Living with the Large Carnivores: The interaction between humans, tigers and leopards in Chitwan National Park, Nepal

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5 Contribution of Buffer Zone Programs to Reduce Human-Wildlife Impacts: the Case of the Chitwan National Park, Nepal

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Abstract

Buffer zones around parks/reserves are designed to maintain ecological integrity and to ensure community participation in biodiversity conservation. We studied the fund utilization pattern of buffer zone programs, mitigation measures practiced, and attitudes of residents in buffer zone programs of Chitwan National Park, Nepal. The buffer zone committees spent only a small portion (13.7%) of their budget in direct interventions to reduce wildlife impacts. Human-wildlife conflicts were inversely related to investment in direct interventions for conflict prevention and mitigation. Peoples' attitudes towards wildlife conservation were largely positive. Most of the people were aware of buffer zone programs but were not satisfied with current practices. We recommend that buffer zone funds be concentrated into direct interventions (prevention and mitigation) to reduce wildlife conflicts. Our findings will be helpful in prioritizing distribution of funds in buffer zones of parks and reserves.

Keywords: Human-wildlife conflict; Buffer Zone; compensation; fences, Chitwan National Park;

5.1. Introduction

Throughout the world, the expansion of human land use in the expense of natural ecosystems caused wildlife habitats to become increasingly insular, fragmented and degraded (Lambin & Meyfroidt, 2011). Some remaining habitats are set aside for protection as parks/reserves where many wildlife populations are recovering (Bruner *et al.*, 2001; IUCN, 2008; Naughton-treves, Holland, & Brandon, 2005). Often in close proximity to these areas, communities farm crops or raise livestock presenting an attractive food source for wild animals, which consequently frequently raid crops, kill livestock or attack humans. In retaliation they may be killed. Such reciprocal impacts by humans and wildlife are among the major threats to wildlife conservation (Dickman, 2010; Madden, 2004). Management of such impacts is even more challenging where endangered wildlife causes serious damage to human lives or livelihoods (Woodroffe, Thirgood, & Rabinowitz, 2005).

Historically, communities managed wildlife impacts locally by clearing habitat or retaliating wild animals perceived as threats (Treves, Wallace, & White, 2009). Such a responses are either illegal or socially unacceptable where they do not comply with national and international regulations for biodiversity conservation (Madden, 2004). Wildlife managers strive to increase or maintain wildlife populations through protection and habitat management, while local communities are interested in access to the natural resources as well as their own safety and property (Andrade & Rhodes, 2012). While human-wildlife impacts are the result of simple competition over shared resources, they may also reflect political conflict between local residents and institutions having contrasting viewpoints about wildlife (Treves *et al.*, 2006). If such conflicts are not managed, affected communities can become antagonistic towards wildlife and conservation authorities, adversely affecting overall conservation goals (Madden, 2004; Woodroffe *et al.*, 2005). Managing conflict thus needs both a biophysical and a sociopolitical approach (Treves *et al.*, 2006) to promote non-lethal management and strategies to increase community tolerance for wildlife (Treves *et al.*, 2009).

When wildlife and humans are sharing the same landscape in close proximity, it is almost impossible to entirely avoid wildlife damage. However, community tolerance of actual and perceived threats can be built through co-management of conflict (Treves *et al.*, 2006), including timely compensation for losses, participation in planning and execution of conservation programs, as well as equitable sharing of conservation benefits (Nyhus, Osofsky, Ferraro, Fischer, & Madden, 2005; Wegge *et al.*, 2018). Buffer zones are often created surrounding the core protected areas to facilitate such processes with the dual purpose of maintaining ecological integrity and ensuring participatory conservation or co-management (Budhathoki, 2004; Heinen & Mehta, 2000; Persoon & Van Est, 2003; Sayer, 1991; Spiteri & Nepal, 2008). Often in the buffer zone areas, communities are subsidized as compensation for wildlife impacts, while wildlife is protected with refuge habitats and migration corridors (Kolipaka, 2018; Sayer, 1991; Wegge *et al.*, 2018). Reducing negative impacts of wildlife on communities and protecting wildlife and their habitat should be the priority actions in the buffer zones (Budhathoki, 2004; Heinen & Mehta, 2000; Silwal *et al.*, 2013).

Reducing human-wildlife impacts requires a combination of strategies based on the location and species involved that can be broadly categorized into 1) preventive measures (or direct interventions), 2) mitigative measures and 3) indirect interventions (Goodrich, 2010; Treves *et al.*, 2009). The direct interventions aim to reduce the severity of the impacts by lowering the frequency and extent of damage from wildlife, whereas mitigative measures and indirect interventions aim to raise residents' tolerance to impacts (Treves *et al.*, 2009). Spatial separation of human and wildlife through physical barriers (fences), guards, repellents are common preventive measures (Goodrich, 2010; Karanth & Madhusudan, 2002; Treves *et al.*, 2009). In addition, altering human behavior through awareness about wildlife, establishing early warning systems, predator-proof corrals, changing to crops less palatable to wildlife, improving livestock husbandry, and manipulating problem wildlife (both lethal and non-lethal) also mitigate human-wildlife impacts.

We selected Chitwan National Park (CNP) in Nepal for this study because it typifies a national park in the tropics where wildlife density inside the park is increasing and communities around the park are experiencing frequent economic loss and safety threats from wildlife (Lamichhane *et al.*, 2018a). Participatory conservation and habitat restoration in the periphery of the park were initiated in the 1990s and a buffer zone was legally declared in 1998 (Budhathoki, 2004). Despite their existence of over 20 years, there are only a few studies focusing on buffer zone programs in Nepal, and whether they have helped to reduce human-wildlife conflict is not well understood. In this study, we examined whether buffer zone interventions are adequate in reducing the negative impacts of wildlife by analyzing buffer zone fund utilization over a decade around CNP. We assessed the fences and mitigation measures practiced by the communities, and examined attitudes of local communities towards wildlife conservation and the management of conflicts to gain more insight in the complex processes of human-wildlife interactions. Our research questions are 1) Are buffer zone funds adequate to reduce the damage caused by wildlife in human life and livelihood? 2) What preventive and mitigative measures are practiced and proposed? And, 3) What are people's attitudes towards wildlife conservation, conflict prevention and mitigation?

5.2. Methodology

5.2.1. Study area

The study was conducted in the buffer zone of Chitwan National Park (CNP), Nepal. CNP (953 km^2) is situated in South Central, Nepal between 27°16.56' - 27°42.14'N latitudes and 83°50.23' - 84°46.25'E Longitudes (Fig. 1). CNP is the first national park of Nepal, established in 1973 and a UNESCO world heritage sites. It is well known for high biodiversity, with nearly 70 species of mammals, >600 birds, 54 herpetofauna and 126 fish species (CNP, 2013b). CNP is one of the 42 tiger source sites globally and holds the second largest population of the greater one-horned rhinoceros (*Rhinoceros unicornis*) (Subedi *et al.*, 2017; Walston *et al.*, 2010). A variety of ungulates including four deer (sambar *Rusa*

unicolor, chital *Axis axis*, hog deer *A. Procinus*, muntjac *Muntiacus vaginalis*), gaur (*Bos gaurus)*, wild boar (*Sus scrofa)*, nilgai (*Boselaphus tragocamelus)* are the major herbivores of the park. In addition to tigers and leopards, there is a range of carnivores such as sloth bear (*Melursus ursinus*) wild dog (*Cuon alpinus)*, stripped hyena (*Hyaena hyaena)*, clouded leopard (*Neofelis nebulosa)*, jackal (*Canis aurenus)*, fishing cat (*Prionailurus viverrinus), jungle cat (Felis chaus),* and leopard cat (*Prionailurus bengalensis)*.

