JIMMA UNIVERSITY

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DEPARTMENT OF BIOLOGY

HUMAN-PRIMATE CONFLICT: WITH SPECIAL EMPHASIS ON PEST MONKEY-HUMAN CONFLICT IN YEROSOKORU KEBELE OF SOKORU DISTRICT, JIMMA ZONE, OROMIA REGIONAL STATE, SOUTH WEST, ETHIOPIA

BY

ZEMEDKUN SIRAJ

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ADVISOR: TSEGAYE GADISSA (PhD)

CO-ADVISOR: GELAYE G/MICHAEL (PhD CANDIDATE)

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ACRONYMS

ANOVA ----------Analysis of variance

FAO ----------Food and agriculture organization

GPS ----------Global positioning system

HPC ----------Human primate conflict

HWC ----------Human wildlife conflict

NHP ----------Non-human primates

SADC----------Southern African Development Community

SPSS ----------Statistical Package for Social Science

ABSTRACT

*Human-primate conflict is a crucial issue when it threatens the economic and social security of rural people as well as compromising biodiversity conservation initiatives. This study was conducted to determine the extent of human-primate conflict: with special emphasis on pest monkey-human conflict in Yerosokoru kebele of Sokoru district, Jimma Zone, Oromia Regional State, South West, Ethiopia. The study was conducted from September, 2013 to April, 2014. Field observation and community based cross-sectional study were employed to this study. Observation, questionnaire survey and Focus group discussion were used to collect data. For the questionnaire survey, 243 respondents were randomly selected from 580 households. The study area was divided into study sites and three habitat types: around human settlement areas, farmland and fragmented forest habitats. Four primate species Papio anubis, Chlorocebus aethiops, Colobus guereza**,** and Cercopithecus mitis were identified. Anubis baboon (Papio anubis) and vervet monkeys (Chlorocebus aethiops) were considered most problematic primates in the study area. Anubis baboon was the most abundant primate species (51.40% in wet season, WS and 50.22% in dry season, DS). Vervet monkeys' abundance was the second (34.97% in WS and 35.32% in DS). Totally, 203.7$\pm$21.04 in WS and 182.4$\pm$17.22 in DS Papio anubis and 138.6$\pm$17.04 in WS and 128.3 $\pm$16.03 in DS Chlorocebus aethiops were recorded in the study area. The abundance of the primates was significant with respect to seasons ($F_{(3,116)} = 139.72$, $P < 0.05$ in DS and $F_{(3,116)} = 123.55$, $P < 0.05$ in WS). Anubis baboon was found distributed on farmland and fragmented forest habitats while vervet monkey was distributed around human settlement areas and farmland habitats. On average, Anubis baboon resulted 31.52% annual loss of maize per hectare and vervet monkey on average, resulted 29.94% annual loss of maize per hectare. Social, economic, security, psychological and health problems were other impacts of pest primates other than crop attack. Pest primates' population size increasing, expansion of agriculture, crop raiding/eating adaptation and behavior of pest primates, and neighboring of pest primates to human residence were found to be significant factors that caused the conflict between human and primates in the study area (X^2 (6) =317.92, $P < 0.05$). Guarding by adult humans (males) was the main crop predation prevention and mitigation way practiced in the area. The pest primates were causing serious and great economic losses and other problems like social, security, health etc. The district administrator, agriculture sector and kebele chairman should pay due attention to the problem and solve being with the stakeholders and also give training on ways of coexistence to the communities.*

Key words: Human- primate conflict, Jimma Zone, Sokoru district, Abundance of primates

1. **INTRODUCTION**

1.1. **Background**

Agriculture plays a key role for global sustainable development as it is a source for food, feed, fuel and fibre and provides a livelihood to about 2.6 billion people (VonBraun, 2005; WDR, 2008; IAASTD, 2009). It is the foundation for human and economic development (Sitati and Walpole, 2006). Moreover, in the first half of the 21st century, demand for agricultural produce is expected to grow by 70%, thereby increasing the pressure on already scarce natural resources (FAO, 2009).

There are a number of pest animals that affect agricultural products. Primates are usually considered as among the wildlife that affect agricultural activities and its products. Thus, they could have role in reducing the outcome of agricultural products; hence, economy and development too. This might be related to the abundance and distribution of the primates in an area (Plumptre and Cox, 2006). Primates are highly significant pests in areas of the tropics where local people are mainly subsistence farmers (Hill, 1997; Priston, 2005).

Primates of the genus *Chlorocebus* are found exclusively in Africa and prefer savannah and riverine woodland areas, as well as coastal scrub forests, avoiding desert, high forest and open grassland habitats (Kingdon *et al*., 2008). *Chlorocebus aethiops* is among the most widely distributed non-human primate (NHP) species in Africa. Moreover, a number of subspecies are found from Southern Africa to Ethiopia along the East coast, as well as in West Africa (Kingdon *et al*., 2008). Vervet monkeys have a very wide distribution, which stretches over a number of different ecological areas (Coetzer, 2012).

The primate groups' columbines range stretches from Ethiopia to Nigeria and they inhabit a wide range of forest types (Dunbar and Dunbar, 1974; Oates, 1977a, b; Rose, 1978). Besides, guerezas are among the largest of Africa's arboreal monkeys with adult males averaging 11.8 kg and adult females 8.6 kg (Oates *et al.*, 1990).

According to Steinfeld *et al*. (2006), competition for space and available resources between people and wildlife is the major driver of human-wildlife conflict (HWC). The competition reduced the 'once' peaceful co-existence of people and wildlife (Steinfeld *et al*., 2006). A study result in Mozambique showed that, human-wildlife conflict incidents are not randomly distributed but form clusters (hotspots) in relation to distance from conservation areas, as well as, vegetation density (Sebastien *et al.,* 2011). Additionally, human-monkey interfaces are often described in terms of the shared use of space or conflict over resources (Wallace and Hill, 2012). Thus, understanding and addressing conflict between humans and wildlife due to crop-raiding, for instance, is a crucial conservation issue (Sitati and Walpole, 2006; Graham and Ochieng, 2008). Crops near forest are often predictable and accessible sources of nutrition for wildlife (Strum, 2010), and extensive damage through raiding can adversely impact farmer livelihood (Hill, 2005; Webber, 2006), compromise food security (Hill, 2000), reduce tolerance of wildlife (Naughton-Treves, 1997), and undermine management strategies (Osborn and Parker, 2003). Furthermore, crop damage is the most prevalent form of HWC across the African continent (FAO, 2009).

Age probably correlates with raiding experience for primates consuming crops (Strum, 2010). Compared to novice raiders, primates with greater experience should access or process crop items more efficiently, and avoid detection by farmers more frequently or for longer durations (Wallace and Hill, 2012). On the other hand, for example, vervets are seen as problem animals in most agricultural communities, reportedly causing substantial damage to crops and thus, are persecuted to prevent such damages (Coetzer, 2012). Moreover, vervet monkeys are extremely adaptable and are frequently found in suburban areas which overlap with their home ranges, where they come in frequent contact. This behavior frequently leads to human / non-human primate conflict. Such conflict also arises with farmers, as vervet monkeys have been blamed for considerable damage to orchards and crops (Coetzer, 2012).

Even if they raid crops along forest edges, primates have become important components of ecotourism-linked conservation efforts (Wallace and Hill, 2012). So, a clear understanding of the distribution of organisms in time and space is central to the evaluation of the conservation status of species or threatened species and critical for the formulation of appropriate conservation strategies (Coetzer, 2012).

Human-wildlife conflict is a complex problem, requiring a combination of approaches to manage the conflict including wildlife barriers, protecting property, traditional methods and removal of the specific problem animals (Nelson *et al.*, 2003; Parker *et al.*, 2007). For any human-wildlife conflict management strategy to succeed, it must be sustainable and is therefore, ideally administered by the local community itself (WWF-SARPO, 2005). Likewise; conflict mitigation requires a comprehensive record of crop-raiding activity, including patterns of raiding, farmer and raider behavior, crop losses, and the parameters of raiding events (Wallace, 2010).

Primates are found in the different regions of Ethiopia and interacting with humans in various situations. However, in order to take conservation measures and mitigating the diverse interaction with humans and the environment, evidence on different aspect of the primates is mandatory. But, such evidences are not yet adequately available. To the knowledge of the investigator, research attention on primates-human conflict might not have been given due attention.

Majority of Sokoru district dwellers are agrarian (91%) (CSA, 2007; SWAAR, 2011). The investigator himself has observed primates conflicting with humans particularly with the farming communities. As well, there is great complaint by the farming communities regarding primate problems and reporting several times to the agricultural sector of the district (Agricultural sector head, personal communication). However, no practical solution was given. The district lacks any researched evidence on the issue of primates. Yerosokoru kebele is one of such areas in the district with the mentioned conflict between humans and primates. To this end, this study was conducted to determine the extent of human-primate conflict: with special emphasis on pest monkey-human conflict at Yerosokoru kebele of Sokoru district.

1.2. **Statement of the problem**

Worldwide crop loss from pests ranges from 35% to 42% (FAO, 2009). Most edge-thriving primate species, including vervets, baboons, and macaques, raid crops regularly as a result, in many places, these species have been referred to as "weed species" (Richard *et al.,* 1989), or pest and vermin species (Fimbel, 1994). The nature of human-primates interaction varies but often characterized by resource competition, for example, over crops and wild resources (Kinnaird, 1992; Hill, 2005). In addition, human-primate conflict is a crucial issue when it threatens the economic and social security of rural people as well as compromising biodiversity conservation initiatives (Naughton-Treves, 1997). Moreover, it is clear that a detailed understanding of the issues surrounding a potential conflict situation is the first step towards reconciling conflict between human and primates (Woodroffe *et al.*, 2005).

Majority of the residents in Sokoru district (Sokoru woreda) and Yerosokoru kebele are agrarian and thus, agriculture is their main economic activities (SWAAR, 2011). In Sokoru district in particular in Yerosokoru kebele pest primates are causing very serious problems such as food security, economy, social, frustration, deprive of people rest, psychological and other problems. However, there was no any scientific research conducted on the issue of HPC in the area in order to aid the communities in mitigating the exacerbating conflict problem. As the result of the several conflicting situations with pest primates, the communities are complaining about primates. The primates are raiding, damaging or destructing their crops. Additionally, spending more time on protecting crops is observed (Agriculture sector head, and some of farming communities, personal communication with the investigator). On the other side, performing human activities that harm and affect the existence of wildlife and primates in particular, imposes negative consequences on the biodiversity of the area directly and that of the country in general. Other environment change and associated problems could occur. For instance, human presence and activities can affect negatively the distribution of primates through habitat modifications or animal persecution (Richard *et al.*, 1989). Conversely, effective mitigation strategies are urgently required to resolve HPC (Hockings and Humble, 2009). To this view, the investigator was interested to conduct scientific research to determine the extent of human-primate conflict: with special emphasis on pest monkey- human conflict at Yerosokoru kebele of Sokoru district.

1.3. **Objectives**

1.3.1. **General Objective**

To determine the extent of human-primate conflict: with special emphasis on pest monkey-human conflict in Yerosokoru kebele of Sokoru district, Jimma zone, Oromia Regional State ,South West, Ethiopia.

1.3.2. **Specific Objectives**

- To identify the pest monkey species in the study area.
- To determine the abundance of pest monkeys in the study area.
- To determine the distribution of pest monkeys in the study area.
- To identify problematic monkeys and rank them according to their pest level.
- To determine the impacts and causes of conflict between humans and pest monkeys.
- To identify traditional methods used to reduce impacts of problematic monkeys.

1.4. **Significance of the study**

No one has taken the initiatives, attention, and responsibilities to conduct such scientific research in the district in relation to primates in particular and wildlife in general. Therefore, conducting this research will have the following significance:

- Such scientific research is necessary to understand the types, abundance and distribution of primates in particular in the study area and also in the district. Thus, the district administrators and other could develop more positive attitudes to support and initiate other researchers on related or other researches in the district.
- Such scientific research is basic to understand and take conservation measures for wildlife (primates) in the district by involving the communities as stakeholders.
- Such scientific research can play crucial role in identifying, understanding and resolving the conflict occurring between humans and primates in the district and particularly in the study area.
- Such scientific research can be used as baseline information for others in the area.

2. **LITERATURE REVIEW**

2.1. **Importance of censusing primates (animals)**

Precise information on the status and trends of animal populations obtained from inventory and socio-ecological studies is a requirement for successful wildlife conservation programs (Plumptre and Cox, 2006). Line transect census is the most commonly used method in forest primate abundance studies (Chapman *et al*., 2000; Fashing and Cords, 2000). Moreover, long-term population monitoring has been central to conservation efforts for several primate species, for example, mountain gorillas (*Gorilla gorilla berengei*) (Harcourt, 1996).

Censusing non-human primates over time are necessary for monitoring population trends, which is important for designing and evaluating management practices (Kremen *et al*., 1994; Gibbs *et al*., 1998). Census data also provide the baseline for more detailed socio-ecological and behavioral studies (Butynski, 1990). However, according to Irwin (2008), censuses alone, if not conducted over time, may not be able to predict the long-term viability of species. On the other hand, census studies have recognized the usefulness of behavioral characteristics for interpreting patterns in spatial distribution data (Ukizintambara, 2010). Also, censuses are very important, but if not repeated over time, they may overlook the viability of populations (Twinomugisha, 2007; Irwin, 2008).

2.2. **Factors that influence abundance of primates**

As it is indicated by different studies, various forest structural attributes have also been found to be important correlates of primate abundance (Wieczkowski, 2004). Accordingly, for many primates, these important attributes include the number and size of trees (Medley, 1993; Ross and Srivastava, 1994), the percentage of canopy cover (Skorupa, 1986), and the size of cut, dead, or damaged trees (Medley, 1993). Other studies have also found primate abundance to be correlated with the availability of the species' primary or keystone resource (Skorupa, 1986; Medley, 1993). According to Chapman and Chapman (1999), there is positive correlation between primate abundance and availability of top diet species.

Additionally, several authors have previously suggested that dietary quality is important in determining female fecundity and hence, population growth rate in primates (Milton, 1982; Chapman and Fedigan, 1984; Milton, 1993). Furthermore, overall carrying capacity or population density in a habitat is thought to be determined by food availability, with special emphasis on periods of food shortage (Terborgh, 1986; Oates *et al*., 1990). On the other hand, Davies (1994) suggests that folivorous primates generally achieve higher abundances than frugivorous primates in tropical forests in Africa because of their ability to eat leaves, especially mature leaves, which allows them to sustain large populations even during periods of seasonal food scarcity.

Nevertheless, the most serious threat to the majority of threatened non-human primates is habitat destruction (Mittermeier and Konstant, 2002). The gradual loss of habitat has led to increasing conflict between humans and wildlife. One of the main consequences of the loss of habitats is the decrease in natural resources available for wildlife. The destruction of natural vegetation around protected areas 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 periphery of protected areas. Likewise, species with a more diversified regime such as primates will encroach on cultivated areas when the availability of natural food diminishes (FAO, 2009). Therefore, it is critical to understand the vegetation attributes that support primates (Wieczkowski, 2004). As, this information can be used to suggest management and conservation strategies (Estrada and Coates-Estrada, 1996; Stevenson, 2001).

2.3. **Distribution and factors that influence distribution of primates**

Murcia (1995); Treves (1999) and Lehman *et al*. (2006), recognize that finding food and avoiding predators are two of the most important ecological demands that influence species distribution and survival. By optimizing feeding, primate species meet their nutritional requirement for survival, growth and reproduction (Ukizintambara, 2010). Evolutionarily, primates, compared with other animals, possess an advanced cognitive ability to process information on the amount, distribution, and quality of potential food items (Ukizintambara, 2010).

Despite the fact that, there are temporal and spatial variations in the distribution of food and that of threats (Treves, 1999; Lehman *et al.*, 2006). Vervet monkeys are distributed across sub-Saharan Africa, excluding most parts of the Congo Basin forest (Ukizintambara, 2010). Other examples include the rhesus macaques (***Macaca mulata)*** that have adapted to open habitats and feed in heavily disturbed parts of forest mosaics in Pakistan (Richard *et al*., 1989) and baboons that use the near edge zone , raid neighboring maize and millet crops (Olupot, 2004).

