MAJOR CEREAL CROPS DAMAGE BY WILDLIFE: A CASE STUDY FROM CHITWAN NATIONAL PARK, NEPAL

Sunita Ghimire[1*], Durga Devkota[1], Shiva Chandra Dhakal[1], Bishnu Raj Upreti[2]

ABSTRACT

Human-wildlife conflict is a major issue for policymakers and conservationists due to economic damage by wild animals, resulting in increasing poverty. This study assesses the wildlife-induced damage to the major food crops viz. rice, wheat, and maize. A total of 434 households from the 10 forest user groups near the Chitwan national parks and buffer zone were randomly selected and interviewed by the use of questionnaires in 2021. A total of 87.86% of rice-growing households reported damage to rice, whereas 90.32% and 87.68% of households reported damage to wheat and maize, respectively. The annual loss of 78 kg of rice per household (NRs. 1776 at prevailing market rates) was reported in the study area. The loss of wheat and maize per household was 86 and 96 kg with the worth of NRs. 2523 and 2019, respectively. The severity of wildlife-induced damage to crops was more near the borders of national parks and buffer zone. Apart from the construction and maintaining permanent fences on the border of the national parks, there should be the provision of conservation education to communities residing along the buffer zone and near the protected areas to practice sustainable agriculture and income-generating programs that are conservation-friendly.

Keywords: Chitwan national park, Crop damage, Human-wildlife conflict,

INTRODUCTION

A protected area is defined as the geographical space that is recognized, dedicated, and managed through the legal and other effective means to achieve the long-term conservation of nature with associated ecosystem services and cultural values (IUCN, 2008). Protected areas include national parks, wilderness areas, community conserved areas, and nature reserves, and these are the mainstay of biodiversity conservation, while also contributing to people's livelihoods, particularly at the local level (https://www.iucn.org/). Besides conserving nature, protected areas provide food, clean water supply, and medicines, and mitigate natural disasters (Lopoukhine et al., 2012). Protected areas often occur in areas of high human population density (Kideghesho, Nyahongo, Hassan, Tarimo, & Mbije, 2006; Msoffe et al., 2007). Wildlife and people around have co-existed for many years, usually with a certain level of conflict (Woodrofee, Thirgood, & Rabinowitz, 2005; Dickman, Macdonald, & Macdonald, 2011). In recent years, the conflict has increased, particularly in developing countries, mainly due to increasing human and livestock populations and changing socio-economic and land use patterns (Gemeda & Meles, 2018). Human-wildlife conflict occurs when the wildlife's requirements

[1] Agriculture and Forestry University, Rampur, Chitwan

[2] Policy Research Institute (Neeti Anusandhan Pratisthan), Kathmandu, Nepal

Corresponding email:ghimiresunita2001@gmail.com

overlap with those of human populations. Direct contact with wildlife occurs in both urban and rural areas, but it is generally more common inside and around protected areas, where wildlife population density is higher and animals often stray into adjacent cultivated fields or grazing areas. Communities bordering protected areas may suffer the loss of economic opportunities, including exclusion from potential resources as well as damage and depredation to crops and livestock by wild animals (Holmern, Nyahongo, & Roskaft, 2007).

The buffer zone concept was developed by United Nations Organization for Education, Science and Culture (UNESCO) to provide an additional layer of protection around protected areas as well as to balance the development needs of the local people and conservation objectives of protected areas (Bajracharya, 2009). The creation of buffer areas encourages both sustainable uses of forest resources from the protected areas and public participation in protected areas management through decentralization of natural resource use along with financial and technical support to the user groups (Wells & Brandon, 1993). This opportunity to meet the dual goals of conservation of protected areas and livelihood improvement (Parker & Thapa, 2012). In Nepal, the buffer zone concept has been adopted as a national strategy to address the issues between national parks and adjacent communities to ensure an optimal balance between the long-term conservation objectives and the immediate needs of residents (DNPWC, 1996). The major goal of the buffer zone program is to involve local communities in nature and wildlife conservation so as for improving the management of the natural resources, and ecological conditions in the buffer zones. The buffer zone areas serve to increase access to natural resources (e.g., non-timber forest products) to be sustainably harvested by the communities that reside within it, thereby reducing the pressure on the core protected areas. Legislation has provided for benefits sharing mechanisms for the implementation of conservation and community development programs related to institutional development, alternative natural resource development, capacity building, financial management, conservation education, and awareness, and gender and special target group mainstreaming (MoEF, 2018).