Contiguous habitat exists toward the South-West (Valmiki Tiger Reserve, India) and the East (Parsa National Park) of CNP. The park is bordered by the Narayani River in the West, the Rapti River in the North and the Reu River and the international border with India in the South. On the other side of these rivers, highly populated human settlements and agricultural areas exist. A corridor forest called Barandabhar connects the park with the northern hill forest (Fig 5.1). The park is dominated by forest (>80%) including a majority of Sal (*Shorea robusta*) forest followed by riverine forest and mixed hardwood forest. Highly productive alluvial floodplain grasslands close to the bordering rivers cover 9.6% of the park, 5% exposed surface and 3% water bodies (CNP, 2016; Thapa, 2011).

An additional 750 km^2 of the buffer zone surrounding CNP was created in 1996 (21 Km^2 of BZ was later included in the park in 2016). More than half (55%) of the buffer zone is effective wildlife habitat including forests, grasslands and water bodies; the rest is used for agricultural land and settlements (Karki *et al.*, 2015). There are more than 70 buffer zone community forests covering approximately 11,000 ha (CNP, 2017). Buffer zone regulations and guidelines provide the legal framework of buffer zone programs in Nepal. Accordingly, the buffer zones are managed in three tiers: 1) user groups are formed at the hamlet level, 2) user committees are formed from the representatives of the user groups, and 3) chairpersons of the user committees form a buffer zone management committee for each protected area. In Chitwan there are 1,770 User Groups and 22 Buffer Zone User Committees (BZUC). BZUCs are responsible for designing and implementing

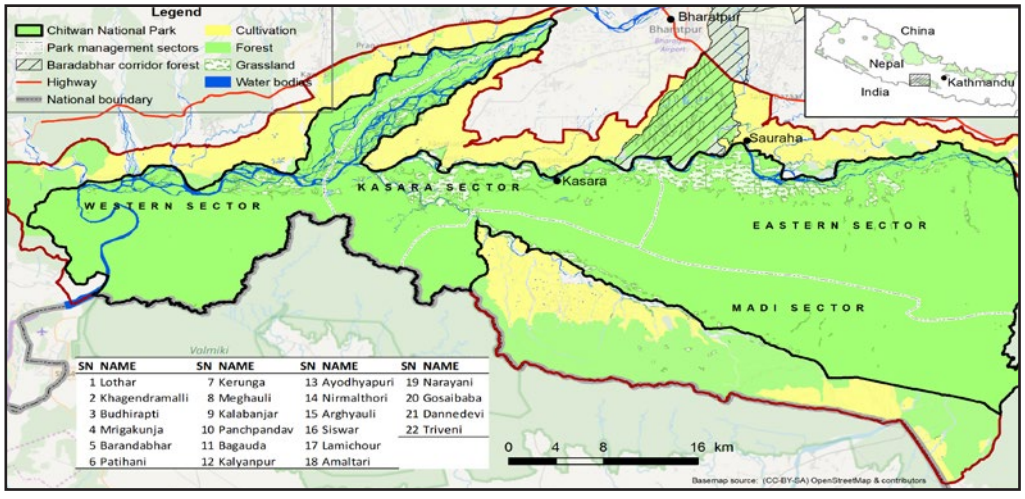

Figure 5.1 Chitwan National Park and buffer zone area.

buffer zone programs. They also deal with the wildlife victims for the recommendation of compensation payments to the national park and liaison between the community and the park authority. The park management and buffer zone are divided into four sectors i.e. Eastern (Sauraha), Northern (Kasara), Southern (Madi), and Western (Amaltari) sector for effective administration (Fig. 5.1).

Historically, only a few settlements of the indigenous Tharu, Bote and Darai communities (of Tibeto-Burmese origin) surrounded the present-day park. However, many people from the hilly area migrated into the Chitwan after the 1950s (Mishra, 1982a). Now the community is a mix of indigenous people and immigrants from the hills including high caste Hindus (*Brahmin, Chhetries*), Tibeto-Burmese hill ethnic groups (*Tamang, Gurung, Magar*) and underprivileged lower caste Hindus (*Kami, Damai, Sarki* etc.). Human density is relatively high (261.5 persons per km^2 in 2011) and increasing rapidly by 2.06% annually in Chitwan (CBS, 2012). The buffer zone includes more than 45,000 households in 12 municipalities in five districts (Chitwan, Makawanpur, Nawalpur, Parasi and Parsa). A majority of people rely on subsistence agriculture but dependence on agriculture is decreasing as the younger generation prefers off-farm activities like tourism (nature-guides and work in hotels), service and foreign employment (Lamichhane *et al.*, 2018a). Livestock keeping is an integral part of subsistence agriculture, and grazing was common in the buffer zone until the last decade. In recent years there has been a gradual shift towards stall feeding combined with restricted grazing, adoption of improved livestock and a shortage of labor (Gurung *et al.* 2009). The demand and preference of youths for off-farm labor has greatly increased during the last decade which resulted in the shortage of labor for farming (Lamichhane *et al.*, 2018a).

5.2.2. Data collection

Fund utilization records

Our study focused on direct financial investments made through the BZUCs in the buffer zone of CNP. We focused on direct investment because it is often difficult to measure the impacts of indirect interventions such as awareness raising, alternative livelihoods, and community development to reduce conflict (Treves *et al.*, 2009). BZUCs are part of the legal bodies for buffer zone management and are mandated to operate their own accounts (Budhathoki, 2004). We collected the income and expenditure records of the BZUCs from their audit reports between 2005/06 to 2014/15 (10 years). As per the buffer zone regulations, it is mandatory for each buffer zone user committee to conduct the annual financial audit. The reports are managed according to the Nepalese fiscal year which runs from mid-July to mid-July based on the Nepalese Calendar (Bikram Sambat) (Lamichhane *et al.*, 2018a). For consistency of data for time series analysis, we used these fiscal years. The audit reports include the sources and amount of the income received by each BZUC in each fiscal year. The indirect benefits in the communities such as income generation in the buffer zone area from tourism do not fall within the scope of our research. Our study does not include the income and expenditure of the more than 70 community forest user groups in the buffer zone which also spend a large amount of their budget in prevention and mitigation of human-wildlife impacts.

Assessment of fences and conflict mitigation measures

We mapped the fences constructed along the boundary separating forest and human settlements/agricultural lands. Members of the survey team walked along the fences in all BZUCS with a GPS device (Garmin etrex 10) using the track log. Waypoints were recorded every 200 m and the type of fence, condition and functionality of the fence, and year established were recorded in a standardized data form. The GPS tracks were downloaded by DNRGPS software and the fence line feature was extracted from the GPS track. Characteristics of the fences recorded in the data form were associated to a line feature. Spatial analysis such as type and length of fence in different user committees and management sectors of the parks was done in QGIS 2.7 (QGIS Development Team, 2016).

The status of the fences and role of the fences in conflict mitigation were assessed through a focused group discussion in each of the four sectors of CNP with 12–20 participants. One day long focused group discussion was conducted in each sector (Fig 5.1) during August – September 2016. Two authors (BRL and SP) facilitated the group discussions. The chairman, the secretary and an office assistant of the BZUCs who are key persons responsible for designing/implementing buffer zone programs and conflict management were invited to participate in the discussion. The sub-group of three persons from each BZUC spent 2–4 hours to assess the status of the human-wildlife conflict, current practices, and future priorities of conflict mitigation within the respective BZUC area. For each of the mitigation measures, the group was asked to rank high, medium or low for construction costs, maintenance costs and effectiveness in reducing conflict along with the risks/challenges. Each of the group presented their findings written in a chart paper for all the participants. The participants provided feedback on the presentations and the chart papers were finalized for each committee. All BZUC representatives participated in the workshops actively. The information on the final chart paper was entered into the excel spreadsheet to represent the summary for each buffer zone user committee. This information is summarized from all BZUCs and presented in a table (Table 5.3).

