

Causes, Impacts and Mitigation Measures of Human Large Mammal Conflict in Estie Densa Forest Reserve, Estie District, Northern Ethiopia

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Abstract

Human-wildlife conflict is a significant threat to the continued survival of many species and the livelihood of humans. This study aims to assess the conflict between humans and mammals in Estie Densa Forest Reserve, located in Estie Woreda. Currently, the forest reserve faces many problems like crop damage, disease transmission, livestock depredation, and even loss of human life. So, the study generates general information about human mammals conflict and provides baseline information for other researchers. Selection of 95 respondents from local communities through purposive sampling. The Chi-Square Test was employed to determine the significance of differences across the three Villages, and the results were presented in the form of tables and percentages. Crop raiding and livestock depredation have been proven the primary drivers of human-mammal conflict and are statistically significant among the Villages ($P \leq 0.05$). Anibus Baboon, Wild Pig, and Common Jackal were the major drivers of the conflict, and had statistical difference among Villages ($P \leq 0.05$). Property Loss, and Wildlife Loss covered more than 91% of the total impact perceived as a result of human mammals conflict, and statistically significant ($P \leq 0.05$). Livestock guarding (using dogs and shepherds; 50.52%) was the most efficient approach for alleviating livestock depredation and disease transmission from wildlife to livestock and vice versa. While fencing and crop guarding (35.79%) were second in terms of mitigation, but ranked first in terms of reducing agricultural damage caused by wildlife. There should be better awareness of the value and significance of wild animals, the ecology, tourism, and overall conservation of wild mammals.

Keywords: Conflict, Estie- Densa, Human, Large Mammal, Mitigation.

DOI: 10.7176/ALST/100-04

Publication date: January 31st 2024

1. INTRODUCTION

Human and wildlife conflict threatens species survival and human livelihoods. The world at large is currently dealing with a major issue of human-wildlife conflict and becoming more widespread as human population increases, agricultural expansions & encroachment. People and wildlife become more competitive for resources as a result of human and environmental influences (Zeyede & Teklay, 2017).

Human-wildlife conflict is prevalent in Africa, where several big wild animals, such as elephants and lions, still move peacefully in marginal rangelands and protected areas. The growing human population has led to encroachment on wildlife habitat, habitat degradation, transforming of land for agricultural use, and other activities that are not compatible with the needs of wildlife (Woodroffe et al., 2005), measures by human beings or wildlife that negatively affect the other (Conover, 2002), and perceptions and/or attitudes in which people's security, in their health, wealth, and livelihood are at risk from these activities (Treves et al., 2003).

The conflict between humans and wildlife becomes more extreme in the tropics and in developing countries whose way of life was subsistence farming, in which livestock and cultivating agricultural crops are crucial features of rural people's livelihood and income. The threat of human-wildlife conflict in developing countries remains beside the concern of biodiversity conservation that has become common in Western countries (Muruthi, 2005; Eniang et al., 2011). It exists whenever human demands and actions negatively affect those of wildlife and vice versa. It may occur when wildlife damage crops, threaten their life and property, negative attitudes of peoples to wildlife. As human population expand resettlements, cultivation of crops and livestock grazing makes peoples and wildlife engaged in resource rivalry (Sillero & Switzer, 2011).

Conflict between humans and wildlife occurs when one side's actions have a negative impact on the other (Conover, 2002). Human-wildlife conflicts have been reported all over the world in all types of aquatic, terrestrial, and aerial contexts and have had a significant impact on a wide range of animal taxa (Torres et al., 2018). Primate species and other wild species are ultimately impacted by habitat loss/fragmentation, agricultural development, and human settlement (Fourie et al., 2015).

