

Full Length Research Paper

Human-wildlife conflict around Midre-Kebid Abo Monastery, Gurage Zone, Southwest Ethiopia

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This human-wildlife conflict study was carried out around Midre-Kebid Abo Monastery. A descriptive survey design method was used and both qualitative and quantitative data were collected using questionnaires. Field experiment was carried out on two selected crops - maize and enset, to estimate crop damage by wild animals. Resource competition (46%), increased wildlife population (42.5%) and livestock populations (11.5%) were the major causes of conflict identified in the area. Wheat and maize were the most affected crops in the area with an estimate loss of 155.29 ± 12 /kg/year and 106.15 ± 12.3 /kg/year, respectively. The average loss of enset obtained from estimation of 0.36 ha in four counts was 36 kg. On the other hand, the average loss of maize from estimation of 0.12 ha in four counts was 48 cobs (9.6 kg). Therefore, estimated damage based on the total coverage of enset (32 ha) and maize (42 ha) has become 3200 and 3360 kg, respectively. The most known problematic wild animals in the study area were apes (86.2%) followed by monkey (71.3%) and hyena (56.3%). Albeit there is an intense human-wildlife conflict in the study area, majority of the respondents (64.5%) have positive perception towards wildlife conservation. Different crop/livestock protection mechanisms, including guarding, chasing, hunting, fencing, cooperative guarding, guarding using dogs, trapping and scarecrow are used by the local community. The use unpalatable crops as buffer crops enforce environment and forest related laws and local government engagement in creating awareness about wildlife conservation and compensatory schemes are important to lessen the problem.

Key words: Crop loss, Human-Wildlife Conflict, Midre-kebid Monastery.

INTRODUCTION

Human-wildlife conflict is any interaction where there is an overlap between wildlife needs and human needs that resulted in costs to residents and wild animals (World Park Congress, 2003). It is a rising global problem, which is not restricted to particular geographical regions or climatic conditions, but it is common to all

areas where wildlife and human populations co-exist and share limited resources (Emmanuel and Furaha, 2016). Direct contact with wildlife occurs in both urban and rural areas, but it is more common in rural areas where wildlife population density is higher. The major reasons for the occurrence of human wildlife conflict

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include: Human population growth, land use transformation, species habitat loss, degradation and fragmentation, growing interest in ecotourism, increasing livestock population and competitive exclusion of wild herbivores and increasing wildlife population (Decker et al., 2002).

Human-wildlife conflict lessens human welfare, health and safety and has economic and social costs. The economic costs are manifested through destruction and damage to property and infrastructure. Social destruction occurs when family members guard crops from crop raider animals that separate families, because males are involved guarding at night and school children during the day, thus preventing them from going to school as they engage in guarding (Griffiths and Southery, 1995). On the other scenario, human-wildlife conflict ranked among the main threats of biodiversity conservation as species most exposed to conflict are more vulnerable to extinction (Ogada et al., 2003).

Human-wildlife conflict exists in different forms all over the world and is more experienced in developing countries (Leta et al., 2016). Crop raiding and livestock depredation are not a new phenomenon; they have most likely been occurring since humans had started practicing agriculture. Different crops and livestock are targeted by marauding animals. In some areas, crop raiding by wild animals is a frequent cause of major conflict between wildlife and villagers. This is especially true in areas close to protected areas, which harbor large populations of wildlife (Sukumar, 1989). Similar to most developing nations, in Ethiopia, conflict between human and wildlife is a common concern in different parts of the country where people depend on agriculture. Much prior research that has been carried out by different scholars also verified this concern (Bezihalem et al., 2016; Yigrem et al., 2016; Leta et al., 2015, 2016; Muluken, 2014; Reddy and Workneh, 2014; Adem, 2009; Mesele, 2006). In the present study area, agriculture and livestock production are the major sources of livelihood. Maize, wheat, bean, potato and enset are major crops grown in the area. Hence, the local communities are suffering with crop raiders. Different wild animals are known to be involved in crop raiding and livestock depredation, albeit they are not systematically investigated so far. Therefore, conducting scientific investigation about human-wildlife conflict in the area has far reaching importance for the co-existence of both the local community and wildlife.

MATERIALS AND METHODS

Description of the study area

Gurage zone, which is part of the Southern Nations Nationalities and People's Region (SNNPR), is located in the southwest part of Ethiopia. The zone is bounded by Hadiya, Kenbata, Alaba and Tenbaro (KAT) zones in the south and Yem special woreda in southwest. It is also bounded by the Oromia Regional state in the northwest and east (PEDD, 1998). The zone is divided into 13

woredas and two city administrations - Wolkite and Butajira. The total population in the zone is 1,279,646 of which 622,078 are males and 657,568 are females (CSA, 2007). Majority of the people (95%) live in rural areas engaged in agriculture. The remaining 5% live in urban areas (PEDD, 1998).

Sodo woreda is located in the Eastern part of Gurage zone, at 8°20'46.58" latitude and 38°34'33.83" longitude (Figure 1). It is bounded by Oromia regional state from the northwest and east and meskan woreda (district) from southwest. The main town of sodo woreda is named Buee. It is 103 km from Addis Ababa, 261 km from wolkite and 198 km from Hawassa. According to the last census in 2007, the total population of sodo woreda was 134,683 of which 67,130 were males and 67,553 were females (CSA, 2007). But according to the recent report from Sodo woreda finance and economic development office, the total population is estimated to be 180,263 of which 88,798 are males and 91,465 are females (SWFEDO, 2015). The total area of the woreda is 88,553.3 hectares. Its altitude is between 1800 and 3040 m above sea level and agro-climatically it is classified into Weina-Dega and Dega in which the average temperature ranges between 7.5 and 17.5°C. Majority (93%) of the inhabitants practice an orthodox Christianity faith. The Woreda is primarily inhabited by the Sodo Gurage and a small number of Oromo and Amhara ethnic groups. There are 4 urban and 54 rural kebeles under the district. The rural part of the district includes both highland and lowland kebeles. Moreover, 90.6% of the population is dependent on farming while 9.4% lives in town engaged in different jobs (SNNPR, CSA, 2012).

Midre-kebid Abo Monastery is located 18 km east of Buee. It is a historical and religious place. A big religious ceremony is celebrated twice a year. It is found 2400 meters above sea level. In the monastery compound different plant and animal species are found. According to CSA (2007) report, the total population which lives around Midire-kebid Abo monastery (Sewatina Gedam Kebele) was 1952, of which 971 are males and 981 are females. The total area coverage (including Midire-kebid Abo monastery) is about 1245 ha.

