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Assessment of types of damage and causes of human-wildlife conflict in Gera district, south western Ethiopia

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Human-wildlife conflict (HWC) exists in different forms all over the world and is experienced more in developing countries. The conflict between human and wildlife ranks among the main threats to biodiversity conservation and has become frequent and severe in different parts of Africa. In the author s' previous study, five species of wildlife were identified as the main crop raiding species in Gera, southwestern Ethiopia. The current study was conducted to assess causes of HWC and types of damage in this area. Data were collected through semi- structured questionnaires, focus group discussion, direct observation and key informant interview. Descriptive statistics was used to analyze the socioeconomic profile of the respondents. One-way ANOVA and Chi-square test were used to analyze causes of HWC. The result showed that 50 and 22% of the respondent reported that the prevalence of HWC is manifested through crop damage and livestock predation, respectively. There was a significant difference between causes of HWC (F=4.2, P=0.000). In this study, habitat disturbance and increase in population of wildlife was the highest and least causes of HWC, respectively. HWC is increasing in both severity and frequency in the study area. Therefore, to minimize the conflict occurring in the whole scope of society in the proper selection of investment site (mainly modern coffee production in the area) is crucial. Furthermore, the wildlife authorities and local institutions are encouraged to address the needs of the local communities or to find the source of alternative livelihood to the society.

Key words: Forest disturbance, Human-wild animal's conflict, crop raiding.

INTRODUCTION

Human-wildlife conflict (HWC) has existed for as long as humans and wild animals have shared the same landscapes and resources (Lamarque et al., 2009; Hoffman, 2011). However, currently, wildlife habitats are fast becoming human-dominated, which means that more wild species are compelled to exploit new human resources to survive (Strum, 2010; Castro and Nielsen, 2003; Warner, 2000). HWC results in negative impact on people or their resources, and wild animals or their habitat. Though human wildlife conflict exists in both

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developed and developing countries, it is more serious in developing nations (IUCN, 2005; Lamarque et al., 2009; Fairet et al., 2012).

HWC is among the most important threats to the survival of many wildlife species (Madden, 2008; Johansson, 2002). In Africa and other developing areas of the world, fast growing human population, settlements and accompanied habitat fragmentation are reducing the wildlife habitats (Hill et al., 2002; Pariela, 2005; Blair, 2008; Mwamidi et al., 2012). This is increasing the interactions between humans and animals (Madden, 2008; Blair, 2008; Lamarque et al., 2009; Mwamidi et al., 2012). Especially, transforming natural landscapes of the earth from predominantly wild to anthropogenic has created competition between humans and wildlife for space and resources and it has reached unprecedented levels (Hanks, 2006; Ellis et al., 2010; Kate, 2012). For instance, in Ghana, the decrease in the forest area available to elephants in Kakum conservation area by about half since the 1970s, was the reason for increasing crop raiding activities and cause of HWC (Barnes et al., 2003).

A wide variety of wildlife comes into conflict with farming activities for search of human resource which causes crop damage and wildlife mortality (Conover, 2002). The major types of wildlife damage on the human being are predation of domestic animals, crop damage and sometimes killing of humans (Madden, 2008). The number and type of damage caused by wildlife varies according to the species, the time of year, and the availability of natural prey and crop raiding species (Warren, 2008; Datiko and Bekele, 2011; Mwamidi et al., 2012).

In spite of diverse and unique nature of the Ethiopian landscape and ecological diversity, the natural resources of the country are declining by human activities (Bekele et al., 2011; Tefera, 2011). This has increasingly restricted wild animals' movement of the country to a few protected areas/habitats (Kumssa and Bekele, 2008).

The forest area of southwestern Ethiopia is under great threat due to over-exploitation (Hundera, 2007; De Beenhouwer, 2011) which forces wild animals to compete with humans for their resource and results in conflict between them. There are some major driving forces that increase pressures on forests in southwestern Ethiopia. The most important pressure causing deforestation is rising in population pressure and overexploitation of the remaining forest cover. Agricultural activities are expanding, leading to forests encroachment, habitat destruction and further to the HWC which in turn makes the farmers to loss crops to pests/problem causing animals (Joseline, 2010; Mwamidi et al., 2012).

