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Identification of Crop Raiding Species and the Status of Their Impact on Farmer Resources in Gera, Southwestern Ethiopia

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Abstract

The study was conducted in Gera district, southwestern Ethiopia. Currently, in different parts of Africa, wild animals seriously compete for resource with human being. This affects the economy of the community and the conservation of wildlife. Therefore, this study was conducted to identify crop raiding species and estimate the magnitude of agricultural field crop and domestic animals loss due to wild animals in the Gera district, Jimma zone, southwestern Ethiopia. Data were collected via semi-structured questionnaires, focus group discussion, direct observation and key informant interview. One-way ANOVA and t-test were used to analyze damage caused by wild animals. Pearson correlation was used to test the relation between distance of study village and family size with damage events. Chi-square test was used to analyze traditional methods used by the respondents. Olive Baboon, Bush Pig, Warthogs, Grivet Monkey and Porcupine were the identified damage causing wild animals on Crops.

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The most predators on small ruminant and chickens were Olive Baboons. A total of 912 damage events were registered on five sample sites on crops such as, maize, teff and sorghum in the production season 2013/2014. The registered damage events were significantly different from site to site (P =0.037) and it was high in sites which have less distance from forest edge. A total of 259 and 240 Olive Baboons, and 126 and 148 Grivet Monkeys were estimated in the sampled forest in dry and wet season respectively. There was no significant difference between the number of wild animals in wet and dry season (P > 0.05). Guarding, chasing, fencing, scarecrow and smoking were used for defending crop and livestock. There was significant difference between types of the strategy used by the community (P < 0.001) where guarding is the most (30%) while smoking is the least (0.8%) used strategy. To control the number of crop raiding wild animals, further study is needed to estimate their population status in the entire district. Production of alternative crop (such as coffee), apiculture, ecotourism and livestock raring were suggested as solution for protection strategy in this study. And investment should be based on proper site selection which is feasible economically and ecologically.

Keywords: Crop raiding; Human-wildlife conflict; Ethiopia.

1. Introduction

Human-wildlife conflict is a well-known phenomenon and is the interaction between wild animals and people. It resulted in negative impact on people or their resources, and wild competition for space between humans and wildlife is prevalent worldwide [1,2].Nowadays human-wildlife conflict exists all over the world as wildlife requirements encroach on those of human populations and involve several animal species [3,4,5,6]. Despite the fact that all countries, whether developed or not were affected by human-wildlife conflict (HWC) developing countries are altogether more vulnerable than developed nations [7,8].

Animals or their habitat and has existed for as long as humans and wild animals have shared the same landscapes and resources[4].Usually, conflict takes place when wild animals cross a line or border between the domesticated and the wild and enter the human sphere uninvited [9]. A wide variety of wildlife comes into conflict with farming activities for searching of resource which causes crop damage and wildlife mortality [4,10].

Human wildlife conflict is a serious issue in Africa and other developing areas of the world where rapidly growing human populations and expanding settlements are reducing the areas left for wildlife habitats and increasing the interactions between humans and animals [11]. The transformation of global landscapes from predominantly wild to predominantly anthropogenic over the last centuries has created competition between humans and wildlife for space and resources and it reached on unprecedented levels [12, 8, 9]. Ethiopia is a large and ecologically diverse country with unique environmental conditions [12,13,14,15].In contrary, since many years ago, the natural vegetation of the country has been destroyed by human action. Agricultural activities are expanding that leads to forests encroachment, habitat destruction and further to human-wildlife conflict which in turn lead farmers increasingly lost crops to pests/problem causing animals [4,9].

Rapid increase of population growth, investment in forested area, deforestation, wetland draining for cropland

areas and using of forest edge for coffee plantations is more experienced in south western Ethiopia. These pose pressure on land resources and reduce the area of core habitat for wild animals and eliminate corridors for migration and increase the probability of contact, and possibly create conflict between wild animals' and farmers [17,18,19]. As majority of the Gera land has been covered by natural forest in the past, now a day it is shrinking in size due to increasing substance agriculture and investment [2] in the forest area. This phenomenon was once and again disturbing the habitat of wild animals and forced wild animals to contact with human being which resulted in conflict [20,3,21].

However, as in other parts of the world, in Ethiopia, large herbivore mammals have been causing damage to agricultural crops and plantations. There are wide varieties of herbivores, primates and small mammals causing damage to crops and livestock. These mammals cause serious damage to agricultural crops in different parts of the country [22]. Nevertheless, in Ethiopia only few studies were carried out on human-wildlife conflict in some specific regions of the country in general [23, 24] and in Gera in particular.

Therefore, this study was conducted in view of bridging this gap and come up with recommendations for future research and policy intervention to reduce HWC. The result of the study may also provide information to planners, researchers, extension organizations, development institutions and individual farmers to enhance farming process.

2. Materials and methods

2.1 Description of the Study Area

The study was carried out in Gera district,Jimma zone of Oromia National Regional State, about 448km south west of Addis Ababa and 93km south west from the zonal town Jimma. Geographically, it is located between $7^0$15'N - 8^0 45'N latitude and 35^0 30" E - 37^0 30' E longitudes (Fig 1).