Questionnaire survey

We conducted a questionnaire survey in the buffer zone of CNP during April–June 2016 to assess people's attitude towards buffer zone management practices and human-wildlife conflict management. To ensure the spatial coverage, we stratified our survey in four management sectors of the Chitwan National Park and three buffer zone user committees (BZUC) were randomly selected within a sector. Within the map of the 12 selected BZUCs (three in four sectors each), we generated 35 random GPS points using QGIS. The nearest household to the GPS point was navigated using a map and GPS device. If there was no household within 500 m of the random point, it was excluded from the survey. We requested the household head to participate in the survey whenever possible. If the household head was not available or ready to participate, we interviewed another member of the household aged 16 or above. We moved to the next household for the survey if there were no members of the first household available or they were not ready to participate in the survey. Consent to participate in the survey was read out to the respondent as some of them were unable to read themselves. All the households approached agreed to participate in the survey. Four trained field assistants with long

experience in the buffer zone conducted face to face interview using a structured questionnaire that took one hour on average to fill out. The questionnaire was originally prepared in English and translated in a local Nepali language and a pilot survey (n=12) was conducted to test the questionnaire and train the field assistants before conducting the actual survey. The questionnaire was reviewed and approved by the ethics committee of Institute of Cultural Anthropology and Development Sociology, Leiden University (Appendix 5.1). Similarly, the Department of National Parks and Wildlife Conservation in Nepal issued research permit to this study after approval from a 'technical committee' at the department which reviews the research applications in Nepal's protected areas.

The questionnaire was divided into four sections: 1) personal and household information such as age, gender, ethnicity, occupation, migration, household income sources, land and livestock owned, forest resources need; 2) past experience with wildlife and their impacts on the households, 3) conflict management and compensation practices; and 4) attitude towards the wildlife and buffer zone program. The attitude of the respondents towards different statements related to wildlife conservation, national park, buffer zone and conflict management was measured on a five-point Likert scale where 1 denoted 'Strongly agree' and 5 denoted 'Strongly disagree' (Likert, 1932; Stapp *et al.*, 2016). The statements were read to the respondents and they were asked to score the statements on the scale.

5.2.3. Data analysis and statistics

We categorized income sources of the BZUCs derived from audit reports into four categories: 1) committee internal sources, such as fees or royalties for resource extraction (mostly sand gravel, sometimes wood) within committee's area, memberships, fines and income from investments; 2) park revenue shared according to existing buffer zone guidelines (30 – 50 % of the total park income); 3) grants and subsidies from other government line agencies (municipalities, district coordination committees); and 4) support provided by conservation NGOs, projects and environmental non-governmental agencies for conservation actions within the BZUC. Redundant budget headings such as programs advance and bank balance from previous years which could be repeated with the previous year's budget were excluded from the analysis.

The buffer zone management guidelines provides five broad categories (and proportion of budget) for expenditure namely a) community development (30%), b) wildlife conservation (30%), c) income generation (20%), d) conservation education (10%), and e) administrative costs (10%). BZUCs prepare a five-year action plan and implement priority actions based on the available budget. Sometimes, the conservation NGOs and government line agencies also approach to the BZUCs to implement activities of their interest within the framework of BZUC action plan. Thus, there was a wide range of activities conducted by the BZUCs, some are cross-cutting the broad five categories. Although all these activities are supposed to reduce the wildlife impacts on humans and increase community tolerance, there is no specific category for targeted activities on wildlife conflict prevention and mitigation. As our research interest lies in the direct investment on reducing human-wildlife impacts, we re-categorized expenditure based on

the activities mentioned in the audit reports into eight categories and two additional items i.e. others and unspecified for those not covered within eight categories and unspecified in the audit reports (Table 5.1). The amount of the funds received and expenditure in each category was summarized as percentages and presented in bar graphs in the final analysis.

We used linear regression and Pearson's correlation to assess the relationship between the investment made to reduce human-wildlife impacts in the buffer zone and the frequency of wildlife attacks on humans and livestock. The data on the frequency of wildlife attacks over the years was obtained from Lamichhane *et al.* (2018). The analysis was done in R (R Core Team, 2017).

Table 5.1 Expenditure categories of the buffer zone user committee fund utilization.

SN	Expenditure category	Description of the category
1	Prevention and mitigation of wildlife impacts	• Construction and maintenance of the fences (electric, mesh wire, barbed, concrete wall etc.) • Construction of guarding machan (tower) • Subsidy for predator-proof corrals or alternative crops (fish ponds, mentha etc.) • Relief support for the wildlife victims
2	Wildlife conservation and habitat management	• Plantation, grassland and wetland management, anti-poaching patrolling, forest management, wildlife monitoring
3	Community development	• Construction of buildings • Road, culvert, bridges, canal etc. • Community infrastructures (cremation site, resting places) • Drinking water and irrigation facilities
4	Community engagement and IGA	• User groups mobilization, saving and credit groups, cooperatives, trainings on income generation activities such as vegetable farming, mushroom farming, livestock husbandry
5	Conservation education	• Awareness materials development and broadcast such as radio programs, hoarding boards, posters, pamphlets • Conduct awareness camps targeted to specific groups • School education support • Exposure visits
6	Alternative energy	• Biogas subsidy, solar energy, improved cooking stoves
7	Climate change adaptation and disaster risk reduction	• Preparation and implementation of community adaptation plans • Disaster relief funds • Support to the disaster victim families
8	Administrative costs	• Salary of the office secretary • Salary of the forest guards and other support staff • Allowances for the committee members • Training for the committee members and office staff • Office maintenance costs (electricity, fuel, telephone, water, sanitation etc).
9	Others	• Other than the above mentioned eight categories such as investment in the share market, household surveys, food & snacks etc.
10	Unspecified	• Unspecified in the audit reports

