

Human-Wolf (*Canis lupus*) Conflict in Upper Mustang of Annapurna Conservation Area, Nepal

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Abstract

Human-wolf conflict has been one of the major issues in the Himalayan region of Nepal. It has obstructed the sustainable management initiatives in Annapurna Conservation Area. The aim of this study is to assess the status of human-wolf conflict, conservation threats to wolf and people's perception towards this endangered carnivore. Questionnaire survey was conducted in different wards of three rural municipalities (RM) of the Upper Mustang. Similarly, key informants were interviewed followed by several discussions with stakeholders. The results indicate "wolf's preference for domestic livestock" as the most probable cause of depredation with IRR value 0.91. The number of victims was found highest in Lomanthang RM (ward number 2) where 90% of respondents reported to be victims. However, in terms of the loss in monetary value, Lo-Ghekar Damodarkunda RM (ward number 4) ranked highest with the loss of NRs. 55,880 (≈\$479.1)/HH/year and Barhagaun Muktichhetra (ward number 3) is the least affected. Similarly, by number, mountain goat casualties (172) were highest in last 5 years, but the maximum economic loss was due to the horse depredation (NRs. 68,00,000 or \$57,347.20) among sampled households. The results indicate that the negative perception of local people is the major threat to wolf. Active participation of local people in conservation and awareness program can play a vital role to reduce and mitigate the human-wolf conflict at community level.

Keywords

Depredation; Economic loss; Perception; Threats; Victims



Introduction

Wolves, wild ancestors of domestic dogs, are one of the most widely distributed carnivores from Canidae family (Mattioli *et al.*, 1995). The trans-Himalayan region of Nepal and India has also been the home for some specific wolf species, particularly Tibetan wolf (Hodgson, 1847). The status of wolves on the Himalayas is difficult to comprehend as distinct species or sub-species; still, they perform an important role in ecology of the trans-Himalaya (Shrotriya, 2012). In Nepal, it is sparsely distributed in the upper Himalayan region of Mustang, Manang, Dolpa, Manasalu Conservation Area (CA), Kanchanjunga CA and Dhorpatan CA (Jnawali *et al.*, 2011). The species is protected under the National Parks and Wildlife Conservation Act, 1973 of the Government of Nepal and listed as Critically Endangered in the National Red List (Jnawali *et al.*, 2011). These species are in proximity with human and livestock; so, the conflict between pastoralists and wolves has been the primary cause for steep decline in their number and even their regional extinction (Mech and Boitani, 2010). Not any concrete scientific study regarding its population status and distribution has been done in recent years, but it can be predicted that only 30-50 individuals of wolf exist in Nepal, and its population size is continuously reducing (Jnawali *et al.*, 2011). The cause for the fall in their number can be low abundance of wild ungulates as the availability of prey is the limiting factor for carnivore density (Karanth *et al.*, 2004). Human-wildlife conflict arises primarily because of competition between humans and wildlife for shared, limited resources (Treves, 2007; Subedi *et al.*, 2020). Beside this, human-wolf conflict can be the cause for decrease in wolf population. Livestock depredation by large carnivore is frequently reported in the Himalayan region (Oli *et al.*, 1994; Jackson *et al.*, 1996). In Upper Mustang and Manang region of Annapurna Conservation Area (ACA) too, human-wolf conflict has been accounted due to the wolves' attack on livestock. Thus, wolves are persecuted in retaliation for livestock depredation (Chhetri, 2016). Though it is critically endangered species in Nepal, national concern for the conservation of this species is very scarce (Jnawali *et al.*, 2011). It is the least known carnivore in Nepal. There is no national level conservation effort made for the conservation of this rare canid. The main occupation of people dwelling in Himalayan region of Nepal is animal husbandry. There is a system of grazing livestock in rangeland and pastures inside Protected Areas (PAs) and, thus, they often greatly outnumber wild ungulates in many PAs. This disproportionate presence of wild and domestic ungulates results in killing of livestock by wild predators and, therefore, a conflict between local communities and wildlife occurs (Mishra, 1997). Low densities of wild prey also appear to promote livestock predation (Meriggio and Lovari, 1996). The livestock act as a buffer species for the wild ungulates. Larger herds hold larger risk from wolves (Ciucci and Boitani, 1998). Thus, these livestock get killed in the encounter with wolves creating a situation of human-wolf conflict. Wildlife-human conflicts are acute when the endangered species poses a serious threat to human welfare (Saberwal *et al.*, 1994). As the wolves are critically endangered, action for this conflict has to be taken promptly or the consequence of this conflict will be fatal. But there is not enough knowledge about the degree of conflict, habitat loss and livestock depredation.

The wolves' habitats are limited only to the rangelands, pasture lands and forests of northern Nepal that are the common grazing destination for wild ungulates and livestock. Due to this disproportionate interaction between wild and domestic ungulates, domestic livestock become easy prey to wolves (Mishra, 1997). Human, in payback, tries to harm wolves and, thus, an obvious human-wolf conflict occurs. The actual cause of this conflict, the landscape location of conflict and extent of the interaction between carnivore, livestock and human activities have to be identified (Jackson *et al.*, 1996; Stahl and Vandel, 2001) along with the extent of habitat encroachment, illegal killing and livestock depredation to be logically interpreted for the better management of this human-wolf conflict. When there is significant conflict between wolf (a critically endangered species and a top carnivore in Himalayan ecosystem), livestock (a primary basis for livelihood support) and human (who still lacks the awareness about the importance of this rare canid), its conservation becomes more tedious and costly (Treves *et al.*, 2009). This research will help build curiosity in the wildlife managers towards the wolf species present in the Himalayas of Nepal. The information about the status of wolves' interaction with human and livestock, the serious damage and loss they are creating to the herders and local people and their habitat condition will be useful to take better judgment about the situation the wolves are facing. Human - wildlife conflict is common in Nepal, but the conflict mentioned

in this research has been least studied so far; neither the local people are compensated for the loss of their property (livestock) nor the wolves are being paid serious attention. This study provides insight into the existing scenario of human-wolf conflicts in Upper Mustang of Annapurna Conservation area and suggests conservation and management strategies to reduce human-wolf conflict. Therefore, the present research will try to unblock the information barrier and will significantly help the conservation area advocate for this ignored canid. It can be valuable in making management plans in coming days. The specific objectives of the current study mainly aim to predict and identify the degree of human-wolf conflict such as livestock depredation and human loss, and to identify and understand the status, threat, perceptions and attitudes of local communities towards wolf conservation and management.

