, extent and season of crop damage with respect to forest location

Human effect	Measurements	Number of respondent	%
Tendency of crop damage	Increasing	165	95.93
	Decreasing	3	1.74
	No idea	4	2.33
The extent of crop damage by wildlife	Very little	24	13.95
	Much	116	67.44
	Very much	32	18.60
Season of the problem occurrences	Summer	126	73.26
	Winter	-	-
	Spring	-	-
	Autumn	46	26.74
damage of crop with respect to location forest	forest zone	109	63.37
	Center	20	11.63
	Both	43	25.00

According to the respondents, the knowledge of crop damage other than primates was listed in table 9. In the study area wild pig (33.72%, n= 58) highly affect crops and warthog (5.81%, n= 10) was least influence on the crops other than primates.

Table9. Response of respondent about animals these raid crop other than primates

Animal	Number of respondent	Percent
Crested Porcupine	14	8.14
Wild pig	58	33.72
Hippopotamus	15	8.72
Warthog	10	5.81
All	17	9.88
Wild pig and Porcupine	25	14.53
Wild pig and Warthog	19	11.05
Porcupine and Hippopotamus	14	8.13

From the total respondents, 88(51.16%) replied as the damage of the crop was sever in wet, 9(5.23%) replied that it was sever in dry and 33(19.18%) responded equal in both seasons (figure 8).

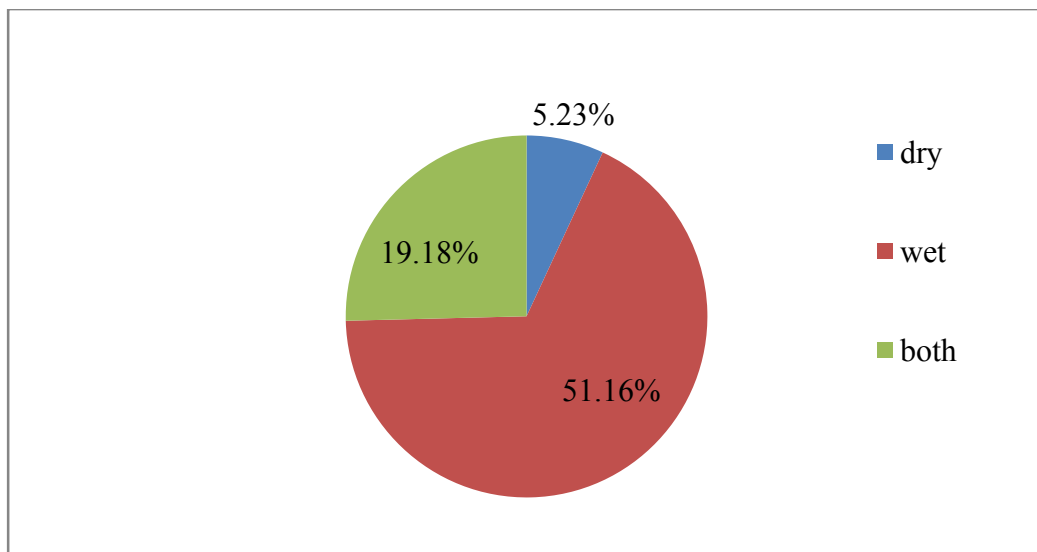


Figure 8. Severity of crop damage on bases of season

According to the respondents, severity of crop damage varies in different reasons. 55(31.98%) responded that, the reason was the presence of plenty food in the farm, 29(16.86%) responded due to the attractiveness of farm crops than wild food, 18(10.46%) responded it was due to shortage of food in the forest, 8(4.65%) responded due to unfavorable condition and 12(6.97%) responded it was due to both the presence of food in the farm and its attractiveness (figure 9).

