Human-Elephant Conflict and Mitigation Measures in Jhapa District, Nepal

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Abstract

Asian elephants are the largest terrestrial animals that are highly threatened due to habitat loss and fragmentation. Human - Elephant Conflict (HEC) is a complex interaction between human and elephant, which represents detrimental impacts for both. The aim of this study was to explore HEC in terms of human casualties and injuries and crop and property damage in all the wards of Jalthal Village Development Committee of Jhapa district, Nepal. It also aimed at identifying the commonly practiced mitigation measures by the local people in the study area. For this study, 179 households were randomly selected for questionnaire surveys followed by 20 key informant interviews and 5 focus group discussions. Our study shows that the settlements located nearby the Jalthal forest had higher risks of elephant attacks. The crop damage was the most frequent damage in terms of HEC in the study area. Among the crops, paddy was the most damaged crop. Property damage was the second problem faced by the local people. However, there were no significant differences in crop and properties damaged by elephants among different socio-economic classes. The most commonly used mitigation measures adopted in the study area were shouting and use of fire but people were not satisfied with the present conflict management strategies due to their ineffectiveness. This study implies that the presence of resident wild elephant has increased the vulnerability of local people living around the Jalthal forest. Thus, detail study on the habitat assessment and seasonal movement patterns of resident herds in and around Jalthal forest area is required for proper planning and implementing suitable mitigation measures and habitat management activities.

Key words: Crop and property damage, habitat, human casualty human, elephant conflict

INTRODUCTION

Human-Elephant conflict (HEC), the interaction between people and elephant that have a negative effect on human well-being, elephants and the environment pose a challenge for biodiversity conservation (Parker *et al.* 2007). Particularly, the case of conflict between humans and Asian elephants (*Elephas maximus*) is one of the serious issues in South Asia and has resulted in challenges towards achieving effective conservation outcomes (Sitati *et al.* 2003). About 20 per cent of human population lives around the habitats of wild elephants in South Asia (Bandara and Tisdell 2002), and thus HEC has increased due to growing human settlements followed by habitat loss and fragmentation (Sukumar 1993; Pradhan 2007; Fernando *et al.* 2008; Perera 2009).

HEC has had multi-dimensional effects besides fear among local communities. Some of the major effects involve crop damage, property damage, and human injury and casualty (Parker *et al.* 2007), among which, crop loss has been reported as a major issue across elephant range countries (Shrestha *et al.* 2007). Nepal is

not an exception to HEC, where cases of elephant attacks have been reported in the recent years (Neupane *et al.* 2014). The increase in HEC is particularly attributed to the fact that the elephant habitats are gradually encroached by humans affecting their traditional migration routes (Sitati *et al.* 2003). A study by Neupane *et al.* (2017) show that every year about 40 per cent of the total human-wildlife conflict and 70 per cent of wildlife - related human casualties in Nepal have taken place due to elephant attacks. Likewise, another study by Neupane *et al.* (2014) show that despite the relatively lower population of resident wild elephants in Nepal, the average annual human casualties and retaliatory killings are 10 and 2 respectively. Among other areas of Nepal, the eastern lowland of Jhapa district has had higher number of incidents of HEC (Pradhan *et al.* 2011; Ram 2014).

Despite adoption of various mitigation measures, HEC has not been effectively addressed till date in Nepal. The commonly practiced measures have involved relief mechanism for elephant damages by the government, planting alternate crops such as tea, lemon and ginger, building watch towers for crop guarding, digging trenches, installing electric fences, shouting and use of fire (Shrestha *et al.* 2007; Yadav 2007; Neupane *et al.* 2014). The mitigation measures adopted by the local people have been inefficient due to behavior flexibilities of Elephants against the measures (Pradhan *et al.* 2011). Despite the rise in HEC cases in the past few years, effective strategies and guidelines to address the issue are lacking in Nepal. Not much has been done besides the endorsement of the Wildlife Damage Relief Guideline in 2010 so as to control human-wildlife conflict (GoN 2010). Moreover, there is a delay as well as lack of transparency and systematic procedures regarding disbursements of relief amount for the victims (Dhakal and Thapa 2017).