Materials and Methods

Study Area

This study was conducted in Upper Mustang of Annapurna Conservation Area (ACA). The study was carried out in the trans-Himalayan region of Annapurna Conservation Area. ACA, lying in a coordinate of 28°47'N and 83°58'E, is the largest protected area in Nepal extended to an area of 7,629 sq. km holding 1,226 species of flowering plants, 101 mammals, 474 birds, 39 reptiles and 22 amphibians (BCDP, 1994). *Ursus arctos* (brown bear), *Hemitragus jemlahicus* (Himalayan tahr), *Muntiacus muntjak* (barking deer), *Moschus chrysogaster* (musk deer), *Pseudois mayaur* (blue sheep), *Ailurus fulgens* (red panda), *Uncia uncia* (snow leopard) and *Canis lupus chanco* (Tibetan wolf) are some of the important wildlife species found in ACA. The area ranges from an altitude of 790 m (2,590 ft.) to 8,091 m, which is the peak of Annapurna-I (26,545 ft.). Average annual rainfall ranges from 193 mm at trans-Himalayan region of Mustang to 2,987 mm at Ghandruk. The average population density is 13.82 per km² (BCDP 1994).

Upper Mustang

The research was focused mainly in Upper Mustang region (Figure 1). The vegetation in Upper Mustang is found between 2,850-3,500 m; grassland shrub is found between 3,500-4,900 m; and rocky terrain is found above 4900 m. Some of the dominant tree species are *Arecaogona bravifolia*, *Linicera obvata*, *Rosa* spp., *Artemisia* spp., *Ephedra gerardiana* and *Juniperus indica*. The terrain in Upper Mustang is rocky, rough and vast riverbeds. There are many isolated grasslands far from settlement. The major occupation of people living in Upper Mustang is agriculture and animal husbandry. There are 3 rural municipalities (Barhagaun Muktichhetra, Lo-Ghekar Damodarkunda and Lomanthang RM) in Upper Mustang that touches Nepal-China border.

Data collection

The study combines data collection through questionnaire survey, key informant interviews, bilateral and multilateral discussion with stakeholders and intense review of literatures. The data was analyzed using different statistical tools. The research was started from a preliminary survey. Local people and protected area officials were interviewed in a crude way in order to identify the probable wolf presence and conflict sites. Then, primary (qualitative and quantitative) data and secondary data were collected. The primary data were collected from the study area by using participatory techniques such as on-site observations, questionnaire survey of households and key informant interview.

After taking information about the wards of Barhagaun Muktichhetra, Lo-Ghekar Damodarkunda and Lomanthang rural municipality (RM) within the Upper Mustang of Annapurna Conservation Area (ACA), depending upon the most conflict-prone areas, eleven wards were selected randomly, i.e., ward number 3 (Barhagaun Muktichhetra RM), ward number 1, 2, 3, 4 and 5 (Lo-Ghekar Damodarkunda RM), and 1, 2, 3, 4 and 5 (Lomanthang RM). Purposive sampling with a sampling intensity (SI) of 10% was used for this study (Table 1).

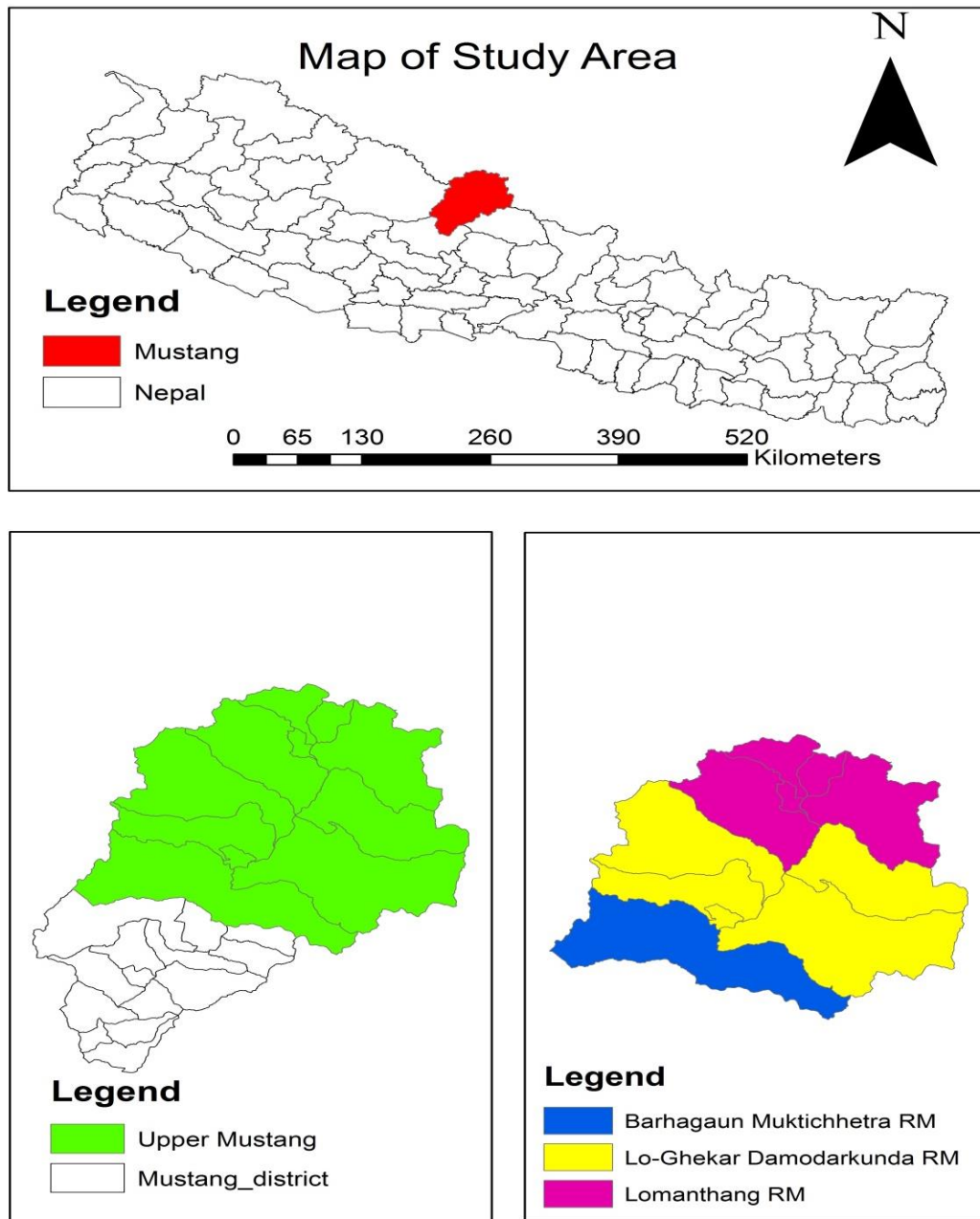


Figure 1: Map of the study area

Household Survey

Household (HH) survey was conducted in 11 wards of all 3 rural municipalities of Upper Mustang. Altogether 115 households from all eleven wards of three rural municipalities were selected for the survey. They could be the victims (who have suffered the damage from wolf), non-victims or the culprits (who have caused damage to wolf) of human-wolf conflict. Questionnaire was prepared and was administered on the local people. The questionnaire included the following items:

- Livelihood practice (occupation), status of animal husbandry and the feeding system.
- Grazing season and grazing site (pasture).
- Types and number of grazing and domesticated livestock.

- Encounter with wolves and the risk posed by them.
- Economic loss due to livestock depredation.
- Beliefs, cultures and social norms that may directly or indirectly harm wolves.

This survey collected the information regarding basic causes of human-wolf conflict. Besides, it gathered the perception of people towards wolf.

Table 1: Total number of households and sampled households (HHs)

S.N.	Rural Municipality	Total HHs	Ward	Total HHs	Sampled HHs	SI (%)
1	Barhagaun Muktichhetra	753	3	103	10	10
2	Lo-Ghekar Damodarkunda	485	1	111	11	10
3			2	94	10	10
4			3	89	9	10
5			4	99	10	10
6			5	92	9	10
7	Lomanthang	556	1	98	10	10
8			2	128	13	10
9			3	102	10	10
10			4	115	12	10
11			5	113	11	10
Total	3	1794	11	1144	115	10

Key Informant Interview

Key informant survey was conducted to identify the extent and frequency of human-wolf interaction. Key informants were ACA management committee personnel and government officials, ACAP authorities, school teachers, local leaders, local elite groups, herders and tourist guides. Another questionnaire was prepared, and details of the conflict were extracted using the interviews. The interview with herders, pastoralists, local elites and farmers focused on following points:

- The best site for grazing their livestock;
- Their history about the observation and interaction with wolves;
- The most probable location where the wolves are encountered; and
- Their technique to avoid the depredation and harming the wolves.

Similarly, the interview with the conservation officials included the following points:

- The frequency of complains regarding the loss due to conflict;
- Magnitude of damage, economic loss, human injuries and death;
- Killing of wolves reported inside the CA and reason for the killing; and
- Attitude of local people towards the conservation of wolves.

This survey highlighted the gross loss due to the conflict and basic conservation threats to wolf.

Secondary Data Collection

Secondary data were collected from Annapurna Conservation Area Project (ACAP), National Trust for Nature Conservation (NTNC) regional office, district forest office, literature reviews, official documents, relevant NGOs and GOs, Institute of Forestry (IOF) library and internet surfing.

Data Analysis

The collected data were compiled in Excel, analyzed in SPSS, and interpreted using various frequency tabulation, Index of Relative Ranking (IRR) and graphical representation tools to draw conclusion.

Calculation of IRR (Miller, 1986):

$$IRR = (R_1S_1 + R_2S_2 + \dots + R_nS_n) / nr$$

R_1 = rank of 1st order R_n = rank of last order

S_1 = score of first order n = no of observations

S_n = score of last order r = total rank given to particular attribute.

Results and Discussion

Status of Human-Wolf Conflict

There are various causes for human-wolf conflict. The intensity of conflict is different in different wards of rural municipality. When there is interaction of human livelihood with any of the conserved species (carnivore), then the contrast between the objective of two group i.e., conservationist and local people, creates conflict. Livestock graze and encounter with wolves in rangelands, thus, act as prey for wolves. Status of conflict is studied on the basis of extent of loss, issues and causes of the conflict, whereas threats and people's perception are studied on the basis of locals as well as other stakeholders' perceptions regarding wolf and its conservation.

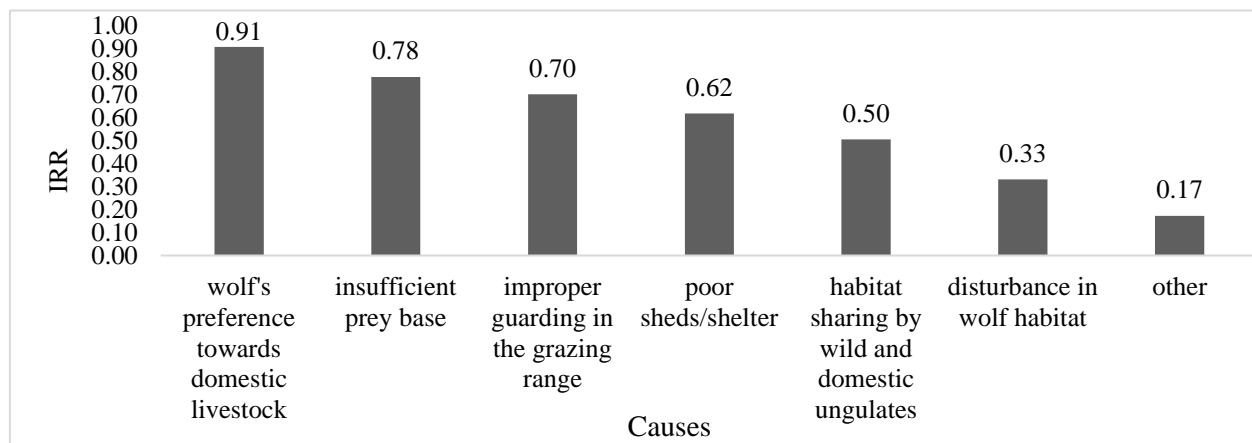


Figure 2: Causes of livestock depredation

Causes of Livestock Depredation

Respondents were said to rank the probable causes of livestock depredation. These ranking from all respondents are analyzed as Index of Relative Ranking (IRR) using Miller's formula (Figure 2). The result in figure (2) shows the ranks of 'wolf's preference over domestic livestock' on top followed by 'insufficient prey base', 'improper guarding' and 'poor shelter'. Wolf is one of the clever predators; thus, it hunts easy prey (livestock) even if there are other wild ungulates (e.g., Himalayan thar) in rangeland. There is not sufficient prey base, which can support the demand of these carnivores; thus, livestock are killed on regular

basis in the ranges of Mustang. Awareness and proper guarding practice of herder to graze and shelter them in shed still lacks that aids in livestock depredation. People do not think that grazing in ranges (habitat for wolves) has disturbed and provoked carnivore to kill their animals. Wolf prefers mountain goat and horse over blue sheep when all are grazing together in a rangeland. This finding is in close agreement with the previous research findings of Meriggi and Lovari (1996).