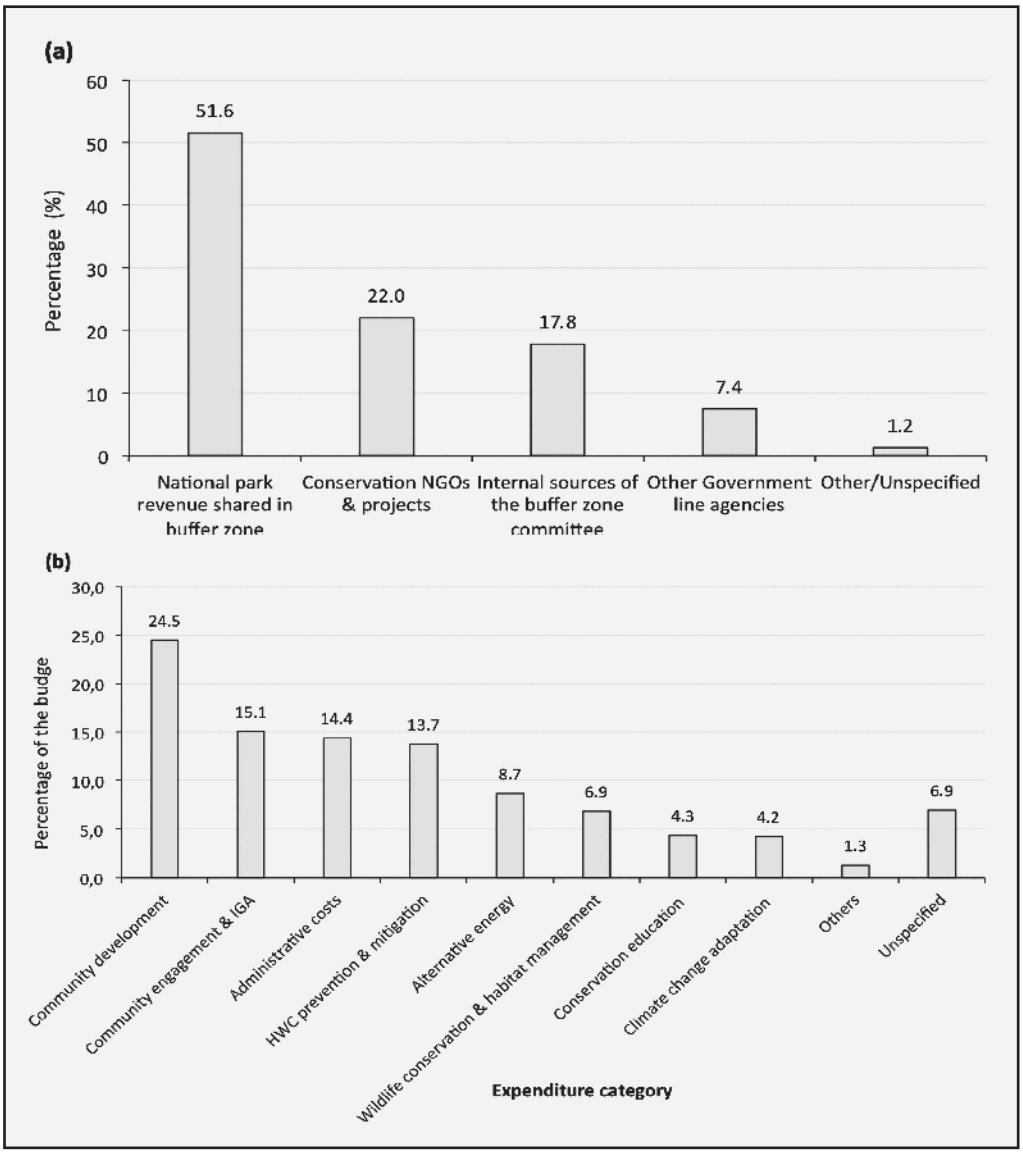

Figure 5.2 (a) Income sources and (b) expenditure in different category by the buffer zone user committees of Chitwan National Park, Nepal during 2005–2015 based on records on annual audit reports.

The Likert scale attitude data were converted into the attitude index by summing response values for each questions dividing by the number of respondents (De Vaus, 2013; Spiteri & Nepal, 2008). We also assessed the socio-economic variables explaining the positive attitude using a binary logistic regression in SPSS 20 (IBM, 2012). The attitude index towards buffer zone management was converted into a dichotomous value to use as the response variable in logistic regression. The values below the mean value on the 1-to-5

was scored as '1' representing the positive attitude and vice versa. Eight independent variables included in the regression analysis which could affect the attitude of people (Carter *et al.*, 2014) were 1) distance to the park, 2) distance to the forest edge, 3) ethnicity, 4) management sector, 5) sex, 6) education, 7) land ownership and 8) occupation.

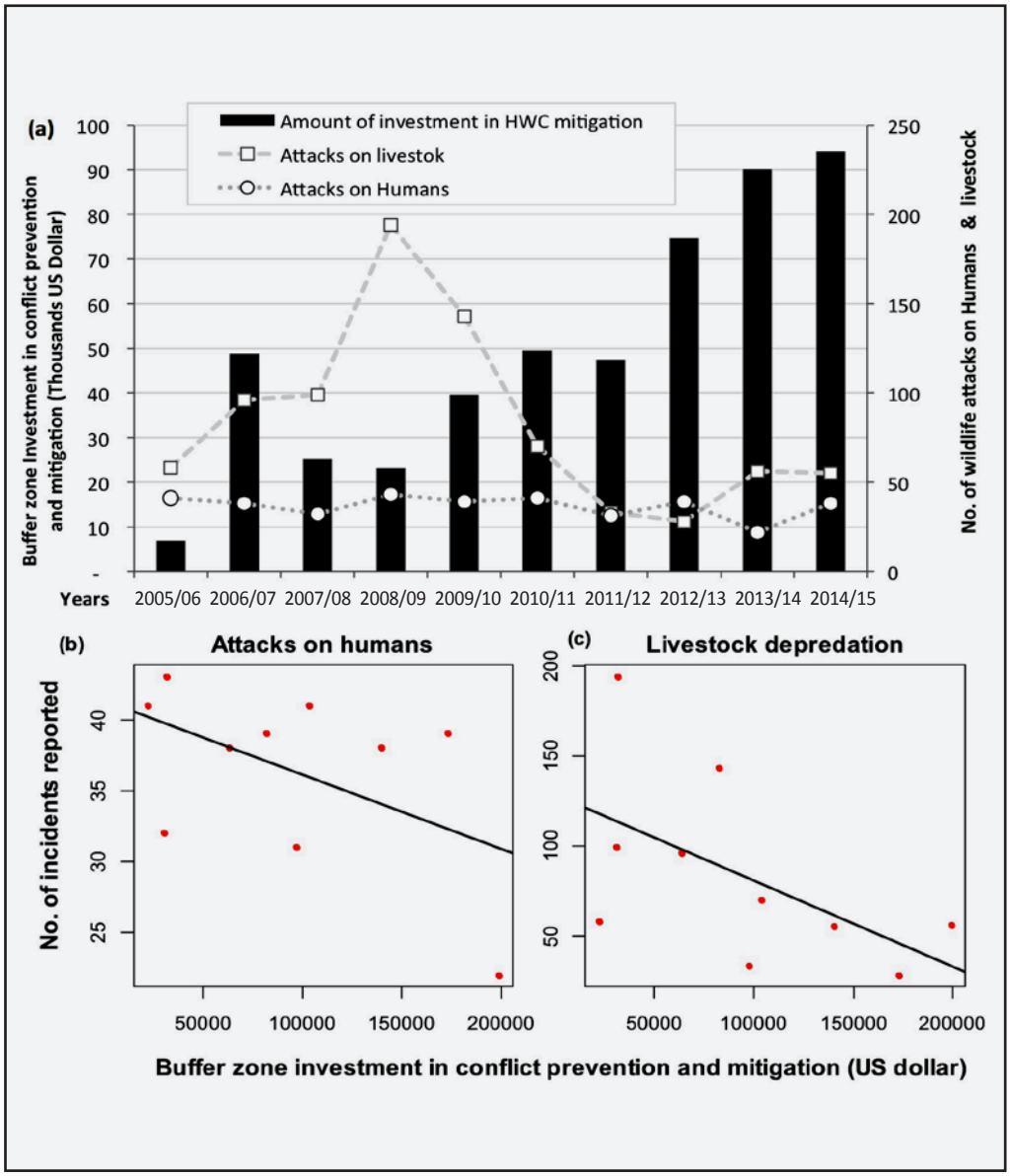

Figure 5.3 Buffer zone investments to minimize human-wildlife impacts and number of incidents (wildlife attacks on humans and livestock) over the years based on audit reports (a) and linear regression of investment versus wildlife attacks on humans (b) and livestock depredation (c).

5.3. Results

5.3.4. Buffer Zone investments and fund utilization

Through the BZUCs, more than US$5.6 million of direct investment was made during 2005/06–2014/15 in the buffer zone of CNP, an average of US$558,000 (range 130,000–1,173 ,000) per annum. Revenue shared by the national park contributed more than half of the BZUC budget (Fig. 5.2).