The conflict between humans and wildlife could result in both direct (death and injury from getting close contact with harmful animals) and indirect effects (agricultural crop destruction, farm animals predation, and infrastructure damage). The primary predators that threaten humans are crocodiles, hippopotamuses, elephants, lions, tigers, and baboons, but mass attacks by birds, big apes, rodents, or insets may quickly destroy agricultural

crops as well (Lamarque et al., 2009). Despite Ethiopia's ample and distinctive geography and diversity of biodiversity, human activities are causing the nation's natural resources to diminish (Bekele et al., 2011; Tefera, 2011). Animal guarding offers an alternative to herding, which is a labor-intensive, time-consuming, and cost-effective method of reducing conflicts between people and wildlife. But according to Ogada et al. (2003), the presence of dogs was only associated with reduced lion invasions on cattle and not on sheep or goats.

In Estie Densa forest reserve, human wildlife conflict is a serious problem. The increasing incidence of human-wildlife conflicts poses a threat to biodiversity, human safety, and the livelihoods of communities residing in proximity to wildlife habitats. Tackling the root causes and developing effective mitigation strategies requires a sound understanding of the ecological, social, and economic factors driving this conflict. The researcher is aware of no scientific baseline data about the root causes, impacts, and potential preventative strategies of the conflict in the study area. By analyzing the fundamental facts about the scope of human-wildlife conflict, the research seeks to address a present knowledge silence. So, in the present investigation, human-wildlife conflict was evaluated in and around the Estie Densa forest reserve in Estie District, Amhara region, northern Ethiopia.

2. METHODOLOGY

2.1 Description of the study area

Estie-densa Forest Reserve is found in Estie woreda, 665 km far from Addis Ababa. The area is located in the north $11^{\circ}36'$ latitude, $38^{\circ}03'$ east of longitude and an elevation of 4231m a.s.l (Figure 1). The area is characterized under woyina-dega agro-climatic conditions and the mean annual temperature is about 16.6°C and an annual rainfall ranging between 1308 to 1501 mm.