Wild elephants and their habitats are protected by stringent laws inside the protected areas of Nepal (NPWC 1973) but such type of protection measures are not implemented in the habitats outside protected areas. For instance, the forests outside the protected areas have been handed over to the local communities as community forests, thereby, disturbing the original wildlife habitats by management practices. Though studies have reported the cases of elephant attacks in the region, they have mostly focused on the number of incidents, while assessment of proper mitigation measures and their effectiveness is largely overlooked. This paper therefore assesses the HEC and existing mitigation measures at Jalthal Village Development Committee (VDC) of Jhapa district Nepal in addition to analyzing the effectiveness of various mitigation measures in addressing the issue.

Materials and Methods

Study Area

Jalthal VDC is located in Jhapa district in between 26° 31' 0" North, 87° 59' 0" East in lowland Terai of South-Eastern part of Nepal at an altitude between 60 m to 180 m from the sea level (Figure 1). The land use in Jalthal is dominated by agriculture and grassland followed by forest in Jhapa (CBS 2012). Covering 8.55 per cent of the district, Jalthal encompasses 80.34 sq. km out of which forest cover comprises of 78.42 per cent (63 sq. km) of the VDC (Bhattarai 2013). The forest comprises of Sal (*Shorea robusta*) as the dominant tree species with other associates such as *Artocarpus chama, Lagerstroemia*

parviflora, Dillenia pentagyna, Terminalia bellerica, T. chebula, and Sizygium cuminii among others. Similarly, the wild fauna consists of elephant (*Elephas maximus)*, chital (*Axis axis*), python, rabbit, fox (*Vulpes bengalensis*), monkey, malsapro, khirkhira, gohoro, tortoise, snake, (*Manis*) pangolin, peacock and different types of birds. Jalthal forest is inhabitated by about 15 resident wild elephants and till date 22 different forest patches have been handed over to the adjoining local communities as community forests (6 Community Forests within Jalthal VDC).