Chitwan National Park (CNP) is also home to many globally significant, rare, and endangered wild animals such as the Greater One-horned Rhinoceros, Asian elephants, Bengal Tiger (*Panthera tigris tigris*), and Gharial (*Gavialis gangeticus*). CNP is one of the most threatened national parks in Nepal (The Himalayan Times, 2021). The CNP buffer zone program started in 1996 with an area of 75,000 hectares (ha) spread out to three districts. It is essentially an impact zone intended to reduce the pressure of local people on the Park and vice versa (DNPWC, 2012b). The buffer zone area has increasing population density and similar projections in the future also; resulting in the human-wildlife conflict. Dense human populations in close vicinity to nature reserves seem to pose the greatest challenges in many countries (Western, 1989). The people-park conflict had also been an ongoing issue due to the wildlife impacts in adjacent communities. Also, local community members had continued to ignore regulations and were engaged in extractive behaviors as well as grazing their cattle inside the park (Nepal & Weber, 1995; Sharma, 1991). Competition between rural communities and wild animals over natural resources is more intense in developing countries, where local human populations tend to suffer higher costs. Considering the current human population growth rate, increasing demand for resources, and the growing demand for access to land, it is clear that human-wildlife conflicts will still be a challenge soon.

Human-wildlife conflict (WHC) has both direct and indirect costs for human beings. Destruction and loss of food crops, livestock depredation, and human harassment are direct costs of human-wildlife conflict. Wildlife is often seen by the local people as belonging to the government; as they alone seem to be responsible for its care (Mekonen, 2020). Wildlife agencies emphasize law enforcement, administrative procedure, and conservation education but cannot contain or fully control wildlife damage and destruction. Conflicts become more intense where livestock holdings and agriculture are an important part of rural livelihoods. Human activities such as expansions of settlements, cultivation, overgrazing, bushfire, and deforestation reduce wildlife habitats thus forcing wild animals such as elephants to enter the croplands causing trampling and destruction of crops in the farm (Galanti, Preatoni, Martinoti, Wauters, & Tosi, 2006; Roskaft, Larsen, Mojaphoko, Sarker, & Jackson, 2013). To control human-wildlife conflict the first approach should be to understand the negative impacts of wild animals on humans (Mekonen, 2020). This study aimed to document these negative impacts in terms of crop destructions in the periphery of Chitwan National Park. Understanding the negative impacts of wildlife on humans should assist the concerned wildlife departments and different stakeholders in proposing short-term and long-term management strategies for sustainable management of the ever prevailing wildlife-human population conflict.

METHODOLOGY

SITE SELECTION

The study was carried out in the buffer zones of Chitwan National Park in Southern-central Nepal (Figure 1). The buffer zone of the Chitwan National Park extends over Chitwan, Nawalparasi, Parsa, and Makawanpur districts and covers 750 km^2. A total of 223,260 people reside there in 36,193 households (DNPWC, 2012a). The human population in this buffer zone comprises 260,352 people, in 45,616 households (CNPO, 2012). The buffer zone is a legally delineated area surrounding national parks or reserves to provide forest resources to local people. It is essentially an impact zone intended to reduce the pressure of local people on the Park and vice versa (DNPWC, 2012b). The map of Nepal showing the study area is given in Figure 1.

Figure 1: Locations of the buffer zones (study area) of Chitwan National Park, Nepal.

SAMPLING TECHNIQUE AND SAMPLE SIZE

To achieve the objectives of the study, the target population comprised the households living adjacent to the national park. The study population covered a total of 45,616 households adjacent to the Park (buffer zone area). The sample size was determined by using the following formula given by Kothari (2004) at a 95% confidence level. Sample size (n):

$$\text{Sample size (n)} = \frac{N \cdot Z^2 \cdot p \cdot q}{e^2 \cdot (N-1) + Z^2 \cdot p \cdot q}$$

Where, N = population size (household number in buffer zone = 45,616)

z = standard variate at a 95% confidence level (1.96)

e = error limit of 5% (0.05)

p = sample proportion (value of 0.5 in which case 'n' was the maximum and the sample yield at least the desired precision)

q = 1 – p (0.5)

$$n = \frac{45{,}616 \; x \; (1.96)^2 \; x \; 0.5 \; x \; 0.5}{0.05^2 \; x \; (45{,}616-1) + (1.96)^2 \; x \; 0.5 \; x \; 0.5} = 381$$

The average response rate is 85% (Ary et al., 1996; Gall et al., 1996; Tuckman, 1999). Thus, an assumption was made that 15% of the respondent would not be able to complete the survey, so the addition of a 15% resulted in 434 sample size. From the secondary source, the total number of conflicts recorded in the different forest users' groups in the last four years, the top ten forest user groups were selected. Based on the total number of conflicts that occurred in the last four years the number of samples in each forest user group was estimated and shown in Table 1. In each forest user group, the communities near the national parks were purposively selected and simple random sampling was administered in that area.

