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Assessment of Distribution and Characteristics of Domestic Damage Caused by Wild Animals Around Yegof National Forest Priority Area

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ABSTRACT

Damage manifestations in terms of crop damage and livestock depredation are common in Ethiopia. Assessment of domestic damage caused by wild animals around Yegof National Forest Priority Area was carried out from February 2016 to January 2017. The forest area coordinates were collected and boundary was prepared using GIS. Coordinates of domestic damage was obtained using GPS and used for measuring the distance from the forest. Type of domestic damage as well as wild animals involved in such damages was recorded by approaching the victims in each ward. The total area of Yegof forest was estimated to 1462.56 hectares. Most of domestic damage was reported along the boundary and inside the forest area. Among 30 incidences, crop damage was significant ($p \leq 0.05$) than livestock depredation. *Theropithecus gelada*, *Papio anubis* and *Chlorocebus aethiops* were identified as major crop pests (85.7%). *Eragrostis tef* (28.6%) was more vulnerable than other crops like *Vicia faba*, *Triticum* spp., *Hordeum vulgare*, *Sorghum bicolor* and vegetables. Most of the crop damage incidence happened during day time (85.7%) and none of the crop raiders were killed. *Panthera pardus* (77.8%) and *Canis aureus* (22.2%) were reported as common predators of livestock. Sheep/goat was the preferred prey for them in all incidences. Majorly, livestock depredation happened in the night time (66.7%) and none of the predators were killed. In conclusion, domestic damage by wild animals around the study area is common and needs special attentions and also demands for sustainable and culturally acceptable conservations solutions to mitigate such incidences.

Keywords: Conservation, Crop damage, Livestock predation, Yegof National Forest Priority Area.

INTRODUCTION

Domestic damage caused by wild animals is prevalent and create serious problems when wildlife activities intersect with those of humans (Treves et al., 2006). Such incidents occur when wild animals leave protected area and enter into the human settlements or when humans reach to close proximity with wildlife to explore the natural resources of nearby forest for their livelihood (Ogra, 2008). Damage caused by wild animals are continuous and it can be in a various forms which include crop raiding, livestock predation, property damage and attacks on humans (Madden, 2008; Ogra, 2008). In many countries, crop raiding and livestock depredation have been identified as a key form of domestic damage and are more prevalent along the borderline of the protected areas (Karanth et al., 2013; Guinness & Taylor, 2014). In fact, species involved in domestic damage are more prone to extinction (Woodroffe & Ginsberg, 1998) and also create a basis for resentment due to undermine welfare of the people through crop damage, livestock predation and human attack.

Economic losses incurred due to crop raiding and livestock depredation can be relatively high in developing countries and are rarely compensated for their losses (Linkie et al., 2007; Nath et al., 2015) which are true with Ethiopia. Such encounter of crop raiding was reported by a wide range of species like elephants (Hoare, 1999; Nyhus et al., 2000; Sitati et al., 2003; Nyirenda et al., 2011; Nath et al., 2015), wild boar (Linkie et al., 2007; Ficetola, 2014), rodents (Singleton et al., 2005) and primates (Hill, 2000; Marchal & Hill, 2009; Hoffman & O'Riain, 2012; Oduntan et al., 2012; Guinness & Taylor, 2014). Also livestock

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depredation by various carnivores were reported in different parts of the world which is exemplified by wolves, bears, jaguars, pumas, tigers, lion, hyena and leopards (Rodney & Rinchen, 2004; Kolowski & Holekamp, 2006; Michalski et al., 2006; Wang & Macdonald, 2006; Røskaft et al., 2007; Kissui, 2008; Sangay & Vernes, 2008; Dar et al., 2009; Iliopoulos et al., 2009; Kabir et al., 2014; Bhattarai & Fischera, 2014). Occurrence of crop raiding and livestock depredation in Ethiopia is similar to the other countries. In fact, the situation of such conflicts can be still severe. However, very few studies are reported on Human-wildlife conflict in Ethiopia (Yihune et al., 2008, 2009a,b; Gebeyehu & Bekele, 2009; Atickem et al., 2010; Yirga et al., 2011; Mekonnen et al., 2012; Datiko & Bekele, 2013a, b; Kumssa & Bekele, 2013).