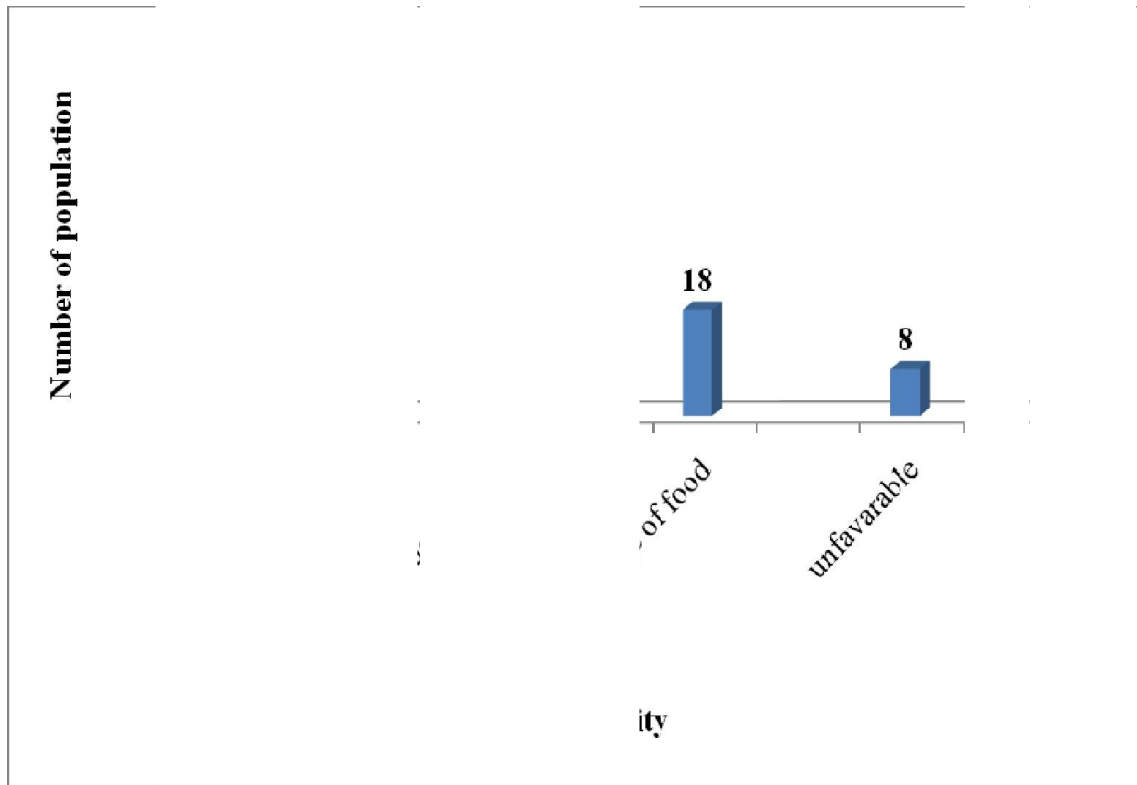


Figure 9. Severity of crop damage in specific season

A 53 (30.81%) of respondents responded the crop was guarded by men and few of the respondents replied that it was guarded by children (table 10).



Table10. Response of respondent about person who guarding the crops

List of guarding	Number of respondent	Percent
Men	53	30.81
Women	38	22.09
Children	37	21.52
Women and Children	44	25.58
Total	172	100

Regarding control measure used to prevent wild animals from crops, 51 (29.65%) permanent guarding, 54 (31.39%) chasing by dogs, 35 (20.35%) placing model of man and 32 (18.61%) hunting (table11).

Table 11. Response of respondents about persons who guarding the crops by using methods.

Method of guarding	Number of respondents	Percent
Permanent guarding	51	29.65
Dog	54	31.39
Placing model	35	20.35
Hunting	32	18.61
Total	172	100



Plate 4. Guarding of crop in study area

Date: 10/09/2006

By: Biset Tesfaw

#### 4.4. Interview

The interviewed persons from the study site indicated that, most of the farmers cultivate crop such as maize, teff, sorghum, and mango. But some of the farmers were restricted to produce only two up to three types of crops due to the small size of their farmland. According to their idea maize, teff and sorghum were commonly cultivated by each farmer in the present study area. The interview was also conducted to realize the presence of forest and the benefit obtained from the forest. The entire eight (8) of them explained the existence of forest in the villages especially around Bako agricultural research institute. Most of the society get from the forest fire wood, fodder, for their cattle and charcoal seller also destroyed the forest.