Wolves mostly attack livestock in summer season, especially, during monsoon i.e., Ashar to Bhadra (June to August) followed by winter season i.e., Poush to Falgun (December to February). The respondents suffered least attack during Chaitra to Jestha (March to May) (Figure 3). Respondents stated that the main reason for occurrence and attempts of wildlife to visit outside their habitat area may be due to the food scarcity in their habitat (Bhatta and Joshi, 2020).

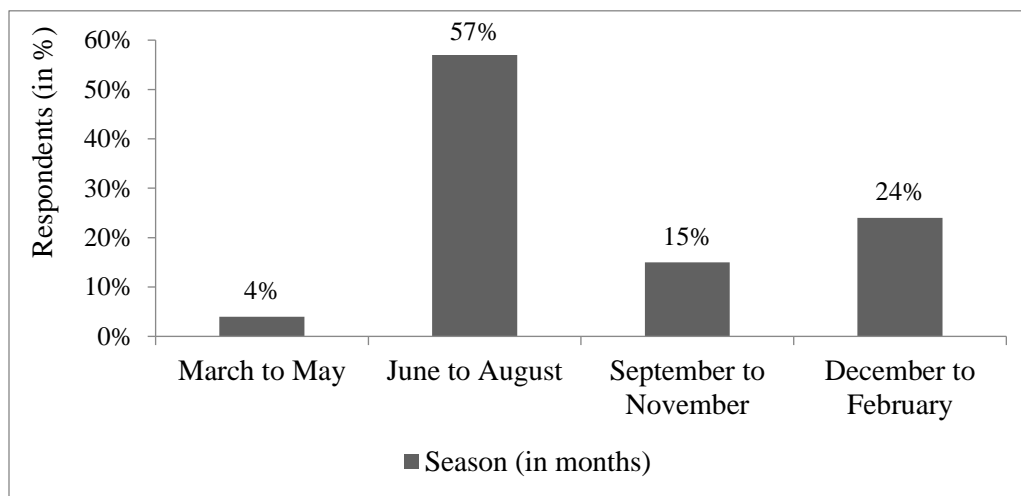


Figure 3: Livestock attack by wolves

Wolves become an active predator during foggy weather when the visibility of herder is low. This helps wolf to attack the herd. According to majority of the respondents (65%), the wolves' attack occurs in daytime. There is comparatively less attack at night, evening and morning (Figure 4).

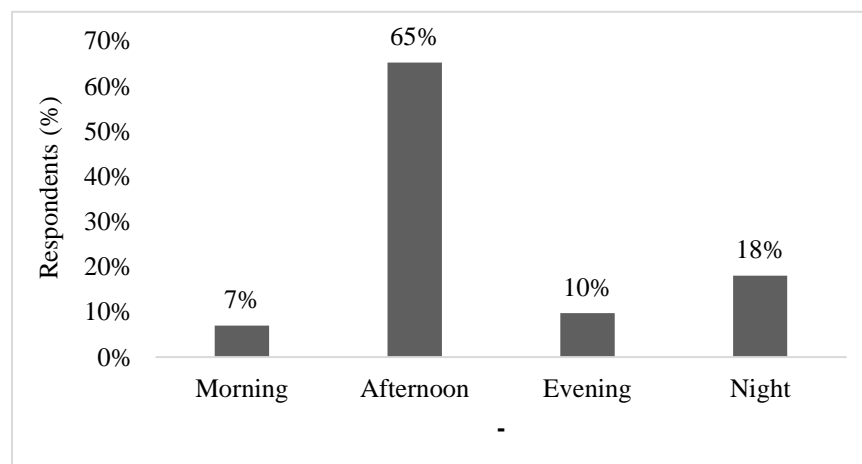


Figure 4: Time of attack

Status of Victims

Most of the respondents in Lomanthang RM (ward number 2) are victims of livestock depredation from wolf (90%), followed by Lomanthang RM (ward number 1) (88%), Lomanthang RM (ward number 4) (80%) and Lo-Ghekar Damodarkunda RM (ward number 4) (80%), respectively. Here, the wolf's victim means those who have suffered depredation of their livestock from wolf only, not including other carnivores. Similarly, Lomanthang RM (ward number 5) and Lo-Ghekar Damodarkunda RM (ward number 3) have comparatively less victims of livestock depredation from wolf (Table 2).

Trans-boundary movement has influenced extent of the loss (Hodgson, 1847; Chetri et al., 2016). Those rural municipalities, which are in Nepal-China border region, are more prone to wolves' encounter rather than other municipalities. Among those vulnerable rural municipalities, Lomanthang RM (ward number 4) is the most victimized municipality because of its open border. Open border with Nepal-India and Nepal-China is seen as the main constraint in controlling illegal trade and conflict (Lamichhane *et al.*, 2020). The border in Lomanthang RM (ward number 5) and Lo-Ghekar Damodarkunda (ward number 3) are sealed, whereas the border in Lomanthang RM (ward number 4) is not sealed; thus, wolves' movement in these areas is significantly high.

Table 2: Respondents response on status of victims by wolf (%)

S.N.	Rural Municipality	Ward	Status of Victims (%)	
			Non-Victim	Victim by Wolf
1	Barhagaun Muktichhetra	3	40	60
2	Lo-Ghekar Damodarkunda	1	30	70
3		2	40	60
4		3	44	56
5		4	20	80
6		5	23	77
7		Lomanthang	1	12
8	2		10	90
9	3		25	75
10	4		20	80
11	5		45	55

Extent of Loss

The loss caused due to livestock depredation by wolf is high enough to drag attention. Lo-Ghekar Damodarkunda RM (ward number 4) is the most victimized territory where people have suffered loss of approximately NRs. 55,880 (\approx US\$ 479.1) per household per year, followed by Lo-Ghekar Damodarkunda RM (ward number 5) with NRs. 48,919 (\approx US\$ 419.4), Lomanthang RM (ward number 4) with NRs. 45,612 (\approx US\$ 391) and Lomanthang RM (ward number 2) with NRs. 43,612 (US\$ 373.9) loss per household per year, respectively. Similarly, Lo-Ghekar Damodarkunda RM (ward number 2) and Lomanthang RM (ward number 5) have suffered relatively less loss, but Barhagaun Muktichhetra RM (ward number 3) suffered the least loss of around NRs. 3,280 (\approx US\$ 27.92) (Table 3). The loss because of wolves' attack is around 41% of total loss caused due to livestock depredation in last 5 years. Loss of NRs. 75,000 (\approx US\$ 634.60) per HH per year is suffered due to livestock depredation by various carnivore of which 41% is contributed by wolf that is proportionate to the economic loss due to same reason in Kibber Wildlife Sanctuary of India (US\$ 128/HH/year) (Mishra, 1997).

