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Human-Wildlife Conflicts in Paschim Kusaha Village of Koshi Tappu Wildlife Reserve, Sunsari District, Nepal

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Abstract: Human-wildlife conflict has been one of the most trouble-causing issues in many areas of Nepal including Eastern Nepal. This study assessed the human-wildlife conflict status in Paschim Kusaha Village of Koshi Tappu Wildlife Reserve (KTWR), Sunsari District, Nepal. Data were collected from 47 respondents of different households through questionnaire surveys and formal and informal interviews. Results revealed that the most destructive wild animals were wild elephants, wild boar, and wild water buffalo and the most raided crops were paddy (63.83 %), maize (19.15%), and potato (17.02%). Most of the encounters between humans and wildlife were recorded at night (after dusk and before dawn) (78.72%). Local people were suffering from damage of physical properties, human harassment or nuisance, and depredation of cropland due to wild animals. A total of 70% of respondents had a positive attitude towards conservation despite disturbing human mortality records (22 deaths in the last five years) from the reserve area and surrounding. Awareness of wildlife behavior together with conservation and easy access to compensation schemes were suggested to minimize conflicts in the area.

Key words: adaptation measures; crop damage; human-wildlife conflict; people's perception

1 Introduction

Human-wildlife negative interaction often called Human-Wildlife Conflict (HWC) is a global conservation challenge (Karanth and Vanamamalai, 2020). It represents the most widespread and complex challenge currently being faced by the conservationist around the world (König et al., 2020). With the rise in the human population, wildlife habitat is increasingly being used by humans, creating massive pressure on wildlife populations (Barua et al., 2013). When wild animals compete with humans for space and resources (Woodroffe et al., 2009), it results in frequent interactions between the two (Barua et al., 2013), making HWC a growing issue of concern to the people living inside the protected areas (Siljander et al., 2020). The conflict between humans and wildlife has resulted in the loss of lives of both humans and wildlife, threatening the livelihoods of millions worldwide (Megaze et al., 2017). The biodiversity-rich countries around the world including Nepal have been facing HWC, especially in areas around the protected areas (Joshi et al., 2020).

Nepal has been successful in wildlife conservation through the establishment of protected areas (Acharya et al., 2016; Aryal et al., 2021). HWC cases have been increasingly and frequently reported in and around these areas (Shah et al., 2021). Several studies related to human-wildlife interactions in protected areas have shown cases of crop depredation as well as human casualties (Bhatta and Joshi, 2020; Subedi et al., 2020).

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Tarai region has a high population density of wildlife in fragmented forest patches with extensive human disturbances (Acharya et al., 2017); hence more HWC cases were reported from this region (Bhattarai and Fischer, 2014). HWC has been raising food insecurity, workload, physical and psychological aspects, economic hardship, and poaching in wildlife areas (Ogra, 2008).

Crop damage, livestock loss, and human casualties are serious HWC problems in different areas of the Tarai region in Nepal (Thapa, 2010). Such problems are dependent on the timing of the animals' visits, frequency of visits, the conservation status of the area, attitude of people towards wild animals, including poaching, and most importantly, mitigation measures adopted in the area. The eastern Tarai region is vulnerable to HWC as it was reported to be a historical migratory route for big mammals like the common leopard, wild boar, rhesus macaque, sloth bear, and wild elephants (Jnawali et al., 2011; Neupane et al., 2013). These studies have been focused on crop depredation as well as human casualties. Since there have not been sufficient studies in the area during recent years despite the plethora of HWC issues, this study has assessed the human-wildlife conflict status and perceptions of the local people towards different wild animals such as wild elephant (*Elephasmaximus*), wild boar (*Sus scrofa*), and wild water buffalo (*Bubalus bubalis arna*) concerning human life, crop, and property damage caused in Paschim Kusaha village.