Contrary to our expectation, the BZUCs spent only a small portion (13.7%) of their fund directly on prevention and mitigation of the human-wildlife conflict through activities such as construction/maintenance of the fences and providing relief for the victims (Fig. 5.2b). However, the amount of budget spent on wildlife conflict prevention and mitigation has been increasing gradually as the total park revenue has been increasing (Fig. 5.3a). The investment for conflict mitigation interventions was negatively correlated to wildlife attacks on humans (-0.49) and livestock depredation (-0.56) but the relationship was not significant (p=0.14 and 0.09 respectively) (Fig. 5.3b).

5.3.5. Assessment of the mitigation measures

Out of the total budget spent on conflict prevention and mitigation, BZUCs invested most of the funds in the construction and maintenance of the physical barriers (85%). The buffer zone communities have constructed approximately 275 km of fence along the forest – settlement boder (Fig. 5.4), about half including electric fences (140 km). The other half includes fences (single or combination with an electric fence) made from barbed wire, mesh wire, PCC with mesh wire, or a dyke (along the rivers) (Table 5.2). Community leaders evaluated multiple mitigation measures practiced within the BZUCs during the focused group discussions (Table 5.3). Most of the BZUCs (13 of 22) proposed mesh wire fences (5 – 7 feet) with PCC on the bottom (2 – 3 feet) as the priority action for conflict mitigation in future (Table 5.3).

Table 5.2. Types and lengths of the fences in different management sectors of the buffer zone of Chitwan National Park based on a field survey in October–December 2017.

Management sector	Types and lengths of fences (km)						Total
	Electric	Barbed	Mesh wire	Mesh wire with PCC	Concrete wall	Others	
East	25.5	21.9	8.9	5.8	4.1	1.8	68.02
Kasara	26.4	13.6	24.0	15.0	1.9	–	80.95
South	47.4	4.8	–	–	–	1.5	53.78
West	40.9	10.5	21.0	–	–	–	72.36
Total	**140.2**	**50.9**	**53.9**	**20.8**	**6.0**	**3.4**	**275.10**

Table 5.3. Major types of fence and other preventive measures currently practiced for reducing HWC in the buffer zone of Chitwna National Park.

Physical barriers

Type of intervention	Years of implementation	No. of BZUCs practicing	Total length of the fences (km)	Future Priority action for no. of BZUCs	Target species	Construction costs #	Maintenance costs	Effectiveness in reducing conflict	Additional evaluation/remarks
Barbed fence	1989-2017	16	50.9	-	All	Medium	Medium	Low	Effective for deer, not effective for wild boar, rhino and elephants
Electric fence 2017	2001-	19	140.2	9	Rhino, elephant	Medium	High	Medium	Effective when maintained properly, regular maintenance is a challenge
Mesh wire fences	2008-2012	12	53.9	-	All	Medium	Medium	Low	Stops deer but not effective for wild boars, rhinos
Mesh wire fences with PCC	2013-2017	7	20.8	13	All	High	Low	High	Effective for most of the species except elephants, cost of construction is high
Concrete wall	2015-2017	3	5.9	1	All	Very High	Low	High	High construction costs, stops natural water flow in flood prone areas

Other

Type of intervention	Years of implementation	No. of BZUCs practicing	Total length of the fences (km)	Future Priority action for no. of BZUCs	Target species	Construction costs #	Maintenance costs	Effectiveness in reducing conflict	Additional evaluation/remarks
Predator-proof corrals	2015-ongoing	7	NA	6	Tiger, leopard	Low	Medium	High	Chances of predation when animals are out of the corrals
Community Guarding machan	All time	4	NA	-	All species	Low	Medium	Medium	Labor intensive, needs active guarding
Awareness programs	1995-ongoing	All	NA	15	All species	Low	Medium	Low	Effective in reducing wildlife attacks on humans, more awareness programs needed
Other*	Different periods	7	3.4	8	Selected species	NA	NA	NA	

** Other includes flashlights, Dyke, fish Pond etc. # costs (USD) per km of fence construction (Very high – more than 10,000 USD per km; High - 5,000 to 10,000; Medium – 1000 to 5000 USD; Low – less than 1,000 per km)*

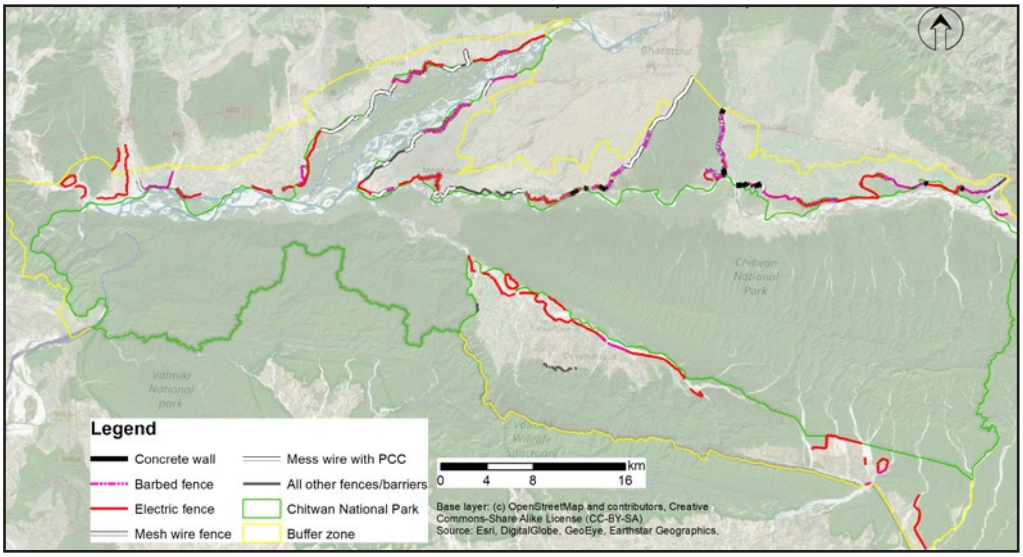

Figure 5.4 Fence installed along the forest - settlement borders in Buffer zone of Chitwan National Park, Nepal.

5.3.6. Attitude towards the buffer zone programs and conflict mitigation

A total of 399 respondents were interviewed, a majority male (58%) and involved in farming (85%). Ages ranged between 16 and 78 years with an average of 45 years. About three quarters (73%) of the respondents had primary education while less than 10% had secondary or higher education and 17% were illiterate. Ethnicity was divided into four categories 1) High cast Hindu (44%), 2) Hill Tibeto-Burmese (24%), 3) Terai Tibeto-Burmese (21%) and 4) Lower caste Hindu (11%). Average land holding per household was 0.5 ha. Most of them (87.5%) had livestock or poultry.

The overall attitude of respondents towards wildlife conservation was positive (2.37 ± SE 0.25) on a 1-to-5 scale (Table 5.4). People's attitude towards the participation of households in wildlife conservation, particularly the willingness to manage human-wildlife conflicts, was more positive (1.91) compared with the attitude towards current practices of conflict mitigation (2.51), the role of the national park (2.42) and the role of the buffer zone program (2.84). Regression analysis shows that a positive attitude is associated with the management sectors (East and Kasara) and ethnicity (Table 5.5).

5.3.7. Conflict management and compensation payments in the buffer zone

About half of the respondents (44.6%) reported the increase in damage from wildlife during the previous five years primarily due to widespread crop raiding by herbivores while another half thinks damage either decreased (43.9%) or has not changed (11.5%). The highest number of the respondents (67%) reported wild boar as the main problem causing species around Chitwan NP followed by rhinos and chital. Conflicts with carnivores

Table 5.4. Attitude of people towards the carnivore conservation, participation and conflict mitigation in Chitwan National Park, Nepal based on questionnaire survey in April - June 2016 ($\bar{x}$ and S.E. - mean and standard error of the attitude scores for each question; G $\bar{x}$ -mean attitude score for each group of questions).