As indicated by Harcourt *et al.* (2005), across a wide variety of organisms, taxa with high local densities (abundance) have large geographical ranges or distributions. Accordingly, taxa whose individuals live at high local densities (abundance) often, even usually, have relatively large geographical ranges or distributions (Brown, 1984; Gaston, 1994; Lawton, 1995; Bell, 2001). Many explanations, both methodological and biological, exist for the positive relationship between range size and density (Harcourt *et al.*, 2005). However, with regard to the carrying capacity hypothesis, primate populations or taxa at low local density might indeed be more likely to go extinct (Harcourt, 1998; Harcourt and Schwartz, 2001), and hence might occupy fewer patches, and so a smaller geographical range (Harcourt, 1998).

Additional studies also indicated that, taxa at low density in a small geographical range (i.e. rare) are more likely to go extinct than are common taxa, other things being equal (Nitecki, 1984; Rosenzweig, 1995; Johnson, 1998). On the other hand, 50% increase in number of primate species in the last decade of the last century was largely a result of raising of former subspecies to species (Isaac and Purvis, 2004). Conversely, if high-density populations are more likely to spread, simply as a density-dependent effect, they should presumably move into more marginal habitat, and hence, broaden their niche. Thus, over time, they might even morphologically adapt to the new habitats (Isaac and Purvis, 2004).

2.4. **Human influence on biodiversity and primates**

Habitat loss is one of the greatest obstacles to biodiversity conservation in the tropics (Nose, 1991; Newmark, 2001). The clear-cutting of forest for agricultural and development activities has isolated and compressed primate populations and other taxa into small island forests and exposed them to disturbances that characterize forest edges (Yahner, 1988; Onderdonk and Chapman, 2000; Siex, 2003). Consequently, the majority of these populations might decline considerably and eventually become locally extinct (Ukizintambara, 2010). For instance, over the last ten years, orangutan populations have declined by more than 30% due to forest clearing in Southeast Asia (Van Schaik, 2004). Other example include that, lemur survival is currently threatened by intense anthropogenic pressure from growing human populations, shifting land use patterns, increasing deforestation and a changing climate (Elmqvist *et al*., 2007; Allnutt *et al*., 2008). Additionally, as canopy-dependent animals, gibbons are particularly vulnerable to habitat loss and disturbance due to human activities (Leca *et al*., 2013). Furthermore, the hoolock's area of occupancy has declined by more than 30% in the past decade due to habitat loss, habitat fragmentation, and human encroachment (Ukizintambara, 2010). Besides of these, there have also been reductions in the quality of remaining habitat fragments due to loss of fruiting trees and sleeping trees and the creation of gaps in the canopy (Das *et al*., 2006).

Human activities affect the vegetation cover (Ukizintambara, 2010). But, dense habitat may reduce predation rates by providing concealment and cover, thereby decreasing predation success (Richard *et al.*, 1989). However, human presence and activities can also affect negatively the distribution of primates through habitat modifications or animal persecution (Richard *et al.*, 1989). According to Harcourt and Fossey (1981), for instance in the Bwindi forest in Uganda, due to the high frequency of human activities on the periphery of the forest, gorillas were more restricted to the interior of the park while groups of baboons concentrated their foraging activities on the forest edge (Olupot, 2004). Furthermore, for forest primate populations to forage in habitats with less cover, they must find a trade-off between the energy gained from food and the energy lost while scanning for predators (Ukizintambara, 2010). Consequently, fitness would be compromised if predator scanning reduced the rates of feeding (Ukizintambara, 2010).

Besides, deforestation has converted large continuous forests into many smaller and isolated forest fragments surrounded by non-forest matrix (Wilcove *et al*., 1986; Newmark, 2001). Direct effects of deforestation account for the amount of habitat loss that occurs simultaneously with the felling of trees (Van der and Petersen, 2005) and the creation of forest fragments characterized by extensive edges (Williams-Linera, 1990).

Deforestation not only reduces the extent of forested areas, but also changes the shape and structure of the interface between the forest and surrounding matrix (Murcia, 1995). Moreover, deforestation also lowers species numbers and modifies community composition within remaining fragments (Turner, 1996). Approximately 125,000 km2 of forests have been cleared each year (Chapman and Peres, 2001), making fragmented landscapes and edge-affected forest one of the most widespread features on earth, especially in the tropics (Williams-Linera, 1990; Laurance, 2003).

Human alterations of the landscape including forest modification, road construction, irrigation systems, and preferential use of specific forest or other habitat areas can modify, restrict or even enhance pathways between groups in a population of primates (Fuentes, 2006). In addition, primates are prey items for a diverse array of human cultures in zones of sympatry, and are also captured by people from both zones for various human needs ranging from ingredients in traditional medicines to subjects of biomedical research hunters (Fuentes, 2006).

2.5. **Human-primate conflict**

Human-wildlife conflict exists when the needs and behavior of wildlife impact negatively on the goals of human beings (Nelson *et al*., 2003). Consequently, it tends to manifest itself in scenarios where human strategies affect free movement of wild animals and vice versa. Accordingly, HWC can be considered inevitable in all communities where human and wildlife coexist and share the same habitat (LeBel *et al.*, 2010). Monkeys occur in human-dense settings with sparse forest cover, which makes visual observations relatively easy (Baker *et al*., 2009). They regularly sought food in people's gardens and farms, and residents were increasingly annoyed with them (Oates *et al*., 1992; Tooze, 1994).

Though, access to and competition for food and other resources may also limit group size (Chapman and Chapman, 2000), monkeys exploit limited areas by raiding the gardens and crops of residents and often using human structures (rooftops, compound walls, etc.) to travel and rest. Conversely, in such anthropogenic sites, there may be an added benefit for monkeys to live and forage in smaller parties (Baker *et al*., 2009).

On the other hand, hunting of primates is common worldwide. Hunting may be more detrimental to primate survival than habitat destruction and can locally extirpate populations even where suitable habitat remains (Mittermeier, 1987; Oates, 1996). Primates are hunted for a variety of reasons: to eat, sell, or keep as pets; for use in medicines, in rituals, or as ornaments; or because they are regarded as crop raiders (Mittermeier, 1987).

3. MATERIALS AND METHODS

3.1. Description of the study area and periods

3.1.1. Sokoru district

Sokoru is one of the districts in Jimma Zone of the Oromia Regional State. Sokoru is bordered on the South by Omo Nada, on the West by Tiro Afeta, and on the North and East by the Southern Nations, Nationalities and Peoples Region; the Gibe River defines the Northern boundary (SWALB, 1998).

The altitude of the district ranges from 900 – 2300 meters above sea level (SWAARCP, 2010). Topography of the district is mainly grouped into three as high land (10%), low land (30%), and semi-high land (60%) agro climatic zones (SWAARCP, 2010). The district has annual mean temperature of 25^0C and mean annual rain fall of 1500mm. The wet season is long and ranges from May/June to November and the dry season ranges from December to March/April (SWWR, 2012). A survey of the land in this district shows that 36.6% is arable or cultivable, 16.8% pasture, 17.2% forest, and the remaining 29.4% is built-up or degraded (SWAARCP, 2010). Moreover, the Abelti-Gibe State Forest covers 159 square kilometers of the forested area. Teff is one important cash crop. Although coffee is another important cash crop of this district, less than 20 square kilometers are planted with this crop.

In the district, 38 kebeles are found. According to the Central Statistical Authority report of 2007 (CSA, 2007), the total number of households was 21,841 with a total population size of 136,297 in which the males accounted for 68,456 (50.23%) of the total population of the district. From the total population of the district, more than 90% are agrarian for which agriculture is the main source of economic activities. In general, the total area of the district is 92,744 hectares (CSA, 2007; SWAARCP, 2010).

3.1.2. **Yerosokoru Kebele**

Yerosokoru is one of the 38 kebeles of Sokoru district. It has an altitude of 1610 – 2009 meters above sea level (m.a.s.l.). Its geographical location is 37^0 23.2' – 37^0 26.8' E and 7^0 54.3' – $7^0$55' N. Yerosokoru kebele has the temperate agro climatic zone of the district with annual mean temperature of 22 - 25^0C and annual mean rainfall of 1550mm (SWWR, 2012).

Yerosokoru has approximately an area of 1700 hectares (Figure 1). It is bordered by Simini River in the North; Daka kebele in the South; Asher in the East and Gibe river in the Western part. It is about 103 Km from Jimma and 251 Km from Addis Ababa. Majority of the populations are agrarian and thus, their livelihood is mainly based on agriculture. Agricultural land expansion and charcoal production could be among the main influencing and land cover altering human activities (Administrator of the kebele, personal communication). Teff, maize, and sorghum are the major crops that grow. Beans, peas, linseed, noug, wheat, barley, also grow in this area (SWAARCP, 2010).

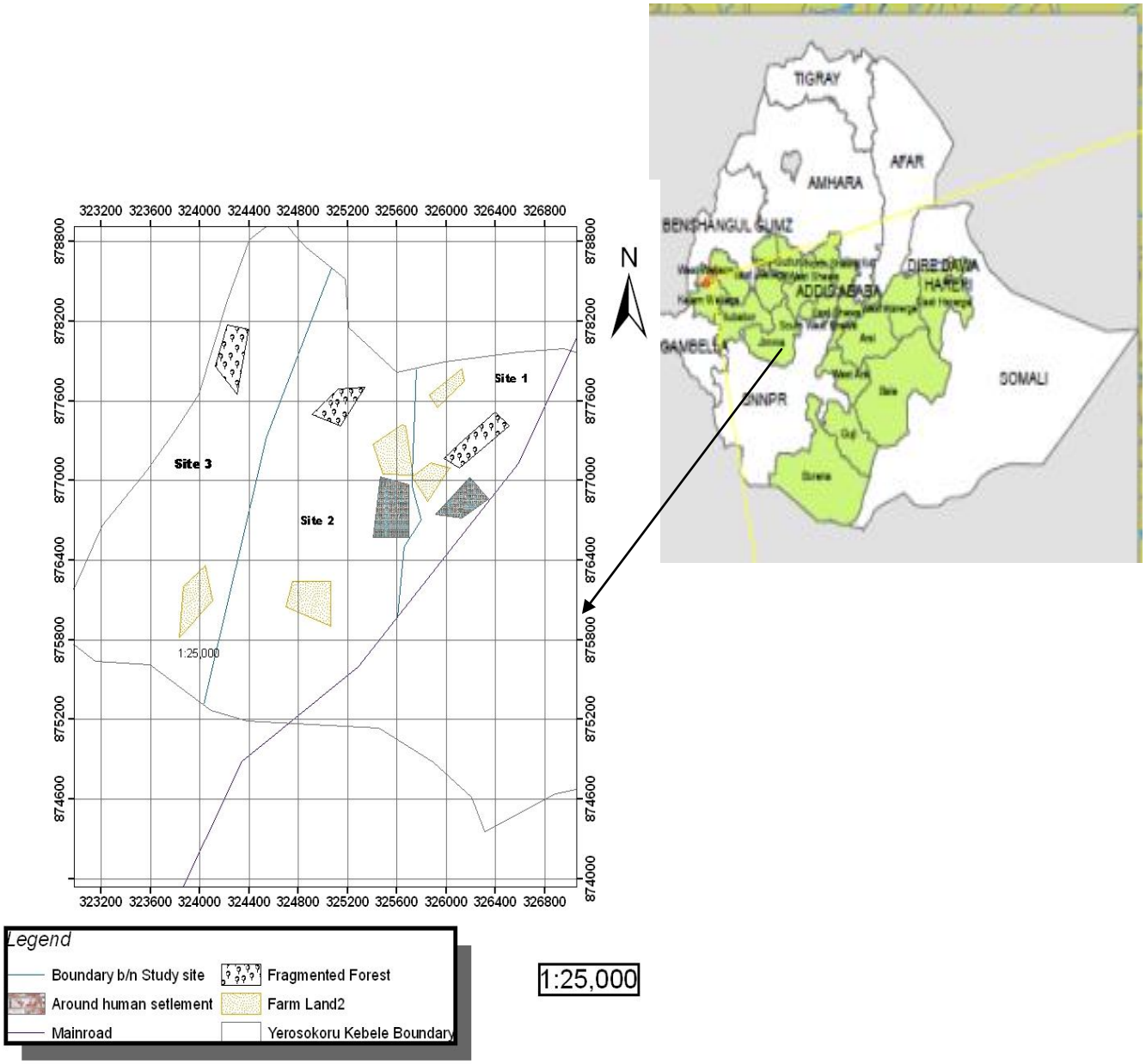

Fig 2 Map of Study Area(Yerosokoru)

3.1.3. **Study periods**

This study was carried out in the study area from September, 2013 to April, 2014.

3.2. **Study Design**

Community based cross-sectional survey and field observation using line - transects method.

3.3. **Sample Size determination and Sampling Procedures**

3.3.1. **Sample Size determination**

3.3.1.2. **Sample size for community based cross-sectional survey**

The size of sample used for this study was determined by using single proportion formula (Cochran,1977) by assuming 95% confidence level with 0.05 marginal errors and p = 0.5.

$$n = \frac{Z^2 PQ}{D^2}$$, Where; n = sample size

$$= \frac{(1.96)^2(0.5)(0.5)}{(0.05)^2}$$ D = margin of error

= 384.16 N = number of households = 580

=384 P = proportion of conflict b/n human and primates

Z = level of confidence

Q = 1-P

D = 0.05

P = 0.5

Z = 1.96

Since the source population was less than 10,000, correction formula was used. Thus,

$$nf = \frac{n}{1+\frac{n}{N}}$$

$$= \frac{384}{1 + \frac{384}{580}} = 231.05 \approx 231.$$

When non-response rate with 5% was considered and then, inclusion of this to the above sample size, gave a total of 243 respondents were randomly selected for the study.

3.3.1.3. **Sample size for line-transect**

The study area was divided into three study sites and different habitat types based on topography and vegetation. Then, each habitat type was divided into blocks by choosing the location of each habitat. Among the established habitats, representative blocks were randomly selected for the actual study (Sutherland, 1996).The randomly selected study blocks were made to cover at least 20 - 25% of the study area (Bibby *et al*, 1998).

3.3.2. **Sampling Procedures**

3.3.2.1. **Community based cross-sectional survey using questionnaire**

The study area was one kebele and 580 households which were found outside and around the town with a total population of 2500 from which 1255 were females. From the total households, 243 households were selected randomly. When two or more eligible householders were encountered in the same household, only one was included in the study.

3.4. **Data collection instruments**

3.4.1. **Field Observation /Survey**

3.4.1.1. **Preliminary Survey**

Reconnaissance survey of the primates was conducted for seven (7) days in September, 2013 to identify the primate species found in the study area. Line transects layout sites were selected and marked using easily visible colored vinyl plastics for identification randomly during this preliminary survey period. This period was also used to recruit and train field assistants, organize and logistic support and purchasing the necessary equipments/materials like water proof pad, flash.

The physical feature of the study area was assessed using ground survey. Classification of the study area into three study sites on the basis of vegetation coverage, topography, availability of primates, and size of the area and suitability for the study and then grouping of the sites into different habitat types was made. The study area was divided into three sites and three different habitat types and the sampling units within the habitat were determined and assigned on the basis of area coverage and vegetation type.

Three habitat types around human settlement, farmland, and fragmented forest were found according to the classification. Each habitat was then classified into study blocks/ units within each study sites. Accordingly, totally 10 study units were selected from all sites. In this survey, an overall view of the primates of the area was conducted and all the available and relevant information such as temperature, rainfall, topography, altitude, habitat types and approximate size of the study area were gathered from concerned governmental, non-governmental authorities and local people living around the study area.

During this period different field equipment were also used such as Garmin Global Positioning System (GPS) 72, video and digital photography camera, note books, pen, plastic tag, tape measure, field data sheet for abundance and distribution, compass, binocular, species identification book/key (Kingdom,1997). The GPS was used to identify the location of study area, study sites, study units and the position of the observed primate/s during inventory time.

