Research Article

Human-Wild Animal Conflict in Banja Woreda, Awi Zone, Ethiopia

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Human-wild animal conflict has serious conservation consequences, both for populations of wild animals and for the people who live around wild animals' habitats. The aim of this study was to assess the human-wild animal conflict in Banja Woreda, Awi Zone, Ethiopia. First, the area was selected purposively because it is expected to be prone to a high level of human-wild animal conflict, and then the selected areas were stratified based on the distance to wild animals' habitats. A total of 95 household heads (HHs) from the two kebeles were interviewed using structured and semistructured questionnaires. Additional information was also gathered through focus group discussions (FGDs), key informant interviews, and personal observation during data collection. About 84 (88%) of the respondents replied that wild animals had an effect on the livelihood of the local communities through both crop and livestock loss. The crop and animal loss was different across the distance categories of the study area ($P < 0.05$). The highest proportion of loss was reported in the closest settlement than far-located settlements. The chi-square association test shows that there was a significant association ($P < 0.05$) between livelihood activity across crops and domestic animal loss. The farmers who led their livelihoods in both farming and livestock activity reported higher animal and crop losses than the only farming or livestock activity. The crop types that were more raided by wild animals were maize and potato. The risks of crop raiding were significantly different among crop varieties ($P < 0.05$). Wild animals affected crops in different development stages, and mature stage ranked the first followed by fruiting stage. Crop growth stages that were attacked by wild animals showed significant variations ($P < 0.05$). Of the crop type that was attacked by wild animals, potato was highly attacked, which reaches to 113.8 quintals (28%), followed by maize 96 quintals (23%) and small millet 74.7 quintals (18%) within three years. The loss of crops in the kebeles was not significantly different ($P > 0.05$). Wild animals also affected the domestic animals; accordingly, 79 (83.2%) of the respondents replied that wild animals attacked all domestic animals and the remaining 16 (16.8%) said wild animals attacked goats, sheep, and chickens. However, the animal loss in the kebeles was not significantly different ($P > 0.05$). The trend of the population status of wild animals was significantly different among the perceptions of respondents ($P < 0.05$). The settlement near the forest habitat of wild animals and habitat loss due to agricultural expansion and deforestation were the major causes of conflict. The proportion of the causes of human-wild animal conflict in the area was significantly different ($P < 0.05$). According to the respondents, the most effective controlling mechanisms of the conflict were guarding, followed by fencing and slipping at night in cropland. Out of the total number of respondents, 65 (68.4%) said guarding is the most effective conflict control mechanism, for protecting both crop and livestock. To limit the negative impact of human-wild animal conflict, good wild animal habitat management is required, such as minimizing agricultural expansion and overgrazing, demarcating the forest habitats for wild animals only, and creating awareness among local communities.

1. Introduction

Humans have lived alongside and interacted with wild animals throughout evolutionary history. Even though wild animals can damage properties or injure humans and domesticated animals, not all interactions between humans and wild animals are negative [1]. Human-wild animal conflict is fast becoming a serious threat to the survival of many endangered species in the world [2]. It occurs when the needs and behavior of wild animals impact negatively on

humans or when humans negatively affect the needs of wild animals [3]. Crop and livestock depredation by wild animals is a primary driver of human-wild animal conflict, a problem that threatens the coexistence of people and wild animals globally [4]. Crop raiding is the most prevalent type of human-wild animal conflict in Africa and Asia [5]. Conflicts between humans and wild animals currently rank among the main threats to conservation in Africa [6]. As human populations expand into areas where wild animals exist, competition for resources and confrontation arises [7]. Human encroachment on wild animals' habitats and the absolute exploitation of natural resources serve to shrink core areas of wild animals, which leads to conflicts between humans and wild animals [8]; for example, the conflict among the farmers, pastoralists, and baboons usually happens due to crop raiding and killing young goats and lambs. Human-wild animal conflict occurs when growing human populations overlap with the established wild animals' territory, creating reduction of resources or loss of life of people and/or wild animals. Predation of livestock by wild animals and the retribution responses it elicits can have strong negative impacts on both people and carnivores [9]. The occurrence and frequency of crop raiding is dependent upon a large number of conditions such as the availability, variability, and character of nutrient sources in the African country, the story of human activity on a farm, and the type and maturation time of crops as compared to natural nutrient sources [10]. The nature and extent of human-wild animal conflict profoundly impacted humans, wild animals, and the environment through crop damage, habitat disturbance and destruction, livestock predation, and killing of wild animals and humans [3]. Deforestation, ecosystem homogenization, and diversity loss are frequent problems in tropical livestock systems, which can foster substantial human-wild animal conflict when wild carnivores with declining prey bases turn to cattle depredation [11].

According to community elders, farmers, and indigenous peoples who have lived in and around the Harenna Forest, Harenna Buluk District, South East Ethiopia, the major threats to and conservation challenges of wildlife are urbanization, agricultural expansion, habitat fragmentation, accessibility, and resource extraction [12]. Human-wild animal conflict has serious conservation consequences, both for populations of wild animals and the people who live alongside them [13]. Human-wild animal conflict is a barrier to achieving sustainable biodiversity conservation and community development in protected areas [14]. Ensuring that compensation reaches all affected people requires standardizing these processes in a transparent and efficient manner, while also monitoring its perceived benefits to wild animal conservation [15]. Human-wild animal conflict is one of the most pressing issues in conservation [16]. Understanding the patterns of human-wild animal conflict and identifying the underlying causes are important components of conservation biology [17]. The Human-wild animal interaction has significant interspecies effects, but it is not widely discussed or studied outside of the livestock animal welfare niche within which it exists [18]. Human-wild animal conflict and conservation challenges in the Awi zone have not been studied or monitored well, despite the value of wildlife, which has captured the attention of domestic and international researchers. These findings will provide detailed and comprehensive information about the human-wild animal conflict in the Awi zone, so stakeholders such as government bodies, NGOs, local communities, universities, and other institutions can play their role in mitigating the problems.