Research design

In this study a descriptive survey design method was used. Both qualitative and quantitative data were collected using questionnaires. Field observation was also used to gather data on crop damage.

Data type and source

During the study both primary and secondary data were used. Primary data was collected from sample households and field observation; whereas, secondary data was collected from office reports, published and/or unpublished articles related to the study and websites. A list of total households for the study villages was obtained from the respective kebele administration.

Sample size and sampling technique

From the total of 5 villages in the study area, 3 villages (Sewati, Geferssa and Wareni with a total household population of 99, 97 and 95, respectively) were randomly selected. Following Gay (1996), a sampling technique for small populations, 30% of the total households (total $N = 291$) was taken as a sample population ($n = 87$). Thereafter, an equal number of randomly-selected households ($n = 29$) were identified from each of the villages by using a systematic random sampling technique ($K = \frac{N}{n}$, where K is the sampling frame, N is the total number of households in the village and n is the sample size allocated in the village).

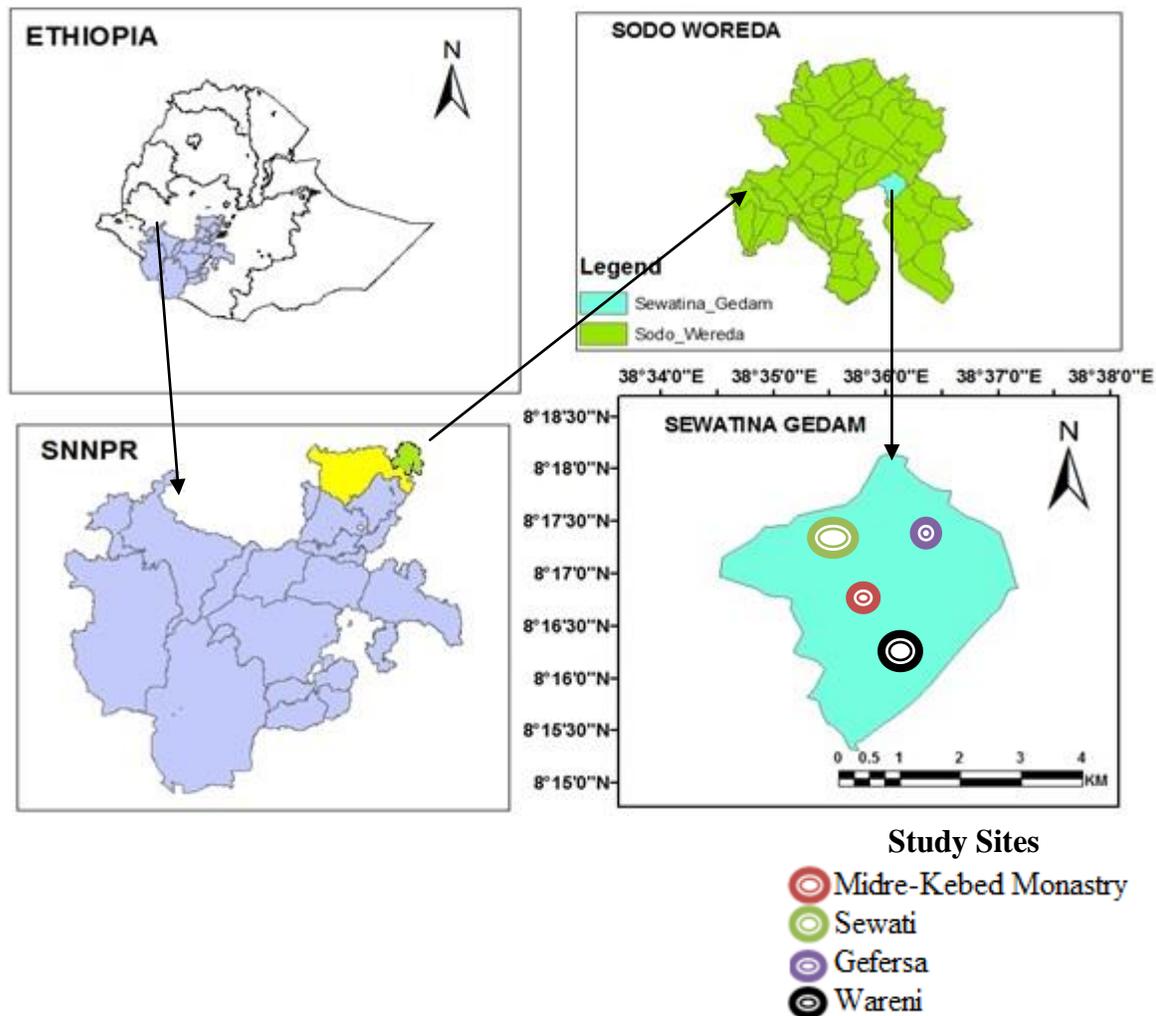


Figure 1. Map of the study area.

Data collection tools

In order to collect both qualitative and quantitative data, questionnaires, interviews and observation were used.

Questionnaire

The questionnaire integrated both closed and open-ended questions. Inconsistencies and/or clarifications in the text were modified based on pre-testing.

Observation

Field observation was carried out to estimate the extent of crop damage by wild animals. Estimation was carried out for two selected crops namely enset and maize. Three sites were selected randomly. For enset a grid was marked in each site with an area of 1200 m² (40 m × 30 m). Each grid was further divided into four equal parts (units) with an area of 300 m² (0.03 ha). For maize, a grid with an area of 400 m² (20 m × 20 m) was marked in each site. Each grid was further divided into two equal parts with an area of

200 m² (0.02 ha). Damage estimation was conducted four times during the month of June for enset and maize. The mean damage of each crop was calculated in kg/day. Current market price was used to determine the cost of each crop type 5 Birr/kg and 7 Birr/kg for enset and maize, respectively. Finally, the loss of each type of crop for the study sites (3600 m² for enset and 1200 m² for maize) was calculated.