Table 1: Top ten committees based on the number of human-wildlife conflicts (HWC) encounters in the last four years and the number of samples from respective forest user groups

S.N.	Forest user groups	No of conflict	Address	Number of samples	Sector
1	Ayodhyapuri	330	Ayodhyapuri-1*, 6, 7, 8, Madi 7, 8, 9, 10*, 11, 12	155	Madi
2	Rewa	101	Madi-6, 7*, 8, 9; Kalyanpur 3, 4, 5, 7, 8, 9*	50	Madi
3	Panchpandab	78	Gardi 1*, 2, 4, 7 Madi 1*	40	Madi
4	Mriga Kunja	70	Ratnanagar-5*, 6, 7*, 8, 9, 17, 18, Bachhyauli-2	34	Sauraha
5	Barandabhar	64	Gitanagar 4, 6, Bharatpur 6, 8*,13, 20, 21*	32	Kasara
6	Nirmal Thori	59	Nirmal Basti 1, 2*, 3, 7, Thori 8	30	Madi
7	Meghauli	46	Narayani 1, 2, 3, Bharatpur 27, 28	25	Kasara
8	Baghauda	34	Bagauda 2, 4 Madi 3, 5	18	Madi
9	Kerunga	32	Bharatpur 23, 24, Jagatpur 1, 9, Narayani 10, 11	15	Kasara
10	Lamichaur	27	Pithauli 4, Kawasoti 11, 13	35	Amaltari
	Total			434	

* Highly conflict-affected ward

METHOD OF DATA COLLECTION

Based on records from the Parks, and in consultation with the Park staff, first, identified the affected settlements (affected by the damage from wild animals within the previous 5 years), and face-to-face interviews were conducted with the head of the households (as possible) with the help of a semi-structured questionnaire. The questionnaires were first designed and pretested to 20 households of Bharatpur Metropolitan – 8, Gaurigunj Chitwan and necessary moderation was done. Data were collected regarding the nature and extent of the damage.

METHODS OF DATA ANALYSIS

To curb these illegal activities more effectively and efficiently, the CNP is divided into four sectors and the area of responsibility assigned, i.e., Sauraha, Kasara, Madi, and Amaltari. Based on this forest users' groups were grouped into four sectors (Table 1). After the collection of primary data, it was coded and entered in Microsoft Excel, and analysis was done by using the Statistical Packages for Social Sciences (SPSS). Mean, frequency and percentage were computed using descriptive statistics.

RESULTS AND DISCUSSION

The data on the loss due to wildlife on humans and properties being collected came from the victims through the CNP authorities and the buffer zone user committee (BZUC) covering the period from the year 1998 to 2018. The people started to report the loss of wildlife (primarily attacks on human and livestock depredation) to the BZUCs following the relief scheme for wildlife victims that started in 1999 along with the implementation of the Buffer Zone Program (GoN, 1996; CNP, 2015). The wildlife victims in the BZ self-reported the incidents through written applications to the local authorities (CNP or BZUC) primarily to claim compensation (only partial cost). The conflict incidents were verified by the BZUC and subsequently, relief was released as per the guidelines. These data on relief application and distribution were maintained in the registers by BZUCs between 1998 and 2009. The government endorsed the relief guideline for wildlife losses in 2009 and designated respective protected areas or district forest offices for relief distribution (Acharya, Poudel, Neupane, & Kohl, 2016). Thus, CNP started to process and verify the relief applications from 2009 onwards. We compiled all the relief applications of wildlife victims reported to both BZUCs and CNP during the last 20 years (1998 to 2018). The data were managed according to the Nepalese fiscal year which runs from mid-July to mid-July based on the Nepalese Calendar (Bikram Sambat). For the consistency of the data for time series analysis, we used these fiscal years. The trend of the total number of damage was found to be slightly increasing over time (Figure 2).