2. Research Methodology

2.1. Description of the Study Area. Awi is one of the zones in the Amhara Region of Ethiopia. Injibara town is the administrative center of the Awi zone. The Awi zone is bordered on the west by Benishangul-Gumuz Region, on the north by Semien Gondar Zone, and on the east by Mirab Gojjam Zone. According to the Awi zone department of agriculture reported in 2018, most of the zone is Woyina Dega (72%), followed by Dega (17%), and Kolla (11%) agroecologies. The area ranges from 700 to 2900 m.a.s.l. in altitude and has a better annual rainfall distribution (800 to 2700 mm/year) in the Amhara region. According to Awi zone agricultural office experts (2020), the temperature of the area ranges from 15 to 24°C. Of the total land area of Awi Zone (8,935,520 ha), 297,133 ha (33.25%) is used for farm practices. In Awi, however, 34.02% of the area is covered by forest (76,554 ha of plantations and 277,842 ha of natural forests); of the total area of land, rangelands and grazing lands cover 24.3% (217,138 ha) of it; and other land uses, like infrastructure and settlement, cover 8.38% (74,853 ha) of land. "Ethiopia has an enormous vegetation types due to its wide range of altitude, geology, and land units [19]." The new knowledge on plant species allows an increasingly detailed floristic characterization of the Ethiopian vegetation [20]. The study area is characterized by heterogeneous landscapes and diverse habitat types. The plant species like *Acacia decurrens*, *Juniperus procera*, *Cupressus lusitanica*, *Pinus radiata*, and *Eucalyptus globulus* are some of the frequently observed plant species in the study area. The area is also home to a variety of wild animals that include amphibians, reptiles, birds, and mammals. *Papio anubis*, *Crocuta crocuta*, *Canis aureus*, *Panthera pardus*, *Felis serval*, *Sus scrosa*, and *Colobus guereza* are some of the frequently observed animals in the study areas. Crop production and livestock rearing are the main economic activities in the community. The study areas are found in Banja Woreda, Awi Zone. It is geographically located between 10°30′0″N to 12°0′0″N and 36°0′0″E to 37°0′0″E (Figure 1).

3. Methods

3.1. Site Selection and Sampling Design. Banja Woreda was selected as a study site purposively due to expectation of high human-wild animal conflict. The reason why we highly expect the conflict is that we observed the area and contacted some key informants about human-wild animal conflict in the area before we collected the actual data. Local people who live around the forest habitat of wild animals and are prone to conflicts between humans and wild animals were selected to investigate the conflicts between them. This study concentrated on two kebeles that were selected purposefully.
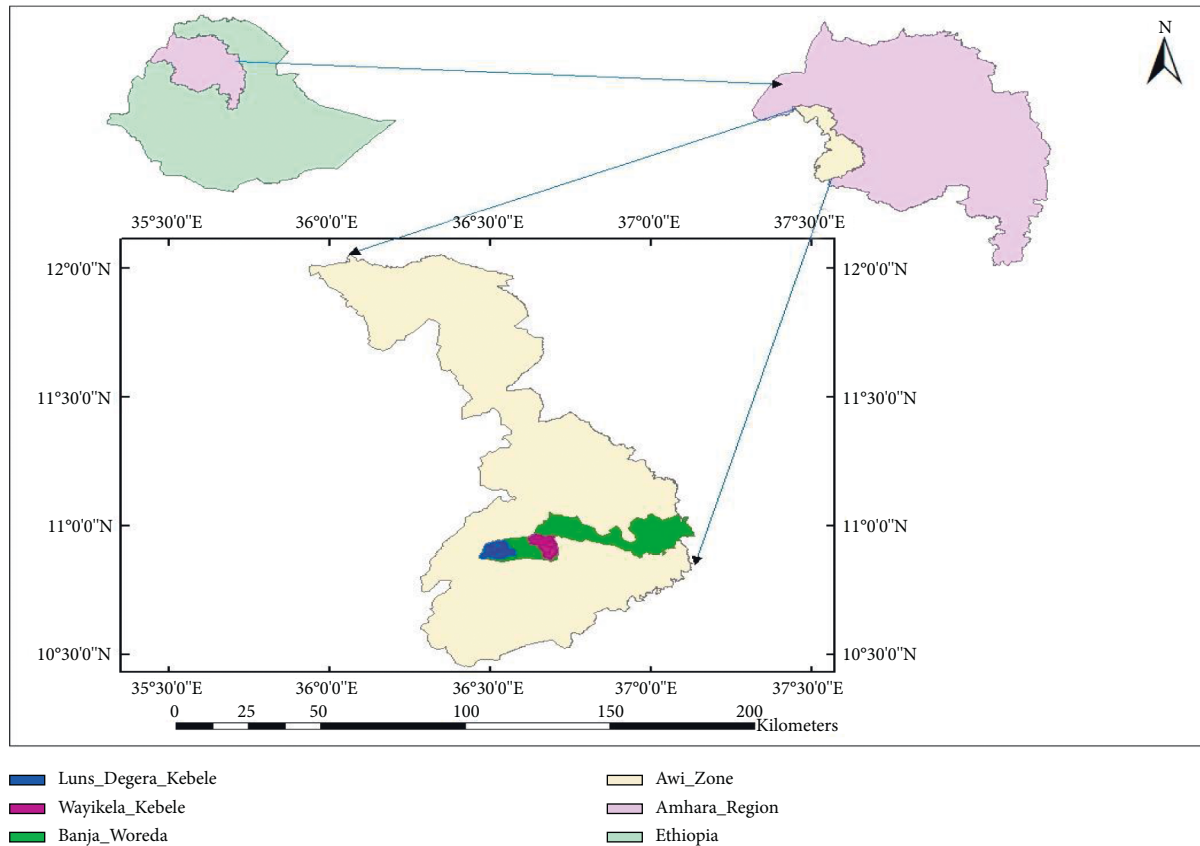
FIGURE 1: Map of the study areas.

In the purposive sampling method, kebeles adjacent to the forest habitat of wild animals and expected to have a high conflict rate were selected to study human-wild animal conflict. The two selected kebeles were Luns-Degera and Wayikela. The names of the forest were Den-Mariam forest in the Wayikela kebele and Gumrakani forest in the Luns-Degera kebele. Then, stratified random sampling was used because the selected areas were not in similar conflict intensity and distance from forest habitats of wild animals. After stratifying the area into homogeneous groups, random sampling was conducted. Each respondent of the study settlement was selected randomly and interviewed [21, 22]. Depending on the distance between the forest habitat of wild animals and the settlement area of the respondent, the distance between the forest habitat of wild animals and the settlement of the local communities was categorized as near (≤2 kilometers), medium (>2 to ≤4 kilometers), and far (>4 kilometers). Sampling is then to follow households from close and faraway where life is led through agricultural practice, following the Yamane [23] formula as follows:

$$n = \frac{N}{\left(1 + N\left(e^2\right)\right)},\tag{1}$$

where N = the total population, n = the required sample size, and e = the precision level that is ±10%, where confidence interval is 90% at P = 10 (maximum variability), which is equal to (±10%); n = 1850/1 + 1850 (0.1)^2 = 95. Accordingly,

from the total (1850) population of two kebeles, a total of 95 respondents were selected and the questionnaire was transferred. A pilot survey was conducted in February 2019. The sample sizes in each study kebele were determined based on their proportion to the total households of the two study kebeles. During this survey, some households were randomly selected and interviewed in the study area. The main purpose of the pilot survey was to evaluate the questionnaire and to check whether it is applicable and suitable in the study area. It is also used to check the questions understood by the people. Based on the result of the pilot survey, the questionnaire was revised and developed. The data were collected in both wet seasons and dry seasons. A cross-sectional design was used for data collection.

