Original Research Article

Human–Wildlife Conflict: People's Perception, Economic Damage and its Management in Banepa-2 of Kavrepalanchok District, Nepal

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Abstract: At present wildlife are facing many acute threats, Human–Wildlife Conflict (HWC) is one of the most prevailing day-to-day issue and is receiving international attention among Conservation Biologists. This study emphasize on the extent of HWC in Banepa-2 of Kavrepalanchok District of Nepal. Data were collected through Reconnaissance survey, HHs, KII, FGD, and various secondary sources. A semi structured questionnaire survey was randomly administered to 98 households with KII & FGD. Statistical Package for Social Sciences (SPSS version 26), MS-Excel, Chi-square test, Friedman Ranking Test was used to analyze the data. The most problematic animal was Wild Boar followed by Porcupine, Leopard, and Monkey. Major problems due to wild animals ranked by respondents were crop damage, followed by livestock depredation and least was human injuries. Average annual crop damage per HH was accounted to NRs.12576.53 of which *Zea mays* L., (35.78%), *Brassica campestris* L. var. rapa (L.) Hartm. (34.48%), *Solanum tuberosum* (L.) (9.74%), *Pisum sativum* (L.) (7.14%), *Glycine max* (L.) Merr. (6.89%), *Tiiticum aestivum* (L.) (4.54%), and *Oryza sativa* (L.) (1.42%) respectively were the major crops raided in the study area. The people's perception on wildlife conservation was based on socioeconomic variables i.e. education (Pearson $\chi2$=10.363, df =4, p =0.035) and occupation (Pearson $\chi2$= 5.188, df = 1, p =0.023) were significantly associated at p value <0.05. Also, health, education, employment opportunities, compensation, conservation, resettlement, etc. should be considered to mitigate HWC. During harvest season it is seen that wild animals raided the crops on daily basis mostly at night. So, shouting and following, shouting, following and throwing stones and regular watching on shift basis were the most effective measures perceived by the respondents to minimize crop raid, livestock depredation and human injuries. Production of non-palatable species, crop diversification, improved cattle sheds, stall feeding of cattle are highly recommended in the study area.

Key words: Conflict, Livestock depredation, Livelihood, Perception, Wildlife Conservation

Introduction

Research in Human-Wildlife Conflict (HWC) is considered inter-disciplinary or multidisciplinary approach, which deals with both humans and wildlife aspects (Heberlein, 2004). HWC is termed as "the shortage of resources occurring in the fringe areas of the forest which will develop adverse impact among humans and wildlife"(Sillero *et al.*, 2007). HWC occurs when wildlife encroaches human settlements for food, resulting in loss either to human or to the wildlife (IUCN, 2003). Also another definition by (WWF, 2005) which states that "Human Wildlife Conflict is any interaction between humans and wildlife that leads to negative impacts on human social, economic or cultural life, on the conservation of wildlife

populations, or on the environment". Conflict is the (-)ve interaction between any two or more species, either for food, shelter or other needs. Conflict ranges from simple nuisance to crop and livestock depredation and potentially human life-threatening emergencies. Development associated with human growth often places humans and wildlife in close proximity. Due to the consequences of human development in the huge home range of wild animals and their dietary needs put them in direct conflict with humans. As a result, top predators are often detached from the system to cut back the risk to humans (Skupein, 2013).

This HWC issue is impaired when the governments establish the necessities of wildlife than the prerequisites of indigenous people. Also, HWC rely on countries political, social, topographical, cultural, historical, monetary and legitimate issues (Madden, 2004). HWC mainly arises due to various anthropogenic activities such as logging, animal husbandry, agricultural expansion and developmental projects (Jenks et al., 2013; Fernando et al., 2005). At the same time as, wildlife population is increasing in the forest, which is due to the inflexible Wildlife Protection Act (Schulz & Skonhoft, 1996). Also, HWC is said to be a universal problem (WWF, 2006) which varies on different land use/land cover, species habitats and behavior of both human and wildlife, thus finding concrete solution is sometimes impossible. The growth in human population and activities such as deforestation and the expansion of agricultural and urban land reduce the habitat and food of wild animals which is regarded as the ultimate cause of crop raiding by wild animals and cause of conflicts (Ellins et al., 1983). Damage quantification and payments (compensation) on moral obligations to the sufferers can minimize its rigorousness, as these are the major contemporary issues (Nyhus et al., 2003; Ogra & Badola, 2008).