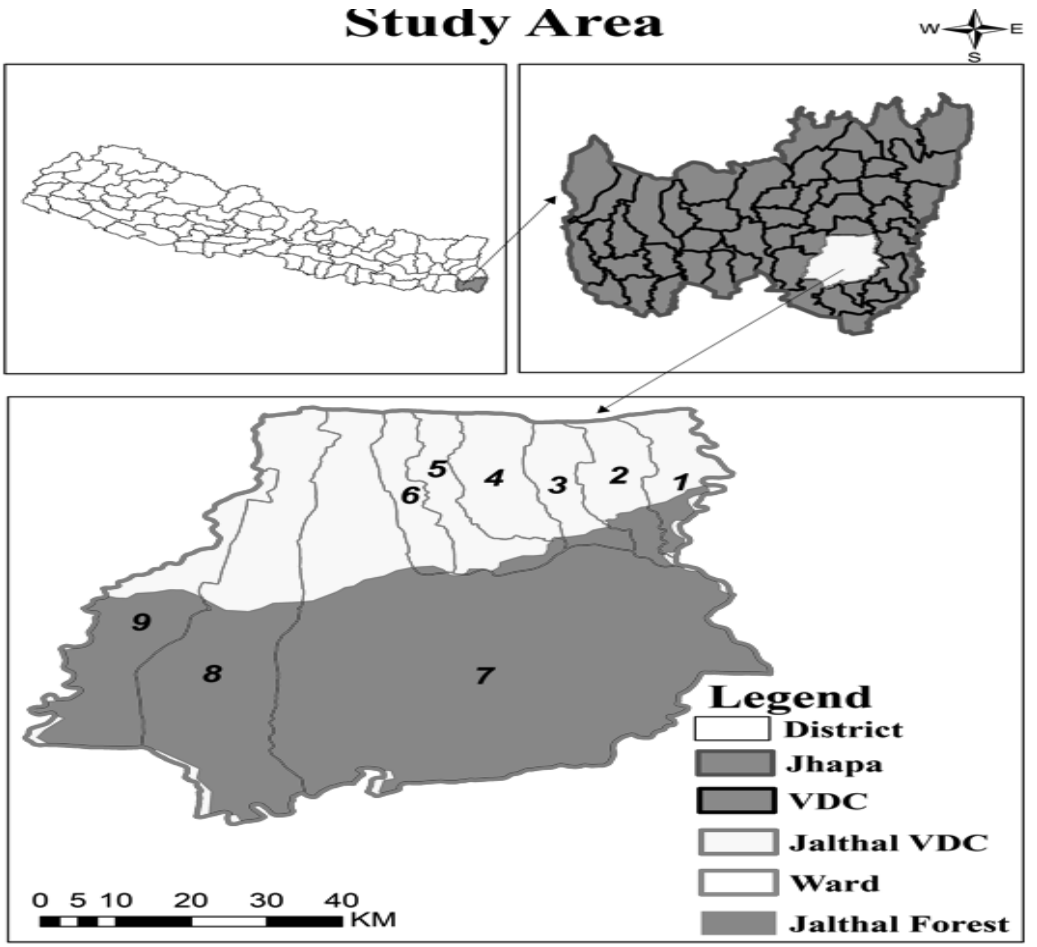

Figure 1: Map of the Study Area

Data Collection

The data for this study was collected during January to March 2017. The study area included all 9 wards of Jalthal VDC (now Haldibari Rural Municipality of Province no. 1 under the new federal system) (Figure 1). The study area was selected following consultations with local stakeholders such as officers and other employee of District Forest Office, Sector Forest Offices (Jhapa) and Chairperson of

community forest user groups (CFUGs). The total population of Jalthal VDC was 13,363 with 2922 households according to the national population census 2011 (CBS 2011). From the official records of the last 5 years, 895 households had filed request for compensation against the damages caused by elephant attack (DFO Jhapa 2016) and altogether 179 households were randomly selected representing affected settlements from each wards for the questionnaire survey (sampling intensity-20%). Similarly, 20 key informant interviews were conducted followed by 5 focus group discussions. Key informants included teachers, Chairperson and executive members of different CFUGs, government employees of the DFO and Sector Forest Offices, farmers and local business people.

The respondents were divided into 4 economic classes based on total land holding sizes of households viz. more than 4 ha, 1 to 4 ha, 0.5 to 1 ha and less than 0.5 ha in 1st, 2nd, 3rd and 4th classes respectively. In addition, the ethnicity of respondents was divided into 3 classes viz. Brahmin/Chhetri, indigenous groups (*Gurung, Magar, Tamang, Newar*) and disadvantaged groups. During the field survey, the knowledge above the HEC, its causes, effectiveness of various mitigation measures and possible solutions to the problem were documented. Similarly, members of the CFUGs, teachers, government officers, local leaders, local farmers and students participated in the focus group discussions where issues pertinent to HEC, its causes, mitigation measures, damages and compensation policies were discussed. In addition, relevant secondary data were collected from official records of DFO, Jhapa.

Data Analysis

The GPS coordinates of the most sighted areas of wild elephants were taken and mapped on Arc GIS. Data regarding the elephant damages, mitigation measures and people's perception were analysed and interpreted in the form of graphs, charts and tables. Besides, the monetary value of both crop and property loss were tested with two different social dimension of HEC (ethnicity and the economic classes of people) through Pearson's Chi-Square test of independence. The significance of test was set at $P \leq 0.05$ (i.e. 5% level of significance).

RESULTS

Hotspot Mapping

Figure 2 shows the map of Jalthal VDC indicating the sites where elephants were mostly sighted by the local people. The results show that elephants were mostly sighted in the areas close to the forest. This was the case in almost all nine wards, where incidents of elephant encroachment outside of the forest was slightly more in wards one and two. This risk of elephant attacks and damages to the property was higher in areas adjacent to the forest compared to those further away.