In Ethiopia, it is evident from the research papers (Atickem et al., 2010; Yirga et al., 2011; Datiko & Bekele, 2013b) that the damage caused by different wild animals varies from place to place and nature of the damage depends on the species involved in the type and level of damage. Damage manifestation in terms of livestock depredation was reported from *Crocuta crocuta*, *P. pardus* and *C. aureus* are common (Yirga et al., 2011). In pastoral area, spotted hyena and leopard were responsible for predominant predation of livestock mainly in south eastern part of the Ethiopia (Atickem et al., 2010). Predation of sheep by Ethiopian wolf (Yihune et al., 2008) and crop damage by gelada was noticed around Simien Mountains National Park (Yihune et al., 2009a). Yihune et al. (2009b) have also reported the pronounced problems of common jackal to the local community around Simien Mountains National Park. This study also emphasized that local community experienced the minimal problems from Ethiopian wolf, leopard, vervet monkey, hamadryas baboon and crested porcupine. In Zegie peninsula area grivet monkey was reported as major problematic animal (Gebeyehu & Bekele, 2009). In addition, crop raiding activity of Bale monkey was reported in Oromia and Southern Nations Regional States (Mekonnen et al., 2012). Datiko & Bekele (2013a) have reported that buffalo, vervet monkey and warthog were the most problematic wild animals that damage crop in agricultural fields in the area of Chebera Churchura National Park. However, warthog was considered as notorious crop pest in Senkele Swayne's Heartbeats Sanctuary (Kumssa & Bekele, 2013). Datiko & Bekele (2013b) have also reported that hyena and leopard were responsible for livestock predation around area of Chebera Churchura National Park.

Considering the existence of domestic damage around different reserve as well as forest priority areas of the country, it becomes prime conservation priority to reduce human- wildlife conflict where people and wildlife co-occur (Karanth et al., 2012) and create a sustainable coexistence. In fact, people often perceive that wildlife can damage up to 100% of agricultural production (Pérez & Pacheco, 2006), especially where there are no adequate buffer zones and/or absolute barriers. From these facts, it is imperative to gain a thorough understanding of the characteristic and distribution of domestic damage by wild animals around Yegof National Forest Priority Area.

MATERIALS AND METHODS

Study area:

The study was conducted around Yegof National Forest Priority Area, South Wollo, Amhara region, Ethiopia. Yegof National Forest Priority Area is surrounded by Kombolcha, Dessie, Kallu and Albuko woredas (Districts). This forest has been reported as dry evergreen afromountain forest dominated by *Juniperus procera* and *Olea europaea* (Bekele, 2005; Mohammed & Abraha, 2013). This forest priority area is located 380 km away from Addis Ababa towards north. The site is located between 11° 01' to 11° 03' North latitude and 39° 40' to 39° 44' East longitude with an elevation between 2000 and 3014 m.a.s.l. (Mohammed & Abraha, 2013) (Fig. 1).

The annual mean temperature of the study area ranges from 12.7°C to 27.1°C, while the average annual rainfall is about 1001 mm (Mohammed & Abraha, 2013). According to the inventory made by Amhara Region Culture and Tourism office, Ethiopia, this National Forest Priority Area supports a wide variety of wild animals, majorly, primates, Menelik's bushbuck (*Tragelaphus seriptus meneliki*), common mole rat (*Tachyoryctes splendens*), wild pig (*Sus scrofa*), leopard (*P. pardus pardus*) and striped hyaena (*Hyaena hyaena*).

Methods:

This study was conducted from February 2016 to January 2017. As the interaction between wild animals and human settlements was evident around Yegof National Forest Priority Area, the focus was made on (i) delineate the boundary of Yegof National Forest Priority Area (ii) record the actual incidences of domestic damage and its respective distribution caused by wild animals. For delineating the boundary of Yegof National Forest Priority Area, Global Positioning System (GPS) coordinates, remote sensing (Google Earth) and Geographical Information Systems (GIS) procedures were used. A total of 525 GPS coordinates were collected from The Amhara Region Forestry Enterprise which was established in 2009 and mandated to develop project and utilization of state owned forest in Amhara region.