Management and conservation are the two HWC aspects i.e. if the control measures implemented to prevent and reduce wildlife encounters considering human dominated landscape falls under management aspect. This approach follows three approaches to manage the conflict viz. "Management for ecological objectives, Management for

economic objectives and minimal or *laissez-faire* management" (Kangwana, 1996). But conservation aspect prioritize the need of both human and wildlife which will eventually enhance co-existence of these two group of species (Nemtzov, 2003). According to (Timock & Vaughan, 2002) wildlife conservation and conflict management can be initiated if accurate estimation of initial wild population of problematic animal is known.

Nepal, not only rich in biological diversity, but also has pronounced conservation projects to preserve local extinction of flora and fauna. But HWC outside Protected Areas (PAs) has been a major contemporary challenge (Acharya et al., 2016). In PAs where there is rigid boundary with human settlements, it is witnessed that crop raiding and human causalities due to increasing population of human & livestock's, and also declining wild animals habitats has resulted in HWC (WWF, 2013). This is because the requirements of both human and wildlife overlaps, and it is evident inside or around PAs or cultivated field or grazing areas, or if the population density of wild animals are higher (Congress, 2007).

Several fringe areas of forest either managed by PAs or Community Forest User Groups, though having concrete conservation plans but, HWC is creating an adverse impact to it. So, to manage HWC scientific research and data are essential. Thus, this research will lay emphasis on the following objectives: To study HWC in Banepa of Kavrepalanchok District, to identify major conflicting animals in the study area and to explore the perception of local people towards wildlife conservation and management as no such research has been conducted in this area.

Materials and methods
Study area description
Kavrepalanchok District of Nepal covers an area of 140,486 ha. The area of Kavrepalanchok lies between 85° 24' to 85° 49' E latitude and 27° 22' to 27° 85' N longitude. Kavrepalanchok, a portion of Bagmati Pradesh, is one of the 77 districts of Nepal (Fig. 1). The district, with Dhulikhel as its regional central station, covers a territory of 1,396 km2 and has a population of 381937 (NPHC, 2011). The climate of the
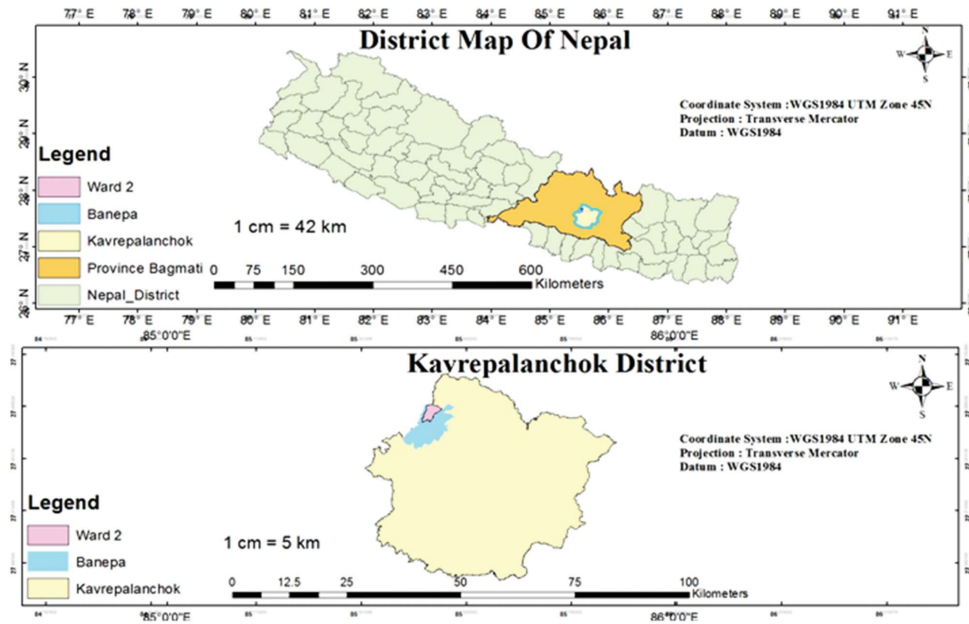
Fig. 1. Study Area

district is sub-tropical to cool temperate. Forest occupies 77,551.74 ha (55.2%) of the total area. 23,952.31 ha of national forest area is managed by 555 user groups in Kavrepalanchok (DNPWC, 2017). "The Banepa lies between 85° 30' 0" to 85° 33' 0"E latitude and 26° 36' 36" to 27° 51' 0" N Longitude on 1466m above sea level. Banepa's climate is classified as warm and temperate. In winter, there is much less rainfall in Banepa than in summer. In Banepa, the average annual temperature is 17.2 °C. About 1745 mm of precipitation falls annually (https://en.climate-data.org/asia/nepal/central-development-region/banepa-56656/).