Plate5. Photo of interview in the study area

All of the interviewed persons discussed about the presence of primates and type of wild animals in their locality and expressed that anubis baboon, wild pig, vervet monkey and porcupine were identified around their village and anubis baboon and vervet monkey were the common pest primates. They were interviewed about the relative important of pest primate and all of them implied vervet monkey was a primate which destroy large mass of crop with in single visit and they ranked it in the first place while anubis baboon in the second stage and the third stage ranked pigs. Also the person interviewed in Bako agricultural research center estimated that average yield lost was 25-40% of maize, 16-26% of teff, 24-32% sorghum, 10-18% tomato and 22-31% of mango per hectare caused by pest primate every year, specially by anubis baboon and vervet monkey. The other point is raised for the interviewed person was about problems caused by pest primate other than crop damage and three persons from the study site , explained that anubis baboon creates great problems like predation of domestic animals such as sheep, goat hen and attaching humans specially children

## 5. DISCUSSION

In the present study anubis baboon (*Papio anubis*), Columbus monkey (*Colobus abyssinicus*), crested porcupine (*Hystrix cristata*), wild pig (*Sus scrofa*), hippopotamus (*Hippopotamus amphibius*) and vervet monkey (*Chlorocebus aethiops*) were identified. Among these, anubis baboon and vervet monkey were the known pest primates. The result of this study showed that there was strong conflict between these animals and the local people. The conflict between these animals and the local people increased during the wet season where they get enough resources for the survival of the species. The competitions for resources cause conflict between wild animals and people. This result in line with the study of Hill (2000) and Quirin (2005) who reported that the wild animals increasing year to year, which is due to competitions for resources between wild animals and human populations. Because of the destruction of natural habitat of the animal by human activities the natural diet of the animals was lost in the area. As a result of this the animals moved to the farmland in search of food and caused damage.

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

The variation in sex ratio provided suitable conditions for male individuals to find mates for reproduction. As a result, the vervet monkey population is in a good status in the area. This was confirmed by observation and population estimation both during the wet and dry seasons. The finding of the current study shown that the sex ratio in the two pest primates were not 1:1. It was 1: 3anubis baboons and 1:2 Vervet monkey. The number of females counted in this study site is high. This variation in sex ratio provided suitable condition for the male individuals to finding mates during the time of reproduction and passes their genes to the next generation. The result of

the present study was agreed with Melese (2007) who reported that anubis baboons and vervet monkeys of sex ratio is 1: 2 during the wet and dry season in wonji shoa.

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

As assumed from direct observation these pest primates caused a great damage on maize crop more than other pests, because of capture of handling maize cobs more than other pests, their ability of feeding large amount of maize cobs within a short period of time, their frequent visiting of farmland and due to their intelligences and there are a number of reasons for primates raiding crops. Firstly, primates are attracted to maize and other tasty crops because they were more nutritious than the food that a primate would eat in the wild. Secondly, people's destruction of woodland may cause more crop-raiding. Where people clear the forest for agriculture, primates lose forest their habitat and their sources of food, so they may start raiding more crops because their own supply of food has been affected. Thirdly, some primates have become used to people. For example, in Uganda, baboons have become used to seeing tourists and so have lost their fear of people. They raid crops in farms at the edge of the forest without fear (Hill, 1998).

On the basis of sample land taken for direct observation, of the total expected yield, 27.43% was lost due to crop raiding wild animals. This result was greater than the result reported by Leta (2014) in Gera district, Western Ethiopia. In addition to this, the result showed that not all crops were equally affected by crop raider during the present study 65(37.79%) of the respondents claimed that maize was the most vulnerable crop and crop raiders followed by sorghum 36 (20.93%).Whereas about 5(2.9%) respondents responded that barley was the last vulnerable crop to damage caused by wild animals. The result agreed with finding of Warren (2008) who reported that maize is the most frequency eaten crop by crop raiding in West Africa.

The result was inconsistent with the study of Warren (2008) who reported that the maximum loss was registered on maize crop which covers 73.4 % of the total loss occurred, the loss of sorghum

were about 17% from the total loss. This might be caused due to the maize crop whether ripe or/and dried, it was the most frequently eaten crop by crop raiders in West Africa. The work done by Vercamen and Mason (1993) showed that about 8.9% of maize was damaged by hippopotamus during the wet season. Conversely, in the present study area, hippopotamus was repeatedly observed in the farmland of fields (0.86%) and it usually damages the maize by grazing on the young shoots of the corn.