3.4.1.2. **Line-transect method**

Inventory of the primate species was carried out using transect line. The number of transect line and the distance between each transect line was determined by vegetation cover and topography of the study site and also size of blocks (Sutherland, 1996). Accordingly, 20 transect-lines were laid out systematically in East to West direction for the randomly selected 10 study units from the three study sites. Two, five and three study blocks/units were selected for around human settlement areas, farmland and fragmented forest habitats, respectively. From the total transect-lines, four, ten and six transect-lines were used for around human settlement areas, farmland and fragmented forest habitats, correspondingly. Two transect-lines were laid out per study blocks for each selected block of each of the three habitats in the study area. The size of blocks for around human settlement areas was, 0.5km x 0.25Km, for farmland the size of blocks was, 0.85Km x 0.25Km and for fragmented forest the size of blocks was 0.5Km x 0.145Km. The length of transect-line was on average 0.5km, 0.85Km and 0.5Km while the width of each transect-line was 100m, 100m and 60m for around human settlement areas, farmland and fragmented forest habitat study blocks, respectively. The distance between transect-line per blocks was 150 meters for both around human settlement areas and farmland and 85 meters for fragmented forest habitat blocks.

The total length of transect-lines surveyed was 13.5Km per the whole selected study blocks. During the survey of primates abundance, ten to twelve times inventory was taken for each transect-line in the study units. Inventory of the primates was conducted during both wet and dry seasons in the morning time (6:30 – 11:30 hours, AM) and in the afternoon time (4:00 – 6:30 hours, PM) when the primates were active (Peres,1999).

The observer walked on foot approximately at constant speed along the transect-line and recorded. When an individual primate or group of primates was observed, the observer stopped his movement and recorded the species, group and group composition, number of individual organisms, habitat type, geographical location and time. The identification of species was done by using the Kingdon field guide book to African mammals (Kingdon, 1997). Visual estimation of the body size of each individual organism of the species was used to categorize individual into one of the three categories as adult, sub adult and juvenile in identifying the age composition of the primates /primate group (Mussa, 2009).

The species in the study site were recorded via direct observation using binoculars (binocular, 7 x 50: Bushnell Model No.781) or naked eye (Erb, 2005). Pre-prepared field observation data sheet was used to record the identified species. In addition, photographs were taken to confirm the identification using digital camera.

Using the data from transect-lines, abundance and distribution of the primates was analyzed. Abundance of the primates was determined by dividing the total number of individuals of species by total number of sample blocks (Brown, 1984).

$$\text{Abundance} = \frac{\text{Total number of individuals of species}}{\text{Total number of sample blocks}}$$

3.4.2. **Questionnaire**

Questionnaire was prepared in English language after reviewing the previous studies conducted on related issues and also by assuming points to be included in the questionnaire in relation with the purpose of the study. Then, it was translated to local languages - Amharic and Afan Oromo for easy understanding of the respondents. The content validity of the questionnaire was checked by advisors.

It contained a total of 33 questions with two parts namely; socio-demographic characteristics assessed by 4 items and human-primate conflict related issues assessed by 29 items.

Data were collected by interviewer administered pre-tested semi-structured questionnaire. The procedure was that first one assistant data collector was recruited on the basis of his educational background and his skills in the local language and familiarity of the study site/area. Brief training was given to him for a day. Then, after giving proper and adequate orientation and then getting consent of each of the sample of the study population, the assistant data collector accompanied the investigator during data collection and gave help when necessary. The investigator interviewed each of the selected samples and filled-out the questionnaire while interviewing the study subjects/selected samples. This was done by house to house interview of selected samples with the assistant.

The respondents were encouraged to give their response based on their attitudes, experience, know-how etc of the issues into consideration in the request in the questionnaire. Then, the filled out questionnaires were collected by the investigator and the assistant data collector for the next analysis. Data collection was conducted for 20 days from December/ 2013 to January/2014. Living in the kebele outside the town, or around the town, and those who have lived at least for two years in the kebele were inclusion criteria whereas residents whose age was less than 20 years and who were unable to communicate were exclusion criteria which were used in randomly selecting respondents. This was assumed to get reliable data.

3.4.3. **Focus Group Discussion (FGD)**

For Focus Group Discussion (FGD), participants were selected purposively from key concerned bodies by contacting with the concerned bodies or individuals. Accordingly, three from kebele dwellers, one from developmental agent of the kebele/district, two from agricultural sector office and manager of the kebele were included. The discussion was guided and facilitated by the investigator based on pre-prepared questions for FGD. It was conducted at convenient place in Sokoru secondary and preparatory school with the permission of the school principal after getting prior consent of each participant in February/2013 with estimated duration of one hour discussion. During the FGD, the investigator recorded the agreed points of the participants following their conditions on each question while guiding and facilitating the discussion.

3.5. **Population**

3.5.1. **Source population**

The source population for this study was all inhabitants of Yerosokoru kebele who were living outside Sokoru town and also who were living around Sokoru town

3.5.2. **Study population**

The study populations were inhabitants of Yerosokoru kebele who were living outside Sokoru town and also who were living around Sokoru town and who were selected randomly from the source population.

3.6. **Data Analysis**

The collected data were checked and edited for completeness before the analysis. The collected data were analyzed using SPSS version 16 computer software programme. Descriptive statistics was also used to analyze both field and questionnaire data. The data were presented using tables, graphs and charts by applying excel computer program to draw graphs. Additionally, responses were compared using chi-square test and one-way ANOVA.

3.7. **Ethical Considerations**

The proposal was approved by ethical review committee of Jimma University. Then, formal letter was written to Sokoru district administrator from Jimma University that requested to get their cooperation to allow the investigator to conduct research in Yerosokoru kebele of the district. Then, Sokoru district administrator wrote another letter to the kebele administrator of Yerosokoru. The respondents were informed that they had the right to withdraw from the study at any time. To ensure anonymity and confidentiality the participants name were not written on the questionnaire. Additionally, they were informed that their response /data were used only for the intended research purpose but not for anything else without their will.

Regarding the primates in the field study, no animal was handled and also harmed or killed by any means related to this study. The ethics for wildlife was also followed here.

4. RESULTS

4.1. Field Survey

4.1.1. Primate species identified in the study area

In the study area, four primate species were observed and identified during the study period in both dry season (DS) and wet season (WS) (Table1). Four groups were also observed for both Anubis baboon and colobus monkey but two groups were observed for vervet monkey and blue monkey in the study area during both seasons (Table1).

Table 1: Primate Species and their groups observed and identified in dry and wet seasons

Local name	Common name	Scientific name	Habitat	Seasons	No. groups
Daljesa	Anubis baboon	*Papio anubis*	FL ,FF	DS, WS	4
Qamale	Vervet monkey	*Chlorocebus aethiops*	AHS, FL	DS, WS	2
Weni	Colobus monkey	*Colobus guereza*	FF	DS, WS	4
Cheno	Blue monkey	*Cercopithecus mitis*	FF	DS, WS	2

Remarks: FL = Farmland; FF = Fragmented forest; AHS = Around human settlement area; DS = Dry Season; WS = Wet Season

4.1.2. Average group size of primates per season in the study area

The average group size of Anubis baboon was 45.6$\pm$17.22, and 50.93$\pm$21.04 for dry and wet seasons respectively (Table 2). For vervet monkey, the average group size was 64.15$\pm$16.03, and 69.3$\pm$17.04 for dry and wet season respectively (Table 2). There was no significant difference in the number of individuals recorded for each group of primate species with respect to seasons but there was significant difference in the number of individuals between groups for both seasons for Anubis baboon ($F_{(3,76)} = 56.57$, $P < 0.05$ between groups of Anubis baboon; $F_{(3,36)} = 20.85$, $P < 0.05$ in wet season and $F_{(3,36)} = 52.05$, $P < 0.05$ in dry seasons) and for vervet monkey ($F_{(1,18)} = 48.94$, $P < 0.05$ in wet season and $F_{(1,18)} = 70.87$, $P < 0.05$ in dry seasons).

Table 2: Average group size of primates per season in the study area (Mean ± SD)

Primate species	Seasons	Group -1	Group -2	Group -3	Group - 4	Total (mean)
Anubis baboon	DS	36.8 ± 4.78	25.1 ± 5.51	59.2 ± 9.96	61.3 ± 9.25	45.6 ± 17.22
	WS	41.5 ± 7.62	28.6 ± 5.91	65.2 ±16.84	68.4 ± 18.04	50.93 ± 21.04
Vervet monkey	DS	78.1 ± 7.28	50.2± 7.54	-	-	64.15± 16.03
	WS	83.5 ± 9.90	55.1± 8.17	-	-	69.3 ± 17.04
Colobus monkey	DS	13 ± 1.33	9.3 ± 1.42	10.5 ± 1.65	7.4 ± 1.58	10.05 ± 2.51
	WS	13.2 ± 1.48	9.3 ± 1.42	10.5 ± 1.58	7.8 ± 1.14	10.2 ± 2.42
Blue monkey	DS	7.7± 2.98	4.6 ± 1.17	-	-	6.15 ± 2.72
	WS	8.2 ± 2.57	5.0 ± 1.15	-	-	6.6 ± 2.54

Remarks: DS = Dry Season; WS = Wet Season; SD = Standard Deviation

4.1.3. **Age distribution of primate species**

In Anubis baboon (*Papio anubis)*, adults accounted for the least proportion in both seasons (19.41%±3.35 in DS and 20.43%±3.96 in WS) while the juvenile accounted for 43.37%±7.65 in DS and 43% ± 8.20 in WS but in the case of blue monkey (*Cercopithecus mitis)*, adults accounted for the largest proportion (43.09%±0.92 in DS and 43.93%±0.99 in WS) while juveniles accounted for 27.64% ± 0.57 in DS and 26.52% ± 0.64 in WS (Table 3).

The proportion of juveniles was the smallest in colobus monkey (*Colobus guereza)* compared to the other primates in both seasons (22.89% ± 0.58 in DS and 23.03% ± 0.62 in WS) (Table 3). The age composition of Anubis baboon was insignificant with respect to seasons ($F_{(1,78)} = 3.23$, $P > 0.05$ for adults; $F_{(1,78)} = 1.01$, $P > 0.05$ for sub-adults and $F_{(1,78)} = 1.31$, $P > 0.05$ for juveniles).

Table 3: Percentage of mean population composition (age) of primate species in the study area

Primate species	Seasons	Species population composition(age), (%Mean ±SD)		
		Adult	Sub- adult	Juvenile
Anubis baboon	DS	19.41± 3.35	37.22 ± 6.60	43.37± 7.65
	WS	20.43 ± 3.96	36.57 ± 6.96	43 ± 8.20
Vervet monkey	DS	30.09 ± 5.94	34.61 ± 6.93	35.30 ± 6.86
	WS	31.10 ± 6.29	34.84 ± 7.0	34.05± 6.79
Colobus monkey	DS	37.31 ± 0.89	39.80 ± 0.88	22.89± 0.58
	WS	38 ± 0.85	38.97± 0.82	23.03± 0.62
Blue monkey	DS	43.09 ± 0.92	29.27± 0.71	27.64± 0.57
	WS	43.93± 0.99	29.55± 0.64	26.52 ± 0.64

Remarks: DS = Dry Season; WS = Wet Season; SD = Standard Deviation

The age composition of Anubis baboon was significant with respect to mean total number of individuals recorded in both seasons ($F_{(3,76)} = 49.85$, $P < 0.05$ for adults ; $F_{(3,76)} = 58.57$, $P < 0.05$ for sub-adults and $F_{(3,76)} = 56.13$, $P < 0.05$ for juveniles) and it was also significant with respect to groups in each seasons ($F_{(3,36)} = 21.07$, $P < 0.05$ for adults ; $F_{(3,36)} = 21.0$, $P < 0.05$ for sub-adults and $F_{(3,36)} = 21.07$, $P < 0.05$ for juveniles in wet seasons and $F_{(3,36)} = 47.45$, $P < 0.05$ for adults ; $F_{(3,36)} = 51.32$, $P < 0.05$ for sub-adults and $F_{(3,36)} = 52.66$, $P < 0.05$ for juveniles in dry seasons).

The age composition of vervet monkey was insignificant with respect to seasons ($F_{(1, 38)} = 1.92$, $P > 0.05$ for adults; $F_{(1, 38)} = 1.14$, $P > 0.05$ for sub-adults and $F_{(1, 38)} = 0.28$, $P > 0.05$ for juveniles). But it was significant with respect to groups in each season ($F_{(1,18)} = 46.63$, $P < 0.05$ for adults ; $F_{(1,18)} = 48.33$, $P < 0.05$ for sub-adults and $F_{(1,18)} = 49.97$, $P < 0.05$ for juveniles in wet seasons and $F_{(1,18)} = 63.89$, $P < 0.05$ for adults ; $F_{(1,18)} = 72.64$, $P < 0.05$ for sub –adults and $F_{(1,18)} = 71.70$, $P < 0.05$ for juveniles in dry seasons, respectively).

4.1.4. **Abundance of primates in the study area**

The abundance of Anubis baboon (*Papio anubis**)*** was found to be the highest among the primate species in both seasons (18.24 in DS and 20.37 individuals in WS) and then followed by vervet monkey (*Chlorocebus aethiops)* (12.83 in DS and 13.86 individuals in WS) but it was the smallest for blue monkey (*Cercopithecus mitis)* (1.23 in DS and 1.32 individuals in WS) (Table 4). There was significance difference in the mean abundance among the primate species in the study area in both dry and wet seasons ($F_{(3,116)} = 139.72$, $P < 0.05$ in DS and $F_{(3,116)} = 123.55$, $P < 0.05$ in WS).

Anubis baboon was the most abundant species (51% in WS and 50.22% in DS) with the highest mean total number of individuals recorded in both seasons in the study area (203.7$\pm$ 21.04 in WS and 182.4$\pm$17.22 in DS) while blue monkey was the least abundant species (3.33% in WS and 3.60% in DS) with the smallest mean total number of individuals recorded in both seasons (13.2 $\pm$2.54 in WS and 12.3$\pm$2.72 in DS) (Table 4). Generally, relatively more number of individuals was recorded in wet season (396.3$\pm$28.47) than the dry season (363.2$\pm$25.89**)** in the study area (Table 4). There was no significant difference with regard to mean total number of individuals recorded with respect to seasons for Anubis baboon (*Papio anubis**)*** ($F_{(1, 78)} = 1.54$, $P > 0.05$) and vervet monkey (*Chlorocebus aethiops)* ($F_{(1, 38)} = 0.97$, $P > 0.05$).

Table 4: Total number of individuals recorded, abundance and percentage of primates

Primate species	Seasons	Total number recorded (Mean± SD)	Abundance	Percentage (%)
Anubis baboon	DS	182.4 ± 17.22	18.24	50.22
	WS	203.7 ± 21.04	20.37	51.40
Vervet monkey	DS	128.3 ± 16.03	12.83	35.32
	WS	138.6 ± 17.04	13.86	34.97
Colobus monkey	DS	40.2 ± 2.51	4.02	11.05
	WS	40.8 ± 2.42	4.08	10.30
Blue monkey	DS	12.3 ± 2.72	1.23	3.60
	WS	13.2 ± 2.54	1.32	3.33
Total	DS	363.2 ± 25.89	36.32	100
	WS	396.3 ± 28.47	39.63	100

Remarks: DS = Dry Season; WS = Wet Season; SD = Standard Deviation

4.1.4.1. **Percentage of Relative Abundance of primates per habitats**

The relative abundance of Anubis baboon was higher in fragmented forest (51.64 % in DS and 52.72 % in WS) than farmland (48.36 % in DS and 47.28 % in WS) during both seasons. But, vervet monkey had relative abundance higher AHS during both seasons (76.38 % in DS and 71% in WS) than farmland (23.62 % in DS and 29 % in WS). Colobus monkey and blue monkey were 100% restricted in the fragmented forest habitats in both seasons (Table 5).