3.2. Data Collection

3.2.1. Primary Data Collection. The techniques used to acquire primary data include questionnaire survey, focus group discussion, key informant interview, and participant observation. The key informant includes woreda and kebele government leaders, kebele elders, and kebele natural resource committees. The number of participants in each kebele depends on the number of various groups (communities) in the respective kebele. A semistructured questionnaire was provided to both male and female head households. Open- and close-ended questions are also used

to collect information from household information [9]. In the open-ended questions, respondents have to evaluate the people's attitude towards the conservation area; while for close-ended questions, they have to choose among the design alternatives. The questionnaire was used to explore the type and extent and causes of human-wild animal conflict, mitigation measures, livelihood characteristics of households, and local people's perceptions towards wild animal conservation. In order to gain the attention and confidence of respondents as well as to gather good information, the interviews took place at respondents' homes [22]. Participant observation in this study physically looks at what is the reality on the ground and what it made comparisons with the respondents in the household and key informant interviews.

3.2.2. Secondary Data Collection. Secondary data involve the collection of information from different sources like reviewing relevant publications and unpublished literature [12]. In addition to that, the information was obtained from the Banja Woreda government office and two kebele offices, namely, Luns-Degera and Wayikela.

3.2.3. Data Analysis. Data were coded to facilitate data entry in the computer. Coding involves the organization of data into categories and where each response category was assigned in numerical code. Data analysis was conducted using Statistical Package for Social Science (SPSS) software, version 26. Descriptive statistics were used to describe local livelihoods by cross-tabulations, chi-square tests were used for categorical variables, and one-way ANOVA was applied to examine the crop and animal loss in the two kebeles.

4. Result and Discussion

4.1. Sociodemographic Characteristics of the Respondents. The sociodemographic characteristics of the respondents are summarized and presented in Table 1. Out of 95 respondents, 80 (84.2%) were male, and the rest 15 (15.8%) were female. The majority 50 (52.6%) of the respondents were within the age range of 45–65 years old, 37 (38.9%) were 25–45 years old, 3 (3.2%) were under 25 years old, and 5 (5.3%) were older than 65 years old. Most of the respondents who participated were between ages 45 and 64 years. The minimum age of the respondents was 19 years old, and the maximum age of the respondents was 71 years old. The mean age of the respondents was 47 years. Half of the respondents 50 (52.6%) were illiterate, 30 (31.6%) and 5 (5.3%) completed primary and secondary school level, respectively, and 10 (10.5%) were others like religious leaders. The respondents' family size was categorized based on the number of family members. 41 (43.2%) of the respondents belonged to medium family size, that is, 3–6 family members; 34 (35.8%) belonged to high family size (6–8); 15 (15.8%) belonged to low (2–3 members); and 5 (5.3%) belonged to very high, that is, greater than 8 family members. The minimum number of family members of the respondent was 1, and the maximum was 9. The mean was 5.8. The distance of the human settlement to the forest habitat of wild animals was categorized

as follows: 60 (63.2%) respondents were near, 25 (26.3%) were at medium distance, and 10 (10.5%) were far. Most of the respondents were near to the habitats of wild animals, so it leads to high conflict due to the small space between wild animals' habitat and farmers' land. The minimum distance of the settlement to the forest habitat of wild animals was 2 kilometers, and the maximum distance was 4.5 kilometers. The mean distance was approximately 2.5 kilometers. A majority of the respondents reported that farming and livestock rearing were their primary livelihood activities. The remaining respondents were primarily involved in livestock activities. Very few were involved in farming activities only. 84 (88.4%) of the respondents' livelihood were involved in both farming and livestock rearing activities, and the remaining 9 (9.5%) and 2 (2.1%) were involved in livestock only and farming only, respectively. 29 (48.3%) of the respondents had medium farm size ranging from 1 to 2 hectares; 17 (28.3) had high farm size, that is, greater than 2 hectares; 11 (18.3%) had small farm size ranging less than a hectare; and 3 (5%) were others like livestock rearing. The minimum farm size was 0.25 hectares, and the maximum was 6 hectares. The mean of respondents' farm size was 2.2 hectares.

4.2. Effect of Wild Animals on the Livelihood of Local People. Wild animals in the study area affected the livelihood of local communities in different ways (see Figure 2). Most respondents 84 (88%) said wild animals affected both their crops and livestock, while 9 (3%) said only their crops were harmed, and 2 (2%) said only their livestock was harmed. Both crops and livestock are highly affected by wild animals in the study area. The respondents of the survey report that some wild animals are omnivores in their feeding behavior, like olive baboons (*Papio anubis*) and common jackals (*Canis aureus*); they eat seeds and livestock. Warthogs (*Phacochoerus africanus*), porcupines (*Cercopithecus*), and wild pigs (*Sus scrosa*) were among the animals attacking only crops. Spotted hyenas (*Crocuta crocuta*), leopards (*Panthera pardus*), yellow-billed kites (*Milvus aegyptius*), and serval cats (*Felis serval*) are carnivores that only attack livestock. Livestock are primarily attacked by wolves (*Canis lupus*), leopards (*Panthera pardus*), and jackals (*Canis aureus*) [24]. According to the study, wild animals attack both livestock and crops, which escalates the conflict between wild animals and local residents. Crop and livestock predation by wild animals is a major cause of human-wild animal conflict, which poses a global danger to human-wild animal cohabitation [4]. Predation of livestock by wild animals and the retribution responses it elicits can have strong negative impacts on both people and carnivores [9]. Conflicts between humans and wild animals have negative impacts on both human and wild animals [3]. For attacks with highest frequency, crop damage and livestock attacks were dominant [25]. Human-wild animal conflict presents major challenges to both wild animal managers and rural livelihoods [26]. Interaction is the relationship between organisms for food, shelter, and other needs, which may be positive or negative [27]. There are high levels of human-

TABLE 1: Sociodemographic characteristics of the respondents in the study area.

Farmer characteristics	Categories	Scoring method	No. of respondents	% of respondents	Min.	Max.	Mean	Std. deviation
Age (years)	<25	Year	3	3.2	19	71	47	11.87
	25 to 45		37	38.9				
	46 to 65		50	52.6				
	>65		5	5.3				
Sex	Male		80	84.2				
	Female		15	15.8				
Education	Illiterate	Year of schooling	50	52.6				
	Primary		30	31.6				
	Secondary		5	5.3				
	Others		10	10.5				
Family size	Low (2–3)	Number	15	15.8	1	9	5.8	1.99
	Medium (3–6)		41	43.2				
	High (6–8)		34	35.8				
	Very high (>8)		5	5.3				
Settlement distance	Near	Kilometer	60	63.2	2	4.5	2.5	0.52
	Medium		25	26.3				
	Far		10	10.5				
Livelihood activity	Farming and livestock		84	88.4				
	Livestock only		9	9.5				
	Farming only		2	2.1				
Size of farm land	Small (<1)	Hectare	11	18.3	0.25	6	2.2	1.50025
	Medium (1–2)		29	48.3				
	High (>2)		17	28.3				
	Others		3	5.0				

wild animal conflict risks in both crop raiding and livestock predation [24, 28, 29]. In a similar study by Blair and Meredith [30], cattle, donkeys, sheep, and goats suffered the most losses, along with chickens, dogs, and cats. The conflict among the farmers, semipastoralists, and wild animals usually happens due to crop raiding and hunting young goats and lambs [10]. Human-wild animal conflict includes livestock predation, crop raiding, and damage to infrastructure [31, 32]. Conflicts with wild animals can cause material and economic losses and may include attacks on humans, the transmission of zoonoses, damage to crops and property, and predation on livestock and pets [33].