2 Materials and methods

2.1 Study area

The study area is under Koshi Rural Municipality 2 (Paschim Kusaha Village) is located in the east of Koshi Tappu Wildlife Reserve (KTWR, 86°55'–87°05'E and 26°34'–26°45'N) and lies on the flood plain of the Sapta Koshi River in Saptari and Sunsari district of Eastern Nepal (Fig. 1). The reserve was established in 1976 AD primarily to protect wild water buffalo (*Bubalus bubalis arna*). It covers an area of 176 square kilometers as the core area and 173 square kilometers as the buffer zone. Realizing the site's importance, Koshi Tappu was designated as a wetland of international importance and added to the Ramsar list on 17th Dec 1987 (IUCN, 1990). The reserve has a subtropical monsoon climate with four distinct seasons: spring, summer, autumn, and winter. Spring (February–April) has pleasant warm temperate and silt-laden solid wind. Summer (May) is intensely hot with minimal precipitation and a maximum temperature up to 40 ℃. Mudflats, reed beds, and freshwater marshes dominate most of the area of the reserve. Crop or livestock depredation by wildlife imposes substantial costs on local people and their livelihoods (Madhusudan, 2003; Karanth and Nepal, 2012). The major crops are paddy,

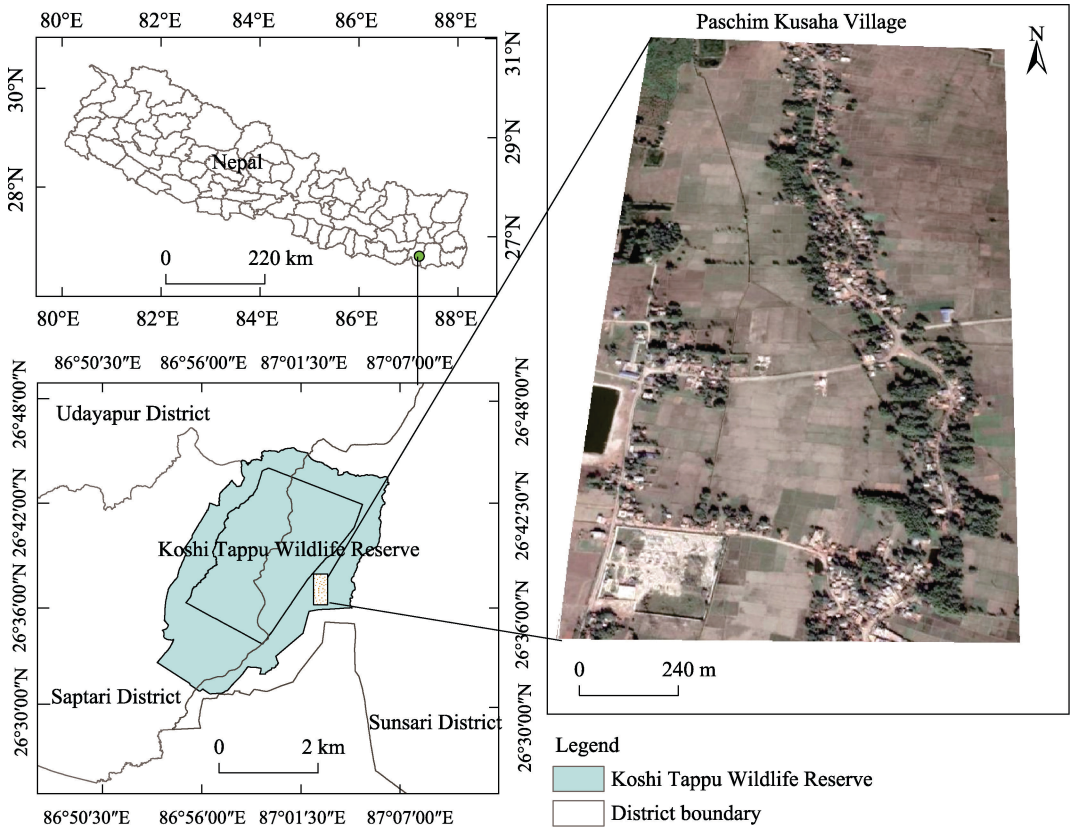

Fig. 1 Study area map of Paschim Kusaha Village of Sunsari District at Koshi Tappu Wildlife Reserve (KTWR)

wheat, maize, millet, sugarcane, mustard, potato, banana, and other seasonal fruits and vegetables in their fields. All households (HHs) have multiple livestock such as buffalo, cow, goats, chickens, pigs, ducks, and fish farming (Field Survey, 2020).