Table 5: Percentage of relative abundance of primate species per habitats per seasons

Primate species	Seasons	Relative abundance		
		AHS	Farmland	Fragmented forest
Anubis baboon	DS	-	48.36	51.64
	WS	-	47.28	52.72
Vervet monkey	DS	76.38	23.62	-
	WS	71	29	-
Colobus monkey	DS	-	-	100
	WS	-	-	100
Blue monkey	DS	-	-	100
	WS	-	-	100

Remarks: DS = Dry Season; WS = Wet Season; AHS = Around human settlement areas

The abundance of Anubis baboon was found to be higher in fragmented forests in both seasons (31.40 individuals in DS and 35.80 individuals in WS) whereas the abundance of vervet monkey was higher around human settlement area **(**49 individuals in DS and 49.2 individuals in WS**)** in both seasons. On farmland, the abundance of Anubis baboon and vervet monkey was small in both seasons (Table 6). The abundance of blue monkey was the smallest in both seasons in the fragmented forest (4.10 individuals in DS and 4.40 individuals in WS) (Table 6). In the study area, the abundance of species of primates was the highest in fragmented forest in WS (53.80 individuals) and the least on farmland in WS (27.30 individuals).

In the dry season (DS), the abundance of primates was found to be almost equal and higher in both AHS and fragmented forest habitats (49 individuals). But, the abundance of primates was less on farmland in dry season too (Table 6). In terms of mean total number of organisms recorded per habitats, fragmented forest was the first in both seasons (40.39% in DS and 40.73% in WS) but AHS was the least in both seasons (26.98% in DS and 24.83% in WS).

Table 6: Mean total number of individuals of species recorded per habitats and their abundance in the study area in both seasons (DS = dry Season and WS = Wet Season) in each habitat

Primate species	Seasons	Total number recorded (Mean ±SD)			Abundance			
		AHS	FL	FF	AHS	FL	FF	Total
Anubis baboon	DS	-	88.2 ± 8.4	94.2 ± 8.7	-	17.64	31.40	18.24
	WS	-	96.3 ± 9.3	107.4 ±11.2	-	19.26	35.80	20.37
Vervet monkey	DS	98 ± 8.9	30.3 ± 6.2	-	49	6.06	-	12.83
	WS	98.4 ± 9.8	40.2 ±5.9	-	49.2	8.04	-	13.86
Colobus monkey	DS	-	-	40.2 ±2.51	-	-	13.40	4.02
	WS	-	-	40.8 ±2.42	-	-	13.60	4.08
Blue monkey	DS	-	-	12.30 ±2.72	-	-	4.10	1.23
	WS	-	-	13.2 ±2.54	-	-	4.40	1.32
Total	DS	98 ±8.9	118.5±11.7	146.7 ±10.4	49	23.70	48.90	36.32
	WS	98.4 ±9.8	136.5± 10.8	161.4 ±13.6	49.2	27.30	53.80	39.63
Percentage	DS	26.98	32.60	40.39				
	WS	24.83	34.44	40.73				

SD = Standard Deviation; AHS = Around human settlement areas; FL = Farmland;

FF = Fragmented forest

4.1.5. **Distribution of primate species observed and identified in the study area**

No primate species was found distributed in all the three habitats. Colobus monkey and blue monkey were 100% confined in the fragmented forest. But, Anubis baboon was found distributed on farmland and fragmented forest whereas vervet monkey was distributed on farmland and AHS in both seasons during the study period.

4.2. **Results of Questionnaire Survey**

4.2.1. **Socio-demographic characteristics of Respondents**

Among the study participants, 49.79% (n =121) were in the age range of 20 – 35 while age groups 36 – 50 , 51 – 65 , and greater than 65 comprised 36.21% (n = 88), 10.71% (n = 26) and 3.29% (n = 8) of the study participants respectively. Of the respondents, males comprised 78.19% (n = 190) while females constituted 21.81% (n = 53) (Table 7).

From the study participants, 56.79% (n = 138) were not educated whereas 8.65% (n = 21) of the respondents were with educational level of secondary school (9 – 10). Majority of the study participants, (86%, n = 209) had farming as their main occupation while only 5.35% (n = 13) of the respondents were government workers. Moreover, as the respondents replied, 68% (n = 165) of the respondents had total number of children greater or equal to four (> = 4) per family (Table 7).

Table 7: Socio-demographic characteristics of Respondents, N = 243

Characteristics /Variables	Frequency	Percentage (%)
Age groups(243)		
20 – 35	121	49.79
36 - 50	88	36.21
51 - 65	26	10.70
>65	8	3.29
Sex (243)		
Males	190	78.19
Females	53	21.81
Educational Status (243)		
Not educated	138	56.79
Can read and write	8	3.29
Grade 1 – 8	76	31.27
Grade 9 – 10	21	8.65
Main occupation(243)		
Farming	209	86.01
Private work	21	8.64
Civil Servant	13	5.35
Family size/ (No. children / family		
0 - 3	78	32.10
4 - 6	106	43.62
7 - 9	53	21.81
>= 10	6	2.47

N = total number of respondents

4.2.2. **Respondents' Response on Issues related to human-primates conflict**

4.2.2.1. **Main crops produced and storage areas in the study area**

The five main crops produced on the farmland were maize (100%, n = 209), tef (100%, n = 209), sorghum (85.85%, n = 179), wheat (64.12%, n = 134) and barley (57.42% n = 120) as the respondents replied (Table 8). Majority of the respondents (96.65%, n = 202) replied that they store their crops around house areas while only 3.35% (n = 7) of the respondents store their crops on farmland (Table 8). These farmland areas were found near to human settlements with no more doubt of primates' attack as they explained.

Table 8: Main crops produced and where crops are stored, N= 209

Variables	Frequency	Percentage (%)
Main crops produced (209)		
Maize (*Zea mays*)	209	100
Tef (*Eragrostis tef*)	209	100
Sorghum (*Sorghum bicolor*)	179	85.65
Wheat (*Triticum spp*.)	134	64.12
Barley (*Hordeum vulgare*)	120	57.42
Other(beans, peas,)	19	9.09
Places where crops are stored(209)		
Around house areas	202	96.65
On farmland	7	3.35

N = total number of respondents

4.2.2.2. **Types of fruit trees and other crops found in the study area**

According to the respondents' response, 89.30% (n = 217) of the respondents replied that they had fruit trees in their garden, whereas 5.35 % (n = 13) of the respondents had fruit trees on farmland and both in the garden and farmland, respectively.

As the respondents replied, avocado (*Persea americana*) (97.94%, n = 238) and mango (*Manifera indica*) (95.06%, n = 231) were the most predominated fruit trees found in the area whereas orange (*Citrus spp*.) and guava (*Psidium guajava*) (26.34%, n = 64) were fruit trees owned by some of the respondents. Other crops found in the garden include coffee plant, enset, yam /taro and sugar cane with the respondents' response proportion of 82.71% (n = 201), 75.72% (n = 184), 48.14% (n = 117) and 31.28% (n = 70), respectively.

4.2.2.3. **Frequency of crop harvest and amount of crop produced per year**

According to the respondents' response, 96.17% (n = 201) of the respondents harvest their crop once in a year and only 3.83% (n = 8) of the respondents replied that they harvest crops twice per year. Interview with agricultural sector of the district showed that in most of the areas of the district commonly crop harvest is performed once in a year.

Respondents reported that, among the main crops, between 16 and 20 quintals of maize /hectare/year was harvested quantity (n = 33, 15.79%) whereas between 6 and 10 quintals of maize/ hectare/year was commonly harvested quantity (n = 124, 59.33%). On average, 10.82 quintals of maize was produced/hectare/year based on the collected data (Table 9). Annually, 11 – 15 quintals of tef was produced /hectare /year (n = 7, 3.35%) while between 1 and 5 quintals of tef was commonly produced /hectare/year (n = 128, 61.24%). On average, annually 5.11 quintals of tef was produced/hectare/year based on the collected data (Table 9).

Concerning sorghum production, 11 – 15 quintals (n = 25, 13.97%), and 1 – 5 quintals (n = 98, 54.75%) were estimated as annual product per hectare. On average, 5.96 quintals per hectare was obtained by calculation as the annual estimated amount of product. Wheat crop production was also estimated as 6 – 10 quintals per hectare/year (n = 29, 21.64%) and 1 – 5 quintals per hectare/year (n = 75, 55.97%) were produced and on average, annually 4.39 quintals of wheat was produced / hectare /year (Table 9).

Only 104 (77.61%) of the respondents were able to estimate the annual product of wheat they produce per hectare but others were unable to give their estimate one reason was that since they produce wheat on a very small scale on the piece of land they owned by dividing the area for other main crops, and thus, difficult to estimate the product in quintals per hectare as they explained. On average, 4.39 quintals of wheat was produced/ hectare/year. On average, 4.33 quintals of barley was produced / hectare/year (Table 9).

Table 9: Annual estimated product of main crops produced on the farmland per crop type per hectare in quintals by the respondents, N= 209

Crop Types Produced	Frequency of products produced per crop type/ quintal/hectare and %								
	1 – 5	%	6 – 10	%	11- 15	%	16 – 20	%	AV.
Maize	-	-	124	59.33	52	24.88	33	15.79	10.82
Tef	128	61.24	74	35.41	7	3.35	-	-	5.11
Sorghum	98	54.75	56	31.28	25	13.97	-	-	5.96
Wheat	75	55.97	29	21.64	-	-	-	-	4.39
Barley	56	46.67	32	26.67	-	-	-	-	4.33

Remark: AV = average; N = total number of respondents

4.2.2.4. **Primates found in the study area**

As 100% (n = 243) of the respondents replied primates are found in the study area. Anubis baboon, vervet monkey, and colobus monkey are the common primates in the study area. Other primate type commonly named blue monkeys are also recognized by some of the respondents (n = 52, 21.40%).

4.2.2.5. **Rank of primates in their commonness and affecting crops**

Anubis baboon (*Papio anubis*) (n = 227, 93.42%), vervet monkey (*Chlorocebus aethiops)* (n = 227, 93.42%), colobus monkey (*Colobus guereza*) (n=243,100%) and blue monkey (*Cercopithecus mitis*) (n=52, 21.40%) were first, second, third, and fourth ranked common primates in the study area, respectively as said by the respondents (Table 10).

On the subject of crop attack, the respondents replied that Anubis baboon (*Papio anubis*) (n = 210, 86.42%), vervet monkey (*Chlorocebus aethiops)* (n = 210, 86.42%) and very rarely blue monkey (*Cercopithecus mitis*) (n = 8, 3.29%) were considered as the first, second and rarely third ranked in attacking crops, respectively (Table 10). But, the respondents vigorously emphasized crop attacking and other impacts of the first two primates. There was a significance difference in attacking crops among the identified primates (X^2 (4) = 547.29, P < 0.05). Anubis baboon and vervet monkey were serious pest primates than the rest.

Table10: Respondents' response on the ranks of primates' commonness and affecting crops

Variables	Frequency of response				Percentage (%)			
	AB	VM	CM	BM	AB	VM	CM	BM
Commonness rank of primates in the area								
1 (First)	227	16	-	-	93.42	6.58	-	-
2 (Second)	16	227	-	-	6.58	93.42	-	-
3 (Third)	-	-	243	-	-	-	100	-
4 (Fourth)	-	-	-	52	-	-	-	21.40
Rank of primates that affect crops (243)								
1 (First)	210	33	-	-	86.42	13.58	-	-
2 (Second)	33	210	-	-	13.58	86.42	-	-
3 (Third)	-	-	-	8	-	-	-	3.29

Remarks: AB= Anubis baboon; VM = Vervet monkey; CM = Colobus monkey; BM = Blue monkey; N = total number of respondents; N = 243

Anubis baboon affect crops on farmland (100%, n = 243), around human settlement areas (AHS) (84.36%, n = 205) and also in the garden (42.39%, n = 103) (Figure 2).

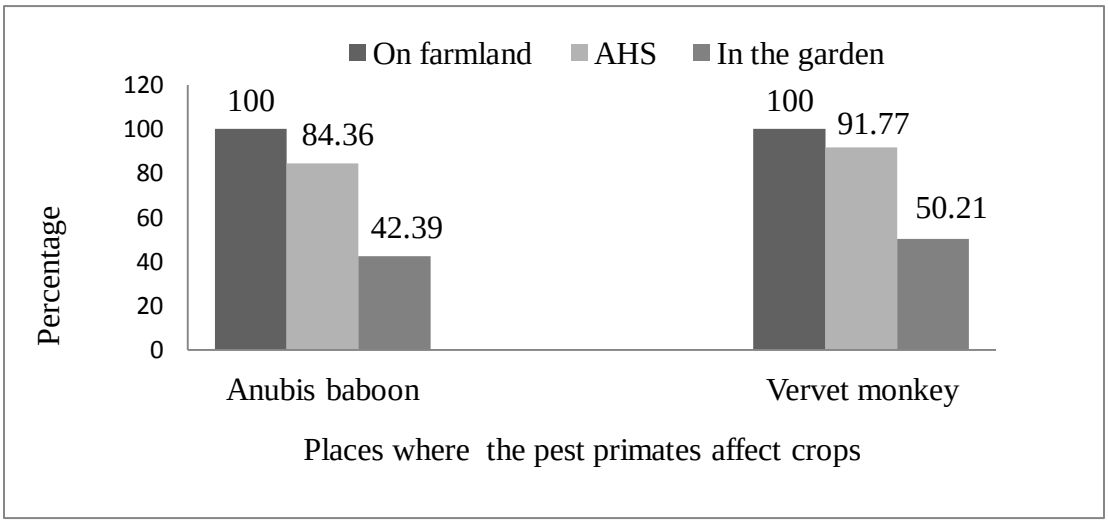

Figure 2. Percentage of respondents' response on areas where pest primates affect crops.

Vervet monkey affect crops on farmland (100%, n = 243), around human settlement areas (91.77%, n = 223) and also in the garden (50.21%, n = 122) (Figure 2). Concerning the overall crop attack in all the three places, as calculated vervet monkey's (*Chlorocebus aethiops)* attack was the first (80.66%, n = 196) followed by Anubis baboon (*Papio anubis*) (75.58%, n = 184) (Figure 2). Places where the pest primates affect crops was not significantly different for both Anubis baboon and vervet monkey (X^2 (2) = 1.20, P > 0.05).

4.2.2.6. **Types and stages of crops mostly affected by pest primates**

Both Anubis baboon (*Papio anubis*) and vervet monkey (*Chlorocebus aethiops)* affect mostly maize and sorghum crops than other crops (100%, n = 243) while wheat was considered as the least affected crop by both pest primates as the respondents reported (93.42%, n = 227 by Anubis baboon and 47.32%, n = 115 by vervet monkey). The crops affected by the pest primates were significantly different among the crops (X^2 (5) = 33.06, P < 0.05).

Anubis baboons affect the seed (mature and immature), stems; seedling, sowed seed and stored grain of maize, tef, sorghum, barley and wheat as the respondents replied (100%, n = 243). They also attack or damage flowers and leaves of tef (100%, n = 243).

Vervet monkeys attack the seed (mature and immature) of maize, tef, sorghum with 100% response rate (n = 243) and seed of barley (mature, 67.08% , n = 163 and immature, 68.72% , n = 167) and seed of wheat crop (mature, 20.99% , n = 51 and immature , 21.81% , n = 53). They attack seedling and sowed seed of maize and sorghum (100%). They also attack flower (100%), stem (87.65%), leaves (87.65%), seedling (55.56%) and stored grain (90.95%) of tef and the stem (83.54%) and stored grain (37.04%) of maize crop. Furthermore, vervet monkeys also attack the seed (mature and immature), stem , seedling , sowed seed and stored grain of sorghum crop (100%) and stem and leaves (77.78%) ,seedling (58.85%) and stored seed (100%) of barley. The stem and leaves (26.75%), seedling (27.98%), sowed seed (32.51%) and stored grain (96.71%) of wheat crop.

4.2.2.7. **Ways by which pest primates affect crops**

The respondents replied that Anubis baboon affect crops by raiding /eating (100%, n = 243), damaging /destructing (100%) and by other ways (62.55%, n = 152) and vervet monkeys affect crops by raiding /eating (100%, n = 243), damaging /destructing (100%) and by other ways like walking and undulating on crops (55.97% n = 136). There was no significance difference among ways of attacking crops by Anubis baboon and vervet monkey (X^2 (2) = 0.68, P > 0.05).