The crop and livestock loss due to wild animals highly affected the livelihood activity of local people. The farmers who led their livelihood both in farming and livestock activity reported higher animal and crop loss than those led farming activity only. A similar study by Biset et al. [34] reported the majority of the respondents (85.6%) perceived both crop and livestock damage due the impact of wild animals on humans. The cross-tabulation test shows that there was a significant association ($P < 0.05$) between livelihood activity and crop and domestic animal loss by wild animals, shown in Table 2.

The crop and animal loss by wild animals was also related to the settlement distance. The chi-square test shows that the level of crop and animal loss was significantly different across the distance categories ($P < 0.05$). A similar study also reported that crop loss at settlements closer to the Borena Sayint National Park was greater than the crop loss of households at medium-
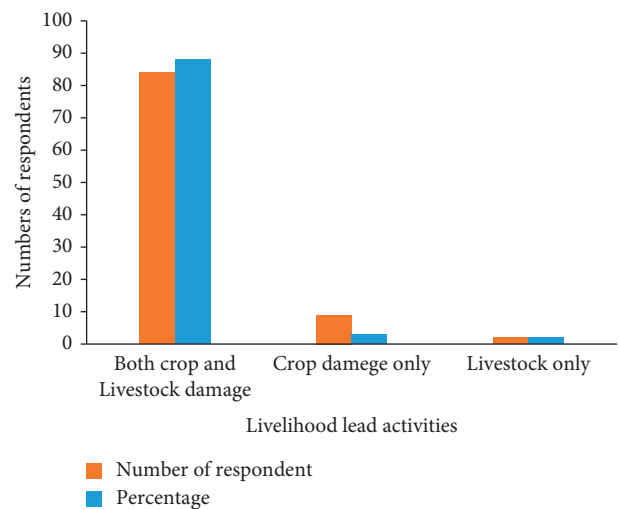

FIGURE 2: Effect of wild animals on the livelihood of local people in the study area.

distance settlements from the park [34]. Other studies also revealed that depredation increased in close proximity to a protected area [16, 25, 35]. The highest proportion of loss was reported in the closest settlement than the distantly located settlement in the study area, shown in Table 2. Settlements near forests will likely remain susceptible to elephant crop depredation and other forms of human-wild animal conflict [4]. Large mammals' (elephants, chimps, monkeys, and swine) attack was a result of the proximity of the arable lands closest to

Table 2: The crop and domestic animal loss by wild animals based on the livelihood activity and distance from the habitat of wild animals.

Questions	Farming and livestock rearing	Farming only	Livestock only	Total	χ^2
Livelihood activity					
Are there any crop and domestic animal losses by wild animals in your settlement?					
Yes	84	9	1	94	47* (df = 2, $P \leq 0.001$)
No	0	0	1	1	
Distance from the habitat of wild animals to human settlement					
Are there any crop and domestic animal losses by wild animals in your settlement?	Near (≤ 2 kilometers)	Medium (>2 to ≤4 kilometers)	Far (>4 kilometers)		
Yes	60	25	9	94	41.6* (df = 2, $P \leq 0.001$)
No	0	0	1	1	

*significance at 1% level.

the protected area [34]. Settlement distance related human-wild animal conflict presents a serious challenge in parks and protected areas across the world [37].

4.3. Crop Types That Were Affected by Wild Animals.

Small millet, maize, teff, barley, potato, and wheat were the most commonly affected crop types by wild animals, according to the majority of respondents. However, respondents had different perceptions about which crop types were attacked by wild animals. The other respondents thought that wild animals attacked maize, small millet, and teff. Some respondents replied that wild animals attacked crops such as small millet, maize, teff, potato, barley, onion, and chickpea, and there were few respondents who perceived wild animals attacked crops such as small millet, maize, teff, potato, barley, oil niger, onion, and coffee. The majority of respondents stated that wild animals attacked all types of crops. Even though the crop types attacked by wild animals vary among the respondents, wild animals attacked almost all types of cultivated crops in the study area, and the variation mostly depends on the type of crops that grow in the specific area. Crop raiding led to high conflict with local communities. Human-wild animal conflict in crop damage implies that there is loss or immediate threat of loss to crops, most commonly to plots of beans, maize, potatoes, or cabbage [30]. Local people are getting a lot of benefits through the animals, but at the same time they are also affected by the destruction of their crops by wild animals [27]. The statistical analysis indicates that the risk of crop raiding by wild animals was significantly different ($P < 0.05$) among crop types (Table 3).

4.3.1. Crop Types That Were More or Less Attacked by Wild Animals.

Even though wild animals affect all types of crops, some crops were more affected by wild animals. The crop types that were more raided by wild animals were maize, potato, barley, small millet, and wheat (Table4). This also indicates the main crop types highly attacked by wild animals in the study area were maize, potato, and barley. A similar study by Mekonen [3] showed that not all crops were equally affected by crop raiders (herbivore wild animals). Potatoes and maize were

the most raided crops [26]. Wheat, barley, and bean were the most frequently raided crops, while lentils and sorghum were the least raided crops by raiders [34]. Potatoes were reported to be the most raided crops [26]. Among the major crop varieties, wheat and small millet were less affected by wild animals compared with maize, potato, and barley. According to farmers, olive baboons (*Papio anubis*) were the most commonly reported crop raiders that cause more damage and ranked first followed by warthogs (*Phacochoerus aethiopicus*) [3]. The chi-square goodness-of-fit analysis shows that the risk of crop raiding on different crop varieties was significantly different ($P < 0.05$). The least affected crop varieties by wild animals were teff, small millet, wheat, and oil niger. The result indicates that teff was relatively free of crop-raiding risk, so the local communities were sowing those crops as a management option to reduce crop damage by wild animals. The statistical analysis in Table 4 shows that the risk of crop-raiding was significantly different among crop varieties ($P < 0.05$).