Data collection

Both primary and secondary information were used to determine Human-Wildlife Conflicts in Banepa 2, Kavrepalanchok. The following are the major primary and secondary data sources.

Primary data collection

Primary data were collected with amalgam of survey methods including reconnaissance survey, participatory techniques- Focus Group Discussions (FGD), Key Informant Interview (KII) and formal & informal interviews, semi-structured questionnaire survey of households, and on-site observations (FAO, 1990).

At 95% confidence level, a formula based on (Cochran, 1977) was used to estimate the sample size (n) for administering the pre-structured questionnaire.

$$Sample\ Size\ (n) = \frac{N \times z^2 \times P(1-P)}{N \times d^2 + z^2 \times p(1-P)}$$

Where,

N = Total number of households (498)

z = value of standard variant at 95% confidence interval (1.96)

P = estimated population proportion (2%)

d = error limit of 2% (0.02)

Data analysis

Data were analyzed qualitatively and quantitatively. Quantitative data analysis was done including both simple and inferential statistics using statistical packages such as Ms Excel 2016 and SPSS Version 26. Qualitative data were analyzed in a descriptive manner. Chi-square homogeneity test was used to determine whether perceptions of local people towards wildlife conservationwhich varied with socio-economic variables like gender, age, education, occupation, landholding size and annual income. A *P* value <0.05 was deemed significant.

Friedman ranking test was used to determine the ranking of major problems created by wild animals. Respondents were

asked to rank the mitigation measures based on perceived level of effectiveness which was on a scale of rank 1 to rank 4 and given a score from 4 (highly effective) to 1 (ineffective). The findings of the study were presented in charts, tables and bar diagram in a descriptive way. The economics loss of crop per year per household was determined by using (Ghimire, 2019). (Average damage per year per HH (Kg) =

$$\frac{Total\ damage\ of\ crops\ of\ sampled\ HH}{Number\ of\ sampled\ HH}$$

Total damage of crops of sampled HH (Kg) = Sum of total damage of crops of each sampled HH

Economic value of crops/year/HH(NRs) = Average damage/year/HH (Kg) x Local market value of each crops/kg

Results

This survey was totally based on household member availability during data collection. However, M : F (Male : Female) ratio of respondents was male biased (68% males, 32% females) and all the respondents were kept above 18 years of age. The majority of the respondents were Brahmins and Chhetris (83%) and the rest were others castes (17%). Among the respondents 38% had a basic primary education, while 33% had a secondary level education, 12% had above High School level education, 12% went to the University, and the remaining (5%) were illiterate. 29 % of the respondents were employed and the rest (71%) were unemployed, but they were all involved in their household activities either directly
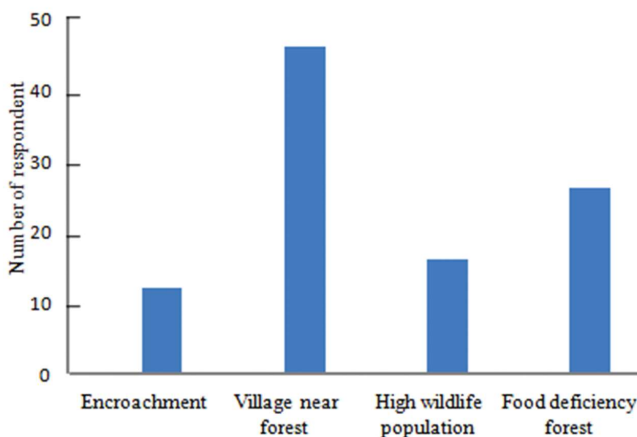

Fig. 2. People's perception on why the wild animals come to the resident's area.

or indirectly. In Nepal, agriculture is the main occupation of the common people, thus in this study 96.9% of the HHs were dependent on agriculture (with livestock rearing and other employment) and few (i.e. 3.1%) had no agriculture possession, but had small business with livestock rearing (Table 1).

