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Addressing Patterns of Human-Wildlife Conflict in Sunsari District of Nepal

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Abstract

The human-wildlife conflict was one of the major challenges in conservation and management of wildlife in Nepal. As Nepal is rich in biological diversity so that wildlife resources contribute a significant level. Interactions of humans with wildlife are a good experience of human existence where it may be positive or negative. Thus, this paper investigates human-wildlife conflict which causes due to crop damage, livestock depredation, and human casualties in Sunsari district from February 2016 to May 2016. Crop raiding by wild animals created serious problems in the village development committees of the study area. The total projected crop loss was NRS 15, 30,927.4 (US$ 14,175.3) and livestock depredation amounted to be NRS 33,000 (US$305.5). There were three (One dead and two injured) human casualties during the study period. Paddy and Sugarcane were the dominant damaged crop, contributing 18.8% and 16.8% respectively. There were mixed attitudes towards the conservation of wild animals. Negative attitudes was developed by those people who suffer from crop loss. Various mitigation methods were used as crop protection strategy, especially preferred shouting. Moreover, the wildlife concerned authority is encouraged to sign the needs of local people as well as increment of livelihood.

Keywords:- Biological diversity, Damage, Human-wildlife, Mitigation, Serious

Introduction

Human-wildlife conflicts have been reported as one of the most challenging issues for wildlife conservation throughout the world (Acharya et al. 2016) which is a common phenomenon in the human inhabitations; close to forest and wilderness areas (Dickman 2010). Crop damage, livestock depredation, property loss, and death or injury to people and wildlife are the principal form of human-wildlife conflict. The continuous increase in the human populations' results in competition between people and wildlife for shared food but the limited resources creates such types of conflict (Peterson et al. 2010; White and Ward 2011). Conflicts associated with biodiversity conservation reflect material as well as socially constructed realities (Guyer and Richards 1996; Schlosser, 2006). In addition, the conflict of wildlife with humans are also perceived when vehicles collisions with animals occur, aircraft strikes birds and diseased wildlife (Messmer 2000). Frankly speaking, all human-caused mortalities of wild animals including illegal poaching for the trade of body parts, also comes under human-wildlife conflict (Muhammed et al, 2007). The loss of human life is also the ultimate form of human-wildlife conflict (Gurung et al. 2008) and the revenge against wild animals for such (Treves et al. 2008). Such retaliatory persecution in defense of livestock and protection of agricultural crops threatens the survival of the wildlife that comes into conflict (Mishra et al. 2003).

The wildlife damage affects significantly towards livelihood of local communities (Bhattarai 2009; Khanal and Singh 2017). Human-wildlife conflicts bring many social, economic and ecological consequences. Mostly, people migrate from conflicted areas to non-conflicted areas to protect themselves from attack. Crop and property damage and livestock depredation are common effects resulting in huge economic losses throughout the world (Aawasti 2014). Several studies have been done on human-wildlife conflict in different places of the world but the nature and extent of human-wildlife conflict are different from place to place (Sukumar 2006). Also, the crop damage is the prominent factor of human-wildlife conflict especially outside the protected areas of Nepal (Aryal et al. 2017; Khanal et al. 2017).

Human-wildlife is also sharing same resources and habitat, due to the scarcity of food the animals need more nutrition for balance, and human disturbance, lack of prey species, climate change, habitat loss, etc. are the key factor (Khanal and Singh 2017).

Nepal has an outstanding record of wildlife conservation, largely as a result of excellent partnerships between government and community (WWF 2018). Such partnerships have recently resulted in 'zero poaching years' for one-horned rhinoceros (WWF 2018) and a substantial increase in the numbers of Bengal tiger (Dhakal and Baral 2015) has led to recent successes. The present study will assess the human-wildlife conflict of the buffer zone of Koshi Tappu Wildlife Reserve (KTWR) (Haripur and Sripurjabdi VDC) which plays a crucial role for the biodiversity conservation as well as wildlife. Furthermore, the study on human-wildlife conflict is lacking in the study area so that by realizing all these facts, the study will concerned with the aim of investigating the human-wildlife conflict by knowing crop damage by wild animals, livestock depredation as well as human casualties. Also, attitudes of local people towards wildlife conservation will be investigated.

Materials and Methods

Study area

The study was conducted in Haripur and Sripurjabdi VDC of Sunsari district, Nepal which lies at the southern part (Buffer Zone) of Koshi Tappu Wildlife reserve (KTWR) (Figure 1). It is one of the 14 districts in Province No. 1 of Nepal. The total population of the study area was 27,092 census report (2011). Most of the people of Haripur and Sripurjabdi are residing near the KTWR and local people graze their livestock around the reserve. People of this area follow different religion such as Hindu, Muslim, Buddha, and Christianity. The main source of income of these people is agriculture and livestock rearing.