4.3.2. Stage of Crops Attacked by Wild Animals.

Wild animals affected crops in different development stages; more than half of the respondents said that at maturity stage followed by fruiting stage, and some of the respondents replied that all stages and at seedling stage. Even though wild animals eat crop in all stages (sowing to harvesting), they mostly affect crops in maturation stage. The patterns of crop raiding by wild animals varied at different crop developmental stages [26]. According to the respondents, during the maturation stage of crop, protecting wild animals' crop raiding was difficult because at this stage wild animals highly attack crops even in the presence of farm guards. Crop raiding by warthogs and crested porcupines peaked in the latter half of the year when favored crops like maize and potatoes matured [26]. The statistical analysis shows that the stages of crop attacked by wild animals were significantly different ($P < 0.05$) in different stages, as shown in Table 4.

4.3.3. Estimated Amount of Crop Loss by Wild Animals.

Figure 3 shows the estimated loss of crop in quintals per three years by wild animals. The study indicates that there

TABLE 3: Main crop type attacked by wild animals according to the respondents' perceptions.

Survey question, by category	No. of respondents	% of respondents	χ^2
The crop types that were affected by wild animals			
Small millet, maize, teff, potato, barley, onion, and chickpea	16	16.8	41.3* (df = 3, $P \leq 0.001$)
Small millet, maize, teff, barley, potato, and wheat	50	52.6	
Maize, small millet, and teff	20	21.1	
Small millet, maize, teff, potato, barley, oil niger, onion, and coffee	9	9.5	
Total	**95**	**100.0**	

*significance difference at 1% level.

TABLE 4: The status of crop-raiding risk among crop types, stage of crops attacked by wild animals, type of animals attacked by wild animals, the age of livestock more or less attacked by wild animal, the trend of the wild animals' population and crop and livestock damage, the season of crop and livestock damage by wild animals, causes of human-wild animal conflict, types of problem faced by wild animals, and human-wild animal conflict management mechanisms of the respondents in the study area.

Survey question, by category	Response (% of respondents)	χ^2
Crop type more attacked by wild animals		
Maize	48.4	52* (df = 4, $P \leq 0.001$)
Potato	20.0	
Barley	13.7	
Small millet	10.5	
Wheat	7.4	
Crop type least affected by wild animals		
Teff	91.6	225* (df = 3, $P \leq 0.001$)
Small millet	5.3	
Wheat	2.1	
Oil niger	1.1	
Stage of crop attacked by wild animals		
Matured	56.8	58* (df = 3, $P \leq 0.001$)
Seed bearing	5.3	
All stage	13.7	
Fruiting	24.2	
Livestock type attacked by wild animals		
Goats, sheep, and chickens	16.8	42* (df = 1, $P \leq 0.001$)
All domestic animals	83.2	
Age of livestock more attacked by wild animals		
Chickens and young and medium-aged sheep and goats	68.4	105* (df = 3, $P \leq 0.001$)
All livestock	6.3	
Not any	2.1	
Only chickens	23.2	
Age of livestock less attacked by wild animals		
Older sheep and goats and other large mammals	60.0	36.7* (df = 2, $P \leq 0.001$)
Large mammals except sheep and goats	30.5	
Not any (attack all)	9.5	
The trend of wild animals' population		
Increase	36.8	36.9* (df = 2, $P \leq 0.001$)
Decrease	56.8	
Stable	6.3	
Trend of crop damage by wild animals		
Increase	46.3	9.1* (df = 2, $P = 0.01$)
Decrease	32.6	
Stable	21.1	
Trend of livestock damage by wild animals		
Increase	31.6	36.9* (df = 2, $P \leq 0.001$)
Decrease	28.4	
Stable	40.0	
Seasons of crop loss by wild animals		
Wet season	92.6	150* (df = 2, $P \leq 0.001$)
Dry season	5.3	
Both dry and wet seasons	2.1	

TABLE 4: Continued.

Survey question, by category	Response (% of respondents)	χ^2
Seasons of animals loss by wild animals		
Wet season	13.7	32.7* (df = 2, $P \le 0.001$)
Dry season	60.0	
Both wet and dry seasons	26.3	
Cause of human-wild animal conflict		
Habitat loss due to agricultural expansion and deforestation	40.0	44.8* (df = 3, $P \le 0.001$)
Wild animals prefer crops and domestic animals	8.4	
Settlement near the habitat of wild animals	44.2	
Increased wild animals' population due to conservation	7.4	
Type of problem faced by wild animals		
Have you ever seen wild animals killed by humans in your area?		
Yes	31.6	13* (df = 1, $P \le 0.001$)
No	68.4	
Have you ever attempted to kill wild animals?		
Yes	18.9	36.6* (df = 1, $P \le 0.001$)
No	81.1	
Do you support wild animal conservation in this area?		
Yes	83.2	36.6* (df = 1, $P \le 0.001$)
No	16.8	
Control mechanisms of crop raiding by respondents		
Guarding with dog	36.8	77.7* (df = 7, $P \le 0.001$)
Fencing and slipping at night in cropland	25.3	
Symbol and use perfume	4.2	
Drive away wild animals from the forest	3.2	
Burning something like dung that create bad odors to wild animals	8.4	
Trapping and killing	10.5	
Awareness creation to the respondent	5.3	
Sowing less attacked crops	6.3	
Control mechanisms of livestock of the respondents		
Guarding	68.4	79* (df = 3, $P \le 0.001$)
Trapping and killing	8.4	
Drive away wild animals from the forest	7.4	
Tie domestic animals with rope around the home	15.8	

*significance at 1% level.

was a high amount of crop loss by wild animals in the study area and the crop types were maize, small millet, teff, potato, barley, wheat, chickpea, oil niger, and onion. Among them, potato was highly attacked by wild animals, reaching to 113.8 quintals (28%), followed by maize 96 (23%), small millet 74.7 (18%), wheat 40.6 (10%), barley 40 (10%), teff 37.25 (9%), oil niger 3.4 (1%), chickpea 2.3 (0.9%), and onion 0.76 (0.1%) quintals within three years (Figure 3). Within the crop variety, potato and maize were in high proportion, that is, 28% and 23%, respectively, among the other crop types. The crop losses recorded in these communities showed similar trends of crop damage by wild animals in Zimbabwe [25]. The study indicates that there was a high amount of crop loss by wild animals. The wild animals had damaged a minimum of 0.25 quintals and a maximum of 6 quintals crops per household within three years. The average amount of crop loss per household was estimated at 1.47 quintals within three years. This indicates each household farmer lost more than one quintal on average. Despite different crop loss risks among households located at a different distance from the forest, the amount of crop loss in the two kebeles was not significantly different ($P > 0.05$), shown in Table 5.
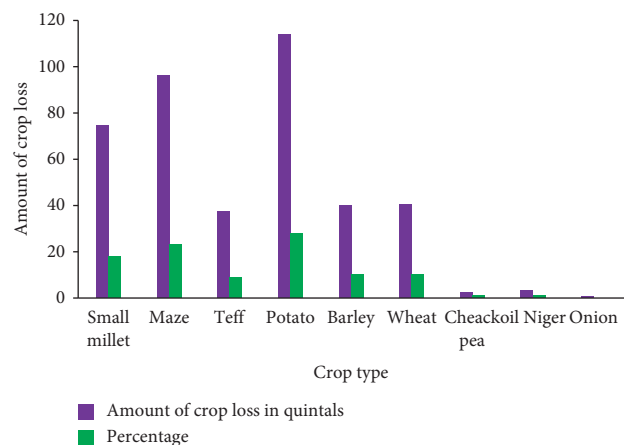

FIGURE 3: The amount of crop loss in quintals per three years of the study area.