The total population of Gera district as calculated based on 2007 national census report and it was 86,849. About 83,375 of them were rural and 3,474 were urban. Out of the rural population 41,437and 41,938 were females and males in respectively. The land cover categories of the district comprise about 26.5% potential arable or cultivable land of which 23.4% under annual crops, 7.0% pasture, 56.6% forest and the remaining 9.9% was classified as degraded, built-up or otherwise unusable.

The study area is characterized as humid, subtropical climate, with a yearly rainfall of about 1800mm to 2080mm per annum and a short dry season with relatively high cloud cover. A peak rainfall occurs between June and September, which is the long rainy season of the district and a smaller peak occurs between March and April, short rainy season. Differences in temperature throughout the year are small with a mean minimum and maximum annual temperature of 11.9 and 26.4°C.

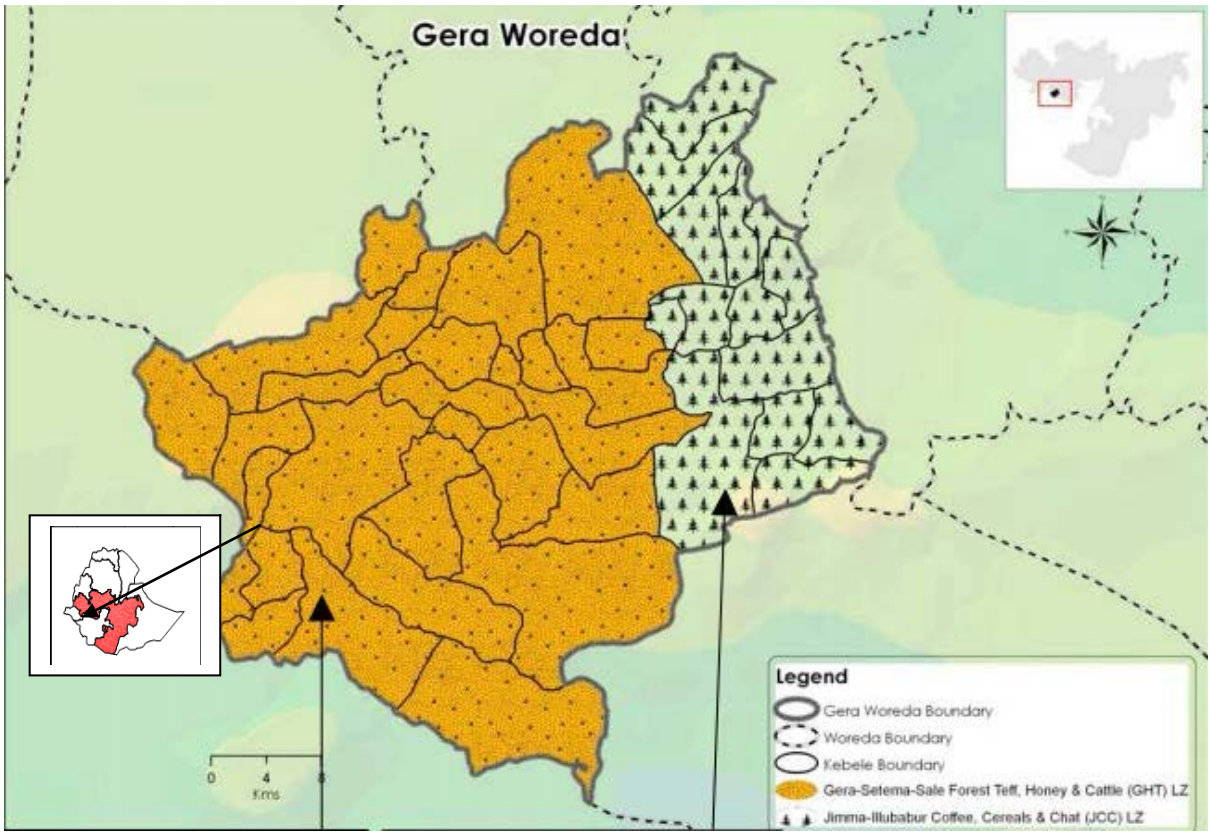

Figure 1: Map of the study area. Source: FEG, 2009

The south-western forests of Ethiopia are characterized as moist montane forest ecosystems [25,26, 20] with high forest, woodland and plantation forests are available in Gera district. Even though the majority of the natural forests are under the government protection it is presently under great treat because of over exploitation [27, 28]. There is no National Park in the area. However, Buffalo, Lion Colobus Monkey, Grivet Monkey, Olive Baboon, Leopard, Warthog, Pig, Civet cat and Antelope are found in the study area.