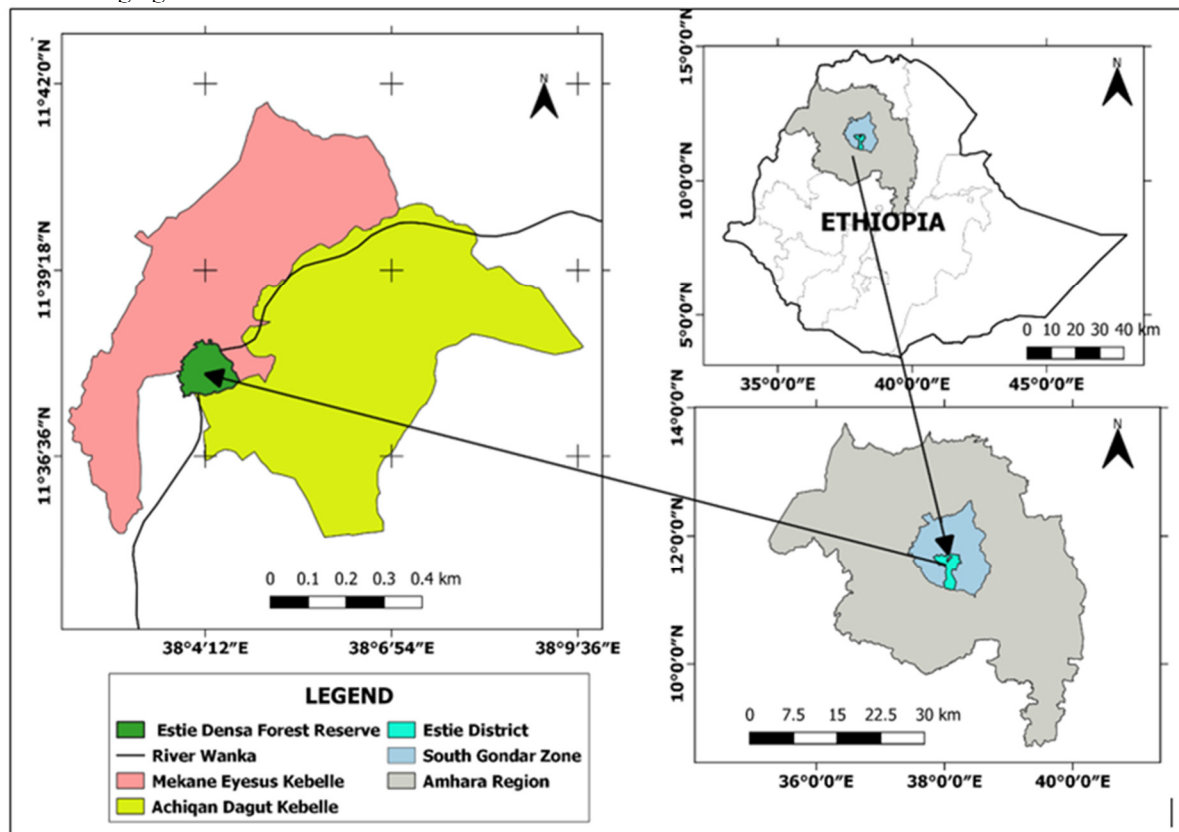


Figure 1. Study area Map

Estie Densa Mountain is a beautiful forest surrounded by green vegetation all year round (Figure 2), about 5km northeast of the capital city of the woreda, Mekane-Eyesus town. It is a breeding and rearing center for a variety of wildlife. This area named a sleeping lion, surrounded by the river Wanka, and has attracted the attention of many spectators and visitors. This tight forest is divided into two kebeles, the Mekane-Eyesus and the Dagut kebeles, with a population of 967 and 667 households respectively, totaling 1654 households (Agricultural & Rural Development Office, 2002).



Figure 2. Estie Densa forest reserve (photo taken by Setie Ewnetu, 2019)

2.2. Sampling techniques

Based on their closeness, proximity and impacts perceived two kebele's (namely Dagut and Mekane Eyesus) were selected by using purposive sampling. The reason behind choosing this technique is it provides appropriate data in relation to the objective of human mammals conflict. Representative samples/respondents were taken from two selected kebele's based on their background experience, knowledge about the issue of human mammals conflict. The respondents were then divided into several strata depending on their occupational background, sex, age, and educational level using stratified sampling. The selection criteria for key informants are the same as those for respondents. Key informants had been involved to strengthen the primary data which are collected from questionnaires and direct field observations. Two from each staff members: forest guards, forest experts and wildlife managers were selected for key-informants to strengthen the information obtained from primary data. The targeted two kebeles have the total household of 1,654 (Dagut 657 and Mekane Eyesus kebeles 997). The Slovenes formula was used to calculate sample sizes in order to meet the desired goals (Yamane, 1967); error terms ranging from 0.1 to 0.01 were employed. Because of time constraints and a lack of funding, 10% was utilized to determine the study's overall sample size.

$$n = \frac{N}{1 + (N \times e^2)} = 94.3 \approx 95 \text{ (roundup)}$$

Where n = sample size, N = total population and e = acceptable level of error

So, a total of 95 respondents were taken from the two targeted kebeles; 38 respondents from Dagut and 57 from Mekane Eyesus kebeles were proportionally selected.

2.3. Data collection

The questionnaire and interviews used in this study were developed and evaluated in three villages close to the study region. Depending on their level of expertise and closeness to the park, both open-ended and closed-ended questionnaires were given to the household members intentionally. Different secondary sources, including books, journals, research reports, magazines, personal diaries, letters, and electronic media like the internet, videos, CD ROMs, broadcast, etc., were used to acquire the data.

2.4. Data analysis

Using an Excel sheet, the data was organized in order. Tables, frequencies, and percentages were used in the organizing and reporting of the facts for purposes of descriptive statistics. The Chi-square test was used to assess the significance of the data among the three villages after the data were analyzed using the R software.