4.4. The Type of Domestic Animals Attacked by Wild Animals. The types of domestic animals attacked by wild animals in the study area are presented in Table 4. Accordingly, about

TABLE 5: Crop and animal loss in the two kebeles within three years.

	Number of respondents	Mean	Std. deviation	Min.	Max.	df	F	Sig.
Crop loss in quintals								
Luns-Degera kebele	40	1.64	1.32	0.25	5.00	1	1.375	0.24
Wayikela kebele	55	1.34	1.18	0.25	6.00			
Animal loss in numbers								
Luns-Degera kebele	40	12.92	11.81	1.00	45.00	1	1.414	0.23
Wayikela kebele	55	10.11	11.08	1.00	60.00			

No significant difference at 5% level.

79 (83.2%) of the respondents replied that wild animals attacked all domestic animals. Livestock loss was the most common, with major loss of cattle, donkeys, sheep, goats, chickens, dogs, and cats [30]. Predators fed on livestock as an alternate food, if the availability of natural prey was low [25]. Wild animals have become a threat to our societies, and they prey on our goats and cattle [29]. The result indicates that the incidence of domestic animals attacked by wild animals among respondents perception was significantly different ($P < 0.05$; Table 4).

4.4.1. Age of Livestock More or Less Attacked by Wild Animals.

Among the different types of domestic animals, chickens and young and medium-aged sheep and goats were highly attacked by wild animals that was responded by 65 (68.4%) of the respondents. Few respondents 22 (23.2%) said that wild animals attacked only chickens, while 6.3% of the respondents said all livestock. The result indicates that the predation risk of domestic animals by wild animals was age-dependent. Some farmers said that separating the young and medium-aged sheep and goats from the other older sheep and goats by keeping around their home reduce predation risk and the old sheep and goats can go to the habitat of wild animals because wild animals were little attacking the large sheep and goats during the day. There was a significant difference in livestock attacked by wild animals ($P < 0.05$). On the other hand, wild animals less attacked older sheep and goats and large mammals like cattle and donkey was responded by 57 (60%), large mammals except for sheep and goats responded by 29 (30%), and some respondents 9 (9.5%) said that wild animals attacked all domestic animals. The study shows the number of livestock loss in numbers within three years; chickens were covered in large numbers (Figure 4). A similar study by Biset et al. [34] also reported that high domestic animals loss by wild animals included 262 cattle, 238 sheep, 7 goats, and 4 donkeys within 5 years. This number of animal losses leads to conflict between humans and wild animals. But, the statistical analysis indicates that the average number of animals lost was not significantly different among the kebeles ($P > 0.05$), which is shown in Table 4.

4.4.2. The Trend of the Wild Animals' Population, Crop Damage, and Livestock Damage.

The trend of the population status of wild animals, crop damage, and livestock damage is summarized in Table 4. The trend of the wild animals' population in the study area was reported mainly
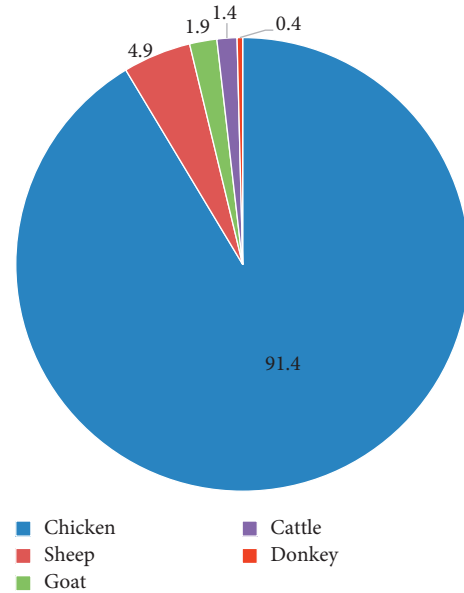

FIGURE 4: Percentages of animals' loss within three years of the study area.

decreased, which is responded by 54 (56.8%) of the respondents; however, 35 (36.8%) of the respondents replied that wild animals' population increased. Similarly, most of the respondents (86.5%) acknowledged that the status of wild animals in the Harenna Forest is decreasing particularly due to the anthropogenic causes [12]. Human-wild animal conflict has serious conservation consequences, both for populations of wild animals and for the people who live alongside them [13]. Respondents in the study area replied that the cause of decrement in the wild animals' population was the expansion of agricultural practice that led shrinking of wild animals' habitats. On the other hand, there is a significant variation in the trend of wild animals' population among the respondent perceptions ($P < 0.05$). It means the respondents in the study area did not have the same perception about the population status of wild animals.

The trends of crop damage in the study area were increased from time to time. The trend of crop damage by wild animals was responded as increased, decreased, and stable by 44 (46.3%), 31 (32.6%), and 20 (21.1%) respondents, respectively. The result indicates that most of the respondents replied that trend of crop damage was increased, and this led to the major cause of conflict between humans and wild animals. The trend of crop damage by wild animals in a time

series was significantly different among the perceptions of respondents ($P < 0.05$). The trend of livestock damage was stable based on the respondent perceptions. In contrary to the conflict perceptions and knowledge, people agreed overall that carnivores and conflict had increased in the past years [28]. The perception difference among the respondents about the trends of livestock damage by wild animals was not significantly different ($P > 0.05$), shown in Table 4. The result indicates that the predation risk of livestock from time to time was similar in the study area.

4.4.3. The Season of Crop and Livestock Damage by Wild Animals.
The season of crop and livestock damaged by wild animals is summarized in Table 4. Wild animals affected both crops and livestock in different seasons. Most of the respondents (92.6%) replied that the crop damage by wild animals was observed more during the wet season than in the other time. The result indicates that most farmers lost their crops during the wet season because farmers sow their crops mainly during the wet season. Even though the crops were harvested in the dry season, some farmers reported wild animals attacked crops in both seasons around the home garden and irrigation areas during the dry season in addition to the wet season. The spatial locations of crops vary by season, and this variation was evident in season-specific changes in crop damage [4]. Wild animals' conflict with mammals appeared more often in spring and summer compared with autumn and winter seasons [17, 33]. Wild animals' predation risk was reported in wet and dry seasons. However, the majority of the respondents 57 (60%) replied that wild animals attacked livestock in the dry season. Some 25 (26.3%) farmers say in both seasons, whereas few respondents 13 (13.7%) reported the risk in wet season only.