2.2 Site Selection and Sampling Design

The study district was purposively selected as the area represents one of the highest case scenarios in HWC. Out of 24 Kebeles found in the district two Kebeles namely Ganjichala and Wanjakersa were selected through stratified random sampling for this study. In the second stage, each village found in the selected Kebeles were categorized in to three, based on their proximity towards to forest edge, as near, medium and far. Following this one village from each group were selected. The total villages from each Kebeles were three and the study covers a total of six villages from the two Kebeles. Based on distance of farm land from forest egged 33.3% households from each stratification were used for formal interview.

Following this households, sample frame was established by collecting complete landholders list record from their respective administration office. The sample frame was all household head living in the two Kebeles and finally the selections of sample household was proportional to each stratification which based on farm land distance from forests to keep uniformity. Accordingly, the total numbers of household head living in both

Kebeles were 915. From all stratification house hold head having farm land in the selected stratification was randomly selected for formal interview.

After getting the total number of household heads living in each selected Kebeles, the fourth step was determining total sample size of household head. Following this; total sample size was determined using probability proportional to sample size-sampling technique [28].

$$no = \frac{Z^2 * (P)(q)}{d^2} \quad n_1 = \frac{no}{(1 + no/N)} \quad \textbf{Where;}$$

$n_{o=}$ desired sample size when population greater than 10000

n_1 = finite population correction factors less than10000

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

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

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

N = is total number of population

d =is degree of accuracy desired (0.05)

Based on [28, 29] population correction factors, a total of 120 sample household head were selected using simple random sampling techniques from the total population of 915 (435 from Ganjichala and 480 from WanjaKersa). Allocations of the number of sample households to each Kebeles was proportional to the number of household head living in each selected Kebeles, accordingly 57 HH from Ganjichala and 63 HH from Wanjakersa were selected for this study.

2.3 Data Collection Methods

Direct observation was used to record frequency of coming crop raiding wild animals to farm lands whereas formal interview were used to identify major crop raiding wild animals and more vulnerable crops.

Estimating the Magnitude of Agricultural Field Crop Loss by Crop Raiders

Agricultural crop losses due to crop raiding wild animals were achieved through direct and indirect methods [17]. For direct observation on crop damage by wild animals, totally five study sites from each stratifications used for formal interview. From each site, crop land having areas of 5,000 m^2 which have equal distance from forest edge were randomly selected from Bonche, Chala, Seke, Wanja and Gado. On the selected farm lands, three crops namely Maize, Teff and Sorghum were sown in the production season of 2013/2014. However,

Sorghum was not sown in Bonche and Chala in the production season.

Following [26] method, the area of the crops damaged by wild animals was measured. After the yield obtained from one hectare was obtained from district agricultural office for each crop types, the amount of yield loss was estimated per hectare. A total of ten days (12 hours each) direct observation was conducted in each study site during each trip. Thirteen data collectors were participated during the time of direct observation in each trip. Their steps forward were supervised by Developmental agents and researcher at weekly and monthly bases respectively to ensure that coverage was sufficient to detect all crop-raiding incidents within the sample area for entire period. Mostly supervision of data collector was carried out on a weekly or monthly basis [18]

For nocturnal animals, following the suggestions of [26,27], the damage was identified using its marks left such as dung, feeding, foot prints, diggings and other physical remains like spines. Local farmers and local assistants were useful in helping to identify signs of crop raiding damage on crops.

Data was analyzed using SPSS version 16.0 computer software. One-way ANOVA and chi square were used to analyze cause of HWC and status of HWC and management options.

3. Results and discussion

3.1 Crop raider species

Olive Baboon (*Papioanubis*), Bush Pig (*Potamochoeruslarvatus*), common Warthog (*Phacochoerusafricanus*) , Grivet Monkey(*Cercopithecusaethiops*)and crested porcupine (*Hystrixcristata*) were the most crop raiders identified during present study. Olive Baboon and Grivet Monkey damaged crop during day time whereas Bush Pig, Warthog and Porcupine damage crop during night time (nocturnal). But Bush Pig and Warthog occasionally have been seen in the morning. Grivet Monkey and Porcupine mainly destroyed maize near maturation stage. Olive Baboon and Bush Pig were observed causing damage on crops in all stages from the time of germination to the time of harvest whereas Warthog affects crop early in the seedling.

3.2 Magnitude of Crop Loss

In the study area, three types of field crops were grown namely maize, teff and sorghum in the production season of 2013/2014 in the selected sites. Maize and teff had more size in terms of area coverage on the farmland taken as a sample hence it was sown in all sites which was 2.5 ha representing 38.4% of the total crop land taken. Sorghum covers less cultivated farmland which was 1.5ha (23.07%) of the total cultivated land in the taken sample farm land hence it was not sown in Bonche and Chala.

The result showed that not all crops were equally affected by crop raiders. During the present study 70.8% of the respondents claimed that maize was the most vulnerable crop to crop raiders followed by sorghum (62.5%).Whereas about 35% the respondent reported that potato was the least vulnerable crop to damage caused by wild animals (Table 1). The result was agreed with finding of [6] who reported that Maize (ripe and dried) was the most frequently eaten crop by crop raiding in West Africa.