Questions 1-to-5 scale (1 = Strongly Agree, 5 0.0 Strongly disagee)	Average Score		
	$\bar{x}$	S.E.	G $\bar{x}$
General attitude towards wildlife			2.04
1. Wild animals have a right to live in the forest	1.45	0.06	
2. Wildlife attracts tourists and brings revenue to the Park, which benefits us	1.90	0.05	
3. If tiger and leopard disappear from Chitwan, it is a not a good news for me.	1.55	0.04	
4. Tiger and leopard population should be increased in coming years	2.29	0.08	
5. Wildlife conservation benefits me directly.	3.01	0.07	
Conflict management			2.51
6. Wildlife should be conserved only if conflict with humans can be reduced.	1.43	0.05	
7. Existing conflict-mitigation measures for wildlife conflict is not adequate	1.89	0.05	
8. In case of severe conflict, problem animals should be terminated	4.20	0.05	
Role of the national park			2.42
9. National Park authorities are responsible for HWC, they should manage it	1.89	0.06	
10. National Park authorities are playing a positive role for human-wildlife conflict mitigation	2.75	0.05	
11. Government relief for loss done by wildlife is helping to victim families.	2.63	0.05	
Role of the buffer zone			2.84
12. Buffer zone institutions playing a positive role for human-wildlife conflict mitigation	2.57	0.05	
13. Buffer zone institutions have given adequate priority to HWC mitigation	3.34	0.05	
14. Community forests are playing a positive role in HWC management	2.62	0.05	
Household responsibility & participation for conflict mitigation			1.91
15. I live close to the forest with risk of wild animals and it's also my responsibility to avoid it	2.30	0.05	
16. I would like to participate in community wildlife conflict mitigation programs.	1.84	0.04	
17. I would like to learn more about wild animals, their behavior and ecology.	1.66	0.04	
18. I should participate to maintain electric fences and physical barriers constructed to avoid conflict	1.85	0.04	

were reported to be less severe. Five carnivores – tiger, jackal, sloth bear, leopard, and jungle cat – were reported to be affecting local residents by threatening their safety or lifting livestock/poultry. Additionally, smaller animals such as monkeys, birds, snakes and porcupines were also reported having negative impacts on the life and livelihoods of people on smaller scales (Fig. 5.5).

The majority of the respondents (60%) were not satisfied with the buffer zone programs and suggested to focus more on direct interventions to reduce wildlife impacts (Fig. 5.6a). Similarly, more than two third of the respondents (71.7%) were aware of government compensation for wildlife damage. However, most of them (more than 90%) were not satisfied with the existing payment mechanism. It took an average of 6.6 months to

Table 5.5. Binary logistic regression examining the relation between sociodemographic variables and positive attitudes towards buffer zone management in Chitwan National Park.

Variables	B	S.E.	Wald	p	
Distance to park	0.00	0.00	0.85	0.36	
Distance to forest edge	0.00	0.00	1.56	0.21	
Ethnicity					
High caste Hindu	–	–	5.51	0.14	
Hill Tibeto-Burmese	1.39	0.61	5.25	0.02	*
Terai Tibeto-Burmese	1.18	0.65	3.29	0.07	
Lower caste Hindu	1.39	0.63	4.85	0.03	*
Management sector					
East	–	–	9.75	0.02	*
Kasara	-0.97	0.45	4.59	0.03	*
South	0.04	0.39	0.01	0.91	
West	0.48	0.42	1.34	0.25	
Gender					
Male	–	–	–	–	
Female	0.21	0.29	0.53	0.47	
Have livestock					
Yes	–	–	–	–	
No	-0.27	0.50	0.30	0.58	
Education					
Illiterate	–	–	5.30	0.15	
Primary education	-0.83	0.75	1.23	0.27	
Secondary education	0.13	0.60	–4	0.83	
Higher education	0.72	0.79	0.82	0.37	
Land ownership					
less than 0.1 ha	–	–	2.91	0.41	
0.1 - 0.5 ha	-0.09	0.57	0.02	0.88	
0.5 - 1 ha	0.50	0.46	1.22	0.27	
greater than 1 ha	0.48	0.48	1.01	0.32	
Occupation					
Agriculture	–	–	2.67	0.45	
Off-farm business	-0.47	0.69	0.46	0.50	
Student	0.14	0.90	0.02	0.88	
Other	0.43	0.91	0.22	0.64	

receive the payments and most of the respondents viewed it as a lengthy and highly bureaucratic procedure. The highest number of people (36.1%, n=399) prefer the compensation payments to be made by BZUCs or community forest user groups while others think municipalities, other conservation organizations or the national park authority itself should make the payments (Fig 5.6b).

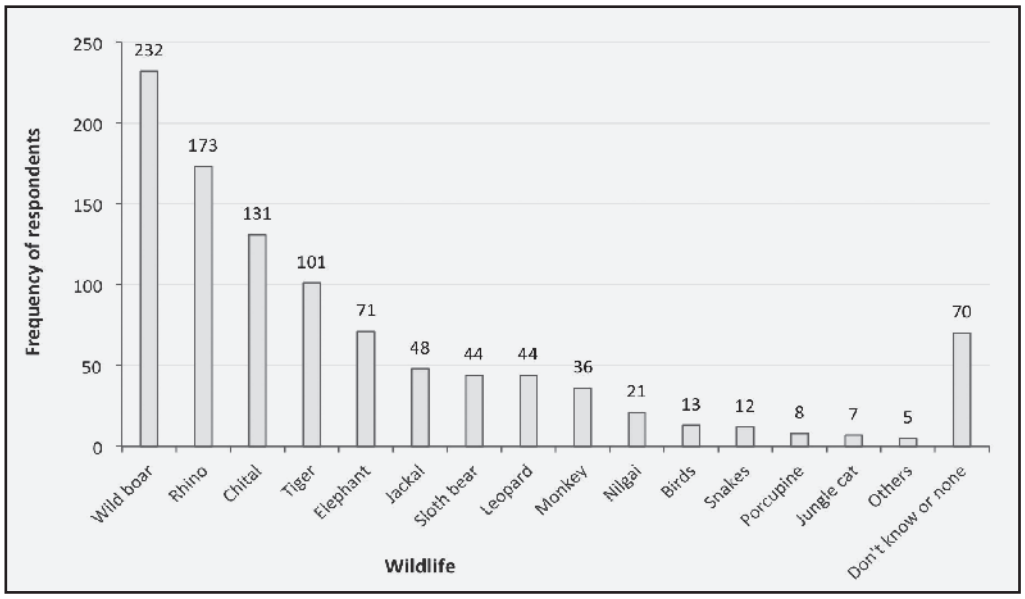

Figure 5.5 Frequency of respondents reporting the problem caused by different wildlife species during a questionnaire survey conducted in April – June 2016 in buffer zone of Chitwan National Park, Nepal.

5.4. Discussion

We found that the buffer zone program around CNP has been firmly institutionalized. They receive a regular support from the government (30 – 50% of the park revenue shared with the buffer zone) as well as grants and subsidies provided by conservation organizations and government line agencies. We documented that a relatively low proportion of the budget was spent on direct interventions to reduce wildlife impacts on communities (13.7%). However, the amount of investment in buffer zone programs, as well as the fund spent in reducing human-wildlife impacts are gradually increasing over the years with increasing revenue of the park. We suggest that various preventive and mitigative measures practiced by the BZUCs have contributed to reduce the wildlife attacks on humans and livestock, although crop raiding was found widespread. Most of the people were positive towards wildlife conservation but they were not satisfied with current practices of the buffer zone program as well as conflict prevention and mitigation measures.