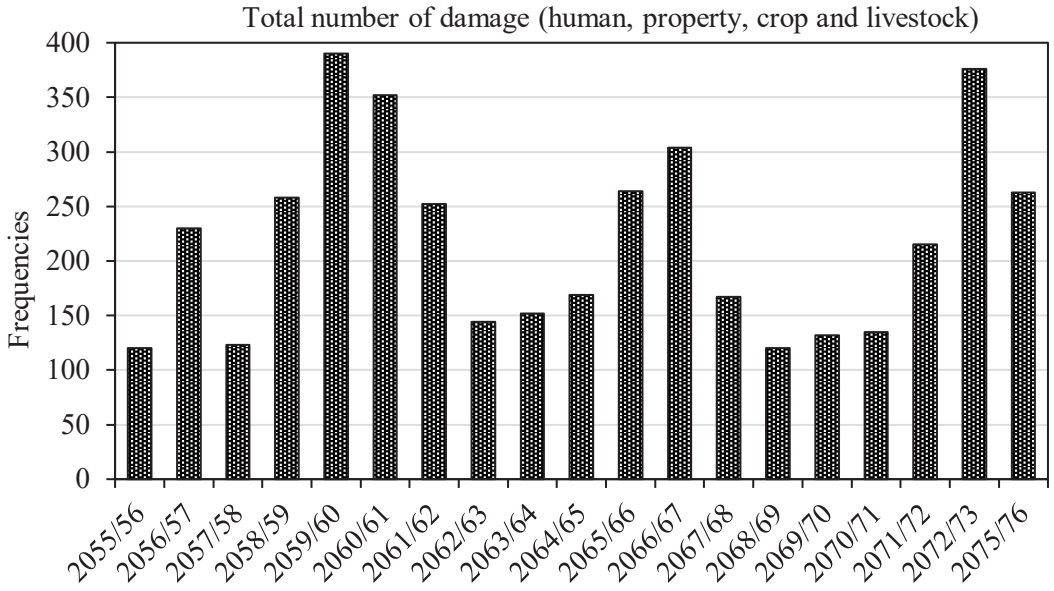

Figure 2: Frequency of total damage due to wild-life conflict around Chitwan National Park

The pattern of HWC in the BZUCs of the CNP revealed that livestock predation is the most common type of harm caused by wild animals in the study area followed by crop damage and human injured (Figure 3). Rhino, Wild boars and elephants were the most conflicting animal from the perspective of crop damage (Figure 4), which is similar to the finding of Sukumar (1994). The damage by wild boar is probably the most widespread because of its availability in almost all forested habitats including highly degraded and fragmented ones (Subedi, Joshi, Poudel, & Lamichhane, 2020). Dangol, Ghimire, & Bhattarai (2020) reported that elephants raid cropland because natural food in the forest is demanding as a result of increasing human encroachment and settlement near the forest. Most parts of the Terai of Nepal were uninhabited by humans until the 1950s due to malaria; but after the eradication of malaria and government resettlement programs in the 1950s, there was a rapid human footprint (Pradhan et al., 2011). Hence, encroachment of elephant habitat by humans resulting in increased croplands with palatable food near forest areas is one of the precursors of increased crop raiding. According to Shrestha (2007), Pradhan et al. (2011), and Neupane et al. (2013), the rate of human-wildlife conflict incidents in Nepal is increasing. Human-elephant conflict incidents in Asian countries such as Sri Lanka, Myanmar, and China is increasing both in extent and intensity (Perera, 2009; Fernando et al., 2011; Zhang, 2011; Das & Mrinmay, 2020; Prakash et al., 2020). Elephants are becoming more habituated to conflict as a result, they frequently raid crops and show more aggressive behavior (Fernando et al., 2011; Das & Mrinmay 2020). As identified by Nepal and Weber (1995) crop damage and threats to human and animal life by wildlife from the park are two of the five major causes of park-people conflict in Chitwan National Park. These animals are regarded as a destructive raiders and prefer crops such as maize, rice, wheat, mustard, and vegetables resulting in substantial losses to the local farmers. Rhino, wild boar, elephant, and deer are the main crop raiders in the study area. Crop damages by the rhinos are a major source of conflict between farmers and wildlife in communities that surround Chitwan National Park (Bailey, 2011).