3. RESULTS

In order to assess the problem that leads human mammals conflict: key informant interviews and questionnaires supported by direct field observation were conducted, analyzed and interpreted as follows:

3.1. General characteristics of respondents'

Males made up more than half of the respondents, representing 62.1% of all respondents. Males are probably more directly and/or indirectly exposed to the issue of human-mammal conflict and much of the phenomena that take place between males and wild animals, which might be the cause of the conflict. According to the age group, the

majority of respondents were adults, accounting for 62.1% of all respondents, with only a few respondents aged 51 and more. According to their educational status, 36 (37.9%) of the respondents were in elementary school, and 85.3% of the 95 respondents were farmers (Table 1).

Table 1. General Demographics of Respondents

No	Respondents demographics	Respondents		
		Numbers	Percentages (%)	
1	Sex	Male	59	62.1
		Female	36	37.9
2	Age category	15-30 year	24	25.3
		31-50 year	59	62.1
		Above 50 year	12	12.6
3	Educational status	Degree	4	4.2
		Diploma	19	20
		High school	29	30.5
		Primary school	36	37.9
		Adult school	2	2.1
		Illiterate	5	5.3
4	Occupational Background	Local communities (farmers)	81	85.3
		Community elders	5	5.3
		Wildlife experts	2	2.1
		Forest guards (scouts)	4	4.2
		Religious elders	3	3.2
Total		95	100	

3.2. Major causes of human mammals conflict

Mostly, local communities practiced subsistence way of farming and cultivation of crops as a means of their livelihood. The magnitude of crop raiding is much more than those of the others and hundreds of quintals of crops are damaged every year by wild animals. Crop raiding (47.67%) and (28.42%) predation on livestock is the predominant issue that gives rise to human mammals conflict. The conflict is mostly takes place in and around agricultural lands either for the need of grazing of their livestock and cultivation of crops.

Agricultural expansion and human encroachment in to mammals' habitat (10.53%), is the third main, and clearing of forest area for cultivation of agricultural crops dismisses the natural habitat of mammals. Human populations expand agriculture in large extent, natural habitats of mammals shrinks, and wild mammals and humans become more competitive over food and dwelling space.

Peoples have negative attitudes (4.21%) towards mammals and assumes that living with mammals has always negative effect on their economy, livelihood, property and even dangerous for their lives. They perceived such type of perceptions as a result of greater negative impact on their livelihood from mammals, particularly from large wild carnivores and herbivores without any compensation for property loss to the local farmers from mammals. The main reasons for conflict between humans and mammals varied significantly ($\chi^2=25.05$, $df=10$, $p \leq 0.005$) among the three targeted categories (Table 2).

Table 2. Root cause of human-wild mammals conflict in Estie Densa Forest Reserve

Major causes	Villages			Total	χ^2	df	P-Value
	Dagut	Gora Dur	Zinjero Meda				
Crop Raiding	16.84	22.11	8.42	47.67	25.05	10	0.005
Livestock Depredation	2.11	21.05	5.26	28.42			
Agricultural Expansion	4.21	6.32	0	10.53			
Grazing Inside Forest	4.21	1.05	2.11	7.37			
Negative Attitude	1.05	0	3.16	4.21			
Others	0	2.11	0	2.11			
Total	28.42	52.63	18.95	100			

3.3. Most Problematic wild animals

Mammals has caused extensive damage to human properties which include agricultural crops and domestic animals and others like loss of human life. Based on their degree of destruction, the most common and well-known crop raider of the area includes Anibus Baboon (35.79%), Wild Pig (21.05%), Porcupine (11.58%), and others (like Common Duiker, Clip Springer; 2.11%).

Many wild animals are responsible for extensive damages to livestock and the most common includes:

Common Jackal (18.95%), Hyena (both Stripped and Spotted Hyena; 10.53%), and others (wild cat, cheetah, leopard etc.). They affect domestic animals throughout the year but mostly become more aggressive especially during rainy season. wild mammals that can triggered the conflict of human wild mammals has a significance difference ($\chi^2 = 43.58$, $df = 10$, $p \leq 0.001$) among villages (Table 3).