Data analysis

Based on the objective of the study and nature of the data collected, different data analysis techniques were employed. Data analysis software – SPSS (Version 21.0) was used. One-way ANOVA was used to compare the mean differences of family size, farm land holding, annual crop production, owning of livestock, owning of private grazing land, loss of maize, wheat, bean, potato and enset between villages. Non-parametric statistics (one sample) was used to compare responses about causes of human-wildlife conflict and the problems caused by wildlife in each village and the study area. Non-parametric statistics (related samples) was also used to compare differences in respondents attitude between villages towards wildlife conservation. Graphs, tables and figures

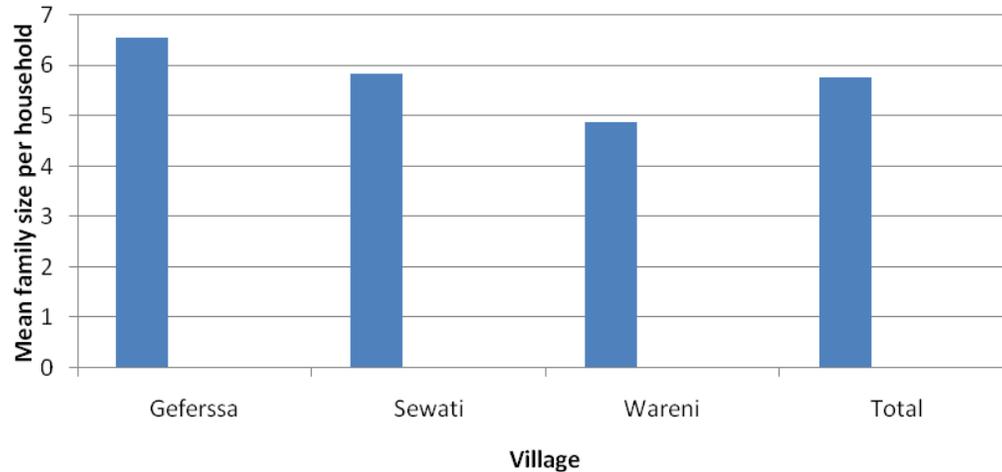


Figure 2. Mean family size per household.

Table 1. Educational level of respondents.

Village	Have no formal education (%)	Primary education (%)	Secondary education (%)	College/university education (%)
Geferssa	48.3	51.7	0	0
Sewati	58.6	41.4	0	0
Wareni	48.3	51.7	0	0
Total	51.7	48.3	0	0

were used to summarize and present the data.

RESULTS

Socio-demographic profile

A majority (47.13%) of the respondents were in the age category between 21 and 40. The age categories of 41-61 and above 60 were also represented by 37.93 and 14.94% of the total respondents, respectively. No respondents of age category below 20 were found. With regard to the gender composition of respondents involved in the study, of the total 87 respondents, 86.2% ($n = 75$) were males whereas 13.8% ($n = 12$) were females. The marital status of the respondents was categorized into four – married, single, divorced and widowed. Thus, most of the respondents (93.1%) were married and only 6.9% of the total respondents were found to be bachelor. Divorced and widowed respondents were not present in the sample population.

Family size of respondents ranged between 2 to 12 per household in the study area. Average family size was 5.77 (± 0.23). The mean number of family size varied across villages. For instance, there was a significant difference in the mean of family size between sewati and

wareni ($F = 6.84$, $df = 6, 22$, $p < 0.05$) (Figure 2).

Concerning the educational level of the respondents, the highest level of formal education considering all the three villages was primary education (48.3%). In each sampled villages, this was 51.7, 41.4 and 51.7% for Geferssa, Sewati, and Wareni, respectively. On the other hand, 51.7% of the total sample households did not attend any formal education. This was 48.3, 58.6 and 48.3% for Geferssa, Sewati, and Wareni villages, respectively (Table 1).

Farmland holding of respondents ranged between 0.13 and 5 ha. Average farmland size was 2 ± 0.12 ha per household. Farmland holdings differed among villages. Thus, there was a significant difference in the mean size of farmland between Wareni and Geferssa villages ($F = 3.95$, $df = 5, 23$, $p < 0.05$) (Figure 3).

In the study area, farmers have grown different types of crops, viz. wheat, maize, bean, teff, potato, pea, enset, barley and sorghum. According to respondents' responses, as well as field observation, wheat (100%), maize (83.91%) and bean (72.41%) were the top three crop types widely cultivated in all sampled villages. Sorghum (4.53%) was the least cultivated crop type in the study area (Table 2).

The amount of crop production in the study area ranged between 2 to 60 quintals per household per year.

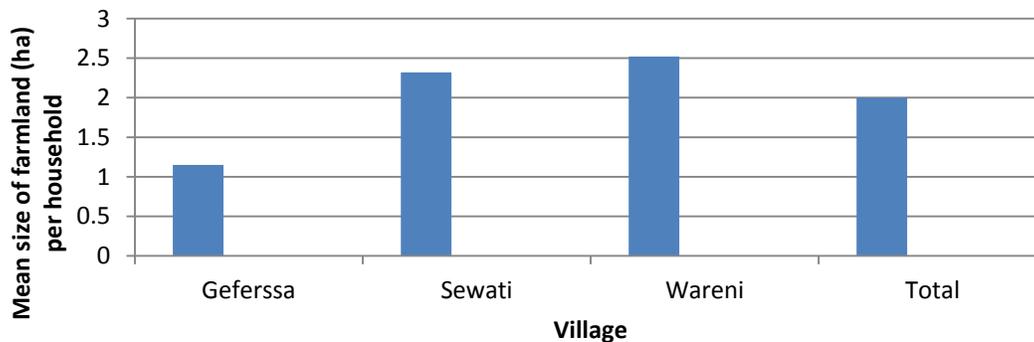


Figure 3. Mean size of farmland per household.

Table 2. Type of crops grown by farmers (based on respondents response and field observation).

Village	N	Wheat (%)	Maize (%)	Bean (%)	Teff (%)	Potato (%)	Pea (%)	Enset (%)	Barley (%)	Sorghum (%)
Geferssa	29	100	65.52	65.52	65.52	13.78	41.38	48.28	6.8	0
Sewati	29	100	93.1	65.52	34.48	6.8	13.76	41.38	65.52	6.8
Wareni	29	100	93.1	86.21	65.52	41.38	0	34.48	6.8	6.8
Total	87	100	83.91	72.41	55.17	20.65	18.38	41.38	26.37	4.53