In the context of climatic condition, the climate of Sunsari district is tropical monsoon with a mean annual rainfall of 2,110mm. Monsoon starts late May or early July with frequents of a violent thunderstorm. Winter starts from October and summer from February. The Humidity remains high all year round varying between 76% to 94% (Shah 1997).

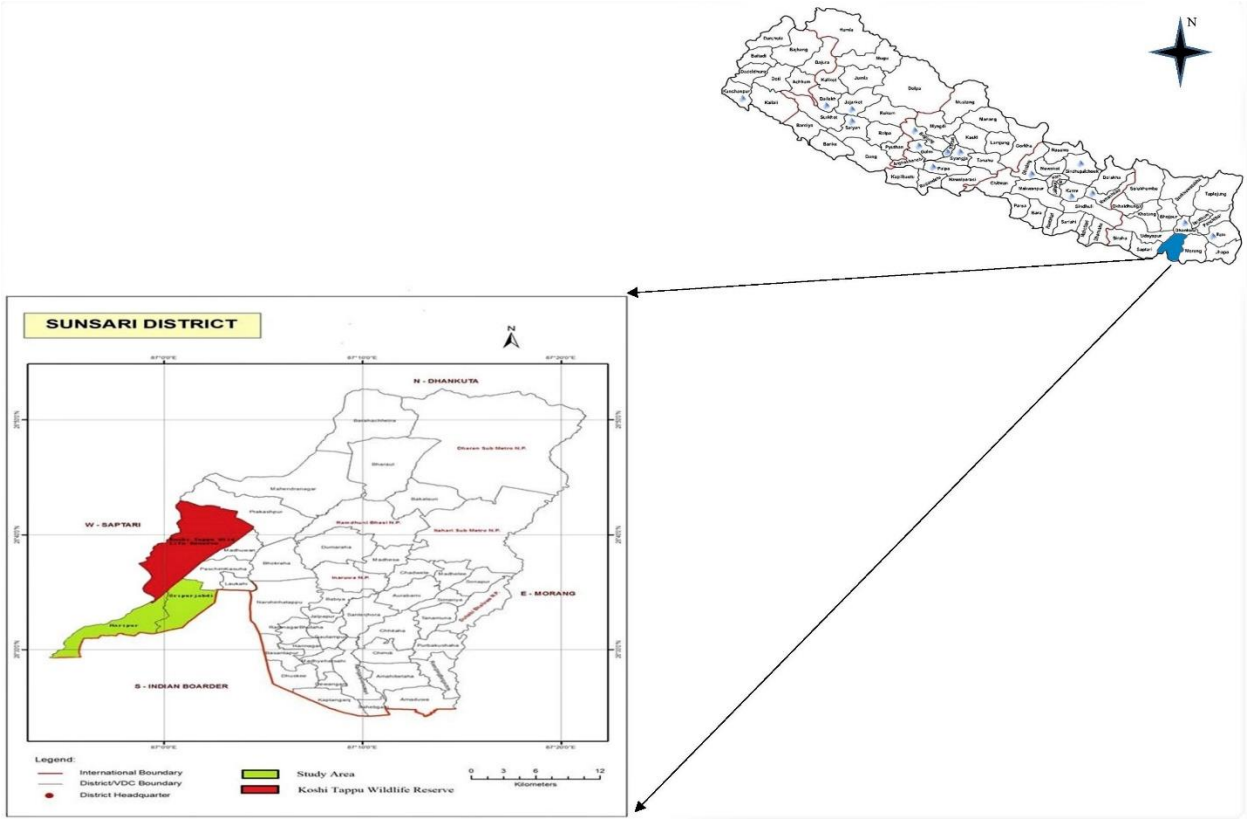

Figure 1: Map Showing Study Area.

Methods

The data regarding Human-wildlife conflict of one year period was collected from the local communities in VDCs of Sunsari district of Haripur and Sripurjabdi VDC (Fig 1). Face to face questionnaire survey was conducted with the household head from February to May 2016 to know the loss due to wild animals during one year period (February 2015 to 2016). If a household head was not present at the home, then the next responsible member was chosen for the interview. The total number of survey houses selected was (n=184). These houses were selected from the conflicted houses which were approximately 10% and selected randomly using a list of number list of households. The data of crop damage, livestock depredation, human casualties and mitigation measures were gathered by direct observation as well as a questionnaire survey.