4.2.2.8. **Habitats of the primates and time/season at which pest primates affect crop**

According to the respondents, Anubis baboons were mostly found in the fragmented forest near farmland (100%, n = 243) while vervet monkeys were mostly found around human settlement areas (97.94%, n = 238) (Table 11).

Table 11: Respondents' response on places where the pest primates are found, N = 243

Habitats	Anubis baboon		Vervet monkey	
	Frequency	Percentage	Frequency	Percentage
Places where the pest primates are found (usually) (N =243)				
In the fragmented forest near FL	243	100	98	40.33
On farmland (FL)	105	43.21	103	42.37
Around Human settlement areas	35	14.40	238	97.94

N = total number of respondents

As the respondents replied, Anubis baboons attack crop the most the whole day during cropping time (55.56%, n = 136), and the least in morning (16.05%, n = 39) (Figure 3). Vervet monkeys attack crop the most the whole day during the cropping time (n = 125, 51.44%) and the least in the morning (15.23%, n = 37) (Figure 3). However, the day time of crop attack by the Anubis baboons and vervet monkeys was not significantly different (X^2 (3) = 0.08, P > 0.05).

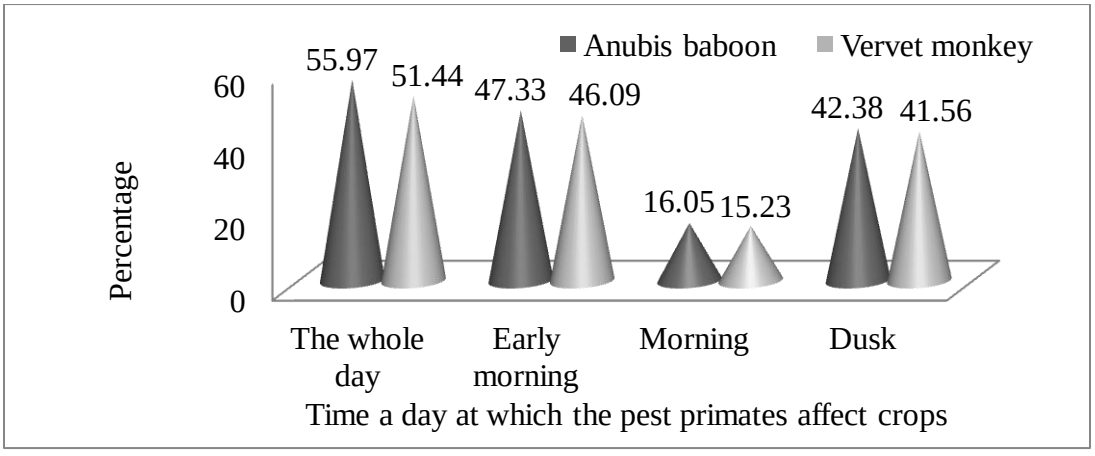

Figure 3. Percentage of respondents' response on time at which pest primates affect crops.

According to the respondents, the pest primates attack crops commonly from April to December (100%, n = 243) and May to November (100%, n = 243). These were the common cropping time in the study area. This was confirmed from the district agriculture department. The pest primates also attack crops from March to May (Anubis baboons, 6.99%, n = 17 and vervet monkeys, 7.41%, n = 18) and in all months or seasons (Anubis baboons, 6.17%, n = 15 and vervet monkeys, 7.41%, n = 18). The season /months at which the pest primates affect crops was not significantly different (X^2 (3) = 0.29, P > 0.05).

4.2.2.9. **Estimated annual crop loss by the pest primates**

The estimated annual crop loss of maize in quintals per hectare was estimated 5 quintals loss per hectare (35.74%, n = 84, by Anubis baboons and 28.94%, n = 68, by vervet monkeys), and 1 quintal loss per hectare (7.66%, n = 18, by Anubis baboons and 7.60%, n = 18, by vervet monkeys) as the highest and the lowest loss estimated by the respondents, respectively (Table 12). On average, the estimated annual loss by Anubis baboons and vervet monkeys was calculated and estimated by using the estimated mean product produced in quintals per hectare for each crop types (main crops) (Table 9) and estimated loss in quintals per hectare by each pest primates per year per crop type (Table 12). Then, the estimated annual loss percentage was calculated. Accordingly, the estimated average loss was 3.41 quintals loss per hectare (31.52% loss on average) and 3.24 quintals loss per hectare (29.94% loss on average) for Anubis baboons and vervet monkeys, correspondingly (Table 12).

As the respondents replied, 2 quintals loss per hectare (27.13%, n = 67) and 1 quintal loss per hectare (70.87%, n = 163) by Anubis baboons and 2 quintals loss per hectare (6.52%, n = 15) and 1 quintal loss per hectare (93.48%, n = 215) by vervet monkeys was estimated as annual loss of tef. The percentage calculation was done by considering the respondents that actually gave their responses for the loss estimates of each crop type by each pest primate type per hectare per quintals. Thus, the calculated and estimated average tef crop loss in quintals per hectare for Anubis baboons and vervet monkeys was 1.29 quintals loss per hectare (25.24% loss) and 1.07 quintals loss per hectare (n = 20.94% loss), respectively (Table 12).

As indicated in the table (Table 12), the estimated annual crop loss for sorghum was 3 quintals loss per hectare (2.66%, n = 5, by Anubis baboons and 1.60%, n = 3, by vervet monkeys), and 1 quintal loss per hectare (59.57%, n = 112, by Anubis baboons and 67.02%, n = 126, by vervet monkeys) as the highest and lowest loss estimated by the respondents. On average, the calculated and estimated annual loss for sorghum crop was 1.43 quintals loss per hectare (23.99 % loss) and 1.35 quintals loss per hectare (22.65% loss) by Anubis baboons and vervet monkeys, correspondingly.

In the case of barley, the estimated loss was 2 quintals loss per hectare (11.93 %, n = 13) and 1 quintal loss per hectare (88.07 %, n = 96) by Anubis baboons and 2 quintals loss per hectare (15.57 %, n = 17) and 1 quintal loss per hectare (84.43 %, n = 92) by vervet monkeys, respectively. On average 1.12 quintals loss per hectare (25.87 % loss) by Anubis baboons and 1.16 quintals loss per hectare (26.79 % loss) by vervet monkeys was estimated. Similarly, for wheat, the estimated annual loss was 3 quintals loss per hectare (6.59%, n = 6), 2 quintals loss per hectare (13.19 %, n = 12) and 1 quintal loss per hectare (80.22%, n =73) by Anubis baboons and 3 quintals loss per hectare (1.10 %, n = 1) , 2 quintals loss per hectare (20.88 %, n = 19) and 1 quintal loss per hectare (78.02 %, n = 71) by vervet monkeys respectively as the respondents replied (Table12). Moreover, on average, 1.29 quintals loss per hectare (29.38 % loss) by Anubis baboons and 1.23 quintals loss per hectare (28.02% loss) by vervet monkey was estimated (Table 12).

Table 12: Respondents' response on annual crop loss estimates of the product per crop type by each pest primates in quintals per hectare, N= 243, N = total number of respondents

Crop Type	Pest primates		Estimated annual crop loss per crop type/ quintals / hectare							
			1	2	3	4	5	Total	Total loss	Average loss
Maize	Anubis baboon	Freq.	18	44	78	11	84	235	804	3.41
		%	7.66	18.72	33.19	4.68	35.74	100	761	31.52
	Vervet monkey	Freq.	25	65	62	15	68	235		3.24
		%	10.64	27.66	26.38	6.38	28.94	100		29.94
Tef	Anubis baboon	Freq.	163	67	-	-	-	230	297	1.29
		%	70.87	27.13	-	-	-	100	245	25.24
	Vervet monkey	Freq.	215	15	-	-	-	230		1.07
		%	93.48	6.52	-	-	-	100		20.94
Sorghum	Anubis baboon	Freq.	112	71	5	-	-	188	269	1.43
		%	59.57	37.77	2.66	-	-	100	253	23.99
	Vervet monkey	Freq.	126	59	3	-	-	188		1.35
		%	67.02	31.38	1.65	-	-	100		22.65
Barley	Anubis	Freq.	96	13	-	-	-	109	122	1.12
	baboon	%	88.07	11.93	-	-	-	100		25.87
	Vervet	Freq.	92	17	-	-	-	109	126	1.16
	monkey	%	84.43	15.57	-	-	-	100		26.79
Wheat	Anubis	Freq.	73	12	6	-	-	91	117	1.29
	baboon	%	80.22	13.19	6.59	-	-	100		29.38
	Vervet	Freq.	71	19	1	-	-	91	112	1.23
	monkey	%	78.02	20.88	1.10	-	-	100		28.02

As shown in the table below (Table 13), the estimated mean product of maize was found to be the highest (10.82 quintals /hectare/year) while that of barley was estimated and found to be the least (4.33 quintals /hectare/year). But, the overall mean for the five crops in the table was estimated and calculated to be 6.12quintals /hectare/year (Table 13).

The estimated mean crop loss by Anubis baboon and vervet monkey was the highest on maize (3.41 and 3.24 quintals loss per hectare per year by Anubis baboon and vervet monkey, respectively) and the least on barley for Anubis baboon (1.12 quintals loss per hectare per year) and the least on tef for vervet monkey (1.07 quintals loss per hectare per year) (Table13). The estimated overall mean crop loss was 1.71 quintals loss per hectare per year with 27.49 % loss by Anubis baboon and 1.61 quintals loss per hectare per year with 26.31% loss by vervet monkey (Table 13). The estimated loss of crops by the pest primates for the five major crops mentioned and between the two pest primates was insignificant (X^2 (4) = 0, P > 0.05).

Table 13: Estimated mean crop produced in quintals per hectare per crop type per year and mean crop loss by Anubis baboon and Vervet monkey based on the respondents'response

		Estimated Crop loss			
		Anubis baboon		Vervet monkey	
CP	EMCP/Q/H/CY/Y	EACMCL	%CL	EACMCL	%CL
Maize	10.82	3.41	31.52	3.24	29.94
Tef	5.11	1.29	25.24	1.07	20.94
Sorghum	5.96	1.43	23.99	1.35	22.65
Barley	4.33	1.12	25.87	1.16	26.79
Wheat	4.39	1.29	29.38	1.23	28.02
OAM	**6.12**	**1.71**	**27.94**	**1.61**	**26.31**

Remarks: EMCP/Q/H/CY/Y = Estimated Mean Crop Produced in Quintals per Hectare per Crop type per year; EACMCL= Estimated and Calculated Mean crop Loss; % CL= percentage of crop loss; OAM = Overall mean; CP = Crop types; N = total number of respondents = 243

4.2.2.10. **Negative Impacts of pest primates other than crop raiding**

Anubis baboon and vervet monkey resulted social problems (to send children to school due to staying the whole day keeping crop on farmland) and problem to participate on social affairs like funeral, disease, "idir", etc and also on meetings due to crop protection from wild animals (100 % by Anubis baboon and 97.53 % by vervet monkey) (Table 14).

In the same table (Table 14) the respondents replied that , economic problem due to crop loss, exposure to causes of various diseases and thus, expense for medication and impact on productivity, and due to restriction on doing other income generating activities (100 % by both pest primates). Destructing /damaging and eating vegetables, fruits and other crops in the garden (100% by both pest primates) were other negative impacts due to the pest primates. Attacking, hunting, killing and eating of goats and sheep. Even calves are being eaten by Anubis baboons mainly during post harvest time (96.71%, n = 235) as the respondents' replied (Table 14).

Intimidating mainly children and women by Anubis baboons was the other negative impact. Now, the pest primates also started to fight / intimidate adult men as the respondents replied (96.71%, n = 235 by Anubis baboon and 6.17%, n = 15 by vervet monkey), respectively. Keeping crop (single activity) for longer time since time of sowing till harvest time (about six months in the farm area) was also indicated as the other negative impacts of the pest primates in addition to impact on crops attack (94.65% , n = 230, by both pest primates) (Table 14).

Psychological problem-developing the sense of having no solution and also developing losing hope in that, nobody hears and tries to solve this existing and exacerbating issue of the community (89.30%, n = 217) (Table 14). Developing fear in that the pest primates might go to eat children in the future if nothing is done and also intimidating adult men too (82.72 % , n = 201 , by Anubis baboon and 34.98 % , n = 85, by vervet monkey) were also the other impacts mentioned (Table14).

Table 14: Respondents' response on other impacts of pest primates in addition to crop attack

S.No.	Impacts (Negative)	Anubis baboon		Vervet monkey	
		Frequency	Percentage	Frequency	Percentage
1	Social problem to send children to school due to parents staying the whole day keeping crops on farmland.	243	100	243	100
2	Social problem to participate on social affairs like funeral, disease, "idir",etc and also on meetings due to Primate predation protection.	243	100	237	97.53
3	Economic problem due to crop loss, exposure to causes of various diseases, and due to restriction of doing other income generating activities.	243	100	243	100
4	Destructing/damaging and eating Vegetables, fruits and other crops in the garden.	243	100	243	100
5	Attacking, hunting, killing and eating goats and sheep. Even calves are being eaten by Anubis baboon mainly during post harvest time	235	96.71	-	-

(continued from Table 14)

S.No.	Impacts (Negative)	Anubis baboon		Vervet monkey	
		Frequency	Percentage	Frequency	Percentage
6	Intimidating mainly children and women. Now, they also started to fight /intimidate adult men.	235	96.71	15	6.17
7	Keeping crop (single activity) for longer time since time of sowing till harvest time (about six months in the farm area).	230	94.65	230	94.65
8	Psychological problem-developing the sense of having no solution for the problem rather than struggling with the problem and leading unimproved life due to the lack of attention to this problem of the community. Also, developing losing hope in that nobody hears and tries to solve this existing and exacerbating issue of the community with primates	217	89.30	217	89.30
9	Psychological problem-developing fear in that the primates might go to eat children in the future if nothing is done and also intimidating adult men too.	201	82.72	85	34.98

(continued from Table 14)

S.No.	Impacts (Negative)	Anubis baboon		Vervet monkey	
		Frequency	Percentage	Frequency	Percentage
10	Social problem-in some part of the area necessarily one individual must be at home even in the winter to keep stored crops and others from predation by the primates.	199	81.89	199	81.89
11	Developing the sense of lack of responsibilities from concerned body to realize and trying to give remedy to problem of community	199	81.89	199	81.89
12	Sometimes parental disputes occur when crop predation happens.	193	79.42	193	79.42
13	Hunting, killing and eating chicken.	52	21.40	-	-
14	Sowing and cultivating limited crops types in limited time	14	5.76	14	5.76

The population size of the pest primates (Anubis baboon and Vervet monkey) is increasing from time to time as 100% of the respondents replied (Figure 4).

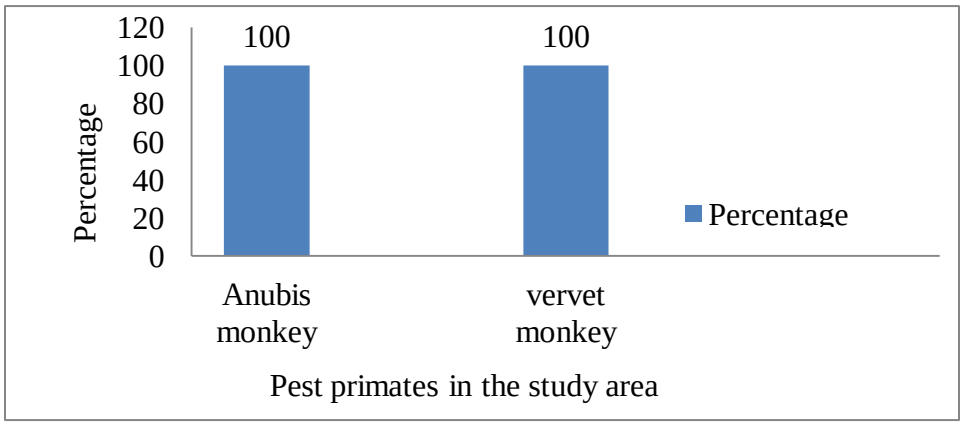

Figure 4. Percentage of respondents' response on the population size of the pest primates from time to time.