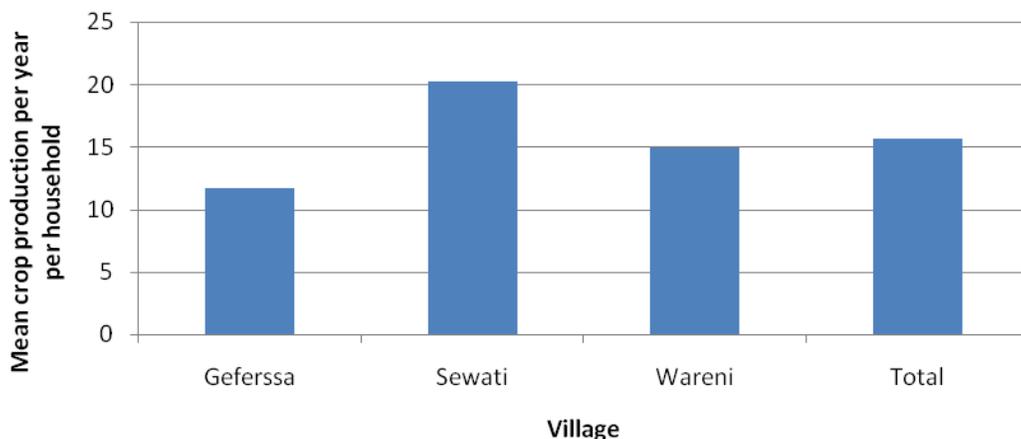


Figure 4. Mean crop production (Kg) per household per year.

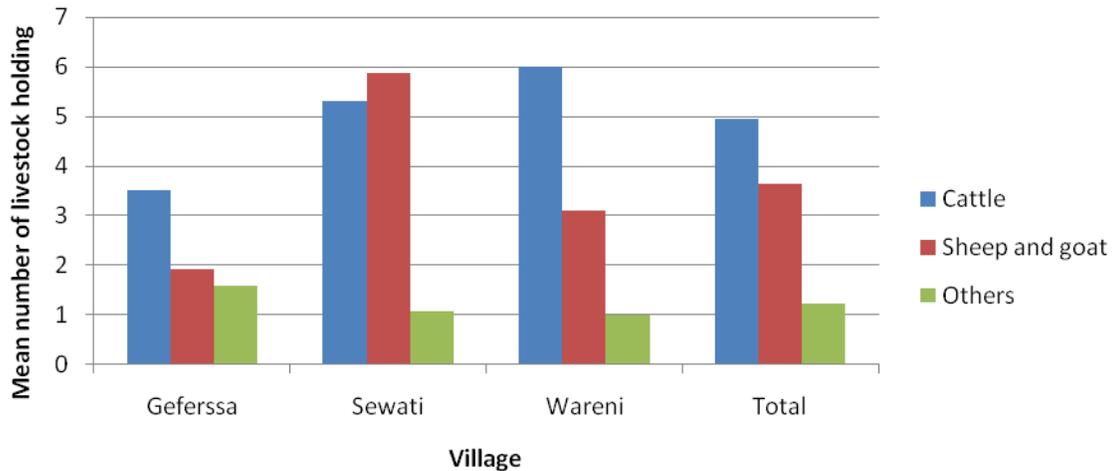
Average crop production per year in the study area was 15.64 ± 1.37 . Production varied among villages. Hence, there was a significant difference between Geferssa and Sewati villages ($F = 5.56$, $df = 8, 20$, $p < 0.05$) (Figure 4).

Among respondents involved in the study, 97.7% had livestock, but the rest 2.3% had no livestock (Table 3). Livestock found in the study area were cattle, sheep, goats, and others (that is, poultry, donkey, etc). The average number of livestock per household was 4.94 ± 0.3 , 3.63 ± 0.3 and 1.22 ± 0.07 for cattle, sheep and goats, respectively. Variation was seen in the mean

number of other livestock and cattle ($F = 3.46$, $df = 2, 84$; $p < 0.05$) and between other livestock and sheep and goats ($F = 5.29$, $df = 2, 84$; $p < 0.05$). But there was no significant variation in the mean number of cattle and sheep and goats ($F = 1.77$, $df = 11, 75$; $p > 0.05$). There was a significant difference in the number of cattle between Geferssa and Wareni ($F = 8.11$, $df = 7, 21$; $p < 0.05$) but the difference between Geferssa and Sewati was not significant ($F = 2.07$, $df = 7, 21$; $p > 0.05$). Moreover, the number of sheep and goats varied across villages. Accordingly, there was significant difference

Table 3. Response about possession of livestock.

Response	Frequency	Percentage
Yes	85	97.7
No	2	2.3
Total	87	100

**Figure 5.** Mean livestock holding per household.**Table 4.** Response about owning of private grazing land.

Response	Frequency	Percentage
Yes	20	22.99
No	67	77.01
Total	87	100

Table 5. Duration of grazing in their private grazing land.

Duration in months	Frequency	Percentage
1 - 3	6	30
3 - 6	6	30
6 - 9	2	10
9 - 12	6	30
Total	20	100

between Geferssa and Sewati ($F = 4.26$, $df = 4, 24$; $p < 0.05$), Geferssa and Wareni ($F = 3.08$, $df = 4, 24$; $p < 0.05$) and Sewati and Wareni ($F = 3.3$, $df = 9, 19$; $p < 0.05$). However, there was no difference in the number of other livestock among villages (Figure 5).

A majority of the respondents in the study area (77.01%) had no private grazing land, whereas the

remaining 22.99% had land (Table 4). However, the maximum size of private grazing land was 0.5 ha.

Respondents who owned private grazing land use the land at different durations within the year. Hence, 30% of the respondents used the grazing land for 1-3, 3-6 or 9-12 months whereas 10% of the respondents used it for 6-9 months (Table 5).

Table 6. Types of wild animals commonly known by respondents.

Types of wild animals mentioned by respondents	Frequency	Percentage
< 3	4	4.6
3 - 4	32	36.8
5 - 6	45	51.7
>6	6	6.9
Total	87	100

Table 7. List of wild animals get in conflict with the local community.

Wild animal	Frequency	Percentage	Rank
Ape	75	86.2	1
Monkey	62	71.3	2
Porcupine	40	46	4
Warthog	8	9.2	7
Fox	14	16.1	6
Hyena	49	56.3	3
Skunk	23	26.4	5
Gazelle	4	4.6	8

Table 8. Major causes of human-wildlife conflict in the study area.

Causes of human – wildlife conflict	Geferssa (%)	Sewati (%)	Wareni (%)	Total (Study area) (%)
Increase in wildlife population	58.6	34.5	34.5	42.5
Increase in livestock population	0	20.7	13.8	11.5
Resource competition between livestock and wild animals	41.4	44.8	51.7	46.0
Others	0	0	0	0
Total	100	100	100	100

Conflict and damage

In order to collect information about types of wild animals found in the study area, respondents were asked to list wild animals commonly found in the locality. Accordingly, 4.6, 36.8, 51.7 and 6.9% of the respondents were able to list less than 3, 3-4, 5-6 and more than 6 types of wild animals, respectively. Therefore, 88.5% of the respondents knew 3-6 different types of wild animals in their locality (Table 6).