Sampling design and questionnaire survey

The questionnaire survey was carried to find out the quantity of crop damage, human casualties, livestock depredation, and mitigation measures and have always proven beneficial. It is very common to access the nature and extent of conflict using interviews (Dickman 2010; Ermala 2003). Attitudes of local people towards wildlife conservation were also assessed. The additional information was added with the informal respondents such as DFO (District Forest Officer), KTWR members, concerned wildlife officers, etc.

Data Analysis

The quantitative data obtained from the field were analyzed using Microsoft excel and SPSS (V.20). All statistical analyses were done using a descriptive form as well as tabular form. Chi-square test was used to find out the attitudes of local people towards wildlife conservation. The economic values were calculated on the basis of the local market rate of crops and livestock.

Crop loss calculation:

To find per household crop loss in Kg;

$$\text{Per household loss in Kg} = \frac{\text{Total loss of crop in kg}}{\text{Total number of surveyed household}}$$

$$\text{Per household loss in NRs} = \frac{\text{Total loss of crop in NRs}}{\text{Total number of surveyed household}}$$

Livestock loss calculation

$$\text{Per household livestock loss} = \frac{\text{Total number of Livestock Loss}}{\text{Total number of surveyed household}}$$

Total Economic Loss= Price of the crop (Rs.) * Total Crop Loss (kg).

Results

Status of Human-Wildlife Conflict

Among 184 respondents, 74% of respondents answered that after the establishment of KTWR, the number of wild animals had been increased and there was increased in conflict,

3% opined that the number of wild animals had been decreased and there is decrease of conflict, 16% respondents opined that conflict was same as past and the population of wildlife was also same and 7% of respondents didn't know about their status.

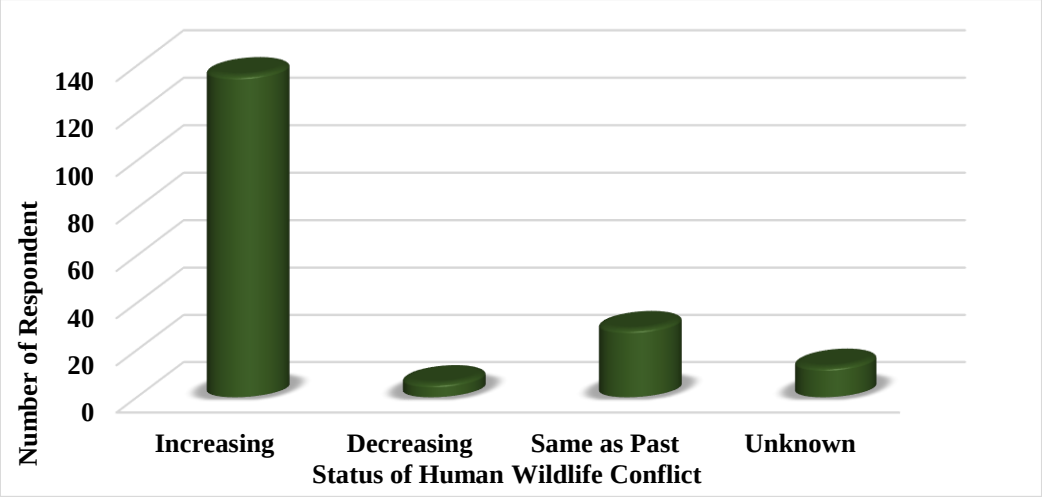

Figure 2: Status of Human-wildlife conflict

Types of Human-Wildlife Conflict

Crop damage, livestock depredation, human casualty, and house destruction were the major human-wildlife conflict types of the study area. Out of 184 respondents, 77% respondents responded that the main type was crop damage, 6% replied about human casualties, 13% about house destruction and 4% were livestock depredation (Figure 3)

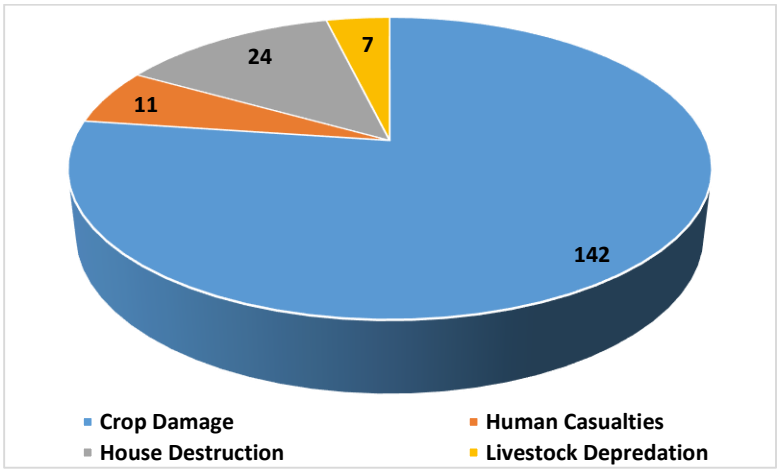

Figure 3: Types of Human-Wildlife conflict

Cause of Human-Wildlife Conflict

Most of the respondents responded that the cause of the human-wildlife conflict was habitat disturbance. About 40% respondents answered that the cause of habitat destruction was feral cattle inside the reserve, 23% stated that it was due to a sandy area, 18% answered about seasonal flooding, 10% replied about deforestation and 3% stated about illegal poaching (Figure 4).