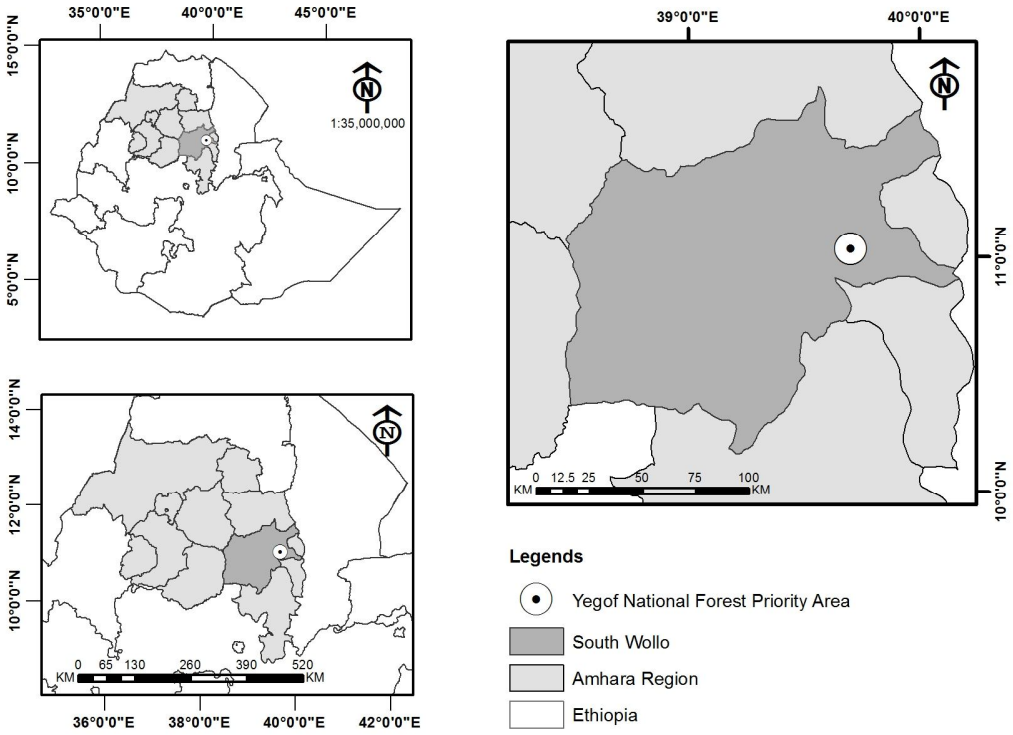

Fig. 1: Location of Yegof National Forest Priority Area

The GPS coordinates were imported into ArcGIS 10.2.1. Software package for preparing the shape files. The boundary of forest was prepared using Universal Transverse Mercator (UTM) coordinates system. The shape file of the forest area was estimated by manipulating the point data into coverage polylines and this was then converted into polygons. Finally the map using the Projected Coordinate System of Adindan_UTM_Zone_37N was produced. The total area of forest was measured using ArcGIS 10.2.1.

Specific location of every events of domestic damage was recorded with the help of GPS coordinates and imported into ArcGIS software package to calculate the distance of events from the forest boundary. In fact, it was reported that the precise situations of such domestic damage can be achieved by using GIS as it provides an effective and efficient means of generating accurate measures of domestic damage caused by wildlife (Anderson, 1996). To analyze the number of domestic damage happened corresponding to the distance from the forest boundary, events were classified as (i) events happened inside the forest area and up to 0.5 km from the boundary of the forest as the predators kill medium size domestic animals and heave to a safer place easier (Dar et al., 2009; Bidi et al., 2013) (ii) events happened from 0.5 km to 1.5 km and (iii) events happened from 1.5 km and above.

To document the details of every incidence of domestic damage around the study area, enumerators were appointed. When incidences of domestic damage was notified, complete report was documented by consulting the victims. Relevant information pertinent to every event was obtained from victims through both open ended and fixed response questions and recorded in the questionnaire. During interaction, enumerator made the victims to step aside to avoid any of the influences on the responses. The correct identification of sighted predators was assured by showing photographs of different predators to the victims. To record the characteristics of domestic damage, the focus was made on characteristics of the incidence. In each domestic damage incidences, more details such as (i) wild animal involved in the incidence, (ii) name of the crop or livestock damaged by wild animals (iii) time of the incidence, (iv) fate of the wild animal responsible for domestic damage was escaped or killed by local residents, (v) type of crop damaged by crop raiders and type of livestock attacked by carnivores and (vi) in case of livestock depredation, fate of attacked livestock was recorded using questionnaire included both open ended and fixed response questions.