2.2 Data collection

The preliminary field visit was conducted in the first week of January 2020 to gain knowledge of the site's socio-cultural and biophysical aspects and build trust with the local people to complement the other research process in a participatory manner. Another field visit was done in the last week of the same month for data collection. Different observations related to the socioeconomic environment such as population, sources of income, and level of education were made in various places like the respondent's home, farm, corridor forest, and surroundings. Adaptation measures practiced at the local level were extensively observed. HHs questionnaire was developed which contained the information about the socioeconomic detail of each household, i.e., family size, education, income, occupation, gender, and management practices performed by them, people-wildlife conflict, movement of wildlife in those areas, and perception of people towards wildlife conservation and the existing presence and absence of wildlife in that area. Before the survey, consent from each respondent was taken verbally, and we strictly followed the social norms and values while conducting the survey. A total of 47 respondents from the village were randomly chosen from 250 different households of the study area and discussed issues of HWC with the park staff for this study.

2.3 Data analysis

Data obtained from the questionnaire survey were schematically recorded in an excel spreadsheet using Excel 2010. The gathered data were represented systematically in the form of graphs, pie charts, and tables. The obtained data were also presented in percentages. The chi-square test was performed to see the relationship between education and perception of people on wildlife conservation.

3 Results

3.1 Demographics of the respondents

A total of 47 respondents were interviewed, of which 63.83% (n=30) were female and (36.17% (n=17) were male. More than half of the respondents, 68.09% (n=32), were between the ages of 31 to 55, 19.14% (n=9) were of the age group 16 to 30, and the rest, 12.77% (n=6), were more than 55 years old. The majority of the respondents (78.72%, n=37) lived in the study area for more than 20 years, whereas the minority 4.25% (n=2) migrated between 10 to 20 years ago, and none of the respondents migrated before ten years. Among the respondents, 57.45% (n=27) were illiterate, 25.53% (n=12) had primary education, 10.64% (n=5) had secondary education and only 6.38% (n=3) had higher secondary education (Table 1).

The major income for the family was from agriculture i.e. 63.83% (n=30), followed by business 10.64% (n=5) and service 6.38% (n=3). Rest 19.15% (n=9) depended on remittance (income from foreign employment) placed in others category.

Table 1 Demographic profile of respondent

Demographic parameter	Description	Total respondents	Percentage (%)
Age	16–30	9	19.14
	31–55	32	68.09
	Above 55	6	12.77
Sex	Male	17	36.17
	Female	30	63.83
Education	Primary	12	25.53
	Secondary	5	10.64
	Higher Secondary	3	6.38
	Illiterate	27	57.45
Occupation	Agriculture	30	63.83
	Remittance	9	19.15
	Service	3	6.38
	Business	5	10.64

3.2 Human-wildlife conflict

3.2.1 Nature and status of conflicts causing animals at Paschim Kusaha Village

Wild elephants, wild water buffalo, and wild boar were the major crop raiders and the major causes of conflict. The wild elephant was reported to be the most conflicted animal (43%) followed by wild boar (30%) and wild water buffalo (27%) (Fig. 2).

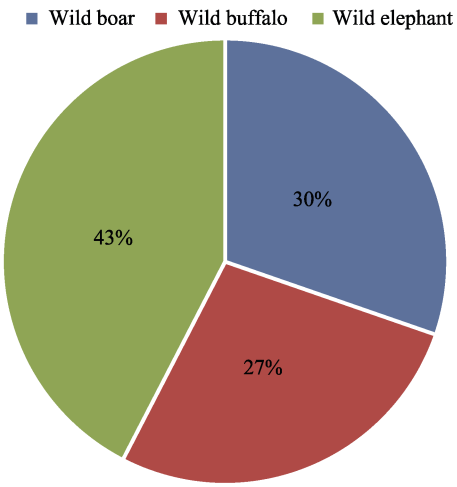

Fig. 2 Percentage of conflicts with different wild animals with wild elephant being the most encountered species

Most of the respondents (57.44%) reported that conflict-causing animals (wild elephant, wild boar, wild water buffalo) visit the village daily, followed by twice a week (10.63%), weekly (27.65%), and monthly (4.28%) (Fig. 3).