5.4.1. Buffer zone fund utilization

The annual budget of all BZUCs sums more than US$1.2 million in recent years, which is a large amount in a poor country such as Nepal. The annual budget of the park and buffer zone substantially increased after the government raised the daily entry fee in 2013 from Nepalese Rupees 500 (~ US$5) per day to Rupees 1,500 (~US$15) per day. The number of visitors is also increasing gradually (~ 150,000 in 2016/17; CNP, 2017). In addition to

the park revenue, more than 70 community forests in the buffer zone also earn annually approximately 0.5 million US dollar from ecotourism activities (CNP, 2017) spending some of it to manage human-wildlife impacts. Not all parks/reserves in Nepal have such a large revenue (DNPWC, 2017). Despite such large and sustained investments over two decades in Chitwan's buffer zone, wildlife damage on life and livelihood of the local community is still substantial (Dhungana *et al.*, 2018; Lamichhane *et al.*, 2018a; Pant *et al.*, 2016; Silwal *et al.*, 2017). Studies show a marginal decrease of wildlife attacks on humans and livestock by carnivores in recent years (Dhungana *et al.*, 2018; Lamichhane *et al.*, 2018a) while people reported a rise in crop raiding by wild herbivores.

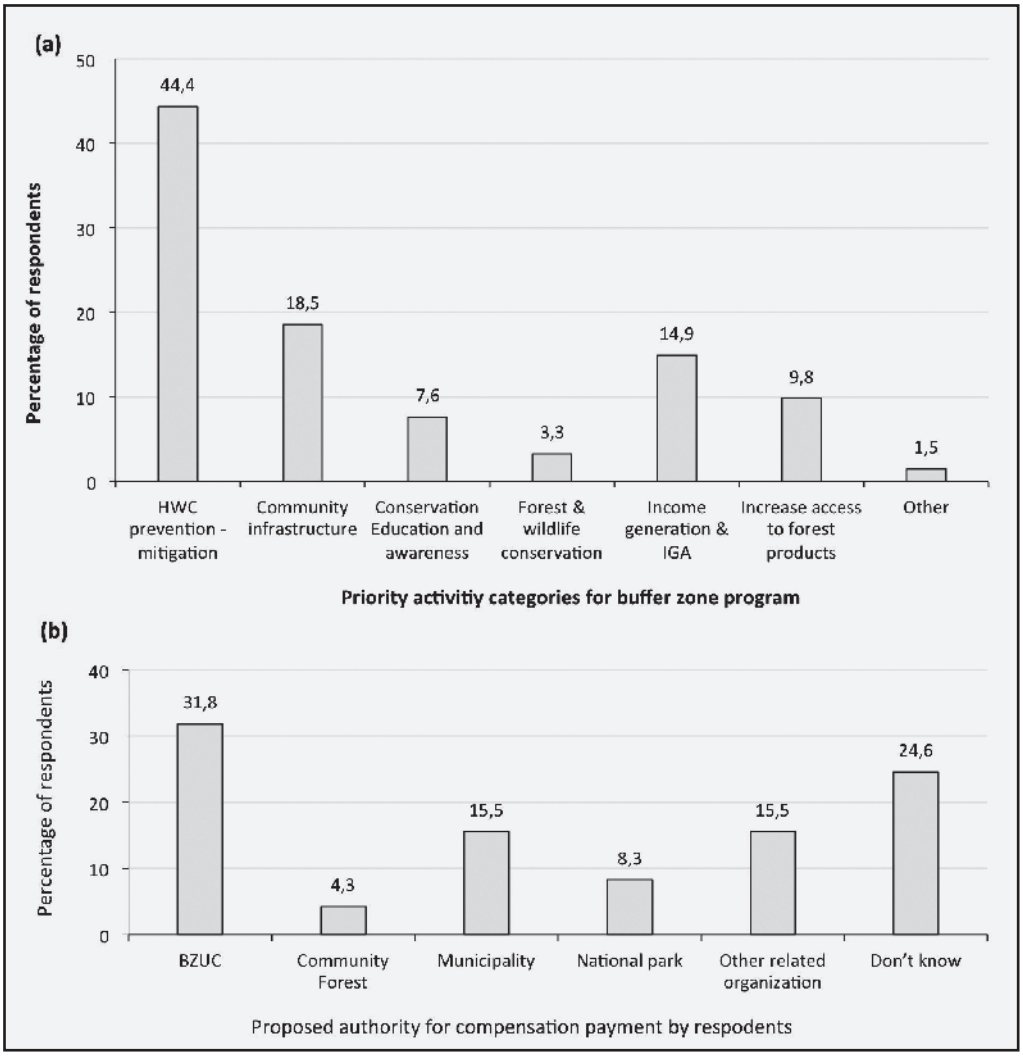

Figure 5.6 (a) Priority actions of the buffer zone program and (b) authority for compensation payments as per the respondents in Chitwan National Park, Nepal.

The buffer zones are designated primarily to create human-wildlife coexistence by providing an ecological buffer to wildlife and a socioeconomic buffer to the communities (Budhathoki, 2004; Heinen & Mehta, 2000; Nepal & Weber, 1994). Although, Nepal endorses these aims, the buffer zone program in Chitwan has given higher priority to community development (24.5%) compared to prevention and mitigation of human-wildlife impacts (13.7%). Similar finding with a much higher proportion of the budget spent on infrastructure development (42%) has been reported by Silwal *et al.* (2013). Additionally, community engagement and IGA programs (15.1%) and alternative energy such as biogas subsidy, solar energy and improved stoves (8.7%) were also implemented to develop alternative livelihoods and reduce forest dependency. In contrast, only 7% was spent on wildlife and habitat management. Such preference towards community development programs is influenced by the political interest of the buffer zone leaders. Although the buffer committees are elected through a democratic process, local political parties have a great influence. The elected members are also interested in gaining popularity in the community through such development activities which supports their political career. The infrastructure development and construction work also generate local economic opportunities for a broader range of community members such as employment for laborers, market for different products and services. However, investments in community development raise aspiration of people from the buffer zone program which is unable to fulfill the extensive development needs with a limited budget. Such concerns have beeb raised since the establishment of the buffer zone in Nepal (Heinen & Mehta, 2000). Hence, prioritization of the activities is required to obtain the intended benefits of the buffer zone programs.

The inverse correlation between budget spent in direct interventions for conflict prevention/mitigation and wildlife attacks on human and livestock depredation respectively indicates the importance of such interventions. Populations of large carnivores and herbivores are increasing over the years (Karki *et al.*, 2015; Subedi *et al.*, 2017) whereas conflict incidents have not increased proportionally (Lamichhane *et al.*, 2018a). Fences have been installed along the forest-settlement borders by the BZUCs and community forest user groups using their internal funds as well as the support of the park authority, conservation NGOs and other government agencies (Banikoi *et al.*, 2017). In addition, interaction between wildlife and humans have also decreased through the facilitation of buffer zone programs and livelihood diversification from off-farm income (less depended on forests, and hence, less frequent visits to wildlife inhibited forests) (Khatiwada *et al.*, 2017). Buffer zone programs also initiated a compensation payment mechanism in 1999 to wildlife damage to humans, livestock, and property damage which is continued in a different form after the government endorsed the relief guidelines for wildlife damage in 2009 nationally (Lamichhane *et al.*, 2018a). Most of the buffer zone committees have also established a basket fund for the immediate relief of victims. Such measures probably have also contributed to reduce the resentment of people towards wildlife.

Although our findings indicate the need of prioritization of buffer zone programs towards direct interventions on conflict prevention and mitigation, the existing buffer zone policy of Nepal favors community development provisioning 30% of the annual budget

(Budhathoki, 2004). However, the policy suggests, such activities should be small-scale, production oriented and have a clear linkage to reduce pressure on forests and enhancing human-wildlife coexistence (MOFE, 1998). In contrast, the community development activities in Chitwan's buffer zone includes community buildings and infrastructures (30%), river embankments (26.1%), road construction (24.1%), drinking water and irrigation facilities (13.7%). A study focusing on conservation incentive distribution in Chitwan's buffer zone shows residents experiencing the greatest costs in terms of crop damage or livestock are benefited least (Spiteri & Nepal, 2008). Thus, despite of large investments in the buffer zone, the affected communities still remain deprived.