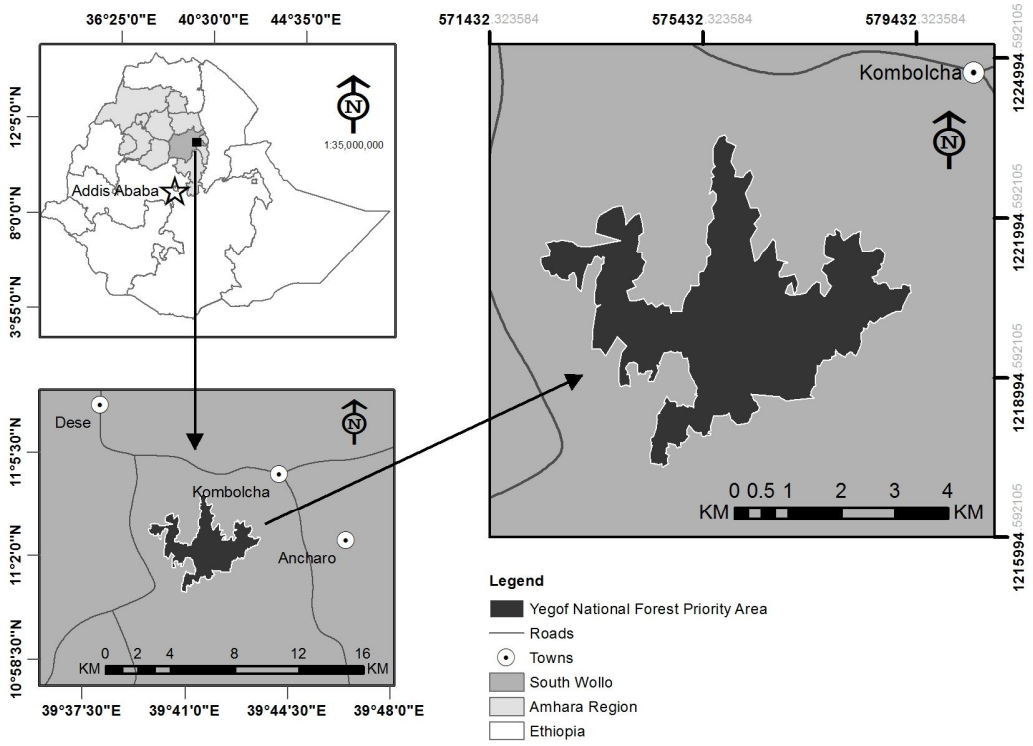

Fig. 2: Total area of the Yegof National Forest Priority Area

Data Analysis:

The collected data was analyzed using Statistical Analysis System (SAS) Version 9.2. Chi square statistical test was used to determine the number of events of domestic damage happened at different distance from the forest boundary and to analyze the data pertinent to domestic damage caused by wild animals and p value for all tests was set at $p \leq 0.05$. Statistical analysis was not applied for some parameters such as fate of crop raider, name of the livestock depredation, fate of predator and fate of depredated livestock as response of these parameters was constant.

RESULTS

Total area of forest and distribution of domestic damage:

Total area of the Yegof National Forest Priority Area was estimated to 1462.56 ha (Fig. 2). Out of 30 domestic damage incidences, two events were not recorded as the incidences were occurred in the remote area within the forest where accessibility was not feasible. Among all incidences, majority of them happened inside the forest area and up to 0.5 km distance from the boundary (Fig. 3). However, as the distance from the forest boundary increased the incidences of domestic damage was decreased, correspondingly ($\chi^2 = 9.8$, df= 2, $p \leq 0.05$).

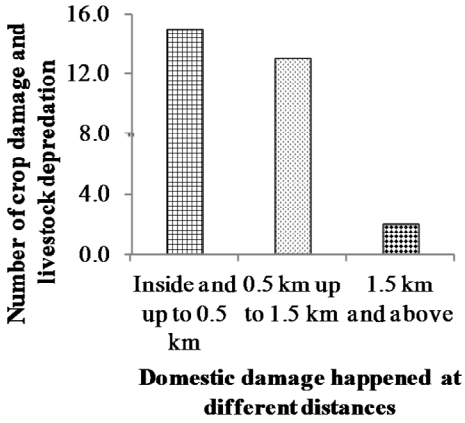

Fig. 3: Number of domestic damage happened at different distances in and around study area

Characteristics of domestic damage:

Majority of the victims reported the incidence of both crop damage and livestock depredation and occurrence of crop damage was more and significant ($\chi^2 = 4.8$, df= 1, $p \leq 0.05$) than the livestock depredation (Fig. 4).

Crop damage:

Primates such as *T. gelada*, *P. anubis* and *C. aethiops* were perceived by the informants as the

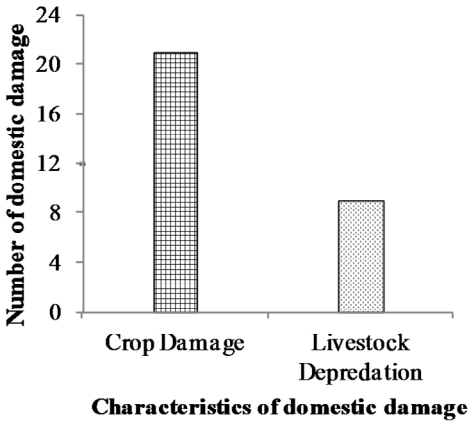

Fig. 4: Characteristics of domestic damage around study area

major species responsible for crop damage as compared to the other wild animals (χ^2 = 41.28, df= 3, $p \leq 0.05$). However, *Sylvicapra grimmia, Numida meleagris* and *Hystrix cristata* were other wild animals responsible for crop damage but damage caused by them was negligible (Table 1). *E. tef* was the relatively most frequently cited crop damage by the forest primates. *V. faba* and *Triticum* spp. was the next most commonly damaged crop according to the victims. However, *H. vulgare*, *S. bicolor* and vegetables were damaged occasionally as they cultivate them rarely (Table 1). As per victims information, except three incidence of crop damage caused by *S. grimmia*, *N. meleagris* and *H. cristata*, all other crop damage incidences caused by primates happened at day time (Table 1). The victim's proportion for time of incidence, especially the day time, was significant (χ^2 = 10.71, df= 1, $p \leq 0.05$). In spite of such damage, wild animals were not killed since they escaped when they were chased by the field owner.