All of the respondents from Bonche, Chala, Wanja, Gado and 47.3% from Seke reported that there was an increase of crop damage by crop raider from time to time. However, all respondents from Agalo not give any response on trends of crop damage. Response on trend of crop damage by crop raiders among respondent differed significantly ($\chi 2 = 91.55$, df = 2, $P < 0.05$ (0.000). About 74% of the respondents reported that it is increasing whereas 8.9% of them said it is unknown and finally no one reported that the trend of crop raiding was decreasing (Table 2).

Table 1: Rank of crops in the order of destruction by crop raider (N=120)

Crop	Frequency	Percentage	Rank
Maize	85	70.8	1
Sorghum	75	62.5	2
Teff	70	58	3
Wheat	50	41.6	4
Potato	42	35	5

Table 2: Percentage of trend of crop damage by crop raiders based on respondents reply

Village	N(120)	Trends of crop damage (%)			
		Increased	No responses	Unknown	Decreased
Bonche	19	100	0.0	0.0	0.0
Chala	20	100	0.0	0.0	0.0
Seke	19	47.3	0.0	52.7	0.0
Wanja	21	100	0.0	0.0	0.0
Gado	20	100	0.0	0.0	0.0
Agalo	21	0.0	100	0.0	0.0
Mean		74	16.7	8.9	0.0

A total of 912 damage events were registered in all five sites (Table 3). There was significant difference on damage event registered between each trip namely before flowering and after flowering ($t=10.6$, $P=0.000$). Damage events was less after flowering than before flowering because almost all the owner of the crop give more emphases on visiting their crop , after maturation of crops they were around their farm for case of harvest and the time of after flowering is shorter than time of before flowering.

Damage events caused by those five crop raiders were significantly different from animals to animals ($F= 12.602$, $P < 0.05$(0.000). The highest damage event was caused by olive baboon (M=60) whereas the lowest damage events was caused by porcupine (M=17.6) (Table 3). Olive Baboon was the most problematic animals for farmers around the study area. Olive Baboons to be major pests not only because they are perceived to be

more destructive than most other species but also they visit farms frequently, sometimes in large groups, and can be very persistent [9].

Damage events were significantly different from site to site (F= 2.796, P < 0.05(.037). As the mean of registered damage event were compared the highest damage event was registered in Bonche (M=53) which have less distance from forest edge. Whereas the lowest damage events was registered in Seke (M=26) which was far from forest. Even though Bonche and Wanja have similar stratification from forest edges, due to higher disturbance of forest in Bonche area than Wanja crop raiders visit Bonche area more than Wanja frequently (Table 4).

Table 3: Damage events caused by five crop raiders

Study Sites	damage event caused by crop raiders				
	Olive Baboon	Bush Pig	Warthog	G. Monkey	Porcupine
Bonche	107	62	50	20	26
Chala	56	53	35	19	10
Seke	34	34	25	19	18
Wanja	68	49	43	23	20
Gado	35	35	33	24	14
Mean	60[a]	46.6[b]	37.2[c]	21[d]	17.6[d]
Std. D	29.9	12	9.6	2.3	6.1

*Means having the same letter have no significant difference

Table 4: Damage events caused by crop raiders in the sample sites

Crop raiders	Sample Site and damage event registered				
	Bonche	chala	Seke	Wanja	Gado
Olive Baboon	107	56	34	68	35
Bush Pig	62	53	34	49	35
Warthog	50	35	25	43	33
Grivet Monkey	20	19	19	23	24
Porcupine	26	10	18	20	14
Mean	53[a]	34.6[c]	26[d]	40.6[b]	28[d]
Std. D	34.7	20.2	7.7	19.7	9.1

*Means having the same letter have no significant difference

There was a significant negative correlation between the number of damage event and the distance of the study village from forest edge (P <0.05(0.046). The study began by hypothesizing a negative relationship between

frequency of damage event and the distance of the study village from forest edge. As the distance of study village from forest edge decreased damage event registered was high and vise verse. There was a significant negative correlation between the number of damage event registered and family size of the respondent (P=0.05). Damage event registered more in farm land of a farmer having less than four family members than for those having six and above families and the Pearson Correlation value were (-0 .879) (Table 5).

Table 5: Correlation of damage event with family size and distance of study site from forest

	Study site	Damage event	Family size
Study site	1	-.283*	
Damage event	-.283*	1	-.879*
Family size		-.879*	1

Out of 6500m^2 sample taken crop land for direct observationabout 3581m^2 crop lands were damaged by crop raiders during 912 damage events. The size of damaged area of maize, teff and sorghum were 2025 m^2, 1189 m^2 and 367m^2 respectively (Table 6). Maize were damaged by all the five crop raiders throughout its growth stage than teff and sorghum and this was the main reason for that more damage was registered during present study. This result is in agreement with [16] who report land covered by Maize is most raided and farmers incurred huge financial losses due to crop raiding (47.19%) in Kenya.