These pressures on land resources and reduction of core habitat for wild animals and elimination of corridors for migration increase the probability of contact, and possibly create conflict between farmers and wild animals (Quirin, 2005). Though, majority of the Gera land has been covered by natural forest in the past, nowadays, it has been shrinking in size due to increasing subsistence agriculture and modern coffee production which results in conflict (Hundera, 2007; Quirin, 2005; Strum, 2010).

Leta et al. (2015) identified the major wildlife species involved in the HWC and local management methods in Gera, Southwestern Ethiopia. However, there were no scientific studies carried out on types of damage and causes of human-wild animals' conflict for wildlife conservation in the study area. Therefore, the main objective of this study was to assess types of damage and the major causes of HWC in Gera district. This can contribute to reduction in HWCs in the study area.

MATERIALS AND METHODS

Description of the study area

The study was conducted in Gera district, Oromia National Regional State, Jimmazone, Ethiopia (7°15'N - 8° 45'N latitude and 35° 30'' E - 37° 30' E longitudes). It is located at about 448 km south-west of Addis Ababa and 93 km south-west from the zonal town, Jimma.

The total population of Gera district is 86,849. About 83,375 of them are rural and 3,474 were urban (living in small town, Gera) (CSA, 2007). The land cover categories of the district comprise about 26.5% potential arable or cultivable land of which 23.4% are under annual crops, 7.0% pasture, 56.6% forest and the remaining 9.9% classified as degraded, built-up or otherwise unusable. The study area is characterized as humid, subtropical climate, with a yearly rainfall of about 1800 to 2080 mm 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 (Schmitt, 2006; De Beenhouwer, 2011).

The southwestern forests of Ethiopia are characterized as moist montane forest ecosystems (NBSAP, 2003). 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 threat because of over exploitation (Hundera, 2007). Despite the absence of wildlife protected areas in this study area, different wildlife species have been recorded from the study area, such as, African Buffalo (*Syncerus caffer*), Lion (*Panthera leo*), Colobus monkey (*Colobus guereza*), Grivet monkey (*Chlorocebus aethiops*), Olive baboon (*Papio anubis*), Leopard (*Panthera pardus*), *Phacochoerus africanus*, Warthog (*Potamochoerus larvatus*), African civet (*Civettictis civetta*) and Menelik's bushbuck (*Tragelaphus scriptus*) are found in the study area.

Site selection and sampling design

Based on preliminary survey (September-Novemebr, 2012), the study district (Gera) was purposively selected because of the presence of serious HWC in the area. Out of the 24 kebels (units in a district) in Gera district, 2 (Ganjicha and Wanjakersa) were selected using stratified random sampling. Each village found in the selected two kebeles were categorized into three groups based on their proximity towards to forest edge as near (<0.5 km), medium (0.5-1 km) and far (>1 km) and 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.

After getting the total number of household (HH) heads living in each selected kebeles, the sample size was determined using probability proportional to sample size sampling technique (Cochran, 1977; Bartlett et al., 2001).

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

Where: n_o= desired sample size of Cochran's (1977) when population is greater than 10000; n_1 = finite population correction factors (Cochran's formula, 1977) less than10000; Z = standard normal deviation (1.96 for 95% confidence level); P = 0.1 (proportion of population to be included in sample, that is, 10%); q = 1-P (0.9); N = total number of population; d = degree of accuracy desired (0.05).

Based on the distance of farmland from forest edge, 33.3% HHs from each stratification were used for the formal interview. For the structured interview, HHs sample strategy was established by collecting complete landholders list record from their respective administration office. The sample includes all HH head living in the two kebeles. Finally, the selections of sample HH were proportional to each stratification, which was based on farm land distance from forests, to keep uniformity. Accordingly, the total numbers of HH head living in both kebeles were 915 (435 from Ganjichala and 480 from WanjaKersa) from the report of kebeles administration (2012). From all the stratification, the HH head having farm land in the selected stratification was randomly taken for a formal interview.

Based on Cochran (1977) population correction factors, a total of 120 sample HH head were selected using simple random sampling techniques from the total population. Allocations of the number of sample HHs to each kebele, was proportional to the number of HH head living in each selected kebele, accordingly, 57 HH from Ganjichala and 63 HH from Wanjakersa were selected for this study.