Table 1: Incidence of domestic damage with reference to crop damage in the study area

Attribute	Response	No. of Incidences (n=21)
Wild animals involved	Primates	18 (85.7%)
	S. grimmia	01 (04.8%)
	N. meleagris	01 (04.8%)
	H. cristata	01 (04.8%)
Name of crops damaged by crop raider	*E. tef*	06 (28.6%)
	Triticum spp.	04 (19.0%)
	V. faba	04 (19.0%)
	H. vulgare	03 (14.3%)
	S. bicolor	02 (09.5%)
	Vegetables	02 (09.5%)
Time of incidence	Day	18 (85.7%)
	Night	03 (14.3%)
Fate of crop raider	Killed	00 (00.0%)
	Escaped	21 (100%)

n = Number of Incidences; Percentage values are presented in parentheses

Livestock depredation:

People around Yegof National Forest Priority Area experienced the damage from *P. pardus* and *C. aureus.* Among incidences of livestock, depredation caused by *P. pardus* was more than *C. aureus* but category of these two were not statistically significant (χ^2 = 2.78, df=1, $p > 0.05$). As per the victim's information, a total of nine sheep/goats were lost due to predation (Table 2) and majority of livestock depredation happened at night time. In every incidence the predators were not killed. However, in every incidence the livestock was killed by wild animals.

Table 2: Incidence of domestic damage with reference to livestock depredation in the study area

Attribute	Response	No. of Incidences (n=09)
Wild animal involved	*P. pardus*	07 (77.8%)
	C. aureus	02 (22.2%)
Name of Livestock depredated	Sheep/Goat	09 (100%)
	Cattle	00 (00.0%)
	Pack animal	00 (00.0%)
Time of incidence	Day	03 (33.3%)
	Night	06 (66.7%)
Fate of Predator	Killed	00 (00.0%)
	Escaped	09 (100%)
Fate of depredated livestock	Killed	09 (100%)
	Injured	00 (00.0%)

n = Number of Incidences; Percentage values are presented in parentheses

DISCUSSION

Living around protected areas could be an opportunity or a threat. As a threat, it entails different types of damages such as crop loss and livestock depredation and even injury or death of local people, occasionally (Studsrød & Wegge, 1995; Sillero-Zuberi et al., 2007; Karanth et al., 2013). Yegof is one of the national forest priority areas which support a different array of wildlife that are prone to conflict with local people. In the present study, the domestic damage caused by wild animals was prominent near the forest areas. However, number of such incidences reduced as the distance increased. Such incidents nearby

national forest priority areas are mainly due to either straying of wild animals outside the forest area (Woodroffe & Ginsberg, 1998; Ogra, 2008) or people approach to the natural resources for their domestic needs (Ogra, 2008).

Many of the victims asserted the crop damage done by mainly primates in their vicinity. Primates were the most frequently identified crop raiding animals and were reported as pest in Uganda (Naughton-Treves et al., 1998; Hill, 2000), Zambia (Nyirenda et al., 2011) and Ethiopia (Yihune et al., 2009a; Gebeyehu & Bekele, 2009; Mekonnen et al., 2012; Datiko & Bekele, 2013a; Kumssa & Bekele, 2013). According to few studies the most important explanatory factor for crop raiding is proximity to forest edges or probable surrogates (Studsrød & Wegge, 1995; Linkie et al., 2007). On the other hand, shortage of forest based food or instead opportunistic (Naughton-Treves et al., 1998) probably be the other factors. Nevertheless, attraction of primates due to palatable crops growing around reserve area (Datiko & Bekele, 2013a) can be the reason for the crop loss. According to Datiko and Bekele (2013a) particular food like maize, teff and sorghum attract crop raiders around Chebera Churchura National Park, Ethiopia. The victims in this study also confirmed the same situation adjacent to Yegof National Forest Priority Area in which *E.tef* was highly preferred by primates. In fact, the reason of large wildlife populations (Jones & Elliott, 2006) or increased population density and range may be another probable answer for such agricultural problems (Studsrød & Wegge, 1995; Engeman et al., 2010) in the study area. As primates are daytime foraging animals, many of the crop damage happened during day time. None of the crop raiders were killed which might be attributed to two attitudes of the people towards animals (Kellert, 1980) such as aesthetic (primary interest in the artistic and symbolic characteristics of animals) or utilitarian (primary concern for the practical and material value of the animals) which needs further investigation.