Based on respondents' information and field observations, major wild animals found to be in frequent conflict with the local community are: Ape, monkey, porcupine, warthog, fox, hyena, skunk and gazelle. The most known problematic wild animals in the study area were apes (86.2%) followed by monkey (71.3%) and hyena (56.3%). On the other hand, the least identified problematic wild animals were gazelle (4.6%) followed by warthog (9.2%) and fox (16.1%) (Table 7).

Regarding the major causes of human-wildlife conflict in the study area, 46% of the respondents mentioned that resource competition between livestock and wild animals was the major cause. However, wildlife population increment and increase in livestock population were also mentioned as causes by 42.5 and 11.5% of respondents, respectively. Causes of human-wildlife conflict varied significantly in the study area ($p = 0.000$) (Table 8).

Crop damage, livestock depredation and disease transmission were the major types of damages that occurred in the study area by wild animals. Of the total respondents, 59.8% have experienced problem of crop damage, whereas 23 and 17.2% faced disease transmission and livestock predation, respectively. However, in one of the study locations, village-Wareni, livestock predation was not a problem. Problem caused by wildlife varied significantly in Geferssa ($P = 0.003$) and Wareni ($p = 0.026$) but not in Sewati ($p = 0.122$). In general, there was a significant difference in problems

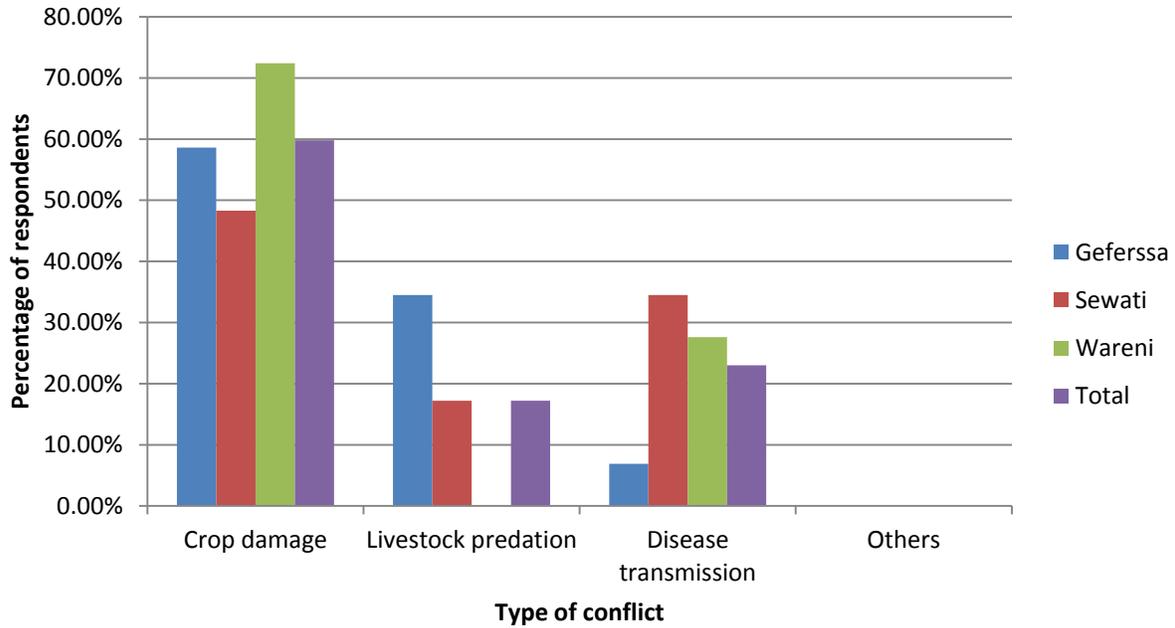


Figure 6. Percentage of respondents that faced problems due to wildlife.



Figure 7. A goat injured by a monkey.

caused by wildlife in the study area ($p = 0.000$) (Figure 6). Sheep, goat, hen, and donkey were livestock most frequently attacked by wild animals in the study area (Figure 7).

The most reported crop riders in Geferssa and Sewati were apes and monkeys, respectively. In Wareni both apes and monkeys were equally important crop riders. Gazelles and warthogs were not reported from Geferssa and Wareni but in a small proportion from Sewati. Overall, the majority of the crop damage in the study area was occurred by ape (83.9%) followed by monkey (71.3%) and porcupine (32.2%). Only 2.3 and 6.9% of the respondents reported crop damage by gazelle and

warthog, respectively (Figure 8).

Based on respondents' responses, the average losses of maize, wheat, bean, potato and enset in kilograms were 106.15 ± 12.3 , 155.29 ± 12 , 57.93 ± 17.7 , 68.39 ± 10.8 and 29.84 ± 7.3 per household per year, respectively (Table 12). There were significant differences in the mean loss of different crop types between villages. Hence, there was significant difference between Geferssa and Wareni ($F = 2.95$, $df = 5, 23$; $p < 0.05$) in maize crop, between Geferssa and Wareni ($F = 3.89$, $df = 6, 22$; $p < 0.05$) in wheat crop, between Sewati and Wareni ($F = 3.62$, $df = 2, 26$; $p < 0.05$) in bean crop, between Geferssa and Wareni ($F = 17.77$, $df = 5, 23$; $p < 0.05$) and Geferssa and