Data collection methods

Pilot survey

A pilot survey was conducted in the selected kebeles from December 2012 to January 2013 based on the information gathered during the preliminary survey. During the pilot survey, 30 HHs were randomly selected and interviewed. The main purpose of the pilot survey was to evaluate the questionnaire and to check whether it was applicable and suitable in the study area, to check whether the questionnaire can be understood by the respondents, to identify the period and the occurrence of human-animals conflict and cause of HWC in the study area. Based on the pilot survey results, the questionnaire was revised and developed following Yihune et al. (2009) and Fairet et al. (2012). HH survey (individual-interviews), focus group discussions, key informant interviews and direct observation were used. The current status of HWC in the study area was investigated through observations, FGD and questionnaires following Anderson and Pariela (2005). To find out why wild animals are involved in crop raiding and livestock depredation which create conflict between farmers and wild animals, variables such as nature of human habitat disturbance, distance of farmland from residence and farmland expansion to forest area were assessed using the questionnaire similarly used by Kivai (2010).

The presence or the absence of human activities which creates forest disturbance or fragmentation was assessed. Human activity assessed includes cutting understory vegetation (plants between the forest canopy and the ground cover) selective cutting of trees, burning and complete clearing of forest mainly for expansion of cultivation. These activities were recorded using quadrat methods. A total of 30 and 20 quadrats having 10 x 10 m size were randomly used in Ganjichala and Wanja-Kersa sampled forests. The area coverage of Ganjchala and WanjaKersa sampled forest were 12.0 and 7 km^2, respectively. The size of the forest was taken from the district Agricultural Office.

The overall status of the forest (disturbance level) due to human activities was assessed during the study time, through observation by giving the scale of 1-4. Scale 1 was recorded if slight activities of human action were observed in a form of cutting of trees to have a track (road like for moving in the forest on foot) in the forest for the case of traditional honey harvest, Scale 2 was recorded when moderate levels of human activities (clearing the understory, cutting tree branches, leftover of burned tree) were observed, Scale 3 was used when extensive human activities (cutting big size trees, continuous burning, but no section of the forest was completely cleared) were observed. Finally, forests in which human activities in a form of complete clearing were observed, were assigned scale 4 as used by Muoria et al. (2003). Data was analyzed using SPSS version 16.0 computer software. One-way ANOVA and Chi-square were used to analyze the cause of HWC and status of HWC and management options.

RESULTS

Socio economic characteristics

The result revealed that the major economic activities of the sampled HH in the study area were subsistence agriculture, which includes crop farming, livestock rearing and/or a mixture of animal rearing and crop farming. About 70% of the respondents earns their income from mixed agriculture (crop farming, animal rearing and bee farming). The remaining 16.7% depends only on crop farming and 13.3% depends on both crop farming and other income sources such as daily labor works.

The size of farmlands owned by sampled HH ranged from 0.5 to 3 ha with an overall mean of 1.8 ha. There was significant difference among HH heads in sizes of farm land they hold ($\chi^2 = 16.00$, df = 5, $P < 0.01$) in which 25.8 and 7.5% possessed 2 and 0.5 ha, which is the highest and the lowest, respectively.

Cattle were the predominant livestock in each site followed by sheep and goat. The overall mean number of cattle, sheep and goat holding per HH were 4.56 ± 0.16, 3.55 ± 0.08 and 3.75 ± 0.19, respectively. While for those of horse, donkey and mule, the overall mean values were 0.34 ± 0.047, 0.64 ± 0.053 and 0.16 ± 0.033, respectively.

Types of damage among sites

In these studies, the type of damage and magnitude by wildlife on the resources of the community significantly differ ($\chi 2 = 25.55$, df = 2, $P < 0.05$ (0.00) from site to site. Of the total respondents interviewed, 50% reported that there were both problem of crop damage and livestock predation, while 22% reported only crop damage, and 28% did not face any conflict. There is no HWC in Agalo (Table 1) while both crop damage and livestock depredation existed in Wanja, Chala, Seke and Gado

Table 1. Percentage of respondents that faced different types of conflict by wild animals in each village.

Villages	No. (120)	Both crop damage and livestock depredation (%)	No conflict at all (%)	Crop damage only (%)	Livestock depredation only (%)
Bonche	19	100	0.0	0.0	0.0
Chala	20	68	0.0	32	0.0
Seke	19	32.3	52.7	15	0.0
Wanja	21	72	0.0	28	0.0
Gado	20	27	15	58	0.0
Agalo	21	0.0	100	0.0	0.0
Mean		50	28	22	0

Figure 1. Habitat disturbances due to increased subsistence agriculture in forest edge (A) coffee plantation (B).