In addition to the occurrence of crop damage, livestock depredation by wildlife predators is another kind of domestic damage in different parts of the world which are more common around protected areas. According to USAID (2013), leopard and hyaena are main livestock predators in Ethiopia. More often, the victims of the present study confirmed that the *P. pardus* was responsible for their livestock predations followed by *C. aureus*. In addition to this, other parts of the country also witness livestock predation by leopard (Atickem et al., 2010; Datiko & Bekele, 2013b) as livestock are inherently vulnerable to depredation due to their reduced anti-predatory skills (Jackson, 2012). Considering the fact that variety of domestic prey available to the leopard and hyaena, medium sized livestock like goats and sheep are most vulnerable than cattle and pack animals to depredation since medium sized can be killed and heave to a safer place easier (Dar et al., 2009; Bibi et al., 2013). Indeed, victims reported that the goat/sheep were targeted and killed in this study period than any other animals such as cattle and pack animals. Similarly, in Chebera Churchura National Park, out of 997 domestic animals depredation, around 200 animals (sheep, goat and cattle) were killed by leopard and hyaena in three years, in which 75.5% of animals were killed by leopard (Datiko & Bekele, 2013b). However, in Bale Mountains, out of 704 domestic animals depredation, 57% and 18% of the animals were killed by spotted hyaena and leopard, respectively (Atickem et al., 2010). Such incidence of livestock depredation may be influenced by either push factors such as reduction of natural prey/food (Lamarque et al., 2009) or pull factors like reduced anti-predatory skills of livestock (Jackson, 2012). Most of the livestock depredation happened at night as livestock were often left unattended and in poorly constructed pens (Kabir et al., 2014). In similar other studies, majority of leopard kills on livestock occurred during the night (Dar et al., 2009; Ahmed et al., 2012). None of the wild animals were killed which might be attributed to positive biophilia about natures right's (Røskaft et al., 2007) and attitudes such as utilitarian and negativistic (primary orientation an active avoidance of animals due to dislike or fear) cannot be ignored (Kellert, 1980).

In conclusion, the domestic damage such as crop damage and livestock depredation was prevalent around Yegof National Forest Priority Area. This demands the appropriate conservation measures to diminish domestic damages between human and wildlife. Since the alleviation of conflict is like a two sided equation, the sustainable and culturally acceptable conservation solutions are necessary to find a balance between conservation priorities and the needs of people who live adjacent to wildlife which enables coexistence and sharing of resources at some level.

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REFERENCES

Ahmed, R. A., Prusty, K., Jena, J., Dave, C., Sunit, K. R. D., Hemanta, K. S., & Rout, S. D. (2012). Prevailing human carnivore conflict in Kanha–Achanakmar corridor, Central India. *World Journal of Zoology, 7(2),*158–164.

Anderson, G. (1996). The Application of Spatial Technologies for Rangeland Research and Management: State of the Art. *Geocarto International, 11(3),* 5-11.

Atickem, A., Williams, S., Bekele, A., & Thirgood, S. (2010). Livestock predation in the Bale Mountains, Ethiopia. *African Journal of Ecology, 48(4),* 1076-1082.

Bekele, T. (2005). Recruitment, survival and growth of *Olea europaea* subsp. *Cuspidata* seedlings and juveniles in dry afromontane forests of northern Ethiopia. *Tropical Ecology, 46(1),* 113-126.

Bhattarai, B. R., & Fischera, K. (2014). Human–tiger *Panthera tigris* conflict and its perception in Bardia National Park, Nepal. *Oryx, 48(4),* 522-528.

Bibi, S. S., Minhas, R. A., Awan, M. S., Ali, U., & Dar, N. I. (2013). Study of ethnocarnivore relationship in Dhirkot, Azad Jammu and Kashmir. *The Journal of Animal & Plant Sciences, 23(3),* 854–859.

Dar, N. I., Minhas, R. A., Zaman, Q., & Linkie, M. (2009). Predicting the patterns, perceptions and causes of human–carnivore conflict in and around Machiara National Park, Pakistan. *Biological Conservation, 142(10),* 2076–2082.

Datiko, D., & Bekele, A. (2013a). Conservation challenge: Human-herbivore conflict in Chebera Churchura National Park, Ethiopia. *Pakistan Journal of Biological Science, 16(23),* 1758-1764.

Datiko, D., & Bekele, A. (2013b). Conservation challenge: Human-carnivore conflict in Chebera Churchura National Park, Ethiopia. *Greener Journal of Biological Sciences, 3(3),* 108-115.

Engeman, R. M., Laborde, J. E., Constantin, B. U., Shwiff, S. A., Hall, P., Duffiney, A., & Luciano, F. (2010). The economic impacts to commercial farms from invasive monkeys in Puerto Rico. *Crop Protection, 29(4),* 401-405.

Ficetola, G. F., Bonardi, A., Mairota, P., Leronni, V., & Padoa-Schioppa, E. (2014). Predicting wild boar damages to croplands in a mosaic of agricultural and natural areas. *Current Zoology, 60(2),* 170-179.

Gebeyehu, G., & Bekele, A. (2009). Human-wildlife conflict in Zegie Peninsula (Ethiopia) with emphasis on grivet monkey (*Cercopithecus aethiops aethiops*). *SINET: Ethiopian Journal of Science, 32(2),* 99–108.