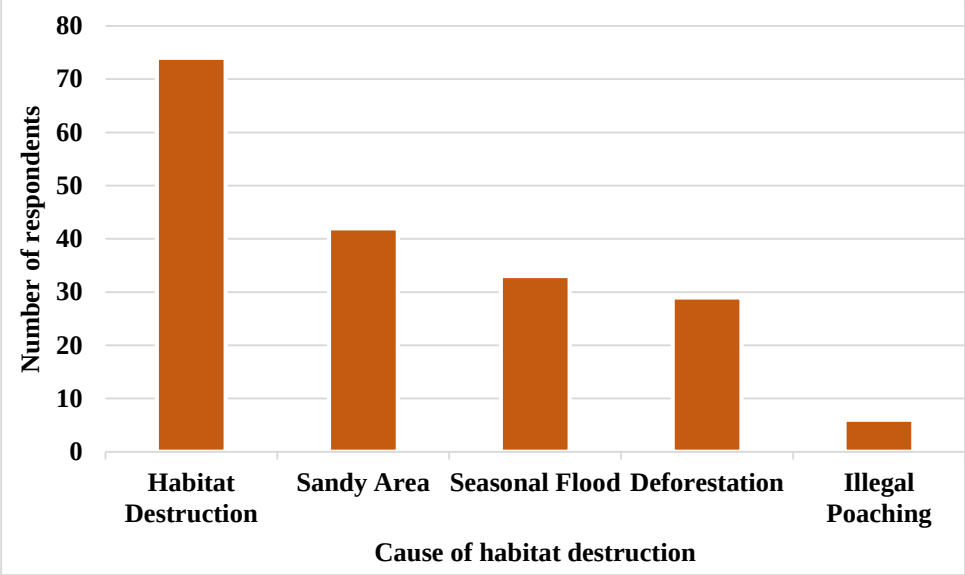

Figure 4: Cause of habitat destruction

Name of crops damaged by wild animals

Table 1: Crop wise major pest animals

Name of the Crops	Pest animals
Maize	Arna, Elephant, Wild Boar, Monkey
Paddy	Arna, Elephant, Wild Boar, Nilgai
Wheat	Arna, Elephant, Wild Boar, Nilgai, Rabbit
Sugarcane	Elephant
Potato	Wild Boar, Arna
Banana	Elephant

Jute	Arna, Elephant
Pulses	Arna, Wild Boar
Sunflower	Porcupine, Arna, Wild Boar
Bamboo	Elephant
Cauliflower	Wild Boar, Arna, Elephant

Altogether 11 crop species were damaged by seven species of pest animals (Table 1). Elephant and wild water buffalo (Arna) were the dominant pest species followed by wild boar, blue bull, monkey, rabbit, and porcupine. Most of the respondents said that wild animals entered into the crops because they like it while some told that these animals want to taste new plant species.

Quantitative Description of the different Crops Damage by Wild animals.

Table 2: Average crop damage in kg and monetary value of damage per year in the study area (1US$=108 NRS)

S.N.	Name of the Crop	Land cover in (Kattha)	Harvested Kg	Harvested NRs.	Damage Kg	Damage NRs.	Damage (US$)	Damage %
1	Paddy	1197.9	191659.2	3833184.0	35991.0	719820.0	6665.0	18.8
2	Wheat	543.2	43458.4	1086460.0	9651.0	241275.0	2234.0	22.2
3	Maize	47.3	5676.0	147576.0	1085.4	28220.4	261.3	19.1
4	Sugarcane	1720.0	516000.0	2580000.0	86600.0	433000.0	4009.3	16.8
5	Potato	32.2	5156.8	82508.8	1087.0	17392.0	161.0	21.1
6	Pulses	21.4	855.2	59864.0	183.0	12810.0	118.6	21.4
7	Jute	48.0	1920.0	76800.0	176.0	7040.0	65.2	9.2
8	Banana	450.0	1050.0	262500.0	109.0	27250.0	252.3	10.4
9	Cauliflower	10.0	1000.0	20000.0	225.0	4500.0	41.7	22.5
10	Sunflower	75.0	3000.0	180000.0	405.0	24300.0	225.0	13.5
11	Bamboo	9.1	1500.0	330000.0	41.0	9020.0	83.5	2.7
12	Others	700.0	1450.0	65250.0	140.0	6300.0	58.3	9.7
	Total	4854.1	772725.6	8724142.8	135693.4	1530927.4	14175.3	17.6

Table 2 indicates that the total damage caused by wild animals at Haripur and Sripurjabdi was NRs 15, 30,927.4 (US$ 14175.3). The dominant damaged crop was Paddy followed by sugarcane, wheat, sunflower, pulses, potato, bamboo, jute, cauliflower, and others.