Table 3. Most problematic animals of the area

Problematic Animals	Villages			Total	χ^2	df	P-Value
	Dagut	Gora Dur	Zinjero Meda				
Anibus Baboon	6.32	15.79	13.68	35.79	43.58	10	0.001
Wild Pig	15.79	5.23	0	21.05			
Common Jackal	2.11	14.74	2.11	18.95			
Porcupine	4.21	7.37	0	11.58			
Hyena	0	7.37	3.16	10.53			
Others	0	2.11	0	2.11			
Total	28.42	52.63	18.95	100			

3.4. Impacts of human mammals conflict

Loss of human property (i.e. livestock depredation and damage of agricultural crops; 50.53%) was the most serious negative impacts of human-wild mammals conflict. Influences of wild animals on people's properties was the first and prominent causes that results crisis on the local economy, food security and livelihood of locals, and leads to poverty at large and low standard of living.

Many wild animals died (41.06%) as a result of conflict and some of the deaths results due to the revenge attacks by humans when wild animals can cause serious damage to their properties. Sometimes wild animals were killed as a result of negative attitudes and cultural believes of local communities' especially large carnivores for a manifestation of courageousness. Zoonotic diseases (mainly rabies; 6.32%) were transmitted from wild animal to humans and vise versa, and loss of human life (2.11%) were also the major impacts that results from the conflict. Impacts of human wild mammals conflict has significance difference ($\chi^2 = 13.81$, $df = 6$, $p \leq 0.05$) between the targeted villages (Table 4).

Table 4. Major impacts of human-wild mammals conflict

Impacts	Villages			Total	χ^2	df	P-Value
	Dagut	Gora Dur	Zinjero Meda				
Property Loss	16.82	25.26	8.42	50.53	13.81	6	0.032
Wildlife Loss	10.53	25.26	5.27	41.06			
Disease Transfer	0	2.11	4.21	6.32			
Human Life Loss	1.05	0	1.05	2.11			
Total	28.42	52.63	18.95	100			

3.5. Mitigation measure of human-wild mammals conflict

As the issue of human-wild mammals conflict in the area became more acute, mitigating measures were initiated. The reason why mitigation measure was developed in the area is that the problems of human mammals conflict becomes the serious problem and have high negative impacts on both the livelihood of local communities, mammals and their habitat.

Guarding of livestock (using dogs and shepherds; 50.52%) was the best method for reducing the issue of livestock predation and the spread of disease. In terms of mitigation, guarding of crops and fencing (35.79%) came in second, but first in terms of reducing crop damage by animal life. Other mitigation strategies like improve land use planning, chasing of wild animals & scaring (by using sounds, alarm call, throwing stones, gesturing, mimicking or impersonating), fumigants & herbicides, and killing of wild animals are also practiced by the local communities to reduce conflict. Regarding potential mitigating measures for conflict between humans and wild mammals, there was no statistically significant difference ($\chi^2 = 5.14$, $df = 6$, $p \leq 0.526$) between the villages (Table 5).

Table 5. Possible mitigation measure of human mammals conflict

Impacts	Villages			Total	χ^2	df	P-Value
	Dagut	Gora Dur	Zinjero Meda				
Guarding of Livestock	13.48	27.37	9.47	50.52	5.14	6	0.526
Guarding & Fencing of Crops	11.58	18.95	5.26	35.79			
Awareness creation	3.16	6.32	3.16	12.63			
Others			1.05	1.05			
Total	28.42	52.63	18.95	100			

4. DISCUSSIONS

4.1. Cause of human mammals conflict in Africa

There are many factors that may contribute to human mammals conflict with regarding of livestock; first, most domestic animals cannot escape from wild predator's attack because of little or no anti-predator behavior. Second, cattle may graze alongside wild predators, reducing the amount of natural prey available to carnivores. Finally, livestock are no longer guarded by peoples or dogs and are thus easy prey for wild carnivores (Chardonnet, 2008). This findings in-line with Parker et al. (2007), Chardonnet (2008), and Kumssa & Bekele (2008) that human mammals conflict was escalated due to the effect of wild animals on livestock depredation and raiding of agricultural crops. Insufficient grazing land and grazing of livestock inside the forest reserve with or without active shepherds is the most common cause for livestock depredation. Most wild mammals can cause adverse effect on agricultural crops that might trigger the conflict seriously (Table 2).