Thirty four respondents (34%) suggested preserving wildlife only in Protected Area while thirty three (33%) suggested wildlife should be conserved near community forest and thirty three (33%) suggested preserving them in the forest where they are presently found. Similar method are adopted by Nepal & Weber, (1995) to find the attitudes of people towards conservation, which can be assessed in relation to their socioeconomic condition.

97% of the HH's were dependent on agriculture for their livelihood, including livestock rearing. Maize, Paddy, Wheat, Potato, Soyabean, Pea and Mustard were major crops grown once a year (Table 2).

Almost 26% of the respondents stated that the cause of wild animals visit to croplands was food deficiency in the wild, 46% of the respondents believed that villages are located between dense forests, 16% respondents said that the number of wildlife population are increasing inside the forest so, they visited nearby area for better habitat components and 12 % respondent believed that encroachment is the cause of the conflict (Fig. 2).

More than 68% (n=67) of the respondents encountered with wild animals. All of them were encountered with Wild Boar. Wild boar, Leopard, Monkey and Porcupine were encountered in this study areas too. More than 75% of the respondents kept wild boar as a most problematic animal and Monkey as least problematic animal (Fig. 3).

Almost 72% respondents mentioned that crop raid/ livestock depredation occurred during night (Fig. 4) and then 65% respondents mentioned that this occurs on daily basis too (Fig. 5), this finding is supported by the research done by Ghimire, (2019). About 46% of the respondents believed that the easy compensation is the best method to cope with Human-Wildlife Conflict where 28% respondents believe conservation is best method to reduce conflicts (Fig. 6).

Table 1. Socio-Economic Characterstics of Respondents.

Variable	Category	PPinCov Yes	PPinCov No	(N)	(%)	Ç²	df	P value
Sex	Male	55	12	67	68.3	0.047	1	0.829
	Female	26	5	31	31.63			
Age group	18-30 years	11	2	24	28.9	4.452	2	0.108
	30-50 years	48	6	47	56.6			
	above 50 years	22	9	12	14.5			
Ethnicity	Brahmin/Chhetri	67	14	81	82.7	0.001	1	0.971
	Others	14	3	17	17.3			
Education	Illiterate	3	2	5	5.1	10.363	4	0.035**
	Primary	36	11	37	37.8			
	Secondary	39	3	32	32.7			
	Primary Secondary	11	1	12	12.2			
	University	12	0	12	12.2			
Occupation	Employed	27	1	28	28.6	5.188	1	0.023**
	Unemployed	54	16	70	71.4			
Livelihood	Agriculture	5	2	7	7.1	5.433	5	0.365
	Agriculture+Livestock	49	14	63	64.3			
	Agriculture+Livestock+ Employment	21	1	22	22.4			
	Employment	2	0	2	2			
	Employment and Livestock	1	0	1	1			
	Agriculture and Employment	3	0	3	3.1			
AnnualIncome(NRs.)	< 50,000	14	5	19	19.4	5.406	2	0.67
	50,000-1,00,000	40	11	51	52.0			
	>1,00,000	27	1	28	28.6			
Landholdingsize (ha)	>10	50	11	61	37.8	0.053	1	0.818
	<10	31	6	37	62.2			