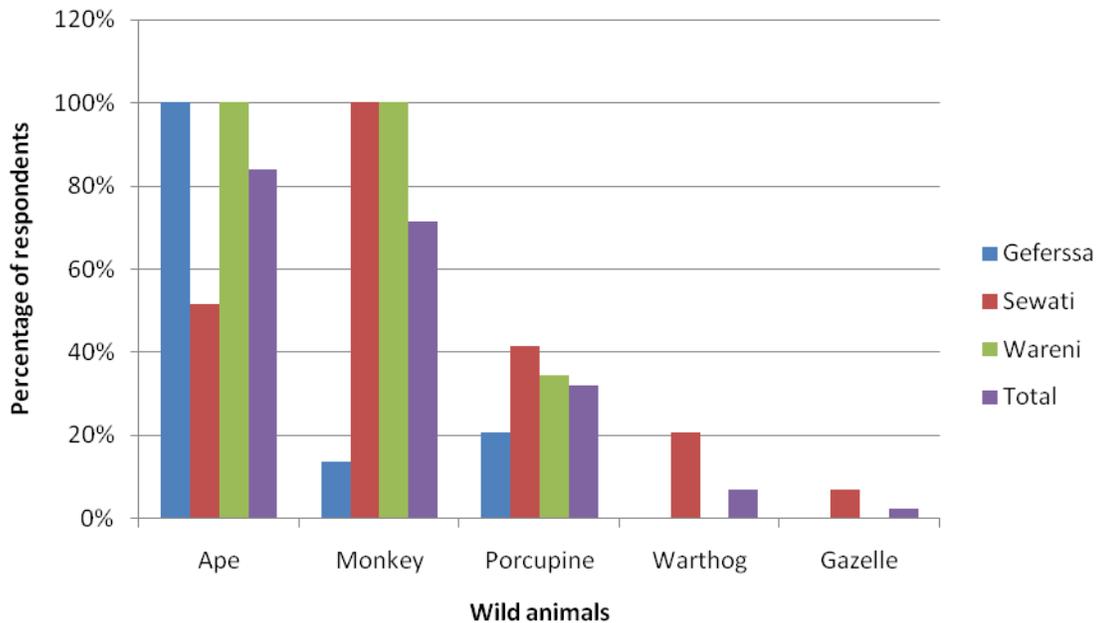


Figure 8. Crop raiders in the study area.



Figure 9. Women working cooperatively to produce 'kocho' from enset.

Sewati ($F= 1.05$, $df= 5, 23$; $p < 0.05$) in enset crop (well known staple food in the study area) (Figure 9). However, the difference in the mean loss of potato between villages was not significant ($p > 0.05$). Generally, the mean loss of all crop types by wild animals accounted for 680.55, 239.48 and 332.76 kg for Geferssa, Sewati and Wareni,

respectively (Table 9). Figures 10 to 12 show crop damage by different animals.

Based on the field experiment, the average loss of enset obtained from estimation of 3600 m² (0.36 ha) in four counts was 36 kg per day or 180 Birr. Hence, estimated damage on enset was amounted to about 3200

Table 9. Average crop loss per household per year.

Crop type	Average crop loss (kg)			Mean
	Geferssa	Sewati	Wareni	
Maize	151.73	81.89	84.83	106.15
Wheat	231.03	115.52	119.31	155.29
Bean	162.06	10	1.72	57.93
Potato	103.45	18.97	82.76	68.39
Enset	32.28	13.10	44.14	29.84
Total	680.55	239.48	332.76	417.6

**Figure 10.** An enset plant whose tuber was damaged by a porcupine.**Figure 11.** A potato plant damaged by an ape.

kg/day or 16000 Birr/day in the whole study area (total enset crop coverage is 32 ha). Estimated loss of enset in the three study villages is given in Table 10. On the other hand, the average loss of maize from estimation of 1200 m² (0.12 ha) in four counts was 48 cobs/day (9.6 kg/day)

or 67.2 Birr/day. Therefore, estimated damage on maize was amounted to about 3360 kg/day or 23520 Birr/day in the whole study area (total maize crop coverage is 42 ha). Estimated loss of maize in the three study villages is given in Table 11.



Figure 12. A maize plant damaged by an ape.

Table 10. Estimated loss of enset in the three sites (with average cost of 5 birr/kg).

Site	Type of crop and damage estimation in kg/day		Total cost in Birr
	Enset		
Geferssa	12		60
Sewati	8		40
Wareni	16		80
Total	36		180

Table 11. Estimated loss of maize in the three sites (with average cost of 7 birr/kg).

Site	Type of crop and damage estimation in kg/day		Total cost in Birr
	Maize		
Geferssa	4		28
Sewati	2.4		16.8
Wareni	3.2		22.4
Total	9.6		67.2

Table 12. Preferred time for wild animals to attack crops or livestock.

Time of attack	Frequency	Percentage
Day	46	52.9
Night	41	47.1
Total	87	100

Crop raiding and/or livestock depredation in the study area occurred both during daytime and at night. However, according to 52.9% of the respondents, day time is mostly preferred by the animals. On the other hand, 47.1% of respondents argued that night is the most preferred (Table 12).

Most of the respondents reported that severe crop damage and/or livestock depredation occurred during the months of September to November (47.13%). However, 19.54, 5.75 and 27.6% of the respondents mentioned that the damage also occurred on the months of December to February, March to May and June to August, respectively

Table 13. Respondents response about months at which severe crop damage/livestock depredation occurred.

Village	Sep-Nov		Dec-Feb		Mar-May		Jun-Aug		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Geferssa	17	58.6	2	6.9	0	0	10	34.5	29	100
Sewati	12	41.4	9	31	2	6.9	6	20.7	29	100
Wareni	12	41.4	6	20.7	3	10.3	8	27.6	29	100
Total	41	47.13	17	19.54	5	5.74	24	27.59	87	100

**Figure 13.** A monkey killed by a boy in vengeance.

(Table 13).

The major human impacts on wildlife identified by respondents were; hunting of wild animals for different purposes, burning and clearing of forests, chasing wild animals to make them abandoned the locality, killing wild animals in retaliation, etc. (Figure 13). Furthermore, 97.7% of the respondents reflected their view that human-wildlife conflict in the locality is increasing (Table 14). These respondents further mentioned that due to the ever-increasing, human-wildlife conflict in the locality, previously well-known carnivores like leopard have now been extirpated.

With regard to reporting the conflict to the concerned governmental authorities, most of the respondents

(88.5%) replied that they did not report at all where as 11.5% argued that they report the case to the local government (Table 15). Reasons for not reporting the case include: remedies given by themselves, they do not know where and to whom to report the case and they believe that reporting will not bring any change.