Not sufficient and satisfactory, ACAP has still managed to provide their institutional and technical support to the rural municipalities, which has suffered the most loss. According to respondents, Lomanthang RM (ward number 2) is the one which has received the most support from ACAP and other NGOs, whereas Lo-Ghekar Damodarkunda RM (ward number 2) received the least. Barhagaun Muktichhetra RM (ward number 3) also has received various supports in the form of material, fund or training even though it is least victimized ward of Barhagaun Muktichhetra rural municipality from wolf's attack. This is because of its accessibility to supporting organizations (Table 3).

Table 3: Extent of loss due to wolf per year (per household)

S.N.	Rural Municipality	Ward	Loss due to wolf per year (per household)	
			NRs.	≈US \$
1	Barhagaun Muktichhetra	3	3280	27.92
2	Lo-Ghekar Damodarkunda	1	16872.7	143.6
3		2	27212	233.3
4		3	21341	183.0
5		4	55880	479.1
6		5	48919	419.4
7	Lomanthang	1	31245	267.9
8		2	43612	373.9
9		3	35619	305.4
10		4	45612	391.0
11		5	27363.6	234.6
Total	3	11	356956.3	3059.1

Table 4: Respondents' response (in %) on institutional support

S.N.	Rural Municipality	Ward	Received Institutional Support (%)	
			Yes	No
1	Barhagaun Muktichhetra	3	60	40
2	Lo-Ghekar Damodarkunda	1	36	64
3		2	20	80
4		3	23	77
5		4	40	60
6		5	38	62
7	Lomanthang	1	58	42
8		2	70	30
9		3	37	63
10		4	40	60
11		5	45	55

Wolves have killed mountain goat the most followed by horse. But economic loss due to horse depredation (NRs. 6,800,000 or US\$57,537) is higher than that of mountain goat depredation (NRs. 2,580,000 or US\$21,830.22) in last 5 years among the respondents (Figure 5).

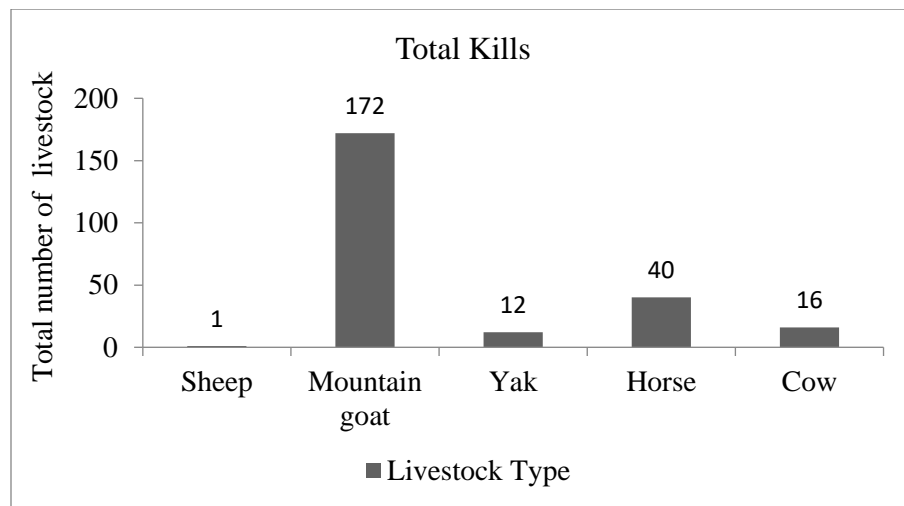


Figure 5: Total number of livestock killed by wolf

Assessing the Threat to Wolf

Wolves in the rangelands of Upper Mustang are under protection of ACAP. The violent action to kill or injure wolves has significantly decreased or nullified after the establishment of ACAP. Still wolves are in threat from herders because herders suffer serious loss from depredation by wolves.

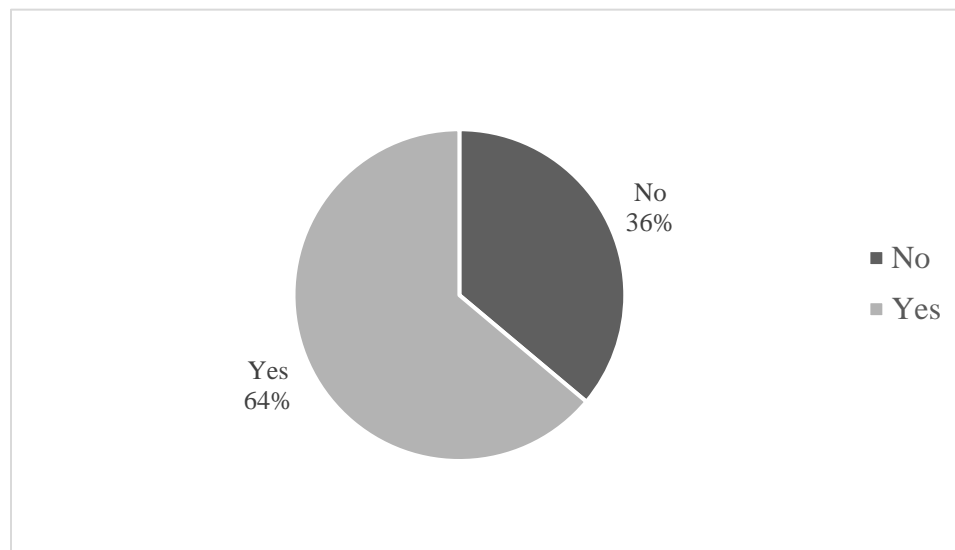


Figure 6: Retaliation action done

About 64% of respondents said that they have done some kind of retaliation action when they witnessed wolves' attack and 36% told they have not (Figure 6). The retaliation action includes only chasing them away using a homemade instrument called Horto. No record of injury or killing of wolves is found. Thus, herders do not possess serious threat to wolves, but the type and seriousness of retaliation action may increase if the quantities of loss of herder's property surpass the limit.