PPinCov= People's Perception in Conservation, N= Total Number, Ç²=chi-square, df=degree of freedom, ** Significant at P<0.05
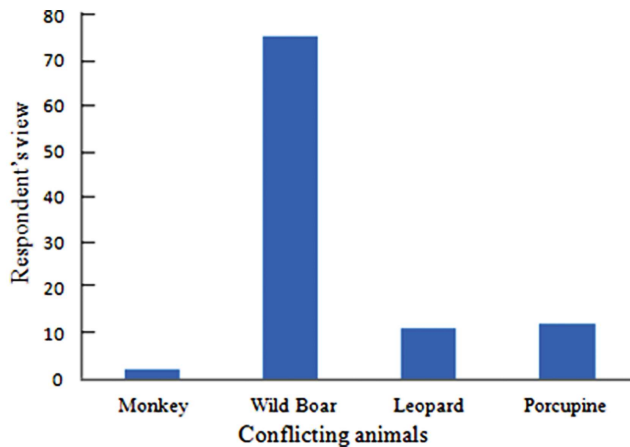
Fig. 3. Major Conflicting Animals.
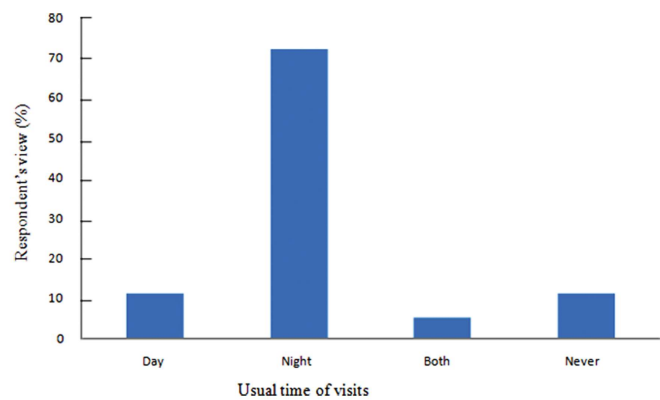
Fig. 4. Animals visited the cropland and/or houses.

Only 15% respondents tried electric fences techniques in their respective field in order to cope with wild animal's damages but due to less number of participation from the local people it was not effective. Out of 98 respondents, 42 chased the animals in which 17% out of 42 chased them by following and shouting and 19% chased them by following, throwing stones, and shouting (Fig. 7).

Table 2. Cropping Calendar.

Major crops	Scientific name	Sowing time	Harvesting time
Paddy	*Oryza sativa*	June/July	November/December
Maize	*Zea mays*	April/May	August/September
Wheat	*Tiiticum aestivum*	November/December	March/April
Soyabean	*Glycine max*	April/May	August/September
Mustard	*Brassica campestris*	October/November	January/February
Potato	*Solanum tuberosum*	October/November	January/February
Pea	*Pisum sativum*	November/December	January/February

Table 3. Quantification of crop damage and their economic value (year 2019).

| Major crops	Crop Damage (quintal)	Market Price (NRs/kg)*	Total loss (NRs)	Loss (%)
Maize	147	30	4,41,000/-	**35.78%**
Wheat	16	35	56,000/-	4.54%
Paddy	5	35	17,500/-	1.42%
Mustard	50	85	4,25,000/-	**34.48%**
Potato	40	30	1,20,000/-	9.74%
Soyabean	10	85	85,000/-	6.89%
Pea	11	80	88,000 /-	7.14%
Total	**279**		**12,32,500/-**	**100%**

Note: *= refers to price rate adopted from the respondents Total number of HH affected from crop damage =80 Total loss =Rs.1232500/year Average loss per HH = Rs.12576.53 (i.e. .1232500=/98)
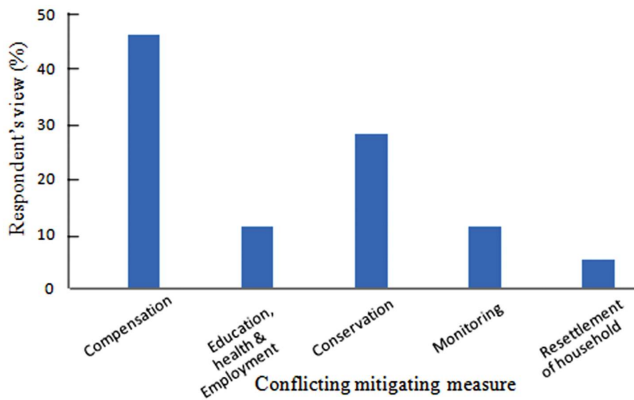
Fig. 6. Ways of conflicts reduction.