Perception towards wildlife

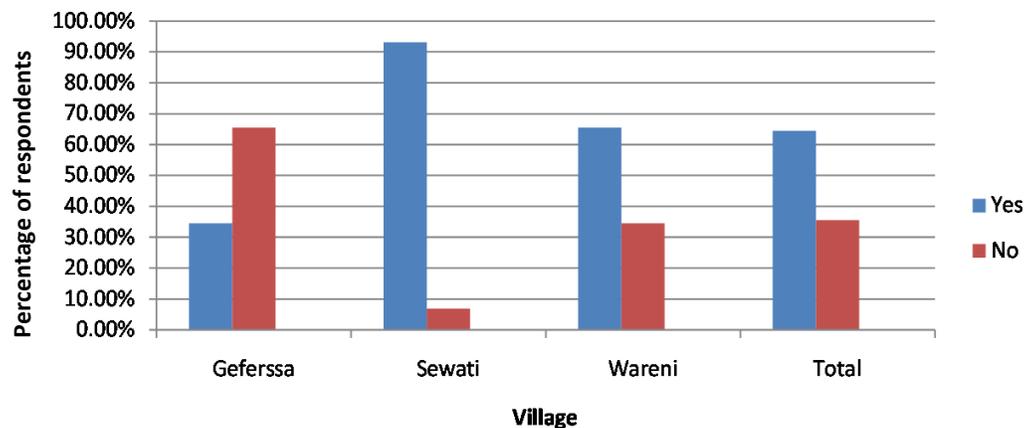
The perception of the respondents towards wildlife was assessed. Accordingly, 64.4% of the respondents had a positive attitude about wildlife, that they thought wildlife conservation is important. On the contrary, 35.6% of the

Table 14. Status of human wildlife conflict in the study area.

Village	N	Increasing		Decreasing		No idea		Total	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Geferssa	29	29	100	0	0	0	0	29	100
Sewati	29	27	93.1	2	6.9	0	0	29	100
Wareni	29	29	100	0	0	0	0	29	100
Total	87	85	97.7	2	2.3	0	0	87	100

Table 15. Reporting the human-wildlife conflict to the concerned authority.

Village	N	Yes		No		Total	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Geferssa	29	0	0	29	100	29	100
Sewati	29	4	13.8	25	86.2	29	100
Wareni	29	6	20.7	23	79.3	29	100
Total	87	10	11.5	77	88.5	87	100

**Figure 14.** Response about the importance of wildlife conservation.

respondents argued that wildlife conservation had no importance. The main reason given for viewing wildlife conservation negatively was due to crop and livestock damage by wild animals. The attitude of the respondents compared across the study villages was highly positive in Sewati (93.1%) followed by Wareni (65.5%). On the other hand, it was highly negative in Geferssa (Figure 14). In addition, there was significant difference in the respondents attitude towards wildlife conservation across Geferssa and Sewati ($p = 0.000$), Wareni and Wewati ($p = 0.008$) and Wareni and Geferssa ($p = 0,004$).

Households strategies to protect crop/livestock from wild animals

In the study area, households used different mechanisms

to protect their crop and livestock from damage by wild animals. Some of these techniques include: Guarding day and night (Figure 15), chasing, hunting, fencing, cooperative guarding, guarding using dogs (Figure 16), trapping (Figure 17) and using scarecrow soaked in naphtha. However, among these methods guarding with or without dogs, trapping and using scarecrow were commonly practiced by most households.

DISCUSSION

Causes of human-wildlife conflict

Human-wildlife conflict arises from a range of direct and indirect negative interactions between humans and wildlife (Ocholla et al., 2013). Habitat modification



Figure 15. A monk living in Midrekebid Abo Monastery guarding farms.



Figure 16. A dog used as fear provoking stimuli to guard crops in farms.

(Owusu and Bakker, 2009), human population expansion (Shibru, 1995; Ferguson, 2009) and climate change (Mustafa et al., 2005) are some among many causes for human-wildlife conflict. In the study area, the major causes of human-wildlife conflict identified were resource competition and increment of wildlife and livestock populations. Among these, resource competition was the most severe cause. As the local community livelihood is

largely based on farming (90.6%) with the average family size of $5.77 (\pm 0.23)$, agricultural expansion that shrinks wildlife habitat is inevitable. Hence, this would ultimately result in an overlap between human and wildlife habitats that could bring direct conflict. As Forthman and Demment (1988) have noted, increase in the human population and the expansion of agricultural land usually forced wildlife into modified habitats. The rise in human



Figure 17. Traps used to catch vertebrate crop pests.

populations undoubtedly led to the expansion of agriculture into areas currently unused (Sillero-Zubiri and Switzer, 2000). Besides, 77.01% of the respondents indicated that they have no private grazing land. Consequently, their livestock directly compete with the free-ranging, wild animals for grazing. Yigrem et al. (2016) indicated that the causes of human-wildlife conflict are mainly wild animals' habitat disturbance, increased subsistence agriculture around forest edges and proximity to natural forest. Similarly, Fernando et al. (2005) identified that human-wildlife conflict occurs mainly because of the loss, degradation and fragmentation of habitats through human activities, such as farmland expansion, logging, animal husbandry and developmental projects.

Wildlife and livestock population increment were also other causes of conflict identified in the study area. Varieties of crops cultivated in the study area, as well as good number of livestock population, might provide an alternative source of food for wild animals that could escalate their population temporarily. Bayani et al. (2016) clarified that in some cases the population status of crop-raiding species can be linked with crop and livestock productivity. Furthermore, pest species are likely to flourish along the edges of natural habitat and agricultural lands, where they can eat both the food available in undisturbed habitats and the crops growing in the adjoining farmland (Sillero-Zubiri and Switzer, 2001). In the study area, 97.7% the respondents had livestock. Thus, livestock production is as common as crop cultivation in the area. Therefore, besides exacerbating the conflict with wild animals through direct competition for resources, some livestock such as sheep, goats and chickens could be victimized by hyena, fox and monkey, if not properly looked after by the households.

Haylegebriel (2015) mentioned that the availability, variability and type of food sources in the area as well as high livestock density can increase human-wildlife conflict.

Damage caused by wild animals

In the study area variety types of crops such as wheat, maize, bean, teff, potato, pea, enset, barley and sorghum are grown. Thus, crop damage was one of the major types of damage occurred in the study area. Ape, monkey, porcupine, warthog, fox, hyena, skunk and gazelle were identified as pest animals in the area. In a similar study in Wondo Genet district, Muluken (2014) reported that the top six animals responsible for the most loss to crops are baboons, warthog, bush pig, vervet monkeys, porcupine and mole rat. Among identified pest animals in the present study, apes and monkeys were the top two known problematic pest animals. This result is in agreement with Strum (1991) who found that primates are particularly serious crop raiders especially due to their intelligence, adaptability and sometimes intimidating behavior. Moreover, Hill (2000) mentioned that primate pests cause more damage because people cannot predict when or whether they will visit an individual farm and that the protection methods available are not considered adequate. On the other hand, porcupines were the third known pest animals in the study area. Respondents mentioned that porcupines mostly damage enset tuber and potato crop in the area. In similar fashion, Andama (1999) noted that porcupines cause intensive damage to crops, and mainly on potatoes.