The finding in-line with Dagne *et al* (2014) that peoples almost have negative attitudes towards mammals and assumes that living with mammals has always negative effect on their economy, livelihood, safety, property and even dangerous to their lives. They perceived such type of perceptions might be raised as a result of greater negative impact on their livelihood, particularly from wild mammals without any tangible benefit like job employment, tourism or ecotourism, compensation for property loss to the local farmers from mammals (Table 5).

4.2. Most problematic wild mammals

The destruction of crops is not a recent incidence; it has most likely been a part of human history ever since people first settled down and began engaging in agriculture. The media frequently covers some of the most spectacular occurrences, such as the outbreaks of locusts that destroy broad expanses of crops within the majority of the world. Crop raiding by vertebrates as well such as birds and mammals is also a significant problem. The most problematic wild animals include elephant, crocodile, lions, buffalo, hippo, bush-pig, baboons & monkey, birds and hyena (Anderson and Pariela, 2005).

In Africa, an extensive variety of vertebrate species, including birds, rodents, monkeys, antelopes, buffalos, hippopotamuses, bush pigs, and elephants, come into conflict with agricultural operations. Elephants are typically seen as the biggest threat to African farmers, despite the fact that they typically do not cause the most harm to subsistence agriculture (Parker et al., 2007). This study has slight difference with Anderson and Periera (2005), and Parker *et al.* (2007). Wild animals including the Anibus Baboon, Wild Pig, Common Jackal, Porcupine, Hyena, and others have caused major damage to agricultural crops, livestock, and other assets in addition to human deaths (Table 3).

4.3. Impacts of human mammals conflict

Predators killing domestic animals is one of the negative consequences of the conflict between humans and other mammals. Attacks on cattle are a problem in the savannah and grasslands, where pastoralism is still an important source of many people's income. Even while the losses are negligible on a national scale, they can be devastating for a single stock owner (Patterson et al., 2004).

On the African continent, crop destruction is the other primary of the conflict between humans and wildlife (Parker et al., 2007). Wild mammals were capable of passing hazardous diseases, like rabies, to domesticated animals and potentially even humans. Predators and scavengers like spotted hyenas, jackals, lions, and vultures spread diseases by opening, dismembering, and scattering bits of contaminated corpses. For instance, anthrax spores are spread broadly in predators' faces when they consume it together with dead body tissue (Hugh-Jones and de Vos, 2002).

The results of this study differ from those of Patterson et al. (2004) and Hugh-Jones and de Vos (2002), and similar with Parker *et al.* (2007). In the study, loss of human property (i.e. livestock depredation and damage of agricultural crops) was the most serious negative impacts recorded from human and mammals conflict. The large percentage, more than half (50.53%) of the respondents assures that the impacts of wild mammals on agricultural crops (crop damage) and domestic animals (livestock depredation) are the core issue that might results negative impact on the local economy's, food security and livelihood, and leads to poverty at large and low standard of living (Table 3).