Guinness, S. Mc., & Taylor, D. (2014). Farmers' perceptions and actions to decrease crop raiding by forest-dwelling primates around a Rwandan forest fragment. *Human Dimensions of Wildlife, 19(2),* 179–190.

Hill, C. M. (2000). Conflict of interest between people and baboons: Crop raiding in Uganda. *International Journal of Primatology, 21(2),* 299–315.

Hoare, R. E. (1999). Determinants of human – elephant conflict in a land use mosaic. *Journal of Applied Ecology, 36(5),* 689-700.

Hoffman, T. S., & O'Riain, M. J. (2012). Monkey management: Using spatial ecology to understand the extent and severity of human–baboon conflict in the Cape Peninsula, South Africa. *Ecology and Society, 17(3),* 13.

Iliopoulos, Y., Sgardelis, S., Koutis, V., & Savaris, D. (2009). Wolf depredation on livestock in Central Greece. *Acta Theriologica, 54(1),* 11–22.

Jackson, R. (2012). Fostering community-based stewardship of wildlife in Central Asia: Transforming snow leopards from pests into valued assets. In V. R. Squires, *Rangeland stewardship in Central Asia* (pp. 357-380). Dordrecht Heidelberg, New York, London,: Springer.

Jones, B. T. B., & Elliott, W. J. (2006). Human wildlife conflict in Namibia: experiences from a portfolio of practical solutions. *Nature & Faune, 21(2),* 20-25.

Kabir, M., Ghoddous, A., Awan, M. S., & Awan, M. N. (2014). Assessment of human–leopard conflict in Machiara National Park, Azad Jammu and Kashmir, Pakistan. *European Journal of Wildlife Research, 60(2),* 291-296.

Karanth, K. K., Gopalaswamy, A. M., DeFries, R., & Ballal, N. (2012). Assessing patterns of human-wildlife conflicts and compensation around a central Indian protected area. *Plos One, 7(12),* 1-13.

Karanth, K. K., Naughton-Treves, L., DeFries, R., & Gopalaswamy, A. M. (2013). Living with wildlife and mitigating conflicts around three Indian protected areas. *Environmental Management, 52(6),* 1320-1332.

Kellert, S. R. (1980). American attitudes toward and knowledge of animals: An update. *International Journal for the Study of Animals Problems, 1(2),* 87-119.

Kissui, B. M. (2008). Livestock predation by lions, leopards, spotted hyenas, and their vulnerability to retaliatory killing in the Maasai Steppe, Tanzania. *Animal Conservation, 11(5),* 422–432.

Kolowski, J. M., & Holekamp, K. E. (2006). Spatial, temporal, and physical characteristics of livestock depredations by large carnivores along a Kenyan reserve border. *Biological Conservation, 128 (4),* 529-541.

Kumssa, T., & Bekele, A. (2013). Human-wildlife conflict in Senkele Swayne's Hartebeest Sanctuary, Ethiopia. *Journal of Experimental Biology and Agricultural Sciences, 1(1),* 32-38.

Lamarque, F., Anderson, J., Fergusson, R., Lagrange, M., Osei-Owusu, Y., & Bakker, L. (2009). Human-wildlife conflict in Africa: Causes, consequences and management strategies, FAO Forestry Paper 157, FAO, Rome, Italy.

Linkie, M., Dinata, Y., Nofrianto, A., & Leader-Williams, N. (2007). Patterns and perceptions of wildlife crop raiding in and around Kerinci Seblat National Park, Sumatra. *Animal Conservation, 10(1),* 127–135.

Madden, F. M. (2008). The growing conflict between humans and wildlife: Law and policy as contributing and mitigating factors. *Journal of International Wildlife Law & Policy, 11(2-3),*189–206.

Marchal, V., & Hill, C. M. (2009). Primate crop-raiding: A study of local perceptions in four villages in North Sumatra, Indonesia. *Primate Conservation, 24,* 107-116.

Mekonnen, A., Bekele, A., Fashing, P. J., Lernould, J., Atickem, A., & Stenseth, N. C. (2012). Newly discovered Bale monkey populations in forest fragments in southern Ethiopia: Evidence of crop raiding, hybridization with grivets, and other conservation threats. *American Journal of Primatology, 74(5),* 423-32.

Michalski, F., Boulhosa, R. L. P., Faria, A., & Peres, C. A. (2006). Human–wildlife conflicts in a fragmented Amazonian forest landscape: Determinants of large felid depredation on livestock. *Animal Conservation, 9(2),* 179-188.

Mohammed, S., & Abraha, B. (2013). Floristic composition and structure of Yegof Mountain Forest, South Wollo, Ethiopia. *Ethiopian Journal of Science and Technology, 6(1),* 33-45.

Nath, N. K., Dutta, S. K., Das, J. P., & Lahkar, B. P. (2015). A quantification of damage and assessment of economic loss due to crop raiding by Asian elephant *Elephas maximus* (Mammalia: proboscidea: Elephantidae): A case study of Manas National Park, Assam, India. *Journal of Threatened Taxa, 7(2),* 6853-6863.