Table 6: Total damaged area (m^2) recorded in three crop type of sampled area

Sample site	Area of crop damaged in (m^2)		
	Maize	Teff	Sorghum
Bonche	570	420	No
Chala	365	250	No
Seke	275	108	78
Wanja	476	290	190
Gado	339	121	99
Mean	405	237.8	122
Std. D	104.9	115.3	70.7

As calculated based on quadrant sampling, from 2500m^2 maize, 2500m^{2}teff and 1500m^2 sorghum sample taken farm land about, 6300kg maize, 2500kg teff and 2700kg sorghum yield were expected. The estimated yield loss of the three crops namely maize, teff and sorghum due to crop raiding wild animals were about 695kg. The loss covers 6.04% of the total annual production of the total sampled area of the three crops.

The maximum loss was registered on maize crop which covers 73.4 % of the total loss occurred. The loss of teff and sorghum were about 17% and 9.5% respectively from the total loss. The main reason was due to that maize crop weather ripe or/and dried, it was the most frequently eaten crop by crop raiders (Warren, 2008). This result was in agreement with finding of [16, 6].

As crops in kg for all sites compared significant difference was found in the amount of crop lost between all site (P = 0.016) (Table 7). At percent the highest loss was occurred in Bonche and Wanja which covers 26.76% and 26.3% of the total loss respectively. The percentage of crop loss increase as the distance between forest edge and study village decrease which are inversely related. In monitory term, the overall loss to farmers in the sampled area was estimated to be 2448 ETB, 1190 ETB and 429 ETB per sampled farm land of Maize, Teff and Sorghum, respectively which represents 8.1%, 4.76% and 2.4 % of the monitory value of the annual production of the sampled area of the three crops respectively.

The result was in agreement with finding of [9] who reported that farms most at risk to losses of crop were near to the forest edge than the far from the forest. Whereas disagreed with finding of [10] who reported Farmland at a distance of 3.1–5.0 km experienced more conflict than farmland at a distance 0–1.0 km from NNP (Nagarahole National Park) India.

Table 7: Amount of crops loss in kg in each sample site

Crop lost (Kg)	Study Sites				
	Bonche	Chala	Seke	Wanja	Gado
Maize	144	92	69	120	85
Teff	42	25	10.8	29	12
sorghum	0	0	14	34	18
Mean	62[a]	39[b]	31[c]	61[a]	38[b]
Std. D	60.4	38	26.7	51.2	30.8

[*]Means having the same letter have no significant difference

3.3 Livestock depredation

Even though, there were carnivores in the study area, like leopard, common jackal, hyaena, and lion, the response of all respondent showed that there was no any livestock predation caused by those carnivores. Respondents report that there was no damaged livestock by wild animals in the study area. The most predators on small ruminant and chickens, during the present study, were Olive Baboons.

Based on respondents' response the killed sheep, goat and chickens between January 2010 and 2013 were 213. Of this about 34.3%, 27.7%, 17.4%, 12%, and 8.5% were caused in Bonche, Wanja, Chala, Gado and Seke respectively. Out of the total kills caused by Olive Baboon in the last three years, about 60% were on chickens

and 23.9% were on goat whereas 15.9% were on sheep. During present study no domestic animals were killed by wild animals in Agalo sites.

Market value of livestock was varied depending on species, age, and sex of the animals. On the base of local market, adult males and adult females differed in the market value. The market value for present estimation was the average of the three years market value. The economic loss due to depredations caused by Olive Baboon in the last three years on goat, sheep and chicken was 27,420 ETB (Table 8). Damage on goats and sheep accounted for a loss of 13550 ETB (49.4%) and 11950 ETB (43.58%) respectively. Whereas damage on chicken caused 1920 ETB loss which represents 7% of the total loss happened.

Table 8: Monitory losses of chicken, goat and sheep killed by Olive baboon between January 2010 and 2013 on bases of respondent response (ETB).

Livestock		Unit price	Respective no of each age category	Total price
Chicken		15	128	1920
Goat	Adult male	600	4	2400
	Adult female	450	7	3150
	Young	200	40	8000
Sheep	Adult male	800	3	2400
	Adult female	550	6	3300
	Young	250	25	6250
Total				27,420

3.4 Traditional Methods Used by Farmers to Defend Crop Raiders from Their Crop

During the present study respondents used different methods to defend crop raider from their crop and include guarding, chasing, live fencing, scarecrow and smoking. There was significant difference between respondents ($\chi 2 = 74.93$, df = 7, $P < 0.05(0.000)$ in using the different traditional methods in which 30% of the respondents were used guarding for their crop (Fig. 2), whereas 0.8% were used smoking to repeal the crop raiders from their crop mostly in the night time which was the highest and the lowest respectively. Most respondents reported that as they guarded their crops throughout crop growing season. Chasing and fencing were also the second and the third important methods respectively. Smoking and scarecrow were also used to as supplementary (Fig. 3). This result agree with the finding of [30, 31 and 32] who founds that guarding and chasing away of animals was ranked first and second in protecting crop raiders from crops.