Maize and wheat were the most affected crop types in the study area (Table 9). Presumably, this is so because

of two reasons, firstly, these crops are widely grown by many households in the area as compared to the other crop types; secondly, they might be more preferred by pest animals due to their palatability and/or nutritious content. Damiba and Ables (1993) had also come to a similar conclusion that production of highly palatable and nutritious seasonal crops such as maize attracts primates and other wild animals. Leta et al. (2015) also reported that not all crops are equally damaged by crop raiders.

In the present study, respondents have estimated the amount of crop loss per annum due to crop raiders (Table 8). However, experimental observation to estimate the damage status has also been carried out on two selected crops - maize and enset. Hence, estimated damage was 3360 kg/day and 3200 kg/day with a worth of 23,520 and 16,000 birr for maize and enset, respectively. This is an indication that crop loss by wild animals in the area is very serious that may result in the local community suffering food insecurity. Moreover, this can reduce peoples' tolerance towards wildlife and may urge them to kill wild animals in retaliation (Figure 17). Hoare (1995) noted that damage caused by problem animals ranges from 10 to 90% depending on location and crop types. Naughton –Treves (1997) observed that crop loss caused by park animals along Kibale National Park boundary is between 4 to 7%. Furthermore, Sillero-Zubiri and Switzer (2001) have estimated crop losses of 19% for maize (range = 7.7-53%) and 25% for cassava (range = 4.5-61%) in the Budongo area. In Ethiopia, Yihune et al. (2005) reported an average crop loss per households of 117 ± 10 kg due to baboons.

Crop raiding and/or livestock depredation in the study area occurred more during the daytime than at night. This might indicate crop and/or livestock protection in the area is not effective as more protection is expected during the day time. Furthermore, except for hyena, fox and porcupine, the other identified animals are diurnal; that are not active during the night. On the other hand, as reported by the respondents, damage by wild animals becomes more severe between September to November. This probably indicates that crops during this period become matured and more attractive to crop raiders.

Reporting the conflict and/or damage caused by wild animals in the study area is very low. Solving the conflict by one's self, lack of awareness where to find assistance, and to whom to report the case, and being despaired on the local government were major causes that hinder people not to report the case. Similarly, Tesfaye (2016) noted that although large numbers of farmers suffered with crop raiding, they failed to report any of the cases to the local government.

Perception towards wildlife

The assessment of peoples' attitudes and perceptions towards conservation has become an important aspect in

many studies of wildlife conservation (Newmark et al., 1993). In the present study, despite 51.7% of the respondents have not attended any formal education (Table 4), their attitude towards wildlife conservation was positive (64.4%). Tessema et al. (2010) noted that educational status is not a sole criteria that determines perception; but there are other socio-demographic factors such as household income levels, age, size of livestock herd, length of residency, gender, sources of income, and household size. In some instances, despite the costs of living with wildlife, some communities have retained a positive attitude towards conservation (Hill, 1997). Similarly, Deresse (2003) mentioned that local communities cannot entirely be antagonistic to wildlife conservation.

In the study area, various methods were used to minimize crop and livestock loss by wild animals such as: Guarding day and night, chasing, hunting, fencing, guarding with/without dogs, trapping, visual stimuli (scarecrows) and traditional chemical repellents (naphtha and soap). Among these, guarding, trapping and using scarecrows are mostly practiced. Mesele (2006) and Naughton-Treves (1997) have also reported that guarding is the most important method to minimize crop damage. In other studies, different protection methods also are reported; for instance, fencing (Ogada *et al*, 2003), using dogs (Castelli and Sleggs, 2000), scarecrows (Heinrich and Craven, 1990) and chemical (Osborn, 2002).

Conclusion

Human-wildlife conflicts have occurred throughout man's prehistory and recorded history. The advent of farming and animal husbandry of the Neolithic Revolution increased the scope of conflict between humans and animals. Human population growth and activities such as agricultural expansion, habitat loss, deforestation, inappropriate site selection for settlement in forested areas and expansion of agricultural activities together have led to increased human encroachment on previously wild and uninhabited areas.

The major causes of human-wildlife conflict identified in the study area were resource competition, high livestock density and increased wild animal populations. As the livelihood of the local community is based on subsistence agriculture, modification of wildlife habitat is unavoidable. Besides, the presence of high livestock density (particularly grazers) further aggravates wild habitat modification as private grazing lands are very scarce in the area. Concerning wildlife population, it seems a paradox that high wildlife population is one of the causes of conflict although their natural habitat is shrinking with agricultural expansion. However, this would be true only for those pest mammals that have wide feeding adaptation and usually synchronize their population

increment with crops availability.

Major wild animals found to be in frequent conflict with the local community were: Ape, monkey, porcupine, warthog, fox, hyena, skunk and gazelle. Of these, primates (monkey and apes) were the most noxious pest mammals in the area. Among different crops grown in the study area, maize and wheat were the most affected crop types due to their wide coverage in the area and palatability and/or nutritious content. The crop loss estimated for maize (3360 kg/day) and enset (3200 kg/day) indicated that crop loss by wild animals in the area is very serious that may lead to food insecurity. A majority of respondents failed to report any conflict/damage to the local government. Though the respondents gave many reasons why they failed to do so, providing appropriate awareness about any compensatory schemes by the local government is very important.

Although the perception of the local community towards wildlife conservation indicated that they are committed to live in harmony with wildlife by protecting their crop/livestock through various methods such as guarding, chasing, fencing, scarecrows, etc., continuing agricultural expansion is a threat to wildlife population in the area.

Recommendations

Based on the findings of the present study, the following recommendations are forwarded:

1. To avoid heavy losses or high guarding investments, highly palatable seasonal crops should not be grown near the forest edge.
2. Farmers should also be encouraged to concentrate on crops which are not prone (non palatable) to wild animals as buffer crops.
3. Farmers should look for alternative source of livelihood that does not promote further agricultural expansion.
4. Farmers should use private grazing land (if available) so that they can reduce conflicts by avoiding overlap of resources between wildlife and livestock.
5. Farmers should identify the best method of prevention and mitigation that is appropriate for each problematic wild animal (except killing).
6. Compensation scheme for crop damage should be designed by the government.
7. Environment and forest related laws should be enforced to minimize encroachment and forest habitat destruction.
8. Governmental bodies should create awareness about importance of wildlife conservation and use good governance to achieve co-existence between wildlife and the local community.
9. The local communities should develop a habit of reporting the conflict to the concerned body on due time.
10. The various conflict resolving methods should be applied with concern and in the context of local

community.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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