Naughton-Treves, L., Treves, A., Chapman, C., & Wrangham, R. (1998). Temporal patterns of crop-raiding by primates: linking food availability in croplands and adjacent forest. *Journal of Applied Ecology,* 35(4), 596-606.

Nyhus, P. J., Tilson, R., & Sumianto, (2000). Crop raiding elephants and conservation implications at way Kambas National Park, Sumatra, Indonesia. *Oryx, 34(4),* 262-274.

Nyirenda, V. R., Chansa, W. C., Myburgh, W. J., & Reilly, B. K. (2011). Wildlife crop depredation in the Luangwa Valley, eastern Zambia. *Journal of Ecology and the Natural Environment, 3(15),* 481-491.

Oduntan, O. O., Akintunde, O. A., Adesina, O. A., Ojo, S. O., & Oladoye, A. O. (2012). Economic damages of primates on farmlands in old Oyo National Park neighborhood. *International Journal of Molecular Ecology and Conservation, 2(4),* 21-25.

Ogra, M. V. (2008). Human-wildlife conflict and gender in protected area borderlands: A case study of costs, perceptions, and vulnerabilities from Uttarakhand (Uttaranchal), India. *Geoforum, 39(3),* 1408–1422.

Pérez, E., & Pacheco, L. F. (2006). Damage by large mammals to subsistence crops within a protected area in a montane forest of Bolivia. *Crop Protection, 25(9),* 933–939.

Rodney, M. J., & Rinchen, W. (2004). A community-based approach to mitigating livestock depredation by snow leopards. *Human Dimensions of Wildlife, 9(4),* 307-315.

Røskaft, E., Händel, B., Bjerke, T., & Kaltenborn, B. P. (2007). Human attitudes towards large carnivores in Norway. *Wildlife Biology, 13(2),* 172-185.

Sangay, T., & Vernes, K. (2008). Human–wildlife conflict in the Kingdom of Bhutan: Patterns of livestock predation by large mammalian carnivores. *Biological Conservation, 141(5),* 1272-1282.

Sillero-Zuberi, C., Sukumar, R., & Treves, A. (2007). Living with wildlife: the roots of conflict and the solutions. In: D. W. MacDonald & K Service, (Eds) *Key topics in conservation biology* (pp 253-270) Blackwell Publishing Ltd. Malden, USA.

Singleton, G. R., Sudarmaji, Jacobm J., & Krebs, C. J. (2005). Integrated management to reduce rodent damage to lowland rice crops in Indonesia. *Agriculture, Ecosystems and Environment, 107(1),* 75–82.

Sitati, N. W., Walpole, M. J., Smith, R. J., & Leader-Williams, N. (2003). Predicting spatial aspects of human–elephant conflict. *Journal of Applied Ecology, 40(4),* 667–677.

Studsrød, J. E., & Wegge, P. (1995). Park–people relationships: the case of damage caused by park animals around the Royal Bardia National Park, Nepal. *Environmental Conservation, 22(2),* 133–142.

Treves, A., Wallace, R. B., Naughton-Treves, L., & Morales, A. (2006). Co-managing human–wildlife conflicts: A review. *Human Dimensions of Wildlife, 11(6),* 383–396.

USAID, (2013). Agricultural Growth Program (AGP) - Livestock Market Development (LMD): Cost-benefit analysis of the meat value chain in Ethiopia. Final report (AID-OAA-C-11-00169).

Wang, S. W., & Macdonald, D. W. (2006). Livestock predation by carnivores in Jigme Singye Wangchuck National Park, Bhutan. *Biological Conservation, 129(4),* 558–565.

Woodroffe, R., & Ginsberg, J. R. (1998). Edge effects and the extinction of populations inside protected areas. *Science, 280(5372),* 2126–2128.

Yihune, M., Bekele, A., & Tefera, Z. (2008). Human-Ethiopian wolf conflict in and around the Simien Mountains National Park, Ethiopia. *International Journal of Ecology and Environmental Sciences, 34(2),* 149-155.

Yihune, M., Bekele, A., & Tefera, Z. (2009a). Human-gelada baboon conflict in and around the Simien Mountains National Park, Ethiopia. *African Journal of Ecology, 47(3),* 276-282.

Yihune, M., Bekele, A., & Tefera, Z. (2009b). Human-wildlife conflict in and around the Simien Mountains National Park, Ethiopia. *SINET*: *Ethiopian Journal of Science, 32(1),* 57–64.

Yirga, G., Bauer, H., Worasi, Y., & Asmelash, S. (2011). Farmers' perception of leopard (*Panthera pardus*) conservation in a human dominated landscape in northern Ethiopian highlands. *International Journal of Biodiversity Conservation, 3(5),* 160-166.