Another important threat to wolves is the abundance of their prey species. Firstly, wolves prefer domestic livestock because they cannot easily kill moose (*Alces americanus*), Himalayan tahr (*Hemitragus jemlahicus*) and Tibetan gazelle (*Procapra picticaudata*), and, secondly, these wild prey species are insufficient to cover the demand of wild carnivore. This directly affects the distribution and population density of wolves. Beside these, there are many other threats that were observed in Upper Mustang like:

- Human activities in the rangelands: herbs and stone extraction from the grassland and wolves habitat.
- ACAPs restricting actions that hamper the day-to-day activities of herders and local people to support their livelihood.
- Development and expansion of roads.

The retaliation action done by local herders, even though not seeming too much intensive and intended towards wolf's persecution, still are serious threat. Human-wolf conflict is one of the important reasons for wolf's disappearance from Hugu-Kori region of ACA (Acharya and Ghimirey, 2012). Negative perception towards wolf set due to livestock depredation in Upper Mustang is a serious conservation threat to wolf.

People's Perception Towards Wolves

Whenever someone restricts the access, agitation is obvious. Wolves make local people suffer huge economic loss every year, so to perceive their conservation negatively is an obvious reaction. People's perception towards wolf is negative, therefore (Figure 7).

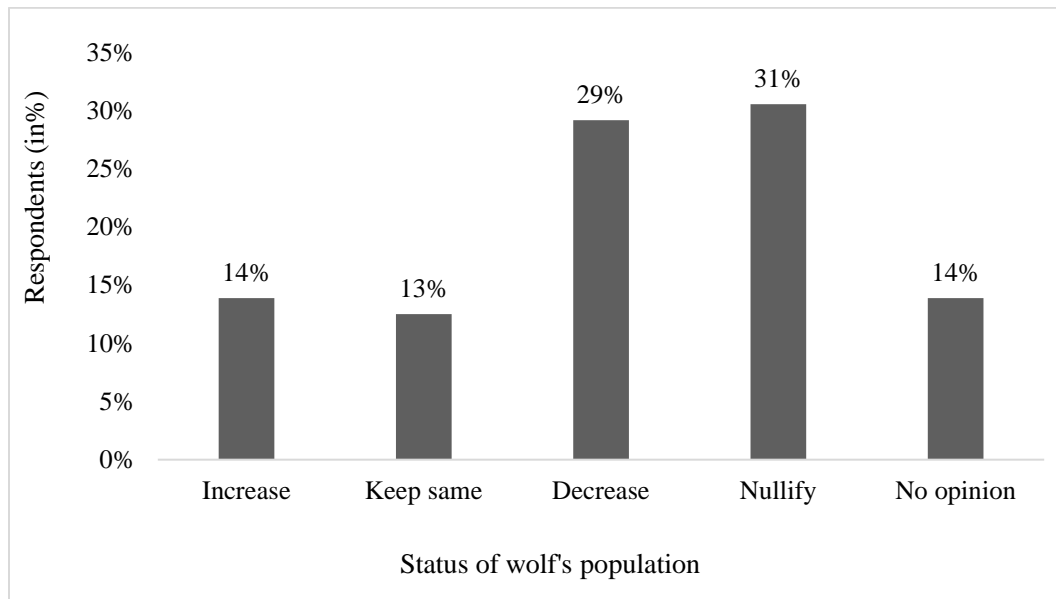


Figure 7: Perception regarding wolf's population in future

Almost 31% of the respondents said that they will be happy if the government and ACAP nullify the wolf's population. There are 29% respondents who think decreasing wolf's population is a better option than conserving them. There are only collectively 27% respondents who said maintaining or increasing wolf population is necessary in grassland of Upper Mustang. More than 50% of respondents think decreasing wolf or removing wolf from rangeland would be the better management scheme, which is also similar to the result of the same research in Hugu-Kori (Acharya and Ghimirey, 2013a) where the researcher concluded that more than one third of the respondents think conservation of wolf is pointless and impractical.

Only 29% of respondents think that they are 'okay' with the existence of wolves in their rangelands and 71% of them do not like the scenario of co-existence (Figure 8). Thus, most of the people are against their conservation. Around three fourth of respondents do not accept the existence of wolf in their rangelands, which goes quite similar to the result of Acharya and Ghimirey (2012) research in Hugu-Kori where he too found that around 69% of respondents do not realize wolf's importance in their neighboring rangeland or forest.