On sampled site based, 52.6% of the respondents from Bonche, 47.6% from Wanja, 40 % from Chala, 10.5% from Seke and 30 % from Gado stated that guarding was the most and effective protective method to minimize the loss of their crop from crop raider. This indicates that as the farm land close to the edge of forest, it needs strict fellow up to reduce crop depredation. Respondents from all sample villages except Agalo used other methods as supplementary, but respondents from Agalo reported that there is no need of crop keeping method hence there was no crop raider in their area (Table 9).

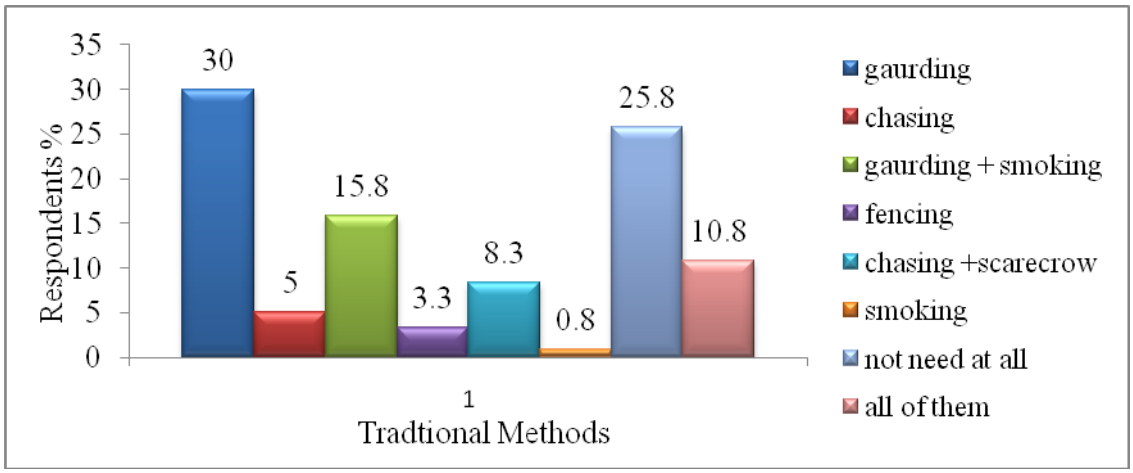

Figure 2: Percentage of respondents thus used different traditional methods.

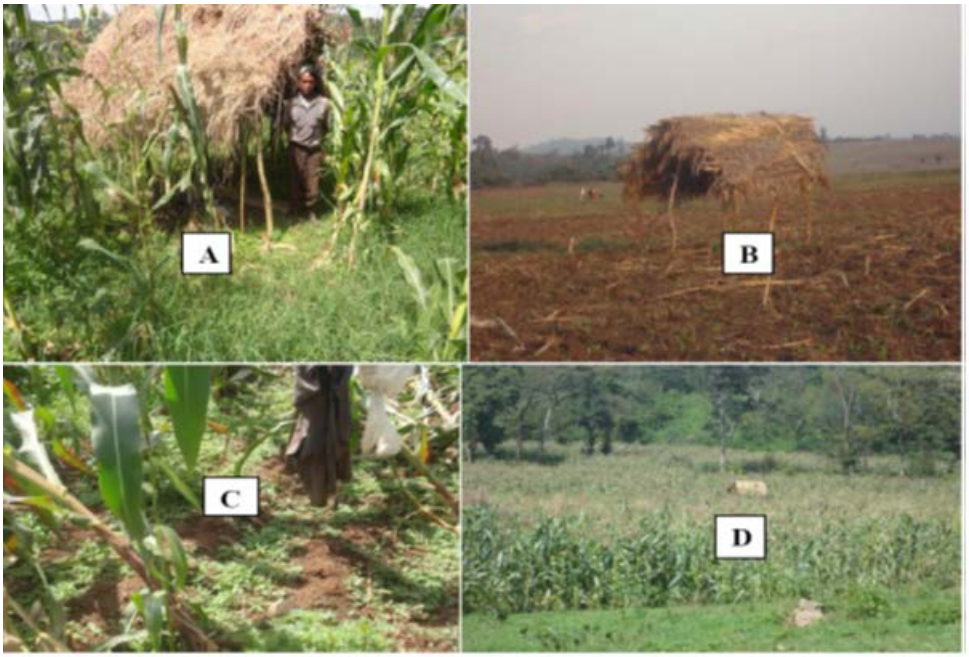

Figure 3: Traditional method used by local farmers to defend crop raider

Table 9: Method of crop protection against crop raider in each study site

Village	No	Guarding	Chasing	Guarding & smoking	Live fencing	Chasing & scarecrow	Smoking	not at all	all
Bonche	19	10	0	5	0	0	0	0	4
Chala	20	8	3	4	1	1	0	0	3
Seke	19	2	3	0	0	4	0	10	0
Wanja	21	10	0	4	1	3	0	0	3
Gado	20	6	0	5	2	3	1	0	3
Agalo	21	0	0	0	0	0	0	21	0
Total	120	36	6	18	4	11	1	31	13

Sampled respondents proposed different management options to overcome crop damage caused by crop raiders. There were significant difference ($\chi 2 = 29.4$, df = 5, $P < 0.05$ (0.000) among respondents on their proposed mechanisms to overcome crop damage. Of the total household interviewed on average about 30.8 % of the respondents suggested it is better to use traditional methods like guarding, chasing, live fencing, scarecrow, and smoking. While 20.8% of the respondents suggest keeping wild animals' habitat intact whereas 16.8% of them suggested compensation of the damaged crop from the government and investors who invest in forest land around the study area. Then they planned to change their farming system to perennial crops. About 10.9% of them proposed reducing their number by killing as a solution and the remaining 4% of the respondents reply not have any response (Table 10).