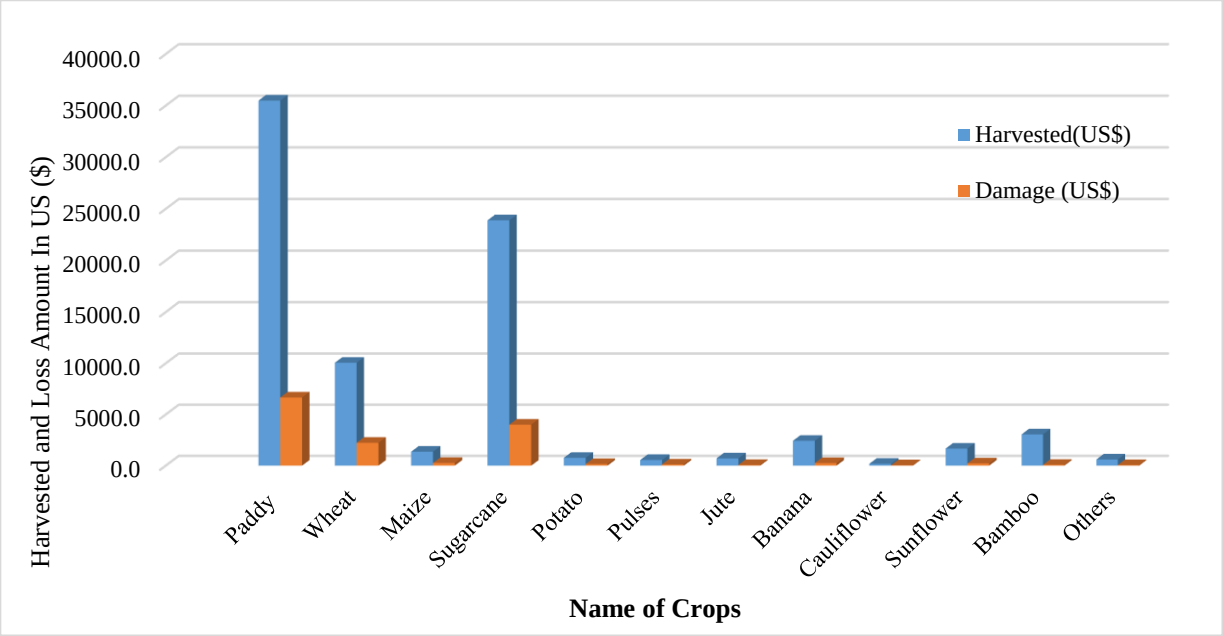

Figure 5: Comparison between harvested and damaged individual crops in US$

Our study shows that the comparison of harvested and damaged crops was highest at paddy followed by Sugarcane, wheat, banana, etc (Figure 5)

Table 3: Livestock depredations and responsible animals.

Livestock/avian stock	No. of killed	Responsible animal	Total in NRs	Total loss in US$
Calf (Cow)	1	Elephant	15,000	138.88
Goat	4	Fox	16,000	148.14
Pigeon	2	Jungle cat	500	4.6
Chicken	2	Indian Civet	1500	13.88
Total			NRs 33,000	US$ 305.5

Mostly. Fox, Jungle Cat, Indian Civet, and Elephant were responsible for livestock depredation. According to respondents, all livestock and avian stocks were killed by wildlife (Table 3). About NRs. 33,000 (US$ 305.55) was found to be loss by livestock depredation in the southern part of KTWR (Haripur and Sripurjabdi). Among 184 households 9 (4.90%) household losses livestock during this year.

Human Casualties

During one year period 2015 to 2016, there were three human casualties due to wild animal attack in the study area. According to our survey, one people died at Haripur while the other two people were wounded by wild water buffalo at Sripurjabdi VDC.

Local people attitudes towards the conservation towards wildlife conservation

The respondents demonstrated negative thinking about wildlife conservation. Majority of respondents 137(74.5%) did not like wildlife and want to eradicate while 47 (25.5%) like wildlife and wanted to conserve them. The reason behind the disliking of wildlife was that wildlife cause high damage to life and property of humans in the study area.