As it was indicated in Figure 8, 77.37 % of the respondents replied that the overall impact of the pest primates was very serious while less than 2 % of the respondents replied that the overall impact of the pest primates was not serious but it is tolerable. The overall impact of the pest primates was significantly different among the respondents response (x^2 (5) = 226.84, P < 0.05).

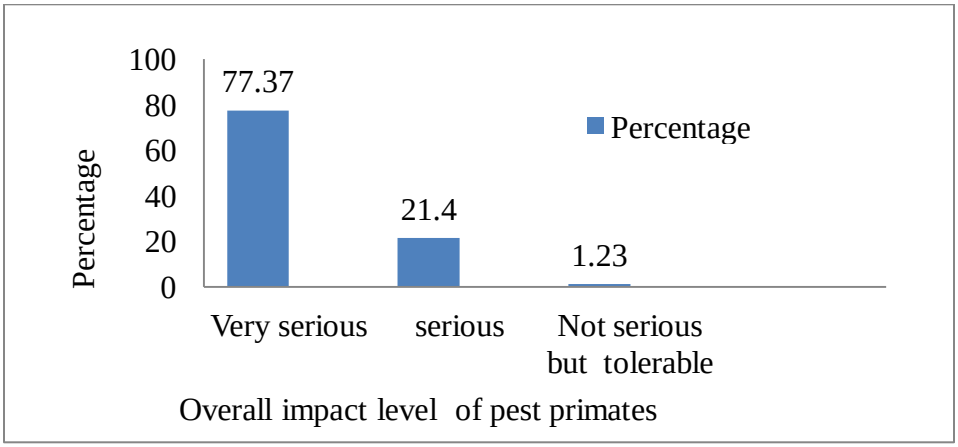

Figure 5. Percentage of respondents' response on the overall impacts of pest primates (Anubis baboon and Vervet monkey) in the study area.

Of the study participants, 73.25 % explained that they had reported to the concerned body/ kebele/agriculture sector of the district regarding the conflict problem while 26.75% did not report (Figure 6).

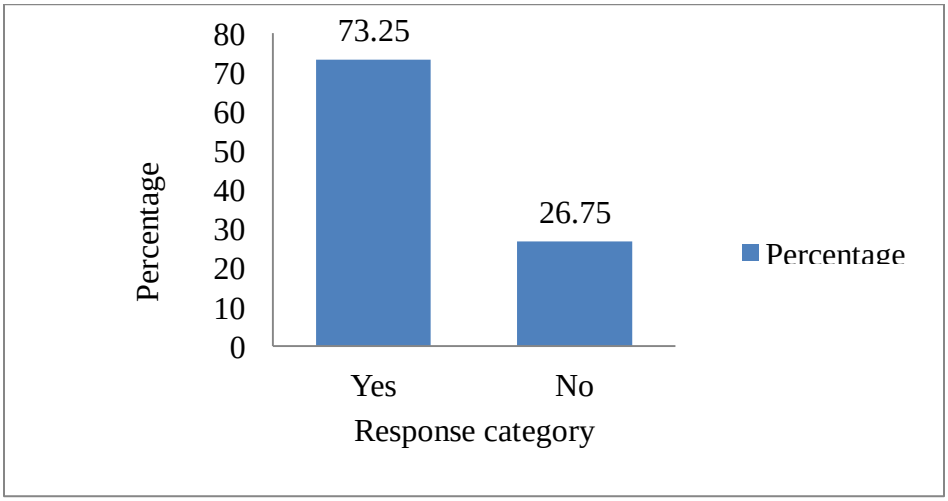

Figure 6. Percentage of respondents' response regarding reporting of the problem to their kebele/district agriculture sector.

As it was indicated in Figure7, even though it had been reported, 80.90% of the respondents replied that no practical solution was given to the conflict problem. Likewise, only < 20 % of the respondents replied that practical solution was given to the conflict problem.

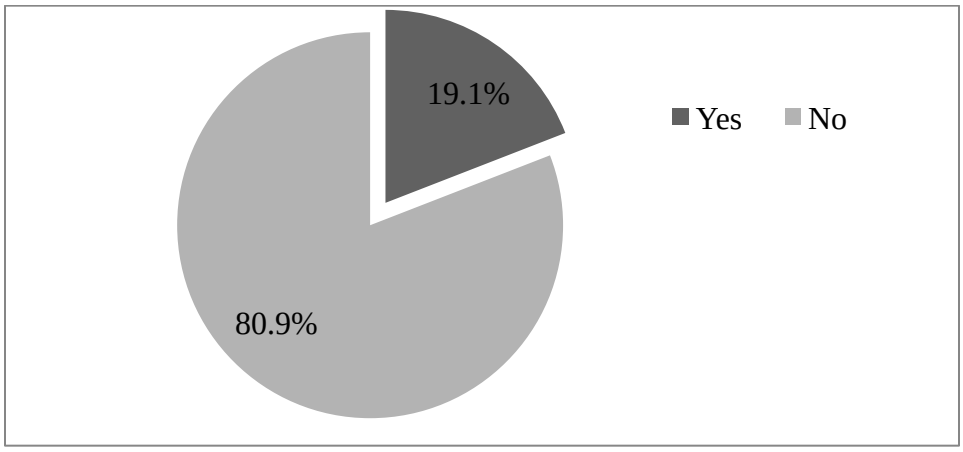

Figure 7. Percentage of respondents' response on obtaining practical solution of the problem of conflict with pest primates following their reporting.

4.2.3. **Possible causes of conflict between human and primates**

As the respondents replied the possible cause of conflict between humans and primates were indicated as the primates' population size increment (75.31%, n = 183), expansion of agricultural land (51.85%, n = 126) and lack/absence of food source plants (36.63%, n = 89) ranking 1 to 3, respectively (Table 15).

In the table (Table 15), lack of farming in the very vicinity to the primates by many farmers was considered as the least possible cause for the conflict with a response proportion of less than 3 %. There was significant difference among the possible cause of conflict between human and primates (X^2 (6) = 317.92, P < 0.05). Pest primates' population size increasing, expansion of agriculture, crop raiding/eating adaptation and behavior of pest primates, and neighboring of pest primates to human residence were found to be significant factors that caused the conflict between human and primates in the study area.

Table 15: Respondents' response on the possible factors/causes and ranks of the possible factors for conflict between humans and non-human primates in the study area, N=243

S.N	Possible causes of conflict	Respondents' response	
		Frequency	Percentage
1	The increasing number of the pest primates population size.	183	75.31
2	The expansion of agricultural land by clearing of forest and habitats of the primates.	126	51.85
3	Lack / absence of food source plants. Even the blue monkey has started raiding crops/eating crops which had no such behavior due to forest and food source destruction by humans.	89	36.63
4	Clearing of forest by humans and thus, habitat destruction and human interference with the primates.	78	32.11
5	Crop eating adaptation and behavior of the primates on farmland, in the garden and other areas and also other crops and fruits eating adaptation. Their adaptation with humans themselves.	32	13.17
6	Since the pest primates are neighbor to humans' resident areas.	19	7.82
7	Since many farmers have not very closed to the primates only very few farmers ploughed very close to the habitat of the primates but farming in large by closing to the primates helps to avoid them	6	2.46

According to the response of 92.59 % of the respondents, the cause of conflict between human and primates may be related to the number and distribution of the primates in the study area while only 7.41% of the respondents replied that the cause of conflict did not relate to the number and distribution of the primates (Figure 8). The conflict between human and primates was significantly related to the number and distribution of the primates in the study area (x^2 (1) = 176.33, P < 0.05).

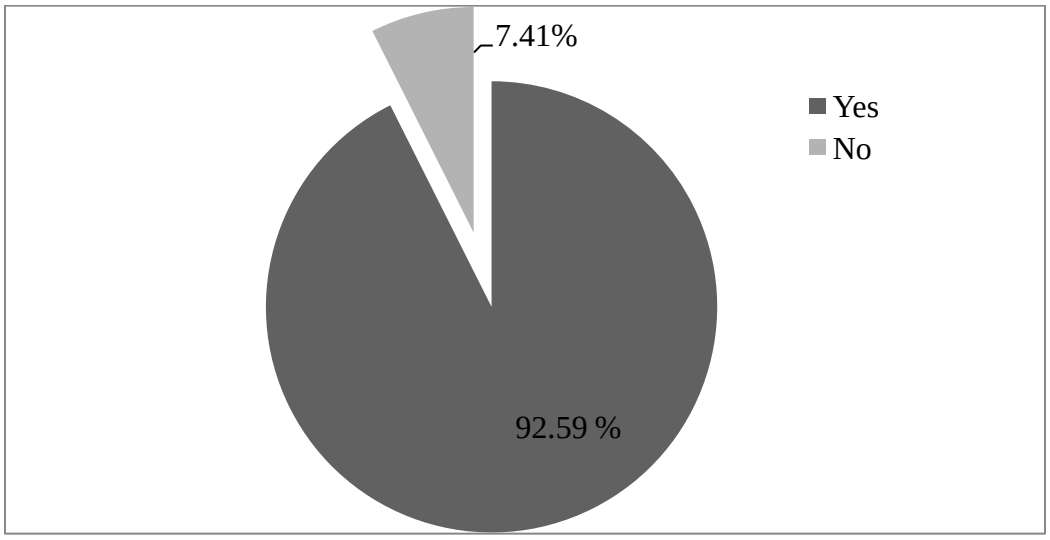

Figure 8. Percentage of respondents' response on the cause of conflict with primates may be related to the number and distribution of the primates in the study area.

4.2.4. **Measures that have been taken to solve the conflict problem**

According to the respondents' response, keeping of crops and other fruits from predation by adult humans (100%, n = 243), hunting and killing some of the adult primates at certain time being in groups (83.95%, n = 204) and making the primates to move to other neighboring areas (chasing) (82.72%, n = 201) were ranked 1 to 3 as predation prevention and mitigation ways, respectively (Table 16). Using poisoning chemicals was also indicated as a method accounting for the least proportion by the respondents (4.12%, n = 10) (Table 16).

Table 16: Respondents' response on measures that have been taken in the area to solve the conflict problem between humans and non-human primates, N=243

S.No.	Measures	Respondents' response	
		Frequency	Percentage
1	Keeping of crops and other fruits from predation by adult humans.	243	100
2	Hunting and killing of some of the adult primates at certain time being in groups. This was used before 10 - 20 years ago. But now, it is not in use.	204	83.95
3	Keeping the pest primates away to move to other neighboring areas turn by turn (chasing).	201	82.72
4	Shifting or changing the type of crop to be sowed/cultivated based on the relative attack of the crops by the pest primates and also preference of the crops to the pest primates	89	36.63
5	By using some primate trapping ways/techniques like the locally named 'gommo' in the previous time. But now, it is not in use.	86	35.39
6	Making discussion and agreement among the neighboring farmers and then, sowing similar or the same crop type at the same time and then, depredation of the pest primates being together by standing at different sides of the crops on the farmland.	24	9.88
7	By using poisoning chemicals to kill some of the pest primates even though it was difficult since most of the time the primates suspect it when given with some grains of crops and thus, reject to eat it with the given food. The adult ones prevent the sub-adult and infants not to eat it.	10	4.12

Majority of the study participants (88.89 %) replied that the primates do not have importance in the area or to the environment while only 11.11% of the respondents explained that the primates may have importance in the area even though they did not specifically mention. It was found that there was a significant difference in thinking on the importance of the primates in the area or to the environment (X^2 (1) = 147, P < 0.05).

4.2.5. **Recommended Measures to be taken to solve the conflict problem**

As indicated in Table 17 , regarding measures to be taken in order to solve the conflict problem, the respondents replied that, being in groups or individually again and again reporting the very seriousness of the issue to the concerned government bodies like administrator and agriculture sector of the district and asking them to take measures in organized way to solve problem with the pest primates (50.62 %, n = 123) ; hunting and killing at least selectively the large and dangerous members of the pest primates from the groups by government (30.09 %, n = 73). This could intimidate others and thus, this will help to reduce their impact. Making the primates to move to other far areas and totally avoiding them from the current area by government and community (22.63 %, n = 55) were indicated as measures to be taken ranking 1 to 3 with the respondents ‘response proportion in the parenthesis.

Table 17: Respondents' recommendations on measures to be taken and the responsible bodies to take the measures in order to solve/reduce the conflict problem between humans and non-human primates in the study area, N=243

S.No.	Recommended measures	Respondents' response		
		Frequency	Percentage	Responsible body
1	Being in groups or individually again and again reporting the very seriousness of the issue to the concerned government bodies like administrator and agriculture sector of the woreda and asking them to take measures in organized way to solve the problem with the pest primates	123	50.62	administrator and agriculture sector of the woreda, other concerned bodies
2	Hunting and killing at least selectively the large and dangerous members of the pest primates from the groups. This could intimidate others and thus, this will help to reduce their impact	73	30.04	Government
3	Chasing to other far areas and totally avoiding them from the current area	55	22.63	Government and communities
4	If possible, assigning, preparing and giving certain areas as ' wild life reserves/parks' to keep these primates in such protected areas	39	16.05	Government

The respondents also replied that strengthening keeping the crops and other fruits from predation by the pest primates for instance being in groups by the communities was mentioned as recommendation measures accounting for the least proportion of respondents' response (5.35%, n = 13).

(Continued from Table 17)

S.No.	Recommended Measures	Respondents' response		
		Frequency	Percentage	Responsible body
5	Reporting the very seriousness of the issue to the concerned government bodies and making the pest primates to migrate to other areas.	37	15.23	administrator , agriculture sector
6	If possible, eliminating all the primates that attack /raid/destruct crops especially Anubis baboons from the area and thus, avoiding the problem as it is.	37	15.23	administrator and agriculture sector
7	Asking permission from the concerned bodies and then hunting the primates.	26	10.70	communities
8	If possible, killing some of the pest primates by using poisoning chemicals; avoiding living in proximity and farming in large and working hard.	15	6.17	Government and communities
9	Strengthening keeping the crops and other fruits from predation by the pest primates for instance being in groups.	13	5.35	communities

N = total number of respondents

4.3. **Results of Focus Group Discussion (FGD)**

According to the FGD results, the participants agreed and replied response indicated that, Vervet monkey, Anubis baboon and Colobus monkey are commonly found in the current study area as well in the other some areas in the district. They explained the existence of conflict between human and non-human primates in the district areas like Daka, Gedelkelta, Gebera, Doyokobota, Kumbi, Gibe, Yerosokoru etc and Vervet monkey and Anubis baboon were mentioned as seriously conflicting pest primates in the area (Yerosokoru). They also reasoned out the possible causes of conflict in the current study area as well in the other areas as expansion of agricultural activities, destruction of trees, and forest for various purposes by humans, increasing population size of the pest primates and adaptation of the pest primates to raid/eat /destruct crops. Additionally, the participants explained that the number and distribution of the primates might be a possible factor for the conflict due to increasing number results increasing the impacts and the distribution was also related with the impact level according to them. Eventually, they suggested solutions to be taken in order to solve the problem as government should protect and safeguard the areas demarked for forest plantation, strengthening using various local predation prevention and mitigation ways, giving training to farmers, and monitoring the population size of the pest primates (Table 18).