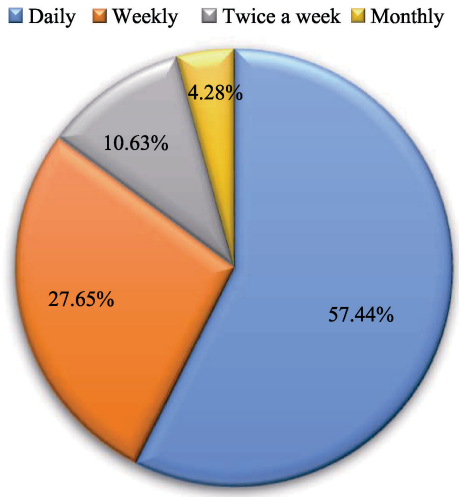

Fig. 3 Frequency of wild animals visit in the village

Among the respondent, 52% stated the HWC events are increasing, whereas 15% of respondents stated that it is decreasing and 33% of the respondents said that conflict events are still the same as before in frequency (Fig. 4).

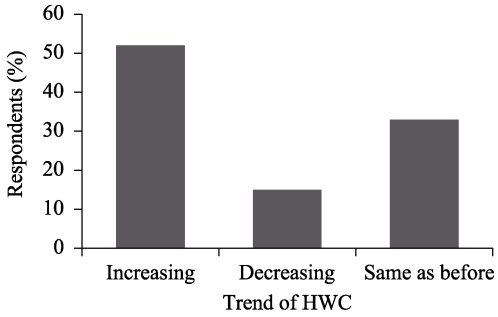

Fig. 4 The trend of HWC cases

3.2.1 Encounter time with major wild animals

Most of the respondents (78.72%) encountered wild animals (Wild elephant, Boar, and Buffalo) at night followed by morning (17.76%), day (4.25%), and evening (4.25%) (Fig. 5).

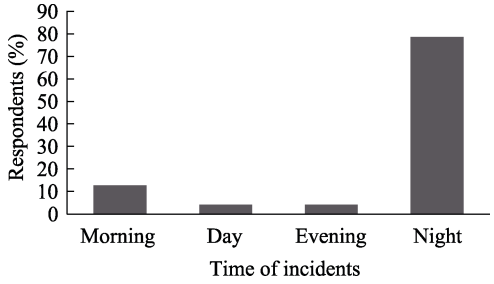

Fig. 5 Time in which people encountered wild animals

3.2.2 Crop raiding by wild animals

Crop-raiding was a frequent problem faced by all respondents. The most three reported crops raided by wild animals were paddy, maize, and potato reported by 63.83% (n=30), 19.15% (n=9), and 17.02% (n=8) respectively (Fig. 6).

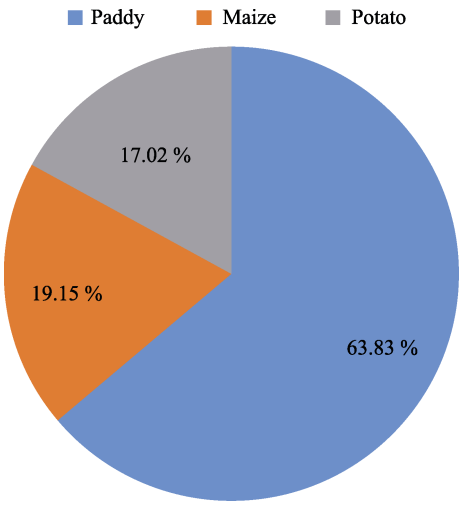

Fig. 6 Major crop raided by wild animals

A total of 70% of the respondents reported that crop-raiding occurs during the cropping and harvesting period from July to November (summer season), and 30% of the respondents reported that it occurs regularly.

The crop area damage was reported to be between 0.03–0.45 ha more than half of the respondents 57.45% (27) reported the crop loss occurred in between 0.03–0.15 ha area followed by 23.40% (11) in 0.15–0.3 ha and 19.15% (9) in 0.3–0.45 ha (Fig. 7).

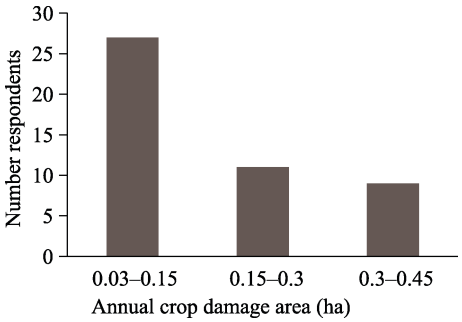

Fig. 7 Crop damage area reported by the respondents

3.2.3 Human casualties and property destruction

A total of 22 deaths cases were recorded from KTWR between 2016 to 2020 (Fig. 8). 37.17% of respondents experienced property damage cases (such as the destruction of houses). A majority (85%) of the respondents reported property damage is more in the summer season during the cropping and harvesting period from July to September and 15% of the respondents reported property damage happens regularly.