It showed that majority of people didn't like wild animal. The attitude of local people was not significant according to sex ($P > 0.05$), age, ($P > 0.05$) and education ($P > 0.05$).

Effective techniques adopted by the local people to reduce human-wildlife conflict

According to our survey, most of the people adopted different techniques to control human-wildlife conflict. Our results indicated that almost all of the respondents had adopted some mitigation measures against crop damage as well as livestock depredation by wild animals. The commonly used method was shouting (56%), followed by beating a drum (33%), electric fencing (9%) and 2% firing and lightening (Figure 5).

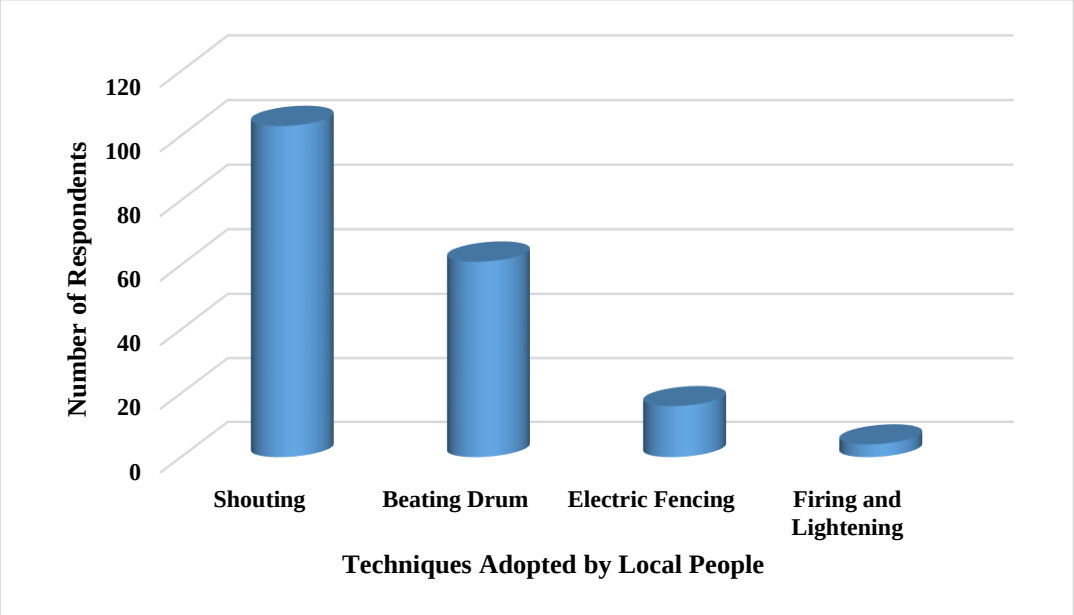

Figure 5: Preventive methods used by local people

Discussion

Status of Human-Wildlife Conflict

There has been in existence of human-wildlife conflict when human have existed; wild animals and people have shared the same resource and landscape (Dar and Mir 2018). Tentatively, higher numbers of incidents related to the human-wildlife conflict were observed in the field. The results of our study signify several interesting insights into the nature and extent of human-wildlife conflicts. There is a major concern of human-wildlife conflict across the greater proportion of the country's geographical area (Anand and Radhakrishna 2017). The status of human-wildlife conflict is similar to (Pokharel and Shah, 2008) as the human-wildlife conflict increased with the establishment of the protected area. The incidents of conflict have increased in recent time as a result of increased human activities in wildlife (Gharam et al. 2005; Dar and Mir 2018). There was the highest incidence of human-wildlife conflict in the study area (Pillalai 2016) that were similar to our study. The study carried out by (Aawasti 2014) was similar to our study which reflects about the increment of human-wildlife conflict.

Moreover, Human-wildlife conflict is a major concern for developing countries (Pillalai 2016), which also effect on socio-economic aspect of those countries people which decrease the per capita income (Khanal and Singh 2017).