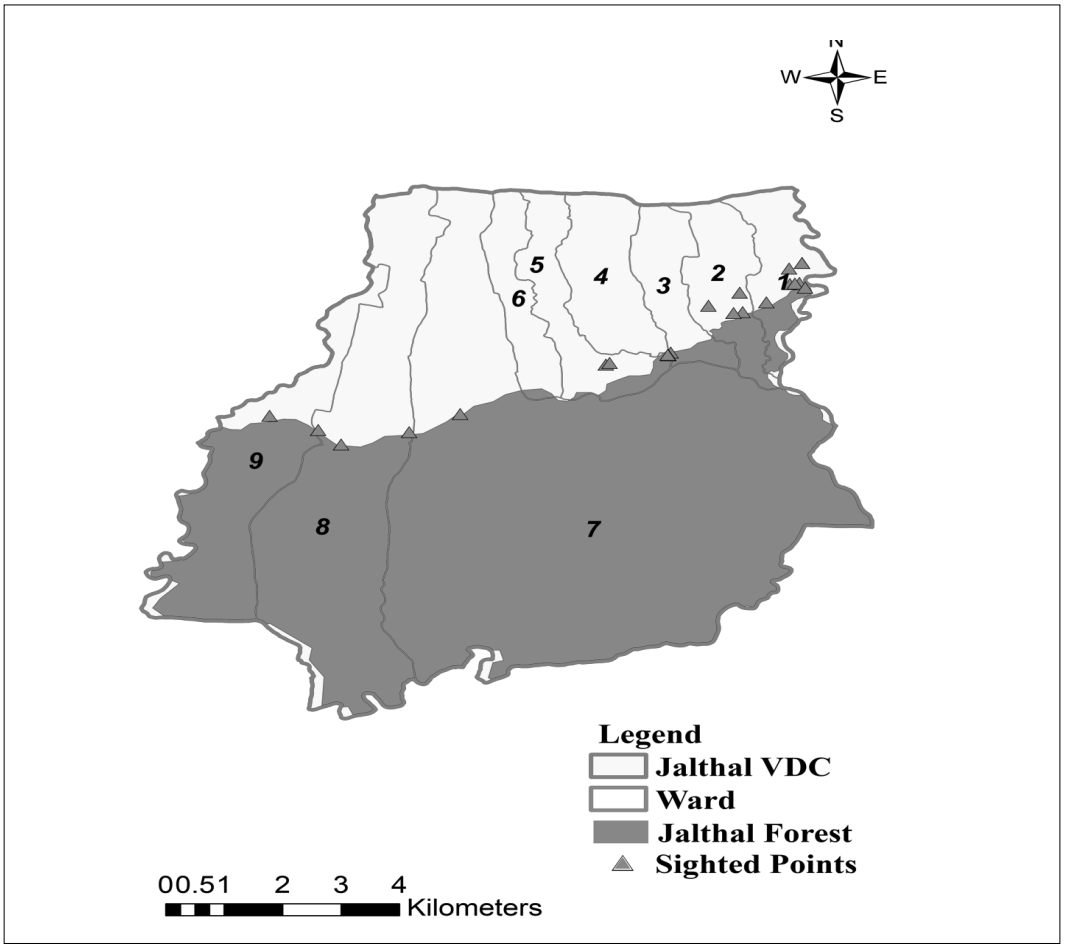

Figure 2: Map of Jalthal VDC Showing Presence of Elephant by Direct Observation

Crop Damage by Wild Elephants

Out of the total respondents, around 42 per cent were affected by various scales of crop damage. The highest crop damage was observed in wards 2 and 5, which was followed by wards 7 and 1. Ward 3 had the least crop damage.

Among the mostly raided crop, paddy stood at the top accounting for 57.6 per cent out of the total crop damage, followed by maize, millet and wheat (Figure 3). Paddy damage was highest during the harvesting season in November/December while maize is harvested during July/August.

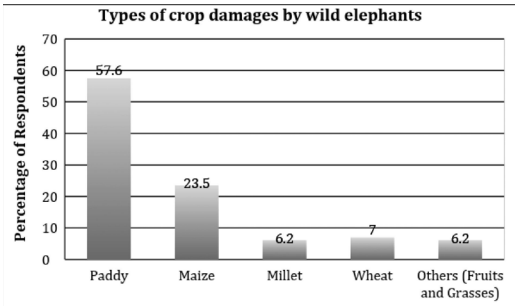

Figure 3: Major Crops Damaged in the Study Area

Out of the total households affected, about 42 per cent reported crop damages from Elephants. People had also experienced crop damages by other wild animals like wild boar, monkey, rabbit and deer. Nevertheless, the damages from these animals were negligible compared to that from elephants and therefore were not recorded for the purpose of this study. Among the total households surveyed, the estimated total monetary value of crop damage amounted to NRs. 27,520 (263.34 USD) in a single year (Table 1), out of which 66 per cent of the total monetary damage was done on paddy crop alone.