According to these respondents, wild animals attacked livestock in the dry season because during the dry season food resource was not sufficiently available for wild animals. A similar study also identified dry season is the most vulnerable time of year for livestock depredation, so strengthened guarding or extra attention can be given to limit the predator attack events [9]. The number of goats, sheep, and cattle predated also varied by months [9]. The statistical analysis indicates that the seasonal crop and livestock damage were significantly different ($P < 0.05$), shown in Table 4.

4.4.4. Causes of Human-Wild Animal Conflict.
The causes of human-wild animal conflict in the study area are summarized in Table 4. The settlement of farmers was near to the habitat of wild animals, and this led to conflict at any time because there are not enough spaces between human settlement and wild animals' habitat. The closer the households and farms located to the protected area boundary, the more the conflicts between the humans and wild animals [6]. Some of the major challenges encroaching for wild animals are farmland expansion, settlements, livestock grazing, and illegal hunting, which are also reported in other studies [12, 38]. The majority of the respondents 42 (44.2%) described the main cause of conflict in the area was the closeness of human settlement to the habitats of wild animals. The closer the households and farms to the wild animals' habitat boundary, the more the conflicts between the humans and wild animals [6, 17]. Distance-related human-wild animal conflict presents a serious challenge in parks and protected areas across the world [37]. Agricultural expansion is a principal driver of biodiversity loss [39]. The gradual loss of habitat by agricultural expansion and deforestation has led to increasing conflict between humans and wild animals. On the other hand, some (20 (30.3%)) of respondents claimed that the main cause of the conflict was the wild animals' habitat loss by the expansion of agriculture and deforestation. Habitat fragmentation leads the area to be less comfortable for wild animals, and the animals cannot get all their needs from the area [38]. People modify the landscape in ways that can reduce connectivity for wild animals with potentially high costs for wild animal populations [13]. Worldwide, wild animals' habitats are being transformed and fragmented by human activities, and the behavior of several species has changed as a result of human activities [40]. Framing is problematic as it can lead to biases in conservation planning by failing to consider the nuances of people's relationships with wild animals and the opportunities that exist for conservation [1]. Wild animals of the country are facing great challenges from human influences: human settlement and encroachment into protected area, habitat conversions, fragmentation, etc. Local communities encroach to wild animals' area to generate the requisite level of domestic animal product for support, and the local communities graze the protected area by entering areas traditionally inhabited by wild animals [2]. The fertility of the land is decreasing gradually from year to year, and the output of crop obtained is decreasing overtime, pushing the farmers to cultivate more land. As a result, an increase in cultivation inside the forest and the buffer zone is frequently observed. A similar study by Mekonen [3] reported the major causes of conflict were agricultural expansion, human settlement, overgrazing by livestock, deforestation, illegal grass collection, and poaching. Continuous land clearing led to habitat fragmentation and decreases in the abundance and diversity of species in the park and the surrounding areas [41]. As wild animals' habitat ranges become more and more fragmented and wild animals are confined into smaller pockets of suitable habitat, humans and wild animals have been increasingly coming into contact and in conflict with each other. The increased wild animals' population in the study area also caused conflict between humans and wild animals. Some (8 (8.4%)) of the respondents said that wild animals prefer crops and domestic animals and this behavior leads to conflict. Areas of conflict include the predation of livestock and farmed fish [32, 42]. The main problems that cause such conflict between wild animals and the local community were created by lack of access to forest resources for the local community and crop and livestock damage [2].

Areas of conflict included the predation of livestock and farmed fish and the perceived competition for wild prey [42]. Deforestation, ecosystem homogenization, and diversity loss were frequent problems in tropical livestock systems, which can foster substantial human-wild animal conflict when wild
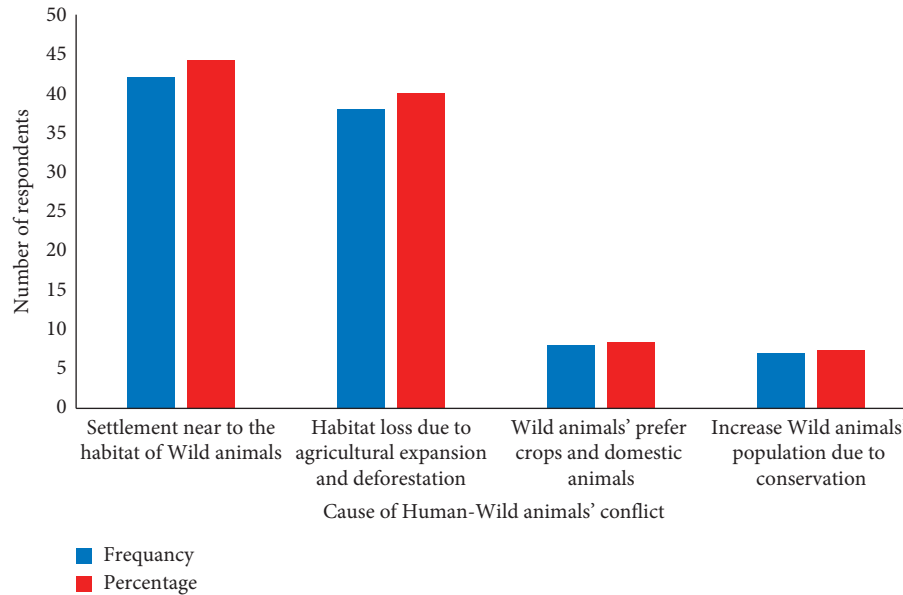
FIGURE 5: Causes of human-wild animal conflict in the study area.

carnivores with declining prey bases turn to cattle depredation [11]. Of the total number, 7 (7.4%) of the respondent said the increase of wild animals' population was the main cause of conflict between them (Figure 5). Some respondents explained that the cause for wild animals' population increase in the area is the presence of conservation. The major causes of human-wild animal conflict in the Harenna Forest, Harenna Buluk District, South East Ethiopia, were agricultural expansion, overgrazing, habitat fragmentation, accessibility, and resource extraction [12]. All these cases of human-wild animals conflict in the Harena forest are also causes of conflict in this study area. Increased predation is likely to compress herbivore populations into a narrower range of habitats [43]. The cause of conflict in the study area was significantly different ($P < 0.05$), which means the cause for human-wild animal conflict was different in the study area.

4.5. Conservation Threat.

The conservation threats are summarized in Table 4. Most of the respondents in the study area said not killed by wild animals, and most said even they cannot see wild animals killed by other people. 65 (68.4.3%) of the respondents replied not seen wild animals killed by others, and 31.6 (31.6%) of the respondents responded seen humans killed wild animals. On the other hand, majority of the local community said not killed wild animals themselves, 77 (81.1%) of the respondents said not killed, and only 18 (18.9%) of the respondents said killed wild animals; those farmers killed wild animals when their crops and animals were eaten by wild animals, that is, to reduce the damage, they kill wild animals. The study indicates that wild animal conservation was high because most farmers were saying due to the presence of conservation by the government, killing any wild animals was not allowed. Most of the respondents said not killed wild animals because of the fear of imprisonment. Positive human values, attitudes, and behaviors indicate tolerance for wild animals (e.g., cultural values that encourage reverence towards species that cause damage) [1].