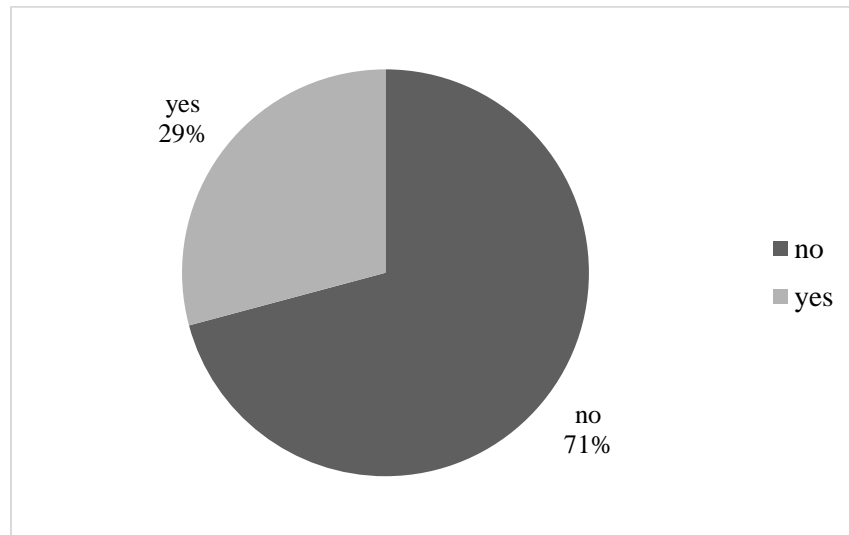


Figure 8: Acceptance of wolves' existence in rangeland

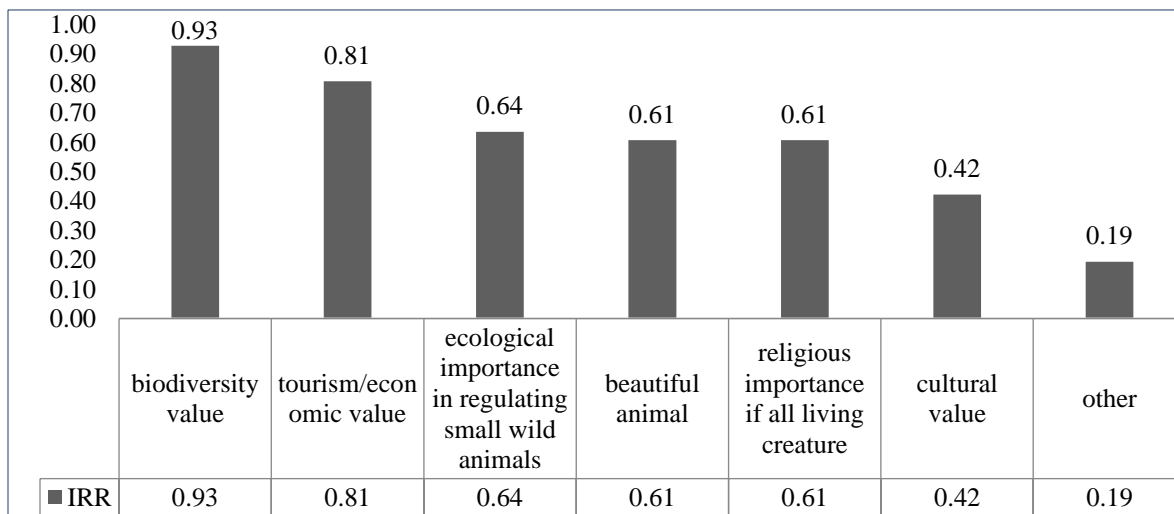


Figure 9: Reason to accept wolves' existence

29% of respondents, who like wolves in their rangeland, think 'biodiversity value' is the main reason for their acceptance. They also appreciate tourism/economic value and ecological importance as other reasons why wolves should be in the rangelands. Besides, they take wolf as a beauty of their rangelands and they perceive it positively from religious and cultural point of view (Figure 9).

About 71% of respondents do not accept wolves to co-exist with them in their rangelands because wolves cause livestock and pet damage. In addition to this, wolf restricts people from using rangeland and products. People (respondents) rarely think that wolf attacks them or damage their farmland (Figure 10).

Out of the total respondents, 67% know about the compensation scheme. Similarly, about 33% of the respondents were not aware about compensation scheme (Figure 11).

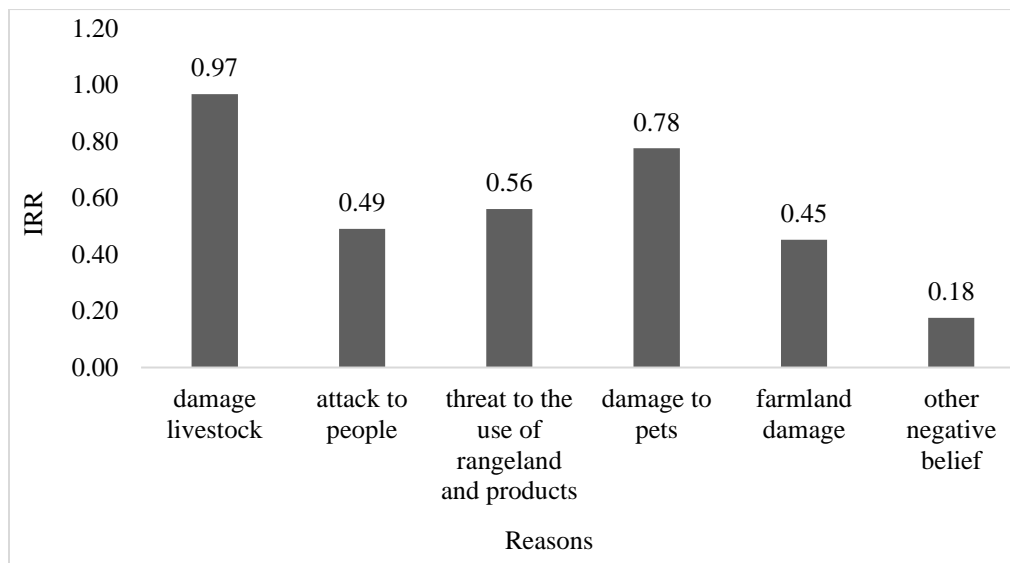


Figure 10: Reason not to accept wolves' existence

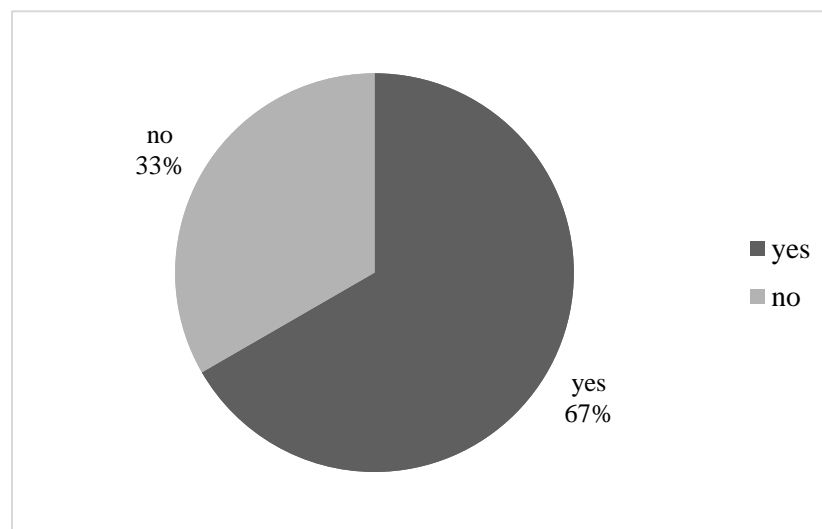


Figure 11: Information about compensation scheme

But among the total victims, only 10% of them have applied for the compensation. 90% have not applied because the process is very complicated and is not victim-friendly (Figure 12). Those who have applied for the compensation have received it as per the rate of ACAP for different animals. ACAP provides 10-25% compensation differentiating the killed animals on the basis of what people do with the dead body. None of the respondents is happy with this scheme of compensation because the loss due to depredation is not overcome on any way by this scheme.