Table 10: Management options proposed by respondents' to overcome resource damage by wild animals

Sampled Villages	Suggested mechanisms by respondents and number of HH respond (%)					
	using traditional methods	keep habitat intact	compensations	changing farming system	reducing their no	no response
Bonche	26.3	21	21.1	10.5	15.8	5
Chala	30	15	25	15	10	5
Seke	36.8	21	15.8	15.8	10.5	0
Wanja	23.8	19	9.5	23.8	14.3	9.5
Gado	30	20	20	15	10	5
Agalo	38	28.6	9.5	19	4.8	0
Mean	30.8	20.8	16.8	16.5	10.9	4

4. Conclusions

The present study identified Olive Baboon and Bush Pig as the main damage causing wild animals. Olive Baboon was cause damage day time whereas Bush Pig caused damage in the night time. Even though not series as Olive Baboon and Bush Pig; Warthog, Grivet Monkey and Porcupine were caused considerable damage. Crop raiders cause significant loss on farmers' production. Maize was the highest vulnerable crop to be damaged whereas chickens, goat and sheep were the most vulnerable livestock. The trend of crop damage was increasing from time to time.

In all sampled sites damage events were caused by the listed crop raiders. Olive Baboon caused the greatest damage events. Crop raiders more frequently visit farm near to the forest. On the bases of sample land taken for direct observation, of the total expected yield about 6.04% was lost due to crop raiding wild animals. The key crop raider protection methods in the study area were guarding and chasing. Farmer's also used fencing, scarecrow and smoking to defend crop raiders from their crop.

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References

[1] E. Gandiwa, N. P. Gandiwa, ''Living with wildlife and associated conflicts in a contested area within the Northern National Park, Zimbabwe''. *Journal of Sustainable Development in Africa.* Volume 14, No.6, 2012) *ISSN: 1520-5509*. 2012

[2] M. Joseline, ''The impact of crop raiding by wild animals from Bugoma forest reserve on farmers' livelihoods''. A research thesis submitted to Makerere University Institute of Environment and Natural Resource (MUIENR) in partial fulfillment of the requirement for the award of the degree of Master of Science in Environment and Natural Resource of Makerereuniversity. 2010

[3] IUCN, ''Preventing and mitigating Human-Wildlife conflicts: WPC Recommendation'' V.20. 2005

[4] L. Naught on-Treves, Farming the forest edge vulnerable places and people around Kibale national park, Uganda . *The Geographical Review*87 (I): 27-46. 1999

[5] M. De Beenhouwer, ''Effects of habitat fragmentation and coffee cultivation on the of epiphytic orchids in Ethiopian Afromontane forests. Dissertations presented in fulfillment of the requirements for the degree of master in biology''.Faculty of Science Department of Biology Plant *Systematic and Ecology Section*. 2011

[6] Y. Warren, ''Crop-raiding Baboons (*Papio Anubis*) and defensive farmers: A West African Perspective. School of Human and Life Sciences, Whiteland College, Roehampton University, Holybourne Avenue, LondonSW15 4JD , *West African Journal of AppliedEcology*,vol.14**.**www.peapleandwildlife.org.uk/crmanuals/CropraidingPrimatesP&WManual''. 2008

[7] Fungo, A.,A Review Crop Raiding Around Protected Areas: Nature, Control and Research Gaps. Department of Forest Biology and Ecosystems Management, Makerere University, P.O. Box 7062, Kampala, Uganda.*Environmental Research Journal* 5 (2): 87-92, ISSN: 1994-5396. 2011

[8] E. Fairet, M. Magu, ''Vulnerability to crop-raiding: an interdisciplinary investigation in Loango National Park, Gabon''. Durham theses, Durham University. Available at Durham E-Theses Online: http://etheses.dur.ac.uk/6399. 2012

[9] M .C. Hill, ''Conflict of Interest between People and Baboons: Crop Raiding in Uganda''. *International Journal of Primatology, Vol. 21, No. 2.* 2000

[10] S. Gubbi, Patterns and correlates of human–Elephant conflict around a south Indian reserve. Biol, Conserv.doi:10.1016/j.biocon.2012.01.046. 2012

[11] K. Kate, ''Possible strategies/practices in reducing wild animal (Primate) crop raids in unprotected areas in Hoima, District, conducted in two Sub-Counties in Hoima District'. Uganda. 2012