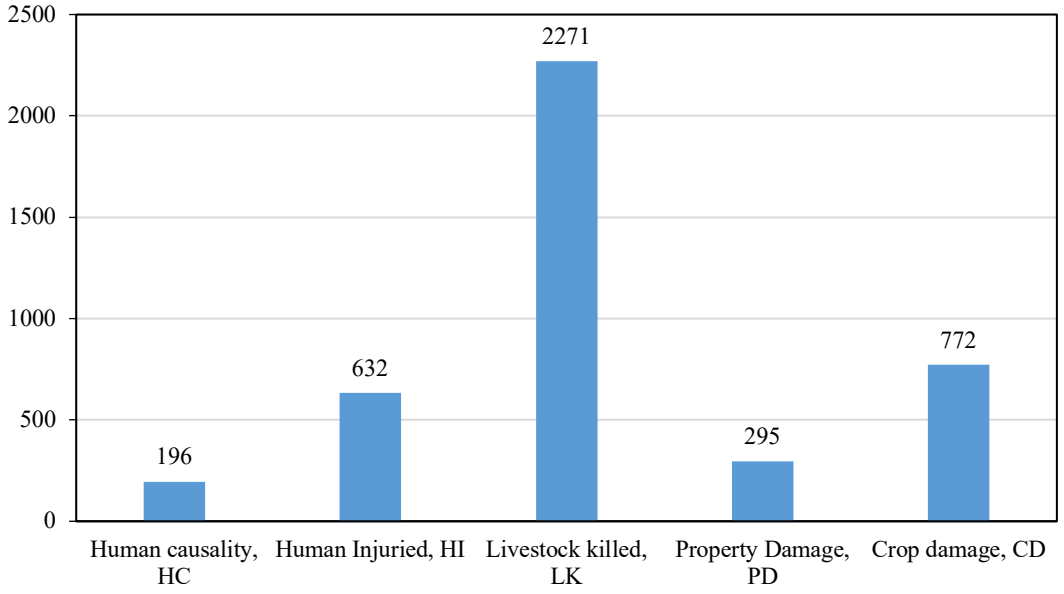

Figure 3: Total frequency of different types of wild-life conflict in the last 20 years around Chitwan National Park

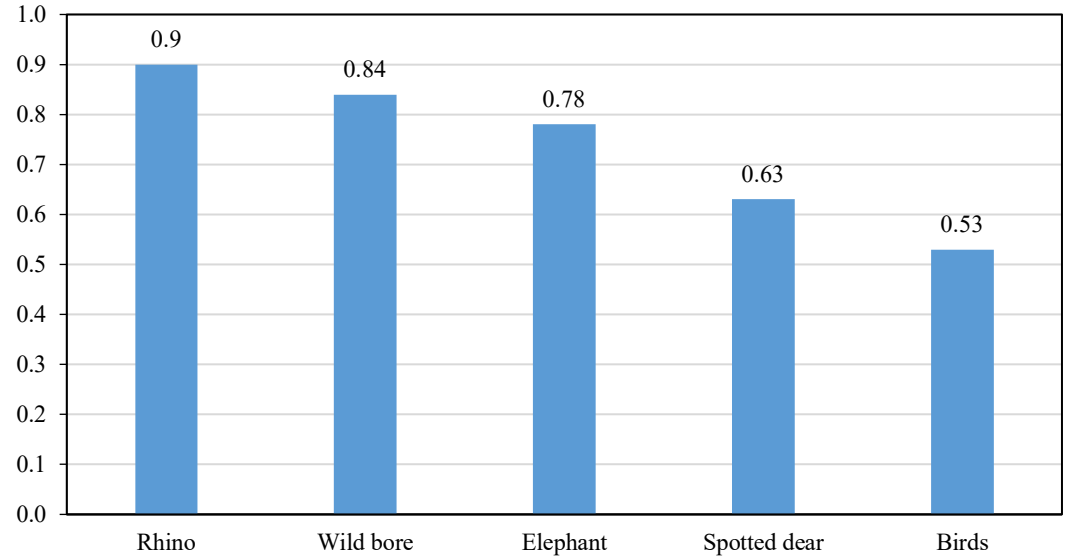

Figure 4: Ranking of wildlife for crop damage

CROP DAMAGE

A total of 369 households reported that the rice crop was damaged by the wildlife (excluding the birds) in a significant amount, whereas 90.32% of wheat growers and 87.68% of maize growers reported the damage during the household survey (Table 2, 3, and 4). All the respondents (100%) from Amaltari reported the rice crop damage by the wildlife, whereas 83.16% from the Madi sector reported the rice damage (Table 2). More than 95% of surveyed households reported their rice crop being damaged. Out of 13.12 kattha rice cultivation, 3.21 kattha was damaged by the wildlife with an average proportion of damage of 25.74%. The damage proportion of rice was the highest (38.72%) in the Sauraha sector and the least in the Madi sector (22.09%). The low proportion of damage from the Madi sector was due to the large area of field crops allocated for cultivation. The Rhino is often regarded as the most destructive raider (Uprety, 1995) and prefers crops such as maize, rice, vegetables, and mustard resulting in substantial losses to the local farmers (Studsrod & Wegge, 1995).