The major problem in the study sites was crop damage, livestock depredation, and human harassment. 76.5% of the respondents said that crop damage is the major problem so respondents kept it into rink first, followed by livestock depredation (77.6%), and human harassment (93.9%) in 2nd & 3rd rank respectively.
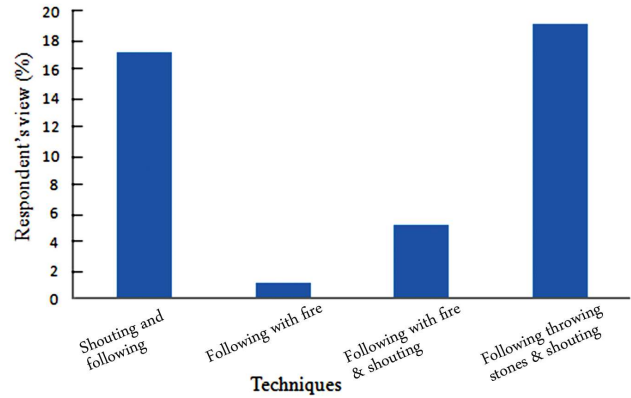
Fig. 7. Techniques applied to animal chase.

Discussion

As per the findings of WWF (2006) and Manral et al., (2016) reported that high number of wild animals in the forest created competition for space, food, and mating. Thus, this situation forced the movement of wild animals into the cropland. Results from (Fig. 2) closely agrees with the propositions of Ghimire, (2019); Sukumar, (1991); and Fernando *et al.*, (2005) in Asia that loss of habitat range increases the probability of contact between wild animals and human settlement and thus leads to an increase in crop raiding. Karanth & Madhusudan (2002), Pokharel, (2009) and Ghimire, (2019) revealed that, the reduction of natural prey within the forest, fragmentation of habitat, increase in the number of wild animals and alteration of countryside were other major causes of HWC which was close to our findings.

Karanth *et al.,* (2012) and Wang *et al.,* (2006) in the Kanha National Park and in Bhutan respectively has reported similar findings as of Fig. 3, where crop raider by wild pig in paddy, maize and wheat were seen the highest. By using Friedman test, we found out that the average rank of different problem by different respondents differ significantly (χ^2= 129.599, df = 2, p =<0.05). Thus, people perceived the different rank to problem differently. Similar method was used by WWF, (2007) to find out the frequently faced problem of wildlife in three sector Shukla, Bardia and Jhapa.

A study carried out in Africa Osborn (2004) and Tuttle (1991) indicated that the onset of crop raiding and the quality of wild food toward the end of the wet season are

linked. In European countries, Schley et al., (2008), reported crop raiding was more frequent near grasslands, the damage was seasonal and it was totally based on crop types. But in present study, wild animals encounter in the crop field were not seasonal but highest during growing and harvesting period. Until the study's conclusion, no incidents of direct Human-Wildlife encounters and injuries were reported. Leopards mainly killed goats in the study area. Athreya et al., (2004) reported similar findings from the Junnar Forest Division, Maharashtra, India.

The people's perception on wildlife conservation and occupation of the respondents were significantly associated (Pearson χ2= 5.188, df = 1, p =0.023) i.e. Employed people were more likely to conserve wildlife than Unemployed. Perception on wildlife conservation and education were significantly associated (Pearson χ2=10.363, df =4, p =0.035). People with a higher degree were more likely to favor conservation of wildlife. Similar finding with the positive attitudes of respondents towards wildlife conservation increases with an increased level of education (Fiallo & Jacobson, 1995., Gautam, 2016., Carter et al., 2014). People with less education expressed negative attitudes towards wildlife conservation. However, there was no significant difference between ethnicity (Pearson χ2= 0.001, df = 1, p =0.971), annual income (Pearson χ2= 5.406 df = 2, N=83, p =0.067), gender of the respondent (Pearson χ2= 0.047, df = 1, p =0.829), age categories (Pearson χ2= 4.452, df = 2, p =0.108, source of livelihood (Pearson χ2= 5.433, df = 5, p =0.365) and land ownership (Pearson χ2= 0.053, df = 1, p =0.818 (Table 1).

According to Friedman's Rank Test more than 77% of the respondents said that crop damage is the major problem so respondents kept it in to rank first, followed by livestock depredation (78%), and human harassment (94%) in 2nd& 3rd rank respectively. Crop damage been the serious issue in the study area because agricultural practices are the significant earning source for most family units. In accordance with Rao et al., (2000), crop losses are serious for farmer who essentially rely upon horticultural practices and were found to be the major cause for HWC. Krithi Karanth & Nepal (2011) and

Rohini et al., (2016) mentioned crop harm as the most prevalent and persistent type of HWC than livestock predation, human injury and casualties which is similar in my study area also.