[12]AfeworkBekele, YosefMamo and DerejeYazezew, ''Population estimation of Menelik's (*Tragelaphusscriptusmeneliki, Neumann* 1902) from denkoro forest proposed National park, Northern Ethiopia''. *International Journal of Ecology and Environmental Science* 37(1):1-13, Addis Ababa university department of Biology, Ethiopia. 2011

[13] MelakuTefera, ''Wildlife in Ethiopia: endemic large mammals''.College of Veterinary Medicine. P.O. Box: 144, Haramaya University, Ethiopia, Tel: +251- 0914 722459 / 251-255, E-mail: melaku22@yahoo.com. 108 World Journal of Zoology 6 (2): 108-116. 2011

[14] NBSAP, ''Natinal Biodiversity Strategy and action plan''. IBC, Addis Ababa. 2003.

[15] S. Kivai, ''Are the Endemic and Endangered Tana River primate's culprits of crop raiding?, Evaluating Human – Nonhuman primate conflict status around Tana River Primate Reserve, in Kenya''.Institute of Primate Research, P.O Box 24481, Nairobi, Kenya. 2010

[16] Hill, F., Osborn and A. J. Plumptre, ''Human Wildlife Conflict: Identifying the problem and possible solutions'', *Albertine Rift Technical Report Series* Vol. 1, Wildlife Conservation Society. 2002.

[17] F. Madden, ''The growing conflict between humans and wildlife: law and policy as contributing and mitigating factors''. *Journal of International Wildlife Law & Policy*, 11:189–206. 2008

[18] Mwamidi, A. Nunow, and S. Mwasi, ''The Use of Indigenous Knowledge In Minimizing Human-Wildlife Conflict: The Case of Taita Community, Kenya''. *International Journal of Current Research* Vol. 4, Issue, 02, Pp.026-030. 2012

[19] Quirin, ''Crop raiding by wild vertebrates in the Illubabor Zone, Ethiopia, A report submitted in partial fulfillment of the Post-graduate Diploma in *Wildlife Management* University of Otago, Department of Zoology. New Zealand, Recommendation''.*Pachyderm* 28**:** 68-72. 2005.

[20] E., Ellis, S. Goldewijk, D. Siebert, N. Ramankutty, ''Anthropogenic transformation of the biomes, 1700 to 2000''. *Global Ecology and Biogeography* 19:589–606 http://dx.doi.org/10.1111/j.1466-8238.2010.00540. 2010

[21] Strum, ''The Development of Primate Raiding: Implications for Management and Conservation. J. Primatol (2010) 31:133–156 DOI 10.1007/s10764-009-9387-5. 2010

[22] DemekeDatiko and AfeworkBekele, ''Population status and human impact on the endangered Swayne's hartebeest (*Alcelaphusbuselaphusswaynei*) in Nechisar plains, park, Ethiopia''. Afr. J. Ecol., 49:311-319. 2011

[24] Tewodros Kumssa and AfeworkBekele, ''Human-wildlife conflict and population status of Swayne's Hartebeest (*Alcelaphusbuselaphusswaynei*) in Senkele Swayne's Hartebeest sanctuary''. Master Thesis in Biology (*Ecological and Systematic Zoology*), Ethiopia. 2008

[25] FeyeraAbdena, ''Floristic composition and structure of vegetation of Chato natural forest in HoroGuduruWollega Zone, Oromia National Regional State, west Ethiopia''. Addis Ababa University, school of graduate studies Department of biology. 2010

[26] G. K,. Rugunda, ''Crop raiding around lake Mburo National park, Uganda Department of Biology Mbrara university of science and technology Uganda''.*African journal of ecology*. 2004

[27] M. Tweheyo, D. Tumusiime, N. Turyahabwe, Asiimwe, A and Orikiriza,L , ''Wildlife damage and control methods around Lake Mburo National Park Uganda''. *International Journal of Pest Management* 58:1, 25-31. 2011

[28]A. Blair, ''Human-wildlife conflict in Laikipia north, Kenya: comparing official reports with the experiences of Maasai pastoralists a thesis submitted to McGill University in partial fulfillment of the requirements of the degree of Master of Science''. Department of Geography McGill University, Montreal. 2008

[29] J. Bartlett, W. Joe, and C. Chadwick, '' Research: Determining Appropriate Sample Size in Survey Research''. *Information Technology, Learning, and Performance Journal*, 19(1) pp.43-50. 2001

[30] J. Hanks, ''Mitigation of human–elephant conflict in the Kavango-Zambezi Transfrontier Conservation Area, with particular reference to the use of chili peppers''. Cape Town: *Conservation International*. 2006

[31] T. Johansson, ''The Spatial dimension of Human-Wildlife conflicts, Discoveries of New Animal Geography''.University of Helsinki, *Finland.tino.johansson@helsinki.fi*. 2002

[32] E. Eniang, H. M. Ijeomah, G. Okeyoyin, and A. E. Uwatt, Assessment of human wildlife conflicts in Filinga Range of GashakaGumti National Park, Nigeria. 2011