Table 2: Rice damage by wildlife among the sample households (n=434)

Sectors	HH report damage		Average area (kattha/HH)		Average production		Proportion of damage (%)	Damage amount	
	F	P	Overall	Damage	kg/kattha	kg/HH		Volume (kg/HH)	Value (NRs./HH)$
Amaltari (n=35)#	35	100	9.50	3.66	120	1142	33.99	172	3,958
Kasara (n=68)	65	95.59	10.43	2.66	124	1298	28.22	101	2,517
Madi (n=285)	237	83.16	14.65	3.17	77	1135	22.09	57	1,253
Sauraha (n=33)	32	96.97	9.24	4.16	113	1045	38.72	221	5,736
Total (421)	369	87.65	13.12	3.21	88	1155	25.74	78	1,776

Note: HH, household; F., frequency; P., percentage; # household report rice cultivation; 1 kattha = 0.033 hectares; $ Rice price depends on the area, on an average 1 kg rice priced NRs. 23 at Amaltari, 25 at Kasara, 22 at Madi and 26 at Sauraha

The data presented in Table 3 shows that all the respondents (100%) from the Sauraha area reported the wheat crop damage by the wildlife, whereas 80.00% from the Kasara sector reported the wheat damage. None of the respondents cultivated the wheat crop in the Amaltari sector. More than 90% of surveyed households reported their wheat crop damage. Out of 8.31 kattha rice cultivation, 3.14 kattha was damaged by the wildlife with an average proportion of damage of 41.27%. The highest area (3.25 kattha/HH) of the maize crop was from the Kasara sector. The damage proportion of wheat was the highest (50.00%) in the Sauraha sector and the least in the Kasara sector (32.28%). On average 86 kg wheat/HH in terms of grains was damaged by the wildlife with a worth of NRs. 2583 per household. At the prevailing market price, the highest damage (NRs. 2597/HH) of wheat was reported from the Madi and the least damage (NRs. 2030/HH) was from the Sauraha sector.

Table 3: Wheat crop damage by wildlife among the sample households (n=434)

Sectors	HH report damage		Average area (kattha/HH)		Average production		Proportion of damage (%)	Damage amount	
	F	P	Overall	Damage	kg/ kattha	kg/HH		Volume (kg/HH)	Value (NRs./HH)$
Amaltari (n=0)#	-	-	-	-	-	-	-	-	-
Kasara (n=5)	4	80.00	12.80	3.25	64	820	32.28	73	2,196
Madi (n=86)	78	90.70	8.17	3.17	55	451	41.50	87	2,597
Sauraha (n=2)	2	100.00	3.00	1.50	68	203	50.00	68	2,030
Total (93)	84	90.32	8.31	3.14	56	466	41.27	86	2,583

Note: HH, household; F., frequency; P., percentage; # household report wheat cultivation; $ On an average 1 kg rice priced NRs. 30

More than 90% of respondents from Sauraha, Kasara, and Amaltari reported the maize crop damage by the wildlife whereas comparatively lower (92.86%) from the Madi sector reported the maize damage (Table 4). Out of 8.94 kattha maize cultivation, 3.94 kattha was damaged by the wildlife with an average proportion of damage of 40.45%. The damage proportion of rice was the highest (52.72%) in the Kasara sector and the least in the Madi sector (38.12%). On average 96 kg maize/HH in terms of grains was damaged by the wildlife with a worth of NRs. 2019 per household. At the prevailing market price, the highest damage to maize was recorded from the Kasara (NRs. 4266/HH) and the least on the Sauraha (NRs. 1555/HH).

Table 4: Maize crop damage by wildlife among the sample households (n=434)

Sectors	HH report damage		Average area (kattha/HH)		Average production		Proportion of damage (%)	Damage amount	
	F	P	Overall	Damage	kg/ kattha	kg/HH		Volume (kg/HH)	Value (NRs./HH)$
Amaltari (n=28)#	26	92.86	7.64	3.33	81	616	29.60	91	2,004
Kasara (n=57)	53	92.98	8.51	4.73	53	448	52.72	185	4,266
Madi (n=169)	141	83.43	9.71	3.97	44	429	38.12	79	1,585
Sauraha (n=30)	29	96.67	6.62	2.87	50	332	39.05	68	1,555
Total (284)	249	87.68	8.94	3.94	49	441	40.45	96	2,019

Note: HH, household; F., frequency; P., percentage; # household report maize cultivation; $ Maize price depends on the area, on an average 1 kg rice priced NRs. 22 at Amaltari, 23 at Kasara, 20 at Madi and 23 at Sauraha.