Athreya et al., (2004), Koirala et al., (2012) and Gautam (2016) reported that the majority of predation occurs on grazing land, however livestock raising inside the forest area is rigorously restricted in our research, which minimizes the rate of animal predation. As a result, livestock predation was rated second, while crop raiding was ranked first. By using Friedman test, the average rank of different problems by different respondents differed significantly (χ2 = 129.599, df = 2, p =<0.05). Thus, people perceived the different rank of problem differently.

Nearly 97% of the HH's were dependent on agriculture, including livestock rearing for their basic livelihood. As per the respondents Maize, Wheat, Mustard, Paddy, Potato, Soyabean, and Pea were the major crops grown throughout the year following the crop calendar. From the household survey it was found that 81 households were affected from crop damage. In monetary terms, Maize damaged accounted for about (NRs 4, 41,000) 35.78% of total loss. Among the others crops Mustard, Potato, Pea, Soya bean, Wheat & Paddy accounted for about (NRs 4,25,000) 34.48%, (NRs 1,20,000) 9.74%, (NRs 88,000) 7.14%, (NRs 85,000) 6.89%, (NRs 56,000) 4.54%, & (NRs 17,500) 1.14%, of the total loss respectively (Table 3). Similarly research by WWF (2007) in Bardia, Shukla and Jhapa reports that major crop damaged was Paddy and it accounted nearly 70% of total loss. The average monetary loss each household faced was the loss of NRs 10,108/year in Bardia and NRs. 11,709/year in Banke National Park. Similar study conducted by Ayadi (2011) in Banke National Park and Bhatt & Joshi (2020) in Suklaphata National Park revealed that the loss /HH/year of Maize was highest, followed by Wheat and of Paddy. A study conducted in North India by Chauhan et al., (2009) revealed that, damage to Finger Millet (38%) in Uttar Pradesh, Paddy (26%) in Madhya Pradesh and Maize in Himachal Pradesh and Rajasthan, was maximum raided.

Various researchers including Madden (2004); DeFries *et al.,* (2010); Ogra & Badola (2008); Peters & Matarasso (2005) have reported that compensation is a significant factor in increasing the co-existence between humans and wildlife. In their study it is reported that conservation education can change the attitude and behavior of people. Also Gurung *et al.,* (2008) has reported long term monitoring of problematic animals along with conservation NGOs, the National Park and the local community are very effective. Similarly, 11% of the respondents said that education, health and employment opportunities are another technique to reduce conflict. Conservation education, proper monitoring, growing non-palatable crops, fencing around the forest area around the village, resettlement of village into proper place with enough facilities are some of the techniques to reduce conflict (Fig. 6). A similar finding by Jayson and Christopher, (2008) further attests to this notion where damage to crops was reported in the Peppara Wildlife Sanctuary and Farmers planted non palatable plants in the immediate fringe areas of the forest.

More than one measure was applied to manage HWC, but the common techniques observed in cultivated land was shouting and clapping either in group or individually. Other approaches were: Shouting & Following, Throwing stones, Chasing with Fire, High point regular watching, etc. during harvesting period (on rotation basis among the HH members) to guard the crops. Thus, the conflict mitigation strategy in Banepa is linked with overall conservation goal.

As per Treves *et al.,* (2006) and Nemtzov, (2003) shooting, poison and traps are the common lethal control measures widely adopted for controlling wildlife and for mitigating HWC all over the world, which may adversely affect the untargeted species too. Also, Cromsigt *et al.,* (2013) hunting for fear method is another mitigate tool practiced in many other countries to induce a behavioral change of the frequent crop raiders. To be perplexed, nothing such lethal/hunting control measures were adopted in this study area.

Besides these 4 techniques to chase the wild animals, people in the study area were also found to be adopting several other techniques for reducing crop damage and livestock depredation. Some of them were: Growing hybrid varieties of crops which are less palatable to wild animals, stall feeding of livestock, grazing livestock in herds, and using improved cattle sheds. Banikoi *et al.,* (2017) in his study stated that Electric fencing as an alleviation technique can't be supported except if great maintenance is practiced. Graham *et al.,* (2017) has clearly stated that conflict mitigation measures applied in one locality may not fit well in other areas because socio-political, cultural, economic and geographic situations are not the same for all places. Therefore, the principle of one-size-fits-all cannot be applied everywhere.

Acknowledgment

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