4.4. Mitigation strategies for human mammals conflict

Animal guarding offers an alternative to herding, which is a labor-intensive, time-consuming, and cost-effective technique for reducing human-wild mammals. But according to Ogada et al. (2003), the presence of dogs was only associated with fewer lion invasions on cattle and not on sheep or goats. In many different places of the world, donkeys have also been employed as guard animals. For example, in Kenya, one or two donkeys have been used for every herd of cattle to protect against lions. Compared to cattle, donkeys appear to have a stronger defensive more sense and are inherently more aware of potential predators (Schumann, 2004). Using little primitive weapons like spears, knives, or firearms, human herders in East Africa have been known to challenge and chase away

harmful carnivores like lions, hyenas, and cheetahs (Parker, 2007). Human herders in this region are effective and courageous in keeping predators away. According to the research, protecting livestock with dogs in addition to shepherds enables avoidance of depredation and prompt reaction to predator attacks since the loss is often smaller when shepherds are present than in herds that are allowed to roam free.

Deterrents and repellents: have been tested against many different wild carnivores, but only a few have produced practical results. Scarecrows can be utilized as a deterrent, although they are less effective against lions than they are against leopards (Madden, 2004). Methods of contraception: a range of mechanical, surgical, endocrine-disrupting, or immune-contraceptive procedures can be used to reduce the fertility of wild animals. These procedures must not injure the target animals, non-target animals, or potential capture victims. (Delsink *et al.*, 2003).

Different findings were observed from Madden (2004) and Delsink *et al.* (2003). Local communities/farmers couldn't practice any Contraception method, deterrents and repellents. Contraception method might not yet applicable because of its complexity, accessibility and totally have not aware in advance to apply it. It is totally different with the finding of Schumann (2004) and similar with Patterson *et al.* (2004). Instead they use fumigants and herbicides to avoid some species of wild animals: porcupines hate fumigants of a certain plant species (**Table 5**).

Promoting understanding and Compensation: Awareness-building may be done in the community at various age and career levels, beginning with primary schools, adult education facilities, and farmer training facilities. A highly cost-effective way to manage conflict would be to educate youngsters and increase awareness among them and/or adults through the traditional authority of chiefs and headmen. Typically, the provision of compensation in the case of a loss is limited to a certain type of loss, such as human mortality, livestock killed by predators, or elephants destroying livestock (Muruthi, 2005).

Similar finding was observed from Muruthi (2005) and awareness creation is the one and best mechanism of reducing conflict. But it is not widely applicable because of different situations: first, lack of attention from all concerned bodies for mammals and almost no effective experience sharing and training about the importance of mammals and its value. Secondly, the local farmers need incentives/annuity at the end of each conference on the issue of mammals. Thirdly, farmers need active compensation for their life and property loss by mammals. Due to the above reasons, awareness creation and payment of compensation strategy becomes ineffective in the area as they need and assume, but they know that it is best and effective mechanism of reducing human mammals conflict (**Table 5**).

5. CONCLUSION AND RECOMMENDATIONS

The conflict between people and wild animals has a detrimental effect on human social, economic, or cultural life as well as the preservation of the wild mammal population or its environment. It has increased mainly as a result of Agricultural expansion and human encroachment in to mammal's habitat, loss of livestock by wild mammals, lack of awareness and negative attitudes of peoples toward wild mammals, and others.

The local communities adopt numerous potential mitigation measures to back-up the problem and for peaceful and co-existence between humans and wild mammals. Fencing, guarding of livestock and of agricultural crops, awareness creation, chasing & scaring (by using sounds, alarm call, throwing stones, gesturing, mimicking/impersonating).

- Wildlife awareness should be spread by emphasizing the worth and significance of wild animals, ecology, tourism, and economic growth in general.
- More study has to be done to determine the extent of human-wild mammal conflict in the region.

CONFLICT OF INTERESTS

I, the authors, declare that I have no conflicts of interest with the research, writing, and/or publishing of this paper.

ACKNOWLEDGEMENT

My deepest gratitude goes out to Mr. Zenebe Ageru for his important suggestions and encouragement that considerably assisted me in improving the text. I'm also thankful to Mekelle University's Dry Land Agriculture and Natural Resources College for agreeing to conduct this research. Last but not least, I am grateful to everyone who has supported me from the beginning of data collecting until the end of the project.

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