Types of Human-Wildlife Conflict

Our study supports that there were different Types of human-wildlife conflict such as crop damage, livestock depredation and human casualties (Pant, 2016; Prashanth et al. 2013; Aawasti 2014). Crop damage was the dominant Types of human-conflict among them (Poudel 2007; Aawasti 2014; Khanal et al. 2017; Aamaja et al. 2016). Different types of crops such as paddy, wheat, maize, sugarcane, pulses, etc were raided by wild-animals which direct effect on people's economy (Joseline 2010; Karanth et al. 2013; Rohini et al. 2016; Khanal and Singh 2017 and Adhikari et al. 2018). The elephant is the dominant animal species which cause huge damage on crops (Muruthi 2005; Rohini et al. 2016 and Silongo 2018) but our study indicates the wild water buffalo was a main crop pest species. The other animal species elephant, wild water buffalo, wild boar, porcupine blue bull Jungle cat, Indian civet, etc were also responsible. (Kharel 1993 and Poudyal 1997) specified that wild boar was the prominent crop pest species in Shivapuri National Park (ShNP). The next is livestock depredation which occurs at home as well as grazing time. Wild animals attack livestock while they were at home as well as grazing time (Aryal et al. 2010; Chhetri 2013; Aawasti 2014; Adhikari et al 2018). Different animal species such as cow, ox, buffalo, dog, and pig were killed by wild animals (Adhikari et al. 2018) which was similar to our study. The participatory discussions revealed that most killings occurred when animals left for grazing in the crop field or wild habitats as similar to the study of (Rao et al. 2015; Pokharel and Shah, 2008). The study of (Pillalai 2016) reflects that the dominant animal species as an African lion, Gray wolf, and tiger. The rate of predation is higher at Jigme Singye Wangchuk National park of Bhutan (Wang and Macdonald 2006). Livestock damage signifies as a leading category of depredation which seriously ramifies for livestock farmers (Wang and Macdonald 2006).

In the context of human casualties, four people were killed at GCA (Aawasti 2014) while at our study there were only one died and two injured by wild animals.

Similar results were seen in the study of (Chhetri 2013). In general, wild animals normally show no aggression towards humans (Goulding 2003; Jeyasingh and Davidar 2003; Khanal and Singh 2017) and ran away when they encounter human. (Chauhan et al. 2009) in India is higher than our findings because of the larger area and long study period.

Cause of Human-Wildlife Conflict

Our study indicated that the cause of the human-wildlife conflict was habitat destruction which was due to feral cattle inside the reserve, sandy area and seasonal flooding which was similar to the study of (Pillalai 2016). In developing countries like Nepal, there was a high dependence of forest ecosystem by extraction of forest resources and prevalent poverty by conversion of forest into agricultural land (Sodhi et al. 2010; Anand and Radhakrishna 2017). Nepal has witnessed a significant transformation with respect to land-use changes and increase in the land area under protection. (Solongo 2018) mentioned that the main cause of the human-wildlife conflict was the negative effect on biodiversity, also habitat degradation (Aawasti 2014). Likewise, the negative effect on biodiversity caused a huge loss of life and property.

Human-Wildlife Conflict due to Crop Damage by Wild Animals

Due to the rapid growth of population, there have been an additional demand on natural resources, wild animals also face more pressure to survive on nature. The destruction of prime habitat was the main reason for human-wildlife conflict. It was also known that the conflicts between human and wildlife caused the main threat to biodiversity conservation (Amaja et al. 2016). Many researchers have indicated human-rhinoceros conflict, human herbivores conflict, human-tiger conflict, human-wildlife conflict were the most crucial research at different regions of Nepal (Srivastava and Begum 2005; Aryal et al. 2010; Bista and Aryal 2013; Adhikari et al. 2018). But majority of cases were seen at human-dominated landscapes (Lamichhane et al. 2018). The inhabitants of Haripur and Sripurjabdi were also suffered from such problems from wildlife that caused huge damage to life and property. Elephant and Wild water buffalo were the main crop pest species while Muntaj deer was the dominant species (Adhikari et al. 2018).

In the Sunsari district, different types of crops were grown by local communities which can be used as food as well as raise income. Our research indicated that the dominant crops preferred by wildlife were paddy, wheat, maize, sugarcane, potato, pulses, vegetables, etc which were similar with the study of (Khanal et al. 2017; Amaja et al. 2018; Bayani et al. 2016; Aryal et al. 2010). These results were consistent with the findings of (Pillalai 2016) which suggest the vulnerability of local communities to human-wildlife conflict. Our study simplifies that in Sunsari district, the total economic loss from crops and livestock damaged by wildlife were NRS 15, 30, 927.4 (US$ 14,175.3) and NRS 33,000 (US$ 305.55) respectively during one year period. (Aawasti 2014) calculated that the total economic loss of crop was NRS 20, 70, 806(US$ 21, 422.5) while (Khanal et al. 2017) indicated of NRS 72, 75, 507 (US$ 68,633.42) during one year period which was quite higher than our findings. Likewise, there was a huge loss of livestock in our study area which also shows similar conditions with (Aryal 2010; Aawasti 2014; Amaja et al. 2016). The total loss of crops in our study area differs from (Jeyasingh and Davidar 2003). Among them, paddy was the highest damaged crop. The percentage of different crop loss such as paddy, wheat, sugarcane, and pulses was higher than that of (Aawasti 2014; Khanal et al. 2017; Karanth et al, 2012) but similar with (Sen 1999). There was high livestock depredation in the study area that signifies with our study (Aryal et al, 2010; Aawasti, 2014; Aamaja et al 2016). It should be noted that the annual economic loss for most of the farmers has a major impact on their annual budget, health, education, affecting nutrition and access to essential social service for the family.