Table 1: Monetary Value of Crop Damages in the Study Households Per Year

Crop	Estimated Damage (Kg)	Market price (NRs./Kg)	Total loss (NRs.)	Estimated % of loss
Paddy	722	25	18,050	66
Maize	230	31	7,130	26
Millet	24	60	1,440	5
Wheat	30	30	900	3
Total			27,520	100

Source: Field survey 2017. Note: 1 USD = NRs. 104.50

The chi-square test of independence shows that there were no significant differences among different ethnic groups ($x^2_{6,191}$ = 2.933; p ≥ 0.05) and among different land holding categories of people ($x2_{9,191}$ = 14.774; p ≥ 0.05) on the monetary value of crop losses by the wild elephants. In other words, there was an equal chance of crop damage by elephants for different socio-economic groups of people.

Property Damage

Damage to properties due to elephant attacks was another issue reported at Jalthal VDC. However, in comparison to crop damage, property damage accounted for 25 per cent of the total respondents at Jalthal. Properties damaged by wild elephants included houses, cattle sheds and fences. Among the damages on fences, majority of them were constructed from bamboo or wood. Moreover, in most of the cases, partial damages to houses were made from the attacks. Cattle sheds and/or fences were both completely and partially damaged by the attacks. Besides, damages on water pipes and furniture also existed.

In terms of the monetary value, the total estimated property damage amounted to NRs. 3,71,000 (3550.24 USD) in a single year, out of which 65 per cent of the total monetary damage was done on houses that amounted to NRs. 2,40,000 (2296.65 USD) (Table 2).

Table 2: Monetary Value of Property Damages

Property Type	Estimated Amount (NRs.)	Estimated % of damage
House	2,40,000	65
Cattle Sheds	60,000	16
Fence	50,000	13
Others	21,000	6
Total	3,71,000	100

Source: Field survey, 2017. *Note: 1 USD= NRs. 104.50*

The chi-square test of independence shows that there were no significant differences among different ethnic groups of people $(X^2_{8,191} = 4.440; p \geq 0.05)$ and among different land holding categories of people $(X^2_{12,191} = 7.535; p \geq 0.05)$ in terms of monetary value of property loss by wild elephants. In other words, there was an equal chance of property damages by elephants for different socio-economic groups of people. During the course of this study, there were only two cases of minor injuries due to wild elephant attacks. Nevertheless, the official records at DFO, Jhapa show that there were 32 casualties and 30 serious human injuries as a result of attackd by wild elephants between 2012 and 2017 in other VDCs of the district.

Mitigation Measures Adopted

The people in and around Jalthal VDC adopted various measures to drive away wild elephants. Among the various measures, shouting and use of fire to chase elephants away from the settlements were the most adopted. To avoid elephant attacks, construction of fences around the houses were also carried out. Due to convenience and its effectiveness, shouting and use of fire collectively was the most commonly adopted measure (62 per cent of the respondents) Likewise, only 2 per cent of the respondents constructed electric fences around their homes at their own expense (Figure 4). Besides, use of fire (9%) and shouting (9%) were some of the other measures adopted in Jalthal.

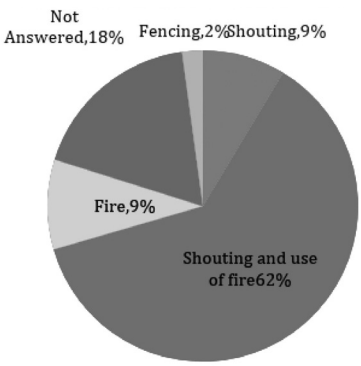

Figure 4: Mitigation Measures Adopted in the Study Area

DISCUSSION

Our study found that the risk of elephant damage was more on the settlements located nearby the Jalthal forest compared to areas further than the forest. Similar findings were recorded in study by Pant *et al.* (2016) which showed that the incidents of elephant damages decreased proportionately with increase in distance from the park boundary in buffer zones of Chitwan National Park and Parsa National P ark. In terms of HEC incidents, crop damage including paddy was more