Regarding the variation of damage in the developmental stages of maize, large amount of damage was recorded during the flowering stage by vervet monkey and during matured stage by anubis baboon and the least amount of was recorded during the seedling stages by both primate in the study sites. In the flowering stage the cob was not matured so that the pests jump from one to another to get the best cob by destroying large amount of maize plants. In matured stage they get delicious food which attract them to farm land initiates them to stay around farm land. On the other hand tassle and ripen stages were suitable for the pests to hide themselves in the farm. The result was agreed with the study of Hill (2000) who reported that during seedling stage the farmland was clear and the guard can control the pest easily by watching them from farm distance in Uganda.

In the study area permanent guarding was a method used by large number of farmers in protecting their crop from damage by pest primates. Placing model of man, hunting was also common methods which were used in the study site. From all these methods, guarding crop permanently was the effective method to protect crops from damage of pests. When they use chasing anubis baboon run to forest and frequently turn back and vervet monkey hide themselves in the bush and branches of trees. Similar study conducted by Ram and Kandel (2008) who reported that in LNP (Nepal) the most commonly used crop protection strategies in that study area was secured their field's constant vigilance during crop season.

The finding of present study indicates successfully guarding required that people be in the fields for long period of the day throughout the seasons when there were vulnerable crop in the most of the year. The study was agreed with the study of Kata (2012) who reported that people had other tasks to complete including attending school, household chores, trading in the local markets and employment for local chores.

In these findings men, women and children were the people who guarded the crop to protect from the damage by pest primate and other. Similar study was conducted by Kate (2012) and Hill (2000) who reported that in Hoima district (Uganda) adults, particularly women were most feared by baboon and two- third of all crop guarding was carried out by women and children(6-15 years old).

## **6. CONCLUSION AND RECOMMENDATION**

### **6.1. Conclusion**

Maize is the main crop which was cultivated by most of the farmers in the study area. Most of the farmers responded that due to these practice pest primates and other wildlife gets opportunities to damage crops easily and some farmers were forced to shift from crop production to other cultivate. Farmers in the study area depend on the forest for different resources such as fire wood, fodder and wood for house construction people were used, so that the competition between human and wildlife animals occurred. The pest primates namely Anubis baboon, vervet monkey, wild pig and porcupine were identified. Most common pest primates in the study area were Anubis baboon and vervet monkey.

The highest crop damage was caused by vervet monkey. Next to vervet monkey, Anubis baboon was the second crop damage causing primate in the study area. Most of the damage was recorded at flowering stage by vervet monkey and in matured stage by Anubis baboon. Other wild animals like wild pig, warthog and Porcupine raid crops at all stages.

### **6.2 Recommendation**

Based up on the finding of the present study, the following recommendations are made so as to mitigate the human pest primate conflict in the study area.

- The people in the study area depended on the forest for different resources such as fire wood, farmland, grazing land and fodder, such activities lead to the degradation of the natural habitat that may encourage wild animals to destroy crop. However to reduce the dependency of the local people on the forest, it is better to encourage the local people to plant trees for their different utilization
- Most of landless youngster of the study area uses the forest as better sources of farmland. This activity is one of the causes for the destruction of the home of primates and other wildlife which push them to damage crops, so to solve this problems youngster should be given education not to be dependent on clearing forest for means of farmland, instead they should be organize with others and participate in activities like coffee plants and



specie cultivation, which is dual benefits in the coming generation for youngster to engage on forest management.

- The government should encourage and organize youngsters in different organizations for creating job opportunities instead of damaging the forest for agricultural purposes.
- The government should control illegal settlements around the forest, expansion of farmland and cattle grazing in the forest.
- The government should discuss with farmers about the problem of crop damage and its solution.
- The local community should protect and conserve the natural habitat of animals and minimize human-wildlife conflict.
- The NGOs should be work with government and with the local community on the conservation of forest.

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## Appendix-I

Data collection sheet for population estimate pest primate.