Generally, wild animals normally behave no aggression towards humans (Goulding 2003; Mayer 2013). In the current study, only two humans were injured and one died but (Aawasti 2014) found four human injuries at Gaurishankar Conservation Area. Likewise, the study conducted by (Khanal and Singh, 2017) showed that ten humans were injured by wildlife. Our study reveals that most of the injured cases were seen outside the house.

Attitudes of local people towards wildlife Conservation

We encountered mixed responses for the conservation of wildlife in the study area. (Rohini et al.2016) mentioned that there were negative attitudes towards wildlife conservation. Similarly,

there developed a negative attitude by deriving the increase in frequency and intensity of damage of crops and livestock (Wang et al. 2006; Rao et al. 2002). Likewise, similar results were developed from (Hill, 1998; Bhattarai and Basnet, 2004; Khanal et al. 2017). (Trygg 2014) found the positive attitudes which show the contrasting results with our findings. Negative perceptions were developed when damage exceeds a tolerance level (Hill, 1998).

Mitigation Measures

The local people of the study area use various means of preventive measures for stopping wild animals enter into their crops. Most of the people use common method shouting, beating the drum, electric fencing, and few used firing and lightening. (Adhikari et al. 2018) suggested the future study is essential for mitigation and prevention to minimize human-wildlife conflict. There were different traditional; methods such as shouting, beating drums, electric fences and firing and lightening (Meena et al. 2014). (Bayani et al. 2016) indicated that guarding was the most effective means of controlling wildlife intrusion. Surprisingly, (Rao et al. 2015) mentioned that local people used human hair, spraying pig dung and colored saris as a traditional preventive methods in India.

Conclusions

Our study reflects that the human-wildlife conflict is a major threat to the livelihood of the local people. Our research also provides the global assessment of human-wildlife conflict of developing country of developing human communities. People are becoming aggressive towards wildlife due to crop damage, livestock depredation, and human casualties. There has been a significant impact on rural people's livelihood and lives due to human-wildlife conflict. Therefore, the human-wildlife conflict is an issue within the context of people's social, economic as well as cultural perspectives. Loss of income due to human-wildlife conflict was a key factor of the people's livelihood of the study area. The total crop loss in the study area was estimated was NRS 15,30, 927.4(US$ 14,175.3) and Livestock depredation was NRS 33,000 (US$ 305.5) during a one year period, damages that range from 2% to 22.22%. Three people (One dead and two injured) were encounters with wild animals. Vulnerable and

endangered species such as elephant and wild water buffalo were the most responsible pest which needs local level conservation and management. The reason behind this issue was the habitat degradation of wild animals where their habitat was changed into the human dominant landscape.

There were mixed responses towards wildlife but most of the people have negative intension towards wildlife conservation. Shouting, beating drums, electric fences, firing and lightening were some measures applied by local people to control human-wildlife conflict. While our study has revealed several conditions of human-wildlife conflict, it has also shown gaps in our study and knowledge for future studies. To reduce malevolence of local communities towards wildlife, compensation schemes is another option after different mitigation measures. Awareness programs are also the next techniques to control those issues. Conservation policy and plans must be implemented for those areas where there is more human-wildlife conflict. In the case of human-wildlife conflict, the policy can only be effective management and conservation tool to reduce poverty among the local people.

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Author's Contributions

Dip Narayan shah and Srijana Khanal designed the study, conducted the literature review, collected data, analyzed the data and prepared the first draft of the manuscript. Nanda Bahadur Singh supervised the project, contributed to study design and data interpretation, and revised the manuscript. All authors revised and agreed on the views expressed in the manuscript and they all have equal contributions to this manuscript.

Compliance with Ethical Standard

Conflict of Interest

The authors declare that they have no competing interests.

Availability of Data and Materials

The data sets supporting the conclusions of this article are available at the institutional repository of Tribhuvan University. According to the data protection regulation of Tribhuvan University, authors are not permitted to deposit the data elsewhere.

Ethics Approval and Consent to participate

Ethics approved was obtained from the Research and Ethics Approval Committee of the Central Department of Zoology, Tribhuvan University, Nepal. Participants were made aware of or leave the survey at any time without prejudice. The questionnaire did not contain any sensitive issues and respondents were not harmed through their participation.

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