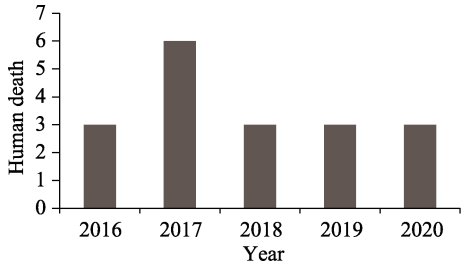

Fig. 8 Number of death cases recorded within five years
Note: Source: Koshi Tappu Wildlife Reserve, 2020.

3.2.4 People's perception and attitude towards conservation

The association between conservation attitude and education was seen positive but not significant (X^2=3.904, df=2, P= 0.14). Out of 47 respondents, 57.45% (n=27) were illiterate among them 33.33% had a positive perception of wildlife management, whereas 66.67% had a negative perception towards wildlife. Among them, 25.53% (n=12) of the respondents who had primary education, 33.33% had a positive perception, whereas 66.66% of the respondents had a negative perception towards conservation. Similarly, out of 10.64% (n=5) of the respondents who had secondary education, (80%) had a positive perception, and 20% had a negative perception. Out of 3 respondents (6.38%) who received higher education, all of them have a positive perception about wild animal conservation (Fig. 9).

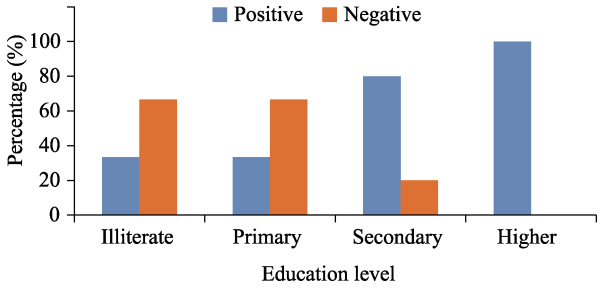

Fig. 9 Respondent's attitudes according to their education level towards conservation

A total of 70% of respondents had positive attitudes towards the conservation of wild animals. Among them, most of them had positive attitudes due to religious causes (70%), tourism and recreation (25%), and aesthetics (5%). None of the respondents reported poaching of wild elephants in the last 10 years, but only a few (n=3, 6.38%) respondents reported poaching.

3.3 Compensation and mitigation measures

3.3.1 Compensation scheme

Only 60% of the respondents have received compensation NRs.10000 (US$ 85.12) for damage caused by wild animals (wild elephants, wild boar, and wild water buffalo). All the respondents reported a lengthy and challenging process to apply for compensation, whereas a key informant interview with the authority said the process had been eased and large numbers of complaints have not been registered.

3.3.2 Mitigation effort

As a preventive measure, out of the 55 km perimeter of the reserve adjacent to Paschim Kusaha Village, the KTWR authority has constructed a barrier with about 18 km solar and electric fence to limit the entrance of wild animals in surrounding areas of the buffer zone. When wildlife comes to the farm, people used to assemble in groups and follow them by fire. More than half (51.06%, n=24) reported that they follow with fire, 29.79% (n=14) reported throwing stones to hit wild animals, and 19.15% (n=9) mentioned making noise through playing drums and tin (Fig. 10).

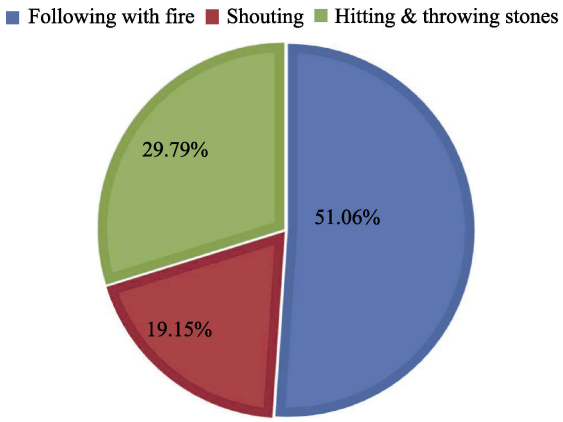

Fig. 10 Mitigation measures applied by respondents

All the respondents expected to receive security assurance, employment activities, infrastructures, and development activities from the KTWR. More than half (55%) of the respondents suggested KTWR authority should focus on strong electric fencing, regular monitoring, and compensation; 25% of respondents said that they feel insecure at night, 4% of the respondents expected developmental work and activities, 6% of respondent agreed to change crop pattern, and 10% focused on conservation of wild animals (Fig. 11).