Table 2. Causes of human-wild animals' conflict as revealed by respondents among sampled villages (all the numbers in the table are numbers of people that responded).

Sample sites	Identified causes of HWC				
	Habitat disturbance	Combined effect	Proximity to natural forest	Increased subsistence agriculture	Increase in wild animals population
Bonche	7	2	4	3	3
Chala	8	3	3	4	2
Seke	7	2	3	5	2
Wanja	3	3	6	5	4
Gado	2	4	4	5	5
Agalo	6	2	5	5	3
Mean	5.3[a]	2.6[d]	4.2[b]	4.5[b]	3.2[c]
Std. D	2.3	0.8	1.2	0.8	1.1

*Means having the same letter have no significant difference.

sites.

Crop damage is the most observed problems in the community (72%) in the study sites. Except one site, Agalo, crop damage was observed in all the selected sites.

Cause of human-wildlife conflicts

The study revealed that the major cause of human-wild animals' conflict in the study area were habitat disturbance (due to expansion of subsistence agriculture around forest edge, coffee plantation (Figure 1), proximity to natural forest and the contribution of all mentioned cases (Table 2).

Causes of HWC showed significant difference among the respondents (F=4.2, P=0.000). In the study sites, the highest cause of HWC, was disturbances of habitat followed by proximity to natural forest and increased subsistence agriculture.

Table 3. Human activities observed in sampled forest of the study area.

Human activities (scale 1-4)	Observation of each activity in the Sampled study area (%)	
	Ganjichala	WanjaKersa
Slight activities (1)	no	20
Cutting of under stories (2)	60	80
Clear cutting with few tree remaining (3)	40	no
Clear cutting (4)	no	no

No = indicates not observed.

A variety of human activities was observed in the sampled forest of the study area. The result of observation of human activities was significantly different between the two study kebeles. Human activities in the form of cutting understory vegetation (plants between the forest canopy and the ground cover) for subsistence coffee production, was a significant difference between the kebeles (t=16.925, P=0.000) and it is more in Wanjakersa (Table 3). Clear cutting with few trees remaining for the search of sun light for intensive coffee production by investors was observed in Ganjichala only, which increased the magnitude of HWC due to lack of food.

DISCUSSION

The study showed that the type of damage and magnitude on the resources of the community by wildlife differs from place to place in the study area. This agrees with the studies in other parts of Ethiopia. According to Datiko and Bekele (2011) and Mwamidi et al. (2012), the number and type of damage caused by wildlife vary based on the species, the time of year, and the availability of natural prey and crop raiding species. Even though both agricultural damage and livestock depredation were observed in the study area, crop loss due to wildlife was the most serious problem in the study sites. It differs from site to site depending on distance from the forest and others.

This study also showed that human population growth and anthropogenic effect such as deforestation, inappropriate site selection for investment (coffee production) in forested area and expansion of subsistence agricultural activities have led to increase in HWC. However, habitat disturbance was the major causes identified as HWC in this study. The result was in agreement with different studies in Ethiopia and other countries in the world (Hill et al., 2002; Barnes et al., 2003; Pariela, 2005; Blair, 2008; Datiko and Bekele, 2011; Mwamidi et al., 2012; Edward and Frank, 2012) which reported increased habitat disturbance as the cause of HWC. Jones (2012) reported that habitat destruction and fragmentation was the main cause of human primate conflict in Indonesia. Priston et al. (2012) reported that an anthropogenic habitat alteration caused crop raiding in southeast Sulawesi, Indonesia by primates.

Conclusion

The study revealed that there is a serious HWC in Gera, Jimma Zone, southwestern Ethiopia because of habitat disturbance. Agricultural product loss, which can affect food security of the community, is the major type of damage identified. On the other hand, the negative attitude of the community towards wildlife due to the serious HWC has a great impact on the biodiversity conservation. Therefore, it is recommend that there is a need to develop strategies of reducing HWC by local people, researchers, wildlife authorities and policy makers by finding mitigation measures for HWC. The strategies can include leaving sufficient conservation areas, better buffer areas for wildlife to move and sufficient connectivity of wildlife habitats so that they can freely move to get their living from the ecosystem. Furthermore, it needs training the community on how to reduce the causes of conflict with the wildlife. Specific strategies based on contemporary situations can be included as the conflict is dynamic in nature.

Conflict of interests

The authors have not declare any conflict of interest.

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