Table18: Results of FGD conducted in the study area by involving a total of seven (7) participants from local communities(3), development agent(1) ,agriculture office (2) and kebele manager(1) by the facilitation and guiding of the investigator, N=7

S.No.	Variables considered in FGD	Participants agreed response
1	Primates that are commonly found in Yerosokoru	Vervet monkey and Anubis baboon, Colobus monkey.
2	Existence of conflict between humans and NHP in the woreda? Mention some kebeles of the woreda with such conflicts. What about the conflict in Yerosokoru?	Yes, there are conflicts in the woreda between humans and NHP. Daka, Gedelkelta, Gebera,, Doyokobota, Asher ,Kumbi, Gibe, Yerosokoru etc. are some of the kebeles with the mentioned conflict.
3	Conflicting primates mainly with the farming communities in Yerosokoru with their ranks	Vervet monkey and Anubis baboon are seriously conflicting pest primates in the area
4	Possible cause of conflict between humans and NHP in Yerosokoru and also in the other kebeles	Due to expansion of agricultural activities, destruction of trees and forest for various purposes; increasing population size of the pest primates; adaptation of the pest primates to raid/eat/destruct crops
5	Number of the primates may be a possible cause for the conflict between humans and NHP?	Yes. Because as the number increases their impact extent and the conflict increases
6	Solutions recommended to be taken by the concerned body	Government should protect and safeguard the areas demarked for forest plantation; strengthening and using various local depredation ways; giving training to farmers; monitoring the population size of the pest primates

5. **DISCUSSION**

In the current study area, four primate species were observed and identified. Namely, Anubis baboon (*Papio anubis***)**, Vervet monkey (*Chlorocebus aethiops***)**, Colobus monkey (*Colobus guereza***),** and Blue monkey (*Cercopithecus mitis***)**. From these primate species, Anubis baboon and vervet monkeys were considered most problematic primates in the study area. This result was in agreement with the study results of Hill (1997) and Priston (2005) who reported that, primates are highly significant pests in areas of the tropics where local people are mainly subsistence farmers. It was also in agreement with the study results of Quirin (2005) who reported that Anubis baboons and vervet monkeys are problematic primates in the South West Ethiopia or Illubabor Zone. Furthermore, according to FAO (2009), baboons are considered as pests and according to Fuentes (2006), vervet monkeys are crop raiders and classified as "pest" species.

The estimated mean group size in Anubis baboon was in line with the study results of Gerald (2001) who reported that the number of individuals in a group or group size in Anubis baboon ranges 15 – 150 with few males and many females and their young. The estimated mean group size of vervet monkey obtained in this study was also in line with study results of Pasternak *et al*. (2013), who reported that vervets live in social groups ranging from 10 to 70 individuals and Isbell *et al*. (1991) and Fedigan and Fedigan (1988), also reported that vervet monkeys live in groups of 7 to 76 individuals.

The estimated mean group size was higher in wet seasons for each primate species in the study area. Relatively, more number of individuals of the primates was recorded in wet season. This result was in contradiction with the study results of Mussa (2009) conducted in and around Denkoro forest in Ethiopia, who reported that the number of Gelada baboon population was more during dry season when compared with that of wet season. The reason was that during the wet season, farmers cultivated their farmland all round the forest and thus, they chased baboons from the edge of the forest in response to this chasing, some of the Gelada population might temporarily migrate to the nearby semi-arid rangeland, where least human interference occur (Mussa, 2009).

For vervet monkey, this result was in agreement with the study results of Mesele (2007) in Wonji-Shoa, central Ethiopia, who reported that the number of Grivet monkey population in farmland increased in wet season compared to dry season. More number of the primates in wet season than dry season could be due to more food and other resources availability in large quantity and with the preferred quality and food sources to the primates. This in turn could help to increase fecundity of females and hence, the size of the primates' group increases. On the other way, if there were migrated individuals from the groups in dry season, they might have returned to their original habitats and thus, result increasing group size of the primates. Or hunting pressures reduction could enable them to respond positively in their group size.

As the age composition study result showed, in Anubis baboon, the adults comprised the least proportion in both seasons while the juveniles accounted for the highest proportion in both seasons. In vervet monkeys, the proportion of adults was relatively small while the sub adults and juveniles accounted for higher and almost equal proportion in both season. For vervet monkey, this result was in line with the results of Cheney and Seyfarth (1990) conducted in Amboseli National Park who reported that the number of adults was smaller in vervet monkey's age composition. In the case of colobus monkey, adults and sub adults counted for nearly equal and higher proportion in both seasons while the juveniles accounted for the least proportion in both seasons. In Blue monkeys, the adults comprised the highest percentage in both seasons whereas juveniles accounted for the least percentage in both seasons. This could be related with the natural birth rate and reproduction of the species and the nature of social structuring in each primate species.

Anubis baboon was the most abundant primate species in the study area in both dry and wet seasons. Vervet monkeys' abundance was the second while blue monkey was the least abundant species. In terms of mean total number of primates recorded per habitats, fragmented forest habitat was the first in both seasons but around human settlement area was the least in both seasons. The mean abundance of the primates was statistically significant in both seasons. This implies that the abundance of the primates could vary with respect to season and habitats may be due to various attributing factors like enough food availability, predation, hunting and others.

From the four primate species identified and observed, Anubis baboon was found distributed on farmland and fragmented forest in both seasons while vervet monkey was distributed around human settlement areas and farmland in both seasons with more distribution around human settlement areas. Colobus monkey and blue monkey were totally found distributed in the fragmented forest habitats in both seasons. This shows that forest habitat harbors many species of primates with supply of preferred habitats to the species while around human settlement areas was preferred by vervet monkeys may be due to their adaptation behavior around human settlement areas, and availability of trees for sleeping (Fedigan and Fedigan, 1988) and food sources in those areas like fruits, vegetables, and others are found in the garden.

The confining of colobus monkey and blue monkey in the fragmented habitat may be due to existence of food source plants in the forest, predation protection preference to other advantages, their adaptation of forest habitat and preference, vicinity to water resources preference, avoidance of attack by humans or domestic dogs, and others. This result was in agreement with results of Fedigan and Fedigan (1988), who explained that vervets are habitat generalists and are tolerant of a wide variety of habitats; their only limitation seems to be water availability and the presence of sleeping trees. Vervets can survive quite well in urban areas (Wolfheim, 1983; Shimada and Shotake, 1997). As Kingdon *et al*. (2008) reported, the vervet monkey inhabits savanna, riverine woodland, coastal forest and mountains up to 4000 m. They are adaptable and able to persist in secondary and/or highly fragmented vegetation, including cultivated areas, and sometimes are found living in both rural and urban environments. Vervet monkeys were absent in fragmented forest habitats during the study periods in the study area which could be due to lack of tree for sleeping, fruits and other food sources unavailability, and fear of risk of predation by their predators including baboons (Seyfarth *et al*., 1980).

Both Anubis baboon and vervet monkey were regarded as highly pests or problematic primates in the area. They affect crops on farmland, around human settlement areas and also in the garden. Places where the pest primates affect crops was not significantly different for both Anubis baboon and vervet monkey. This implies that, the pest primates affect crops where they are found provided there is availability of crops in the area with no discrimination of areas where the crop is found. This could intensify the wide area problematic nature of the pests and thus costs the respondents a lot and also influences the perception and attitude of the respondents to wildlife, wildlife

conservation and management activities when initiated. This result was in agreement with the results of FAO (2009) which explains that, baboons are among the main aggressors and can devastate agricultural crops in a short time. Also, according to Saj *et al*. (2001), in more developed and agricultural areas, vervets are less subject to nutritional stress and seasonal availability of food because they depend on sources of food provided by humans including cultivated fruits, vegetables, and cereal crops. They consume fruits and vegetables grown in subsistence gardens and on larger plantations. It was also in line with the study results of Butler (2000) in Zimbabwe who reported that, baboons raid gardens and food in lodges and camping areas and can cause an immense nuisance in small urban settlements if left unchecked. Likewise, species with a more diversified regime such as primates will encroach on cultivated areas when the availability of natural food diminishes (Butler, 2000).

Both Anubis baboons and vervet monkeys affect mostly maize and sorghum crops than other crops while wheat was considered as the least affected crop by both pest primates. The crops that are affected by Anubis baboon and vervet monkey was significantly different but the attack each brings on the crops was insignificantly different. This implies that the pest primates show preference to certain crop types provided there is availability of that crop type than the others. Thus, the preferred crop type could be highly affected or damaged by the pests to the other crop types. Eventually, great loss occurs on that crop type by the pests' attack effect. However, the crop attack each results was not different means both pest primates result no loss difference; both are equally problematic in the area. This result was in accordance with the study results of Skinner (1990) who reported that vervet monkey eats a primarily vegetarian diet, living mostly on wild fruits, flowers, leaves, seeds, and seed pods. Moreover, skinner explained that in agricultural areas, vervets become problem animals, as they will raid bean crops, peas, young tobacco plants, vegetables, fruit, and various grain crops. According to Boulton *et al*. (1996) and Saj *et al*. (2001), some of the most damaged crops by vervet monkeys include corn, sweet potato, bananas, mangos, papayas, guavas, cherries, cucumbers, peanuts and yams. Thus, they have become an increasing nuisance to farmers that grow these crops. Furthermore, study results of Fedigan and Fedigan (1988) showed that vervet monkeys have a strong preference for fruit and flowers, which are seasonal resources, and from month to month vervets vary their diet tremendously to cope with fluctuations in food availability.

Anubis baboons and vervet monkeys affect mostly maize and the attack of maize was the highest during the flowering stage of the crop and the greatest crop damage occurs than the other stages. This could be related with nutritional content of the immature seed which is greatly attracting the pests. Tef is also attacked by the pests like maize including its flowers and leaves except no attack on the sowed seed by vervet monkeys. In the case of sorghum, except its flowers and leaves, it is affected by the pests. Wheat and barley crops are also affected in a similar manner by these pests. A wide variety of vertebrates conflict with farming activities in Africa. These include primates (FAO, 2009). This result was in line with the results of FAO (2009) which states that, baboons and vervet monkeys are highly skilled at raiding food crops. They will even chew on young tobacco or wheat stems to extract the juice and then spit out the fibre, in the same way that humans chew on sugar cane.

In areas where subsistence agriculture is practiced, baboon raids on grain crops such as maize, sorghum and millet, as well as fruits and some vegetable crops can reduce the yield by a significant percentage (Weladji and Tchamba, 2003; FAO, 2009). According to Weladji and Tchamba (2003) study conducted in Cameroon revealed that, baboons are among the species inflicting most of the crop losses. Ram and Kandel (2008) in Nepal (at Langtang National park, LNP) showed that, maize cobs were the crops that are highly preferred to be eaten by pest primates (62%), potato tubers (23%, millet (7%), and buck wheat (6%). Additionally, Hill (2000) in Uganda showed that, baboons appear to concentrate their crop-raiding activities on maize via out the year when the crop is present in the field. Baboons have the potential to cause large amounts of damage locally and raid farm more frequently than other species of wildlife do, cause proportionately greater amounts of damage than all other animals combined and vist farms via out most of the year (Hill, 2000). Their highly adaptable nature, along with their ability to learn very rapidly and change their behavior make primates (Anubis baboon and vervet monkey) very successful and potentially troublesome when living close to humans (Else *et al*., 1986). Moreover, study results of Kate (2012) showed that, vervet monkeys were reported for feeding on roots, fruits and seeds of maize in Hoima District in Uganda.

The attack of crops in day time by both Anubis baboons and vervet monkeys during cropping time showed that, there was no statistically significant difference. The season /months at which the pest primates affect crops was not also significantly different. This implies that there was no particular and specific consistent time of crop attack during the day time and there was no particular and specific consistent months /seasons of crop attack by the pest primates. They can affect crops at any time of the day and at any months/seasons provided there is access or availability of the crops with no particular day time and month/season preference. This implies that in order to avoid predation of crops, always man should be around the farmland or crop area during entire day time and months/seasons since time of sowing till harvest. It may take many months about 6 to 8 months which could also pose various other socioeconomic, health, productivity and other related issues by the respondents for this action. This result was in accordance with study results of Hill (2000) who reported that, baboons damage maize via out much of its growing cycle, as cleared by local farmers in Uganda.

On average, Anubis baboon resulted estimated loss of 3.41(31.52%) quintals of maize per hectare per year. Vervet monkey also on average resulted estimated loss of 3.24 (29.94%) quintals of maize per hectare per year. The estimated loss of crops by the pest primates among maize, tef, sorghum, wheat and barley crops and between the two pest primates was insignificant. Thus, the two pest primates result equal crop loss in the area for these crops. This shows that the overall mean attack of crops was almost with the same loss result by Anubis baboon and Vervet monkey and implying that both could be regarded as equally and serious pests in the study area. This also implies, the pest primates are causing great crop loss annually in the study area that significantly matter the livelihood of the subsistence farmers in which majority were not educated and possessed more children per family. Hence, the loss impact could highly influence the socioeconomic and living standards of the respondents. Therefore, the problem needs to be solved with the attention of the concerned bodies. This result was in agreement with the results of FAO (2009) which states that, crop damage not only affects farmers' ability to feed their families, it also reduces cash income and has repercussions for health, nutrition, education and ultimately development. When crop damage occurs finances are diverted from these areas to cover the cost of staple foods (FAO, 2009).

Similarly, study results of Mussa (2009) in and around Denkoro forest showed that Gelada baboons caused the greatest damage events than other animals. Furthermore, study results of Eniang *et al*. (2011) in Gashalla Gumt National Park (GGNP) in Nigeria showed that, primates cause more damage of crop than other pests. Additionally, study results of Ofor *et al*. (2009) in Nigeria showed that, about 30% of loss was caused on commercial farms but less than from damage caused in peasant's maize field (up to 70% loss) by monkeys moving in groups. It was also in line with the results of Fuentes (2006) who reported that, crop raiding and related resource exploitation patterns by nonhuman primates are the traditional reference point for human-nonhuman primate interactions. These competitive relationships can have substantial impacts on human nutritional intake and agricultural patterns (Fuentes, 2006).

The pest primates were resulting various problems in the study area other than crop raiding/attack. Social problems like problem to send children to school and problem to participate on social affairs, economic problem, attacking, predation, killing and eating of goats, sheep and chicken and even calves are being eaten by Anubis baboon during post harvest time, intimidating mainly children and women, keeping crop (single activity) for longer time regularly being in the farm area and psychological problems. This result was similar with study results of Sunanda and Saikia (2008) in India who showed that, monkeys not only attack humans but also they destroy and damage valuable human properties. Similarly, it was in line with the study results of Mesele (2006) who reported that, 6.7% of the respondents reported that the loss of sheep and goats to Hamadryas baboons and among villages, 40% of the respondents from Mechekan –Tikurwuha reported loss of sheep and goats to Hamadryas baboon in and around Simien Mountains National Park, Ethiopia. This study result was also in line with the study results of Mussa (2009) who reported that, Hamadryas predated on sheep and goats in and around Denkoro forest, Ethiopia.

Moreover, study results of Eniang *et al*. (2011) in Nigeria showed that, baboons prey on domestic chicken and sometimes baboons attack women and children even up to their house and sometimes kill fowls. Ram and Kandel (2008) also showed that, loss of crops, food, money and loss of time (via time spent guarding fields) were problems associated with crop raiding by macaques in Nepal.

Similarly, study results of Kate (2012) showed that, social and other problems occur due to primates' impacts in Hoima District in Uganda. This result was also in line with the results of FAO (2009) which explained that, baboons will intimidate humans – especially women – in urban areas, when scavenging for food. Similarly, Study in Zimbabwe by Butler (2000) also showed that, 241 livestock were killed between January 1993 and June 1996 by baboons, lions and leopards in which baboons contributed to 52 percent of their kill. Baboons attack by day and usually kill small stock such as goats and sheep (Butler, 2000). Additionally, this study result was in accordance with the study results of Hoare (1992) who reported that, other economic costs of human-wildlife conflict include the time spent and cost of guarding crops from baboons by day. The primates may affect human welfare, health and safety, and have economic costs. The conflict also pose negative social impacts such as withdrawal and absence of children from school, absence from work, additional labour costs for crop guards, loss of sleep, fear and restriction of travels (Hoare ,1992).

Similarly, study results of Fuentes (2006) showed that, sympatric primate populations may prey on human agricultural lands resulting in increased time spent by humans in protection of the fields and potentially decreased yields per human labor effort. The overall impact of the pest primates was very serious according to majority of the respondents. The overall impact of the pest primates was significantly different. This implies that the pest primates are causing more impacts to the majority of the respondents and thus, great attention will be required to solve the problem from woreda administrator, agriculture sector of the district and others.