4 Discussions

4.1 Human-wildlife conflict

HWC has created pressure on the people of the Paschim Kusaha village. The crop damage in Koshi rural municipality and Baraha rural municipality adjacent to KTWR revealed the highest economic loss; 55% of the loss was in paddy crop (*Oryza sativa*), followed by wheat (*Triticum aestivum*) (18%) and maize (*Zea mays*) (15%) which has been reported in another similar study (Joshi et al., 2020). A study conducted in the Kavrepalanchowk District of Nepal showed the highest economic loss for maize (35.78%), followed by mustard and potato (Pudasaini, 2020) and in a study conducted at Chitwan National Park, rice accounted for the highest economic loss NRs. 1399800 (US$ 11917.25), followed by wheat and maize (Dhakal, 2020). This study

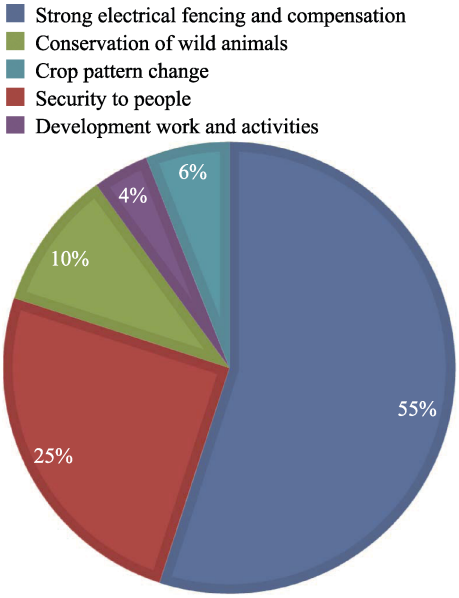

Fig. 11 People's perception of mitigation measures

showed crop-raiding as one of the most serious issues similar to other studies from Nepal (Shrestha, 2007; Karanthand Nepal, 2012; Neupane et al., 2018; Pokhrel and Aryal, 2020).

Humans and wild animals use/occupy the same area and use similar resources, the attacks and the conflicts between the two increase (Tshewang et al., 2021). The present study's findings show that wild elephants, wild water buffalo, and wild boar are the major crop raiders which are similar to other studies conducted in KTWR (Timsina and Ranjitkar, 2014). This study showed the rate of crop-raiding to be high during the night which is similar to the study in Chitwan National Parkand it might be due to the difficulty in wild animals' detection (Ghimire, 2019). But another study carried out in Sundarpur, Udaypur reported high crop-raiding in the afternoon (Pokhrel and Aryal, 2020). Crops were raided during the cropping and harvesting period similar to a study in Chitwan National Park which might be due to the abundance of nutritious and easily available crops (Ghimire, 2019) or insufficiency of food in the reserve (Limbu and Karki, 2003).

This study showed 22 deaths at KTWR between 2016 and 2020. Another study conducted in KTWR demonstrated that the community people experienced wildlife attacks every month, leading to increased conflict between the park and people (Timsina and Ranjitkar, 2014). Other studies conducted in different parts of Nepal also showed that people were killed or seriously injured every year by encounters with wild animals such as wild elephants, wild boars (Limbu and Karki, 2003; Acharya et al., 2016; Ghimire, 2019; Dhakal, 2020).

4.2 Compensation and mitigation measures

Compensation for wildlife-caused damage is a fundamental strategy to mitigate or minimize HWC as it increases the community's tolerance level (Ogra and Badola, 2008; Karanth and Nepal, 2012; Kusi et al., 2020; Pudasaini, 2020). Compensation is given based on relief guidelines approved by the Government of Nepal. The amount has been categorized as NRs. 10000 (US$ 85.13) to victims of crop damage and NRs. 1000000 (US$ 8513.54) to human loss. The compensation scheme is a major issue to the respondents due to the lengthy process and insufficient compensation amount which might be due to the lack of clarity in the government's rule to compensate the wildlife victims because of lack of provision for compensation to crop damage (Timsina and Ranjitkar, 2014).