The study also found that majority 79 (83.2%) of the respondents replied local communities support wild animal conservation, while few of the respondents opposed wild animal conservation. According to opposing respondents, killing wild animals is also a helpful way to reduce the conflict. They understand that the main cause of human-wild animal conflict is wild animal conservation because it increases wild animals' population and aggravates conflict. The attitudes of respondents towards each crop-raiding animal species varied [26]. To increase positive attitudes towards nature, wild animals, and pro-conservation behavior, awareness of negativity bias by policymakers and managers is conducive [44]. Human-wild animal conflicts restrict conservation efforts, especially for wide-ranging animals whose home ranges overlap with Human activities [45]. The study indicates that the perception of respondents on the conservation of wild animals was significantly different ($P < 0.05$), which means the community attitude about wild animal conservation was not the same. In the FGD, the local community did not kill wild animals because of the wild animal conservation regulations; it did not allow any wild animals being killed by humans.

4.5.1. Human-Wild Animal Conflict Management Mechanisms.

Human-wild animal conflict management mechanisms are summarized in Table 4. In the study area, there was a different type of human-wild animal conflict management mechanisms used by local communities such as guarding with the dog, fencing and slipping at night in cropland, burning something like dung that create bad odors to wild animals, sowing less attacked crops, awareness creation to the respondent, trapping and killing, and others. Attitudes around human-wild animal coexistence are primarily influenced by how conflict is managed and,

importantly, the severity of conflict events [46]. Measures taken to minimize crop damage were guarding (watching by dog), chasing, physical barrier (walls and fence), and scarecrow [32, 34]. The role of shepherds in guarding their flocks from predators goes back into pre-history, and it is a method that is still used in many areas, often in combination with livestock-guarding dogs [42]. Guarding was reported as the main traditional measure of conflict management [34]. Farmers used a combination of guarding, patrolling, fencing and trenching, smoky fires, flashed lights, and made noise to scare crop raiders [6, 26]. Livestock guarding strategies including human guarding in grazing time and rearing livestock in pens at night can reduce the depredation probability [9]. Farms at agricultural frontiers face distinct challenges from wild animals in historically farmed regions and require distinct support structures [47]. Awareness creation programs should be organized in the community, and it will help to reduce wild animal threats and to develop wild animal management [4, 12, 47]. Creating awareness is the main concern for wild animal protection and conservation now days [3, 48]. Training is an important component to employee success [18, 49]. Among the most common human-wild animal conflict management mechanisms used by local communities, guarding with dogs and fencing and slipping during the night in croplands were the comments one. Guarding and tie domestic animals with tie rope around the home were used for livestock protections. Livestock depredation significantly differed between guarded and unguarded management strategies [9]. At last, expanding education and awareness and scientific research on wild animals should be given priority. Improving the awareness level of society may help to reduce the impacts on wild animals [38]. For resolving human-wild animal conflict, traditional wild animal management often uses population control [50].

To defend crop raiders, farmers practiced crop guarding, live fencing, scarecrow, chasing, and smoking. However, fencing, chasing, scarecrow, and guarding were controlling techniques to defend livestock predator animals [3]. Currently, a wide range of low-cost avoidance, barrier, and deterrence systems (that are not monitored or activated by humans) are available. Coexistence of people and large carnivores depends on a complex combination of factors that vary geographically [28, 51]. The nonviolent approach to human-wild animal conflict will be a paradigm shift from conflict to a meaningful coexistence between people and wild animals to protect people, assets, wild animals, and habitats [49]. Preservation of greater concentrations of natural prey may reduce possible attacks of wild animals on cattle [11]. High-resolution monitoring of human-wild animal conflict may facilitate more realistic and effective incorporation of the experienced impacts of human-wild animal conflict in conservation planning and management [30]. To achieve conservation goals, mechanisms to de-escalate conflict and foster coexistence are needed [52]. For resolving human-wild animal conflict, traditional wild animal management often uses population control [50]. The statistical analysis indicates that there was a difference among management mechanisms in the study area ($P < 0.05$), which means the management mechanisms were not similar among the respondents. In the FGD also, the management mechanisms were keeping, fencing, and slipping at night in cropland, sowing the less attacked crop, disturbing the wild animals without killing, and drive wild animals far away from their surroundings.

5. Conclusions and Recommendations

This study provides baseline data on livestock predation and crop raiding to help develop wild animal management plans that will enable local people and wild animals in the study area to coexist for the long run. The conflicting result shows that the wild animals in the study area affect the livelihood of local communities in different ways. While wild animals attack both crops and livestock, they prefer some crops and livestock more than others. Maize, potato, and barley were the most frequently raided crop types, and teff, wheat, and oil niger were the least affected crop types by wild animals. Even though wild animals consume crops at all stages of their growth (from sowing to harvesting), they primarily affect the maturation stage. Wild animals in the study area attacked nearly all livestock; however, some domestic species were preferred by wild animals. Chickens and young and medium-aged sheep and goats were the most commonly attacked by wild animals. The major causes of human-wild animal conflict in the study area were the proximity of wild animals' habitats to human settlements as well as habitat loss due to agricultural expansion and deforestation. As agricultural practices expand to wild animals' habitats, wild animals' habitats become smaller and smaller. Hence, the conflicts between humans and wild animals are aggravated by these and other factors. Among the major conflict management strategies in the study area, guarding with dogs, fencing and slipping at night in cropland, burning dung, which creates bad odors for wild animals, sowing less attacked crops, creating awareness among local communities, and trapping and killing wild animals were the conflict management methods. Crop and domestic animal losses by wild animals differed significantly with the season, indicating future conservation efforts should be geared towards wild animals' activity in different seasons. Therefore, wild animals' authorities should develop mitigation strategies with local communities before the conflicts worsen. The livestock and crop protection measures are provided, as well as on the integration of these into locally adapted holistic management systems should be applied. Generally, the researcher suggested that stakeholders and concerned bodies should create awareness in the local community about the appropriate usage of wild animal management strategies and human-wild animal conflict mitigation approaches. A small number of respondents say killing wild animals is an option for managing wild animals. Therefore, the concerned body must make these people aware of other management techniques that could solve problems without killing wild animals. To remedy the problem, preventative (such as artificial and natural barriers, guarding, and alternative livestock husbandry practices) and mitigation (such as compensation systems, community-based natural resource schemes, and regulating harvest) techniques should be used. Generally, it is essential to take appropriate wild animal

management measures to ensure that the wild animals and their habitats are well protected.

Data Availability

The raw data are available through the first author or are available through the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Acknowledgments

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