Pest primates' population size increasing, expansion of agriculture, crop raiding/eating adaptation and behavior of pest primates, and neighboring of pest primates to human residence were found to be significant factors that caused the conflict between human and primates in the study area. There was significant difference among the possible cause of conflict between human and primates. This means among other factors mentioned by the respondents as possible causes for the conflict problem, some were not statistically important factors for the cause but some were found to be important factors that need to be addressed and thus, solution should be suggested to solve the problem. This study result was partly in line with the study results of Mesele (2006) and Kelil (2011) conducted in and around Simien Mountains National park and in Indato forest, Eastern Arsi, Ethiopia and who reported that destroying forest for the purpose of firewood, cattle grazing and other benefits engages primates to raid crop.

According to majority of the respondent (92.59 %), the cause of conflict between human and primates may be related to the number and distribution of the primates in the study area. This was statistically significant. This implies that the greater the number and wide area distribution of the pest primates, it could have contribution for the conflict with humans. Conversely, areas where the pest primates are absent or confined to very limited areas with less abundance, there could be less conflict with humans. This result was partly in line with the study results of FAO (2009) which states that, the wariness of wild species can explain why some fields are more prone to raiding than others. For example, baboons and monkeys tend to raid smaller fields surrounded by large trees and rocky hillocks, which provide cover for them. These vantage points provide them with easy escape routes and make it difficult for guards to follow them. On the other hand, when, for various reasons, wild species lose their fear of humans, this can also cause conflict (FAO, 2009).

Different ways of prevention and mitigation have been used by the respondents in the study area in order to reduce the loss due to the pest primates. Keeping of crops and other fruits from predation by adult humans (guarding by males) and using poisoning chemicals to kill some of the pest primates have been the most and the least common ways practiced. This result was in agreement with the results of FAO (2009) which reported that rural communities use agricultural pesticides to control lions, leopards and to some extent also baboons. It was also in line with the study results of Ram and Kandel (2008) who reported that, in Nepal (LNP) the most commonly used crop protection strategy was guarding their field constant vigilance during crop seasons. But, it was partly in contradiction with the study results of Kate (2012) who stated that two-third of all crop guarding was carried out by women and children in Uganda and locally adults particularly men, were most feared by baboons in Hoima district. Hill (2000) also showed that in Uganda children (6 – 12 years) carry out nearly a third of all guarding and just over a third is done by women, the remaining third is carried out by men. The difference could be due to the intimidation behavior and action of the pest primates on women and children and also fear of the risks on women and children in the current study area which then forced men to be the main group of human who engage in guarding of crops in the farm areas regularly.

Majority of the study participants replied that the primates do not have importance in the area or to the environment. It was found that there was significant difference in thinking on the importance of the primates in the area or to the environment. Majority of the respondents had negative attitude towards the importance of the pest primates in the area or to the environment which could be the outcome of the conflict problem in which they felt the impact side only and thus, shaped their attitude more towards the negative side rather than developing a balanced outlook. Moreover, majority of the respondents were not educated even the highest education level was grade 10 and thus, this could have influenced their attitude and dimension of considering the importance of the pest primates to the environment or in the area. They also need to see practical, tangible and clear importance to their understanding about the pest primates; lack of awareness by the concerned body about wildlife and primates in particular importance, and other conservation related issues may be additional reasons to focus only self benefit without much concern about the primates' survival. This result was in line with the results of FAO (2009) which explained that, in general rural Africans have little sympathy for wildlife and see animals purely in terms of their meat value. Rural communities consider wildlife, particularly large mammals as threats to their safety and food security. This adverse perception is particularly strong near protected areas where the presence of wildlife populations inflicts daily costs on local communities, which can erode local support and tolerance. In turn, local people can develop a negative attitude towards reserves and wildlife, exacerbating conflict and undermining conservation efforts (FAO, 2009).

According to Siex and Struhsaker (1999), the continued negative attitude of communities towards wildlife emanates from losses (including human life, property, crops and even agricultural land set aside for conservation purposes) incurred by wildlife. The association of wildlife with damage is now so integrated in the minds of local populations that they will even blame beneficial species (Siex and Struhsaker, 1999). Study result of Kumssa and Bekele (2013) in Senkele Swayne's Heartbeest Sanctuary in Ethiopia, also showed that large number of respondents stated that the wildlife is not important and the continued existence of wildlife as had a negative impact on their livelihood and some of them considered wildlife as important. This implies in order to reduce the conflict problem and coexist with wildlife; first it is mandatory to change the attitude of stakeholders via education, benefit sharing and others.

6. **CONCLUSIONS AND RECOMMENDATIONS**

6.1. **Conclusions**

Anubis baboon (*Papio anubis)*, Vervet monkey (*Chlorocebus aethiops***),** Colobus monkey (*Colobus guereza***),** and blue monkey (*Cercopithecus mitis***)** were the four primate species observed and identified in the current study area. From these primate species, Anubis baboon (*Papio anubis)* and vervet monkey (*Chlorocebus aethiops***)** were considered most problematic primates in the study area.

The estimated mean group size was higher in wet seasons for each primate species. The age structure composition in Anubis baboon showed that the adults comprised the least proportion while the juveniles accounted for the highest proportion in both seasons. In vervet monkeys, the proportion of adults was relatively small while the sub adults and juveniles accounted for higher and almost equal proportion in both seasons. In the case of colobus monkey, adults and sub adults counted for nearly equal and higher proportion while the juveniles accounted for the least proportion in both seasons. In blue monkeys, the adults comprised the highest percentage whereas juveniles accounted for the least percentage in both seasons.

Anubis baboon was the most abundant primate species and vervet monkeys' abundance was the second while the abundance of blue monkey was the least in both seasons. Generally, relatively more number of individuals of the primates was recorded in wet season than the dry season.

In terms of mean total number of primates recorded per habitats, fragmented forest habitat was the first but around human settlement area was the least in both seasons. From the four primate species identified and observed, Anubis baboon was found distributed on farmland and fragmented forest habitats via out the study periods while vervet monkey was distributed around human settlement areas and farmland with more distribution around human settlement areas in both seasons. Colobus monkey and blue monkey were totally found distributed in the fragmented forest habitats in both seasons.

Maize, tef, sorghum, wheat and barley were the main crops which are harvested most commonly once in a year and yielding between 4 and 11 quintals per year per hectare in the study area. Almost all crops are stored around human settlement areas. The pest primates attack these crops with no difference in their impact between them. They attack crops on farmland, around human settlement areas and in the garden with no area and ways of attacking difference. The primates attack crops with no particular day time and particular month/ season preference but at any time of a day and month/season provided that there is availability of the crops.

Both pest primates result the highest estimated annual loss of maize (3.42 quintals, 31.52%, by Anubis baboon and 3.24 quintals, 29.94%, by vervet monkey) per hectare. On average the estimated overall mean crop loss from the five main crops was 1.71 quintals (27.94%) by Anubis baboon and 1.61 quintals (26.31%) by vervet monkey per year per hectare. There was no difference in the crop loss that both pest primates bring on these crops per year per hectare. This was a great loss of crop per year alone from pest primates' attack. This means the two pest primates are equally problematic primates resulting nearly equal percentage loss of crops in the study area. Hence, the loss impact could highly influence the socioeconomic and living standards of the respondents. Thus, the problem needs due attention from Woreda administrator, agriculture sector head and kebele administrator.

The pest primates imposed social, economical, psychological, health and other impacts other than crop attack impacts. For this, majority of the respondents considered the conflict issue very serious and also majority of the respondents had negative attitudes towards the importance of these pest primates in the study area or to the environment. The number of the pest primates is increasing from time to time and thus, majority of the respondents explained that the conflict with the pest primates may also be related with the number and distribution of the pest primates. The cause of conflict were identified as population size increment of the pest primates, the expansion of agriculture, crop eating adaptation and behavior of the primates, since the primates are neighbor to human resident areas as statistically significant factors. Guarding by adult males was the major way used to reduce the impact of the pest primates. In order to make and help the communities in the study area productive and lead better life, it is mandatory and timely issue to take responsibility and give appropriate attention in solving this problem by considering the issue of both in a reasonable manner.

6.2. **Recommendations**

The following recommendations were given based on the findings of this study:

- The woreda administrator should encourage and give the necessary support in this area since the conflict problem results many problems on humans as well as on the animals. The necessary attention is required in order to find appropriate solutions and hence, boost the productivity and living standards of the communities in the woreda.
- Appropriate and adequate training should be given by experts like wildlife experts, forest agency expert, and natural resource conservation expert to the farmers and other community members regarding various aspects of wildlife.
- Making the appropriate hierarchical communications by the administrator of the district, agriculture sector head and kebele administrator is required in order to appropriately regulate the population of the pest primates from the concerned bodies.
- The framers in the study area need to communicate and sow crops at the same time and protect their crops being in groups in regular bases.
- The farmers need to avoid cultivating crops that are more palatable to the pest primates near forest edges and also shift the crops to be cultivated based on crop preference to primates.
- The farmers are advised to avoid expansion of agriculture by destructing forest and wildlife habitats in the study area. Additionally, the farmers need to have the right awareness and importance of family planning issues to limit their family size.
- The woreda administrator is advised to find alternative farm areas and share it to those farmers that are farming to the vicinity of forest and between forest fragments.
- The farmers should keep their crops regularly the whole day and seasons from time of sowing till harvest by strengthening the various nonlethal traditional methods.
- The farmers and others in the study area should focus on ways of coexistence.
- The forest habitats need to be protected and conserved by the farmers and others.
- Woreda administrator, agriculture sector head and kebele administrator in the woreda should pay attention and try to find appropriate ways of solving the conflict problem between human and primates in the study area that considers the issue of both.

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Appendices

Appendix-1: Questions for Focus Group Discussion (FGD)

JIMMA UNIVERSITY

COLLEGE OF NATURAL SCIENCES

DEPARTMENT OF BIOLOGY

The purpose of this **Focus Group Discussion (FGD)** is to collect relevant data /information on the human – primate conflict: with special emphasis on monkey – human conflict in Yerosokoru kebele of Sokoru woreda. Thus, your genuine response is necessary for the success of this study. Therefore, the investigator would like to express his thanks in advance for your genuine responses.

1. What primates are commonly found in Yerosokoru kebele? List them.

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2. Do you think that there is conflict between humans and primates in the woreda? 1. Yes 2 .No .If'yes', would you mention some of the kebeles with this conflict in the woreda? What about the conflict in Yerosokoru? ----------

3. Which primates are conflicting with humans (mainly with farmers) in Yerosokoru? List them in rank.

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4. What do you think are the possible causes for the conflict between humans and primates in Yerosokoru? In the other kebeles you mentioned in the above (Q.no.2)?

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5. Do you think that the number of the primates may be a possible cause for the conflict? 1. Yes 2.No. If 'yes', would you explain the reasons?

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6. What solutions would you recommend to be taken to solve the conflict? By whom?

THANK YOU!!!

JIMMA UNIVERSITY

COLLEGE OF NATURAL SCIENCES

DEPARTMENT OF BIOLOGY

The purpose of this questionnaire is to collect relevant data /information on the human – primate conflict: with special emphasis on monkey – human conflict in Yerosokoru kebele of Sokoru woreda. Thus, your genuine response is necessary for the success of this study. Therefore, the investigator would like to express his thanks in advance for your genuine responses.

The Investigator

Appendix-2: QUESTIONNAIRES TO BE FILLEDOUT BY INTERVIEWER/INVESTIGATOR

Remarks: I. Do not write the name of study participant on the questionnaire

II. Put the responses of the study participant on the given spaces or write brief and clear responses as it requests you on the given space

III. Put the response of study participant without bias.

Part I: Questions on Socio-demographic characteristics of the community

1. Personal information

Sex: 1.Male ----- 2.Female-------; Respondent's Age (in years):---------

2. Educational Status of respondent:

1. Illiterate **2**. Can read and write **3**. Grade1-8, 4. Grade 9-10

5. Grade 11-12 **6**. Above grade 12

3. What is your main occupation?

1. Civil servant 2. NGO 3. Merchant 4. Private **5**. Farmer 6.Other specify----------

4. How many children do you have? 1. M--------- 2.F-------- 3.T---------- 4.No

Part II. Main part of the Questionnaire related to primates and human conflict

1. If, a farmer, which crops do you mainly produce on your farm land? (More> 1 is possible)

1. Maize 2.Teff 3. Sorghum 4. Barley 5. Wheat 6. Other----------

2. If, a farmer, how many times you harvest crops in a year?

1. Only once 2.Twice 3. Three times 4. Other----------

3. What is your annual estimated product of the main crops you produced on the farmland? per crops (in quintals)? ----------

4. Where do you store your crops? 1. On farmland 2. Around house 3. Other

5. Do you have fruit trees on your farm land? 1. Yes 2. No

6. Do you have fruit trees in your garden? 1. Yes 2. No

7. What fruit trees are found on your farm land or garden? ----------

8. What other crops are found in your garden? ----------

9. Do primates are found in your area/kebele? 1. Yes 2.No

10. Which primates are found in your area/kebele? 1.Monkeys 2.Vervet monkey 3.Guerezas 4.Other

11. Which primates are more common in your area/kebele? Rank them.

1. Monkeys ---------- 2. Vervet monkey---------- 3.Guerezas----------

12. Which primates affect your crops? Rank them.1.Monkeys-- 2. Vervet monkey--- 3.Gurezas--

13. Where do these primates affect your crops? 1. On farmland 2. Around house 3.In the garden

14. Which crops are mostly affected by the primates? ----------

15. What part of the affected crops is attacked by the primates? ----------

16. How do the primates affect your crops? 1. by raiding/eating 2.damaging/destructing the plant 3.other----------

17. Where do the monkeys are usually found in your area? 1. On farmland 2. In the forest near the farmland 3. Around settlement areas 4.Other

18. When do the primates mentioned above affect your crops/fruit trees/others crops? (Time)----------

19. In which seasons /months crop damage by the primates is common? ----------

20. Would you estimate the annual loss of crops by each primate per crop types? ----------

21. What other impacts do the primates have other than crop damage? ----------

22. How do you guess the population size of each primate types from time to time?

1. Increasing 2. Decreasing 3. No change 4. Impossible to guess

23. What would you say the overall impacts of primates in your area and in your case?

1. Very serious 2. Serious 3. Not serious but tolerable 4. No considerable 5.No problem

24. Have you ever reported the problem between you and the primates to your kebele/agriculture sector of the woreda? 1. Yes 2.No. If 'yes', have you got any practical solution? 1. Yes 2.No

25. What do you think is/are the possible cause/s of conflict between humans and primates in your area/in your case? Mention them with rank ----------

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26. Do you think that the cause of conflict between you and the primates may be related to the number and distribution of the primates in your area? 1. Yes 2. No 3. I don't know

27. What measures have you been taking in your area/ in your case to solve the problems?

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28. Do you think that the primates have importance to your area/ to the environment?

1.Yes 2.No

29. What measures would you recommend to be taken to solve the conflict? By whom?

THANK YOU!!!

Appendix-3:

Field data sheet used for surveying abundance and distribution of primates (monkeys)

Study area---------- Study site---------- Date---------- Observer----------

No	Species	Group	No. of individuals			Habitat type	Time	Latitude	Longitude	altitude	Method of identification
			adult	sub - adult	juvenile						

Appendix 4: Different plates showing some of the activities performed during the study periods

Farmland areas during post harvest in the dry season

Farmland areas covered by different crops (during wet season)

Topography of the study area overview

Plate 1. Photos of farmland areas post harvest, during the dry season and overview of the study area.

Fragmented forest (during dry season)

Around human settlement areas (during wet season)

Plate 2. Some photos of fragmented forest and around human settlement areas in the study area.

The investigator collecting data by interviewing respondents using questionnaire

The investigator interviewing the district agriculture office vice head (right side) and expert of crop production and protection (left side)

Plate 3. Some photos showing data collection activities in the study area.

Vervet monkeys on farmland (right side) and around human settlement areas (right side)

Anubis baboon

Plate 4. Some photos of Vervet monkey and Anubis baboon in the study area.