CONCLUSION

There were negative interactions between the wildlife and local communities; there was increased crop damage and the wildlife induced-damage. The major problematic animals in the study area are rhinos, wild boars, elephants, spotted deer, and birds. Almost all (87.65-90.32%) people are suffering from crop and livestock as well as poultry loss damage. The average loss from crop damage was 78 kg rice/HH (worth of NRs. 1776), 86 kg wheat/HH (NRs. 2583/HH), and 96 kg maize/HH (NRs. 2019/HH). Thus, there should be the provision of conservation extension educational activities to communities adjoining protected areas to practice sustainable agriculture and income-generating programs that are conservation-friendly.

REFERENCES

Acharya, K.P., Paudel, P.K., Neupane, P.R., & Kohl M. (2016). Human-wildlife conflicts in Nepal: patterns of human fatalities and injuries caused by large mammals. *PLoS One, 11*: e0161717

Ary, D., Jacobs, L.C., & Razavieh, A. (1996). *Introduction to Research in Education*. Harcourt Brace College Publishers, Fort Worth.

Bailey, R. (2011). *A study of relationship between crop damages inflicted by the one-horned Rhinoceros and the defensive responses to these damages by the farmers in Chitwan National Park, Nepal.* Doctoral dissertation, Simon Fraser University, Canada.

Bajracharya, L. (2009). Biodiversity Conservation in buffer zone – problems and opportunities: conservation practices, buffer zone vegetation and livelihood needs in Pithauli VDC, Chitwan national park, Nepal. (Unpublished) Masters degree dissertation. Tribhuvan University. Kathmandu, Nepal.

CNP. (2015). *Loss from wildlife and relief distribution details FY 1998/99 to 2014/2015.* Kasara: Chitwan National Park Office.

CNPO. (2012). Chitwan national park and its' buffer zone Management Plan (2013-2017). Department of National Parks and Wildlife Conservation, Chitwan National Park Office, Ministry of Forests and Soil Conservation

Dangol, D. Ghimire, A., & Bhattarai, S. B. (2020). Human-elephant conflict in the buffer zone of Chitwan national park, Nepal. *Nepalese Journal of Zoology, 4*(1) https://doi.org/10.3126/njz.v4i1.30671

Das, C. N. & Mrinmay, M. (2020). Human-elephant conflict in Panchet Forest Division, Bankura, West Bengal. *Gajah, 51*:10-15.

Dickman, A.J., Macdonald, E.A., & Macdonald, D.W. (2011) A review of financial instruments to pay for predator conservation and encourage human-carnivore coexistence. *Proc Natl Acad Sci,108*: 13937–13944

DNPWC. (1996). *Buffer zone management rules*. Department of National Parks and Wildlife Conservation, Kathmandu: Department of National Parks and Wildlife Conservation, Nepal.

DNPWC. (2012a). *Chitwan national park and buffer zone management plan 2012–2016.* Department of National Parks and Wildlife Conservation (DNPWC), Kathmandu, Nepal.

DNPWC. (2012b). Parsa wildlife reserve and buffer zone management plan 2012–2016. Department of National Parks and Wildlife Conservation (DNPWC), Kathmandu, Nepal.

Fernando, P., Jayewardene, J., Prasad, T., Hendavitharana, W., & Pastorini, J. (2011). Current status of Asian elephants in Sri Lanka. *Gajah, 35*:93-103.

Galanti, V., Preatoni, D., Martinoti, A., Wauters, L. A., & Tosi, G. (2006). Space and habitat use of the African elephant in the Tarangire-Manyara ecosystem, Tanzania: Implications for conservation. *Mammalian Biology, 71*(2): 99-114. http://dx.doi.org/10.1016/j.mambio.2005.10.001

Gall, M. D., Borg, W. R., & Gall, J. P. (1996*). Education research: an introduction*. New York: Longman Publishers.

Gemeda, D.O., & Meles, S. K. (2018). Impacts of human-wildlife conflict in developing countries. *J. Appl. Sci. Environ. Manage., 22* (8) 1233–1238. https://dx.doi.org/10.4314/jasem.v22i8.14

GoN. (1996). *Buffer Zone Management Rules 2052 (1996).* Kathmandu: Government of Nepal

Holmern, T., Nyahongo, J., & Roskaft, E. (2007). Livestock loss caused by predators outside the Serengeti National Park, Tanzania. *Biological Conservation, 135*(4), 518-526. http://dx.doi.org/10.1016/j.biocon.2006. 10.049

Kideghesho, J. R., Nyahongo, J. W., Hassan, S. N., Tarimo, T. C., & Mbije, N. E. (2006). Factors and Ecological Impacts of Wildlife Habitat Destruction in the Serengeti Ecosystem in Northern Tanzania. *AJEAM-RAGEE, 11*: 917-932.