The mitigation measures applied to chase wild animals were following with fire, hitting and throwing stones, shouting by using tools, regularly watching the wild animals from a high elevation (often called watchtowers) were the main coping activities adopted by the local people to chase the wild animals and electric/solar fence was the primarily used protective measures. The application of these techniques was to threaten the wild animals from entering the field. These methods have been applied in various parts of the country (Thapa, 2010; Neupane et al., 2013; Pudasaini, 2020). However, it is essential to examine these methods' effectiveness and introduce advanced, practical measures to cut down HWC (Pokharel and Aryal, 2020) in KTWR. In addition to these mitigation methods, reinformed cement concrete fencing was also used in KTWR to stop the crop raiders. According to different studies by Kioko et al. (2008) and Banikoi et al. (2017), using an electric fence can also be highly effective in alleviating the damage to crops and property, given that they are adequately monitored and maintained.

4.3 People's attitude towards wildlife conservation

The attitudes of people towards wild animals were positive as well as negative. The people receiving benefits from the conservation initiatives are more likely to tolerate the wildlife damage and be positive towards conservation (Studsrod and Wegge, 1995). People might also tolerate or have a positive attitude towards wildlife due to religious beliefs for instance in Bardia and Shuklaphanta (Shrestha, 2007). People of Sundarpur were also in favor of elephant conservation because of their religious sentiments of elephants as Lord Ganesh (Pokhrel and Aryal, 2020). There are also examples from other parts of the country where people have a positive attitude towards wildlife conservation due to similar beliefs (Bhattarai and Fischer, 2014; Kusi et al., 2020).

HWC is the most challenging issue of KTWR, most of the techniques to reduce it was manual and human-based. Applying the techniques singly or in combination with others depends on the severity of the problem and the number of wild animals approaching the cropland and houses. There must be a solution-based collaboration between national parks, divisional forest offices, buffer zone communities,

community forest management committees, and local communities (Pudasaini, 2020).

5 Conclusions

Human-wildlife conflict is one of the major issues of wildlife conservation throughout the world. A survey-based study in Paschim Kusaha Village, Koshi Tappu wildlife reserve showed that wild elephant, wild boar, and wild water buffalo were the major HWC causing animals and most of them were active in causing HWC during dusk. Most of the respondents reported that cases of HWC are increasing and animals encounter cases were more at night. Paddy, maize, and potato were the major crop damaged by the wild animals. The crop loss area per household was between 0.03 ha to 0.45 ha. A total of 22 human casualty cases were recorded within the past five years. Most of the educated people were positive towards conservation than uneducated people. People were getting compensation for their loss but respondents reported the process of granting compensation is lengthy and cumbersome. Chasing wild animals with fire was the most reported mitigation measure for HWC in the area. This study recommends finding sustainable solutions to mitigate HWC through detailed and long-term research in habitat improvement, technology use, and human-wildlife behavior.

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尼泊尔 Koshi Tappu 野生动物保护区中村落人类与野生动物冲突

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摘　要：人类与野生动物的冲突一直是尼泊尔许多地区（包括尼泊尔东部）面临的最棘手的问题之一。本研究评估了尼泊尔 Sunsari 区 Koshi Tappu 野生动物保护区 Paschim Kusaha 村的人类与野生动物冲突状况。通过问卷调查和正式/非正式访谈，从不同家庭的 47 名受访者中收集数据。结果显示，破坏力最大的野生动物为野象、野猪和野水牛，袭击最多的农作物为水稻（63.83%）、玉米（19.15%）和马铃薯（17.02%）。人类与野生动物之间的大部分相遇发生在夜间（黄昏后和黎明前），有记录显示夜间相遇占总相遇次数的 78.72%。当地居民受到的主要负面影响包括财产损失、动物骚扰以及野生动物对农田的破坏等。尽管保护区和周边地区的人类死亡率记录令人不安(在过去 5 年中有 22 人死亡),但仍有 70%的受访者对野生动物保护持积极态度。建议提高对野生动物行为的认识以及保护，设立容易获得补偿的计划和项目，以尽量减少该地区的人类与野生动物的冲突。

关键词：适应措施；作物损害；人类与野生动物的冲突；认知