People are actually not against wolves' existence, they are against the trend of livestock depredation by wolf. They are also against the ACAP's approach of conservation neglecting the livelihood supports to locals. That is the reason why 50% of respondents suggested "zoo" as the best place for wolves conservation so that wolves won't be under threat and their livestock too. Beside these, there are around 35% respondents who suggest "grasslands of conservation area" the suitable place for wolf, if wolves' territory remains beyond the grazing land or if wolves' don't depredate on their animals (Figure 13).

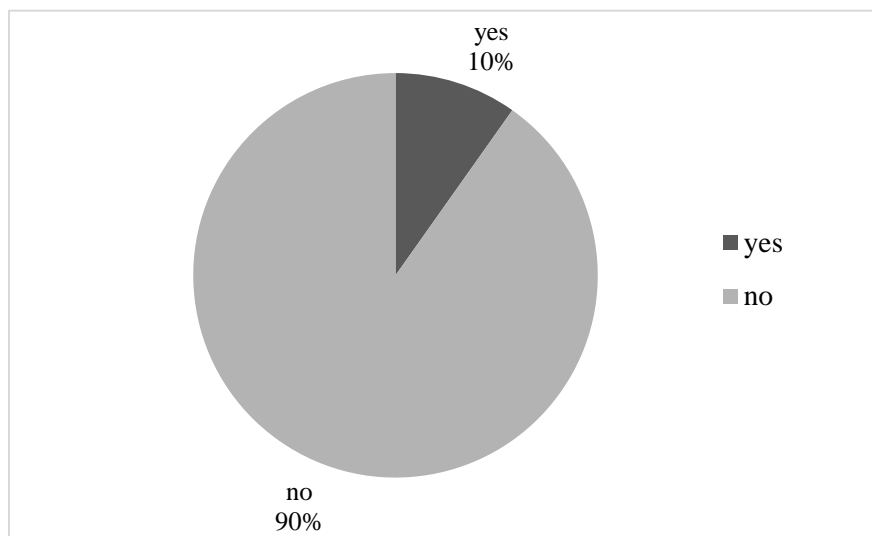


Figure 12: Applied for compensation scheme

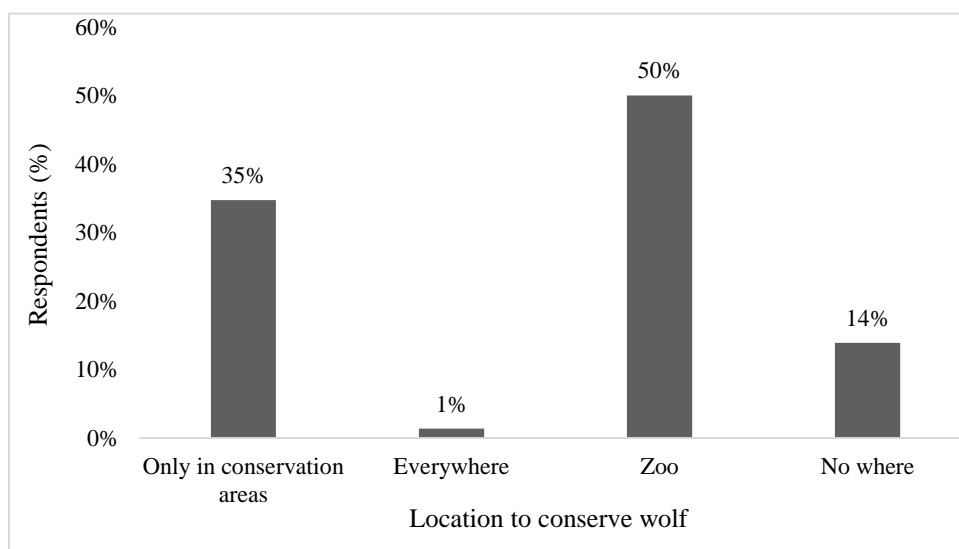


Figure 13: Location where wolves should be conserved

Thus, the perception of people is negative towards wolves. ACAP has done praiseworthy effort to stop wolf hunting, but it is unable to change the perception of local people. In short, action has changed but perception has not. Wolf possesses threat to human and their livestock and wolves are equally in threat from the action and perception of local people.

Conclusion and Recommendations

Upper Mustang is severely suffering from human-wolf conflict in recent years. Till date, ACAP has controlled the action of people but there is no guarantee that the anger against wolf will not burst out and scatter conservation acts into pieces. The perception of people towards wolf is not significantly differed in relation to victim/non-victim or education level. But to some extent, people who are directly or indirectly benefitted by conservation efforts of different GOs, NGOs and INGOs have positive perception. Wolves are threatened by herder's action and other natural processes (prey insufficiency). The result shows "wolf's preference towards domestic livestock" as the most probable cause of depredation with IRR value 0.91. The

number of victims was highest in Lomanthang RM (ward number 2) where 90% of respondents were victims. Since the damage done by wolf is quite high, wolf's existence cannot be shadowed in any form. They are equally important as other carnivores in upper Himalayas.

Hence, promoting awareness campaign and enhancement of Conservation Area budget allocation for human-wolf conflict management activities and reasonable relief fund mechanism may help to minimize the problem. It is recommended that a systematic review of current implementation of Conservation Area Project to understand existing problems and design improved strategies and policies for compensation of livestock depredation and economic loss to change perception and attitude of local people towards wolf.

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Authors' Declarations and Essential Ethical Compliances

Authors' Contributions (in accordance with ICMJE criteria for authorship)

Contribution	Author 1	Author 2	Author 3
Conceived and designed the research or analysis	Yes	Yes	Yes
Collected the data	Yes	No	No
Contributed to data analysis & interpretation	Yes	Yes	Yes
Wrote the article/paper	Yes	Yes	Yes
Critical revision of the article/paper	Yes	Yes	Yes
Editing of the article/paper	Yes	Yes	Yes
Supervision	No	Yes	No
Project Administration	Yes	Yes	Yes
Funding Acquisition	Yes	Yes	Yes
Overall Contribution Proportion (%)	40	35	25

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Research involving human bodies (Helsinki Declaration)

Has this research used human subjects for experimentation? No

Research involving animals (ARRIVE Checklist)

Has this research involved animal subjects for experimentation? No

Research involving Plants

During the research, the authors followed the principles of the Convention on Biological Diversity and the Convention on the Trade in Endangered Species of Wild Fauna and Flora.

Research on Indigenous Peoples and/or Traditional Knowledge

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(Optional) PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)

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