Date \_\_\_\_\_

Species name \_\_\_\_\_

Season \_\_\_\_\_

Place \_\_\_\_\_

Site \_\_\_\_\_

Name of collector \_\_\_\_\_

Table 8. Data collection sheet for population estimate pest primate

No	Group type	Age structure				Remark	
		Adult		sub adult			Juvenile
		male	female	male	female		
1							
2							
3							
4							
Total							

## Appendix-II

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

Name of data collector \_\_\_\_\_

Place \_\_\_\_\_

Season \_\_\_\_\_

Stage of crop development \_\_\_\_\_

Distance of the field from the forest boundary \_\_\_\_\_

Table 9. Data collection sheet for direct observation of crop damage by wild animal or primate

No	Species observed	Type of crop and amount of damage	Part of crop damaged	Time of observation	Traditional method used to control wildlife	Remark
1						
2						
3						
Total						

## Appendix-III

### Questionnaire

**Part one:** Respondent's demographic information for close ended questions encircle the letter of your answer and for open ended questions given precise answer.

1. Respondent name \_\_\_\_\_  
Age \_\_\_\_\_ Sex \_\_\_\_\_
2. Education background  
A. Illiterate B. Read and write C. Elementary D. High school
3. Position of the house hold  
A. Head of the house B. Member of the house hold
4. How long you have lived in this got/ village.  
A. Below 5 year B. 5-10 year C. 11-15 year C. 16-20 year E Greater than 20 year

**Part two:** The crops cultivated in the study site and estimate of the yield obtain.

\*For the following question give your answer by encircling the letter of your choice and fill the correct answer in space provided. You can choice more than one answer.

5. Do you have your own farmland?  
A. Yes B. No
6. If your answer is 'yes' on question number 5 above, how much is its size?  
A/ Less than 0.5ha B/ 0.5ha C/ 0.6-2ha D/ 2.1-3ha E/ 3.1-4ha F/ >4.1ha
7. If your answer for your question number 5 is above is 'no' where you are cultivated?  
A. Renting the land B. correlating with other
8. Which of the following crop do you cultivate on your farmland?  
A. maize and teff B. sorghum and maize C. teff D. barley E. other \_\_\_\_\_

9. In your activity of farming do you have cooperation with farms of neighboring fields?

A. yes B. no

10. If your answer is 'no' for question number 9 above, what problem have you faced through your practice?

A. being helps B. easily damage of the crop by wildlife

C. If any more mention \_\_\_\_\_

11. How many kilogram (quintal) yields did you get last year?

\_\_\_\_\_  
\_\_\_\_\_

**Part three:** Respondent knowledge and practice about human primate conflict.

12. Is there forest in your settlement?

A. yes B. no

13. How much the distance of your farmland from the forest?

\_\_\_\_\_  
\_\_\_\_\_

14. If your answer is 'yes' for question12 above. What types of resources do you use from the forest?

A. fodder and fire wood B. wood for house construction C. all of them

15. Are there wild animals around your village?

A. yes B. no

16. If your answer is 'yes' for question number 15 above which of the following are they?

A. Anubis baboon B. Vervet monkey C. wild pig D. porcupine E. other \_\_\_\_\_

17. Which of the above mentioned wild life have conflict with human? Please mention them

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18. Which of the following is the cause of conflict?

A. crop damaging B. predation C. attacking human D. all

19. If your answer for question number 18 is crop damaging, which types of wild life damages crop more?

A. primate B. birds C. rodent D. other \_\_\_\_\_

20. If your answer for question number 19 is primate, which of the following primates damage crop?

A. Anubis baboon B. Vervet monkey C. wild pig D. porcupine

21. How many % of your annual crop yield was damaged by primate pest?

A. 1-5% B. 6-10% C. 11-15% D. 16-20% E. 21-25% F/ more than 26%

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

A. increasing B. decreasing

23. The damage is severing in which season?

A. dry B. wet

24. In which season the problem is more servers?

A. Summer B. Winter C. dry season E. Autumn

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

A. scarce of food in the forest B. the presence of excess crops on the farmland C. unfavorable of the weather condition D. attractiveness of farm crops

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

A. women B. boys C. men D. girls

27. What measure do you think should be taken by the following bodies in order to prevent the crop damage?

A. by the government B. by non-government C. by farmers

## Appendix -IV

### Interview

Give precise answer for the following question on provided space

1. What type of crops do you grow on your land?

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2. Can you estimate the amount of yield you get last year from each type of crops?

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3. Is there forest around your village? A. yes B. no

4. If your answer is 'yes' for question three above, what resource do you used from the forest?

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5. List the primate found in the forest around your villages.

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6. Which of these primates cause crop damage?

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7. What about the number of these primates, is it increasing or decreasing? Explain the reason.

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