Kothari, C.R. (**2004**). *Research methodology: methods and techniques*. 2nd Edition, New Age International Publishers, New Delhi

Lopoukhine, N., N. Crawhall, N. Dudley, P. Figgis, C. Karibuhoye, D. Laffoley, J. Miranda Londoño, K. MacKinnon & T. Sandwith. (2012). Protected areas: providing natural solutions to 21st Century challenges. *S.A.P.I.EN.S*, 5.2. http://journals.openedition.org/sapiens/1254

Mekonen, S. (2020). Coexistence between human and wildlife: the nature, causes and mitigations of human wildlife conflict around Bale mountain national park, Southeast, Ethiopia. *BMC Ecology,* 20

MoFE. (2018). *Nepal's sixth national report to the convention on biological diversity*. Ministry of Forestry and Environment, Singh Durbar, Kathmandu, Nepal. 6th NR_Bio_Diver_1576649610.pdf (mofe.gov.np)

Msoffe, F., Mturi, F. A., Galanti, V., Tosi, W., Wauters, L. A., & Tosi, G. (2007). Comparing data of different survey methods for sustainable wildlife management in hunting areas: the case of Tarangire-Manyara ecosystem, northern Tanzania. *European Journal of Wildlife Research, 53*(2): 112-124. http://dx.doi.org/10.1007/s10344-006-0078-7

Nepal, S. & Weber, K. (1995). The quandary of local people: Park relations in Nepal's Royal Chitwan National Park. *Environmental Management, 19*(6), 853–866

Neupane, D., Johnson, R. L., & Risch, T. S. (2013). *Temporal and spatial patterns of human elephant conflict in Nepal. 2013 International elephant and rhino conservation and research symposium proceedings*, 26-30 August 2013, Pittsburgh Zoo and PPG Aquarium.

Parker, P. & Thapa, B. (2012). Natural resource dependency and decentralized conservation within Kanchenjunga Conservation Area Project, Nepal. *Environmental Management, 49*(2), 435–444.

Perera, B. 2009. The human-elephant conflict: A review of current status and mitigation methods. *Gajah, 30*:41-52

Pradhan, N. M., Williams, A. C., & Dhakal, M. (2011). Current status of Asian elephants in Nepal. *Gajah, 35*:87-92

Prakash, T. S. L., Wijeratne, A., & Fernando, P. (2020). Human elephant conflict in Sri Lanka: Patterns and Extent. *Gajah,51*:16-25

Roskaft, E., Larsen, T., Mojaphoko, R., Sarker, R. A. H. M., & Jackson, C. (2013). Human dimensions. In C. Skarpe, J. du Toit, & S. Moe (Eds.), *Elephant conservation in Botswana*. Oxford: Oxford University Press.

Shrestha, R. (2007). *A case study on human-wildlife conflict in Nepal (with particular reference to human-elephant conflict in eastern and western Terai regions).* WWF Nepal, Kathmandu, Nepal

Studsrod, J. E. & Wegge, P. (1995). Park-People Relationship: The case of damage caused by park animals around the Royal Bardia National Park, Nepal. *Environment Conservation, 22* (2): 133-142.

Subedi, P., Joshi, R., Poudel, B., & Lamichhane, S. (2020). Status of human-wildlife conflict and assessment of crop damage by wild animals in buffer zone area of Banke national park, Nepal. *Asian Journal of Conservation Biology, 9*(2): 196-206

Sukumar, R. (1994). Wildlife-human conflict in India: an ecological and social perspective, In *Social Ecology*, R. Guha (ed.), Delhi: Oxford University Press, 303-317.

The Himalayan Times (2021). https://thehimalayantimes.com

Tuckman, B. W. (1999). *Conducting educational research*. Fifth Edition. New York: Harcourt. Brace College Publishers.

Uprety, H. K. (1995). *An assessment of agricultural and livestock depredation by wild animals at Patihani and Jagatpur areas near Royal Chitwan National Park.* World Wildlife Fund Nepal Program.

Wells, M. & Brandon, K. (1993). The principles and practice of buffer zones and local participation in biodiversity conservation. *Ambio, 22*(2/3), 157–162.

Western, D. (1989). Conservation without parks: wildlife in the rural landscape. In *conservation for the twenty-first century*, U.K.: Oxford University

Woodroffe, R, Thirgood, S., & Rabinowitz A. (2005). The future of coexistence: resolving human-wildlife conflicts in a changing world. *Conserv Biol Ser Camb., 9*: 388.

Zhang, L. (2011). Current status of Asian elephants in China. *Gajah, 35*:43-46.