frequently recorded in Jalthal area. Another study by Shrestha *et al.* (2007) confirms similar findings in the lowlands showing crop raiding by elephants as the major issue. Similarly, Yadav (2007) also reported HEC as the most common cause of crop damage in eastern Nepal. This follows the pattern of previous studies conducted in other countries. Crop damage was the most common type of HEC incident in Sri Lanka (Campos-Arceiz *et al.* 2009) and the type of HEC incidents followed similar patterns in India (Sukumar 1990), China (Zhang and Ning 2003) and Africa (Hoare 2000; Parker *et al.* 2007).

Among the different crops, paddy was found to be the most damaged crop and occurred often during the harvesting season. Crop raiding is part of elephant's optimal foraging strategy and raiding peaks during specific times of year when paddy becomes more palatable and nutritious as it approaches harvesting (Sukumar 1990). In contrast, property damage and human casualties/injuries were less predictable and tend to take place any time in the year. However, the patterns of different incidents of HEC depend on several factors including individual behavior of the elephants (Parker *et al.* 2007). Storage of grains in houses is a common practice in the rural settings of Nepal and coincidentally, elephant raids in most of the cases happens when rice is stored immediately after harvesting in November/December. Property damage was not found to be common in this study primarily due to the fact that the surveyed houses did not practice storage of grains in their houses. The overall situation concludes that the damage to properties by elephant attacks can be attributed to several factors including the harvesting season, storage of grains in houses, and choice of crop.

The mitigation measures commonly practiced in the lowlands of Nepal involve use of fire or fire crackers, shouting and beating of drums (Neupane *et al.* 2017). While most of the measures adopted are cost effective and easily available, there are cases where the use of electric fences have been more effective compared to other indigenous techniques to chase elephants away. For instance, in Bahundangi VDC of Jhapa, about 17 km solar-powered fence was installed and this has proven to be highly effective in addressing HEC (Portel 2016). Nevertheless, due to the cost associated with the installation of wires including construction of watch towers, shouting and use of fire have been the most preferred choice by the communities.

The prediction of HEC through analysis of trends in the spatial pattern of elephant movement is difficult (Sitati *et al.* 2003). Nevertheless, in most of the cases, the frequency of HEC is high in areas close or in proximity to the protected areas (DiFonzo 2007). The case of Jalthal is in conformity to the previous findings where the risk of HEC is higher in areas proximate to the forests. However, categorization of forest regimes and the level of risk from HEC was out of the scope of this study. The findings suggests that the prioritization of the mitigation measures in the affected settlements located nearby forest areas should be carried out regardless of the type and management regime of forest.

CONCLUSION

This paper analysed the various damages caused as a result of HEC and measures to minimize at Jalthal VDC of Jhapa district. The findings show that the settlements in proximity to forest areas are vulnerable to elephants attacks. Although there were no human casualties in Jalthal VDC, crop damage (mainly paddy and maize) was one of the major problems faced by the local people followed by property damage (mainly damage to houses). However, there were no significant differences in monetary value of crop and property damages among different socio-economic categories of people. Though various indigenous techniques like shouting and use of fire was used to drive away elephants, they have not proven to be effective in many cases. Rather, use of electric fences and construction of watch towers were used in other locations, which were rather effective in minimizing elephant attacks.

This demands for further research on elephant habitat and impact of different land use in minimizing HEC. This would provide an opportunity to determine if there are seasonal pattern of elephants' movement, if their movement is influenced by availability of water, and if movement is related to the distribution of types of forest vegetation and floral species. Such information would also enable researchers to evaluate how the elephant population is affected by the availability of forage and water resources. Moreover, this would support the concerned authorities to develop appropriate strategies in the affected areas in order to mitigate HEC. Finally, awareness and capacity building activities on adopting adaptive measures to tackle HEC needs to be targeted to the population living in proximity to forests.

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