5.4.2. Direct interventions to reduce human-wildlife impacts

We documented a range of preventive and mitigative measures practiced over time in the buffer zone of CNP for reduction of detrimental wildlife impacts on local communities. During the initial years of the buffer zone programs (early 1990s), barbed fences (sometimes accompanied by trenches) were installed encompassing forest patches with the dual purpose of preventing domestic livestock grazing and checking wildlife to enter into the settlements (Sharma, 1990). These fences effectively stopped some wild herbivores such as chital and muntjac while rhinos and wild boars usually break through such fences (Sharma, 1990).

In early 2000, electric fences have been adopted (constructed using local materials) in the buffer zone to stop large animals like elephants and rhinos (Sapkota *et al.*, 2014). Generally, the electric fences are 5 – 6 feet tall with 2 – 3 parallel galvanized wire attached to wooden poles using plastic insulators and connected to the energizer which gives intermittent electric pulses. Electric fences became very popular; 19 of the 22 BZUCs installed them in their areas during 2006 –2012 with a total length of 140 km. In some communities, the electric fences reduced up to 60% livestock depredation and 70% of crop loss especially from the rhinos (Sapkota *et al.*, 2014). Regular maintenance of the electric fences is necessary to function well, which was the major challenge in Chitwan NP's buffer zone. Banikoi *et al.* (2017) reported only 26% of the electric fences are operational around Chitwan NP, the rest are non-functional due to lack of maintenance. Although BZUC receives funds from the park authority annually, they do not have a practice of allocating funds for maintenance of the fences. During our survey, we also observed that local people sometimes break the fences to enter forests for forest resources.

With the recent failure of the electric fences, the BZUCs are replacing or complementing the fences with the construction of mesh wire fences or concrete walls. During the focused group discussions with community leaders, a majority expressed a preference for construction of fences that are effective for wide range of species, reasonable cost, durable and requiring a low level of maintenance. Among the different types of the fences, most of the community leaders preferred the 5 – 7 feet tall mesh wire fence with 2 – 3 feet concrete base along the forest-settlement borders (Fig 5.7). In areas with frequent elephant visits, they suggested two electric fence wires attached towards the forest side of the mesh wire fence. Along the rivers, dikes with electric fences on the top were proposed.

Figure 5.7 An example of the mesh wire fence communities prefer to construct along the forest-settlement border. The fence has a concrete base of about 2 feet and 5 feet tall mesh wire anchored to the iron poles set in a concrete base.

The fence construction should be synchronized among the BZUCs to avoid the increase of wildlife impact in other areas without fences. In addition to monetary investments of the buffer zone programs, some regulations such as grazing restriction (Gurung *et al.*, 2009) and limits on forest resources collection have also contributed to a reduction of damage caused by wildlife, especially to the livestock depredation around Chitwan NP (Lamichhane *et al.*, 2018a). Because most of the livestock depredation happened within the stalls, some committees (six of 22 BZUCs) recommended a subsidy for predator-proof corrals, especially for goats.

5.4.3. Attitudes of local people towards conservation and buffer zone program

People's attitude towards wildlife conservation was largely positive similar to those reports of previous studies (Carter *et al.*, 2014; Stapp *et al.*, 2016). We found that people's willingness to participate in conflict prevention and mitigation is relatively high compared with the attitude towards current practices of buffer zone and management of human-wildlife impacts. Although attitude index is still towards the positive side (below 3 on 1-to-5 scale), the role of buffer zone programs received least positive response among the categories.

Only ethnicity and the management sector had a significant effect on attitudes of people towards buffer zone programs. Eastern sector of Chitwan is associated with generally

positive attitude, while Kasara sector with negative attitude. The eastern sector received more attention since the establishment of the park and buffer zone activities were initiated here in the 1990s, thus a positive attitude is expected here. In contrast, the Kasara sector has experienced a high number of human (western & central part) and livestock loss (eastern part) caused by wildlife. Although the southern or Madi sector are most affected by the wildlife impacts, their attitude was not significantly different. Hill Tibeto Burmese ethnic groups are involved in more off-farm activities and foreign employment which could have resulted in positive impacts as they have less day to day interaction with wildlife. The positive attitude of lower caste Hindu was not expected but the recent focus of buffer zone programs on underprivileged groups might have been a contributing factor.

The majority of people think wildlife damage is decreasing or not changed over the previous five years as documented in an earlier study based on reported cases of wildlife attacks on humans and livestock (Lamichhane *et al.*, 2018a). Compared to the initial decades of park establishment (Mishra, 1982a; Nepal & Weber, 1995; Sharma, 1991) the wildlife damage has been reduced in recent decade (Dhungana *et al.*, 2018; Lamichhane *et al.*, 2018a; Sapkota *et al.*, 2014). However, about half (44.6%) of the respondents still think there is an increase in wildlife impacts. The reason could be the widespread crop raiding by herbivores. For instance, locals reported herbivores like wild boar, rhino and spotted deer are causing more damage in their life and livelihood compared to carnivores (Lamichhane *et al.*, 2018a). Although different preventive measures are practiced, they seem to be less effective in deterring crop-raiding herbivores, especially wild boar, from entering agricultural areas. The majority of the respondents (55%) were aware of buffer zone activities in their locality but only 40% of them were satisfied with the current interventions. Although a wide range of activities covered by the buffer zone programs over the years, local people suggested to focus on direct interventions to reduce wildlife impacts.

Although ~75% of respondents were aware of compensation for wildlife damages, a large majority (more than 90%) were not satisfied with current practice. They think the process is highly bureaucratic and payment is not sufficient. The Nepalese government has endorsed compensation guidelines to the damages caused by major 14 wildlife species throughout the country (MOFE, 2017). To receive the payment, victims should make an application to the respective park together with 6 – 9 supporting documents based on type of the damage (attack on human, livestock, property damage or crop raiding) including the photographic proof of damage, financial loos assessed by authorized persons, and recommendation from the respective municipality as well as the buffer zone user committee. The parks used to forward the application to regional forest directorates which review the application and releases the funds through the same channel. Recently, the government amended the guidelines and gave authority of fund disbursement to respective park authority. On average, locals received the payments more than half a year after the incident. The compensation payments cannot deliver the intended outcome of increasing the tolerance of wildlife damage when the victims are dissatisfied with the payment in terms of time, amount, and procedure (Nyhus *et al.*, 2005). Respondents have

thus suggested to simplify the payment process and authorize local institutions such as BZUCs, respective parks or local government (municipalities) to make the compensation payments. Moreover, the existing compensation scheme only covers a group of species (tiger, common leopard, snow leopard, clouded leopard, rhino, elephant, gaur, wild water buffalo, bears, wild boar, wild dog, grey wolf, mugger crocodile, Burmese python). Crop raiding by wild boar and chital is reported frequently and was not covered by the compensation guideline during our survey. Loss caused by chitals and wild boars were widespread in the buffer zone, and thus considered too costly for the government to cover, and quantification of the loss is difficult. However, recent amendment of the compensation guidelines in 2018 included the crop loss from wild boar.

5.4.4. Implications for buffer zone policy in Nepal

Our study documented the importance of the buffer zone programs in reducing human-wildlife impacts and encouraging community participation in conservation. It has been more than two decades since the buffer zone program was formally recognized in Nepal (Budhathoki, 2004; Heinen & Mehta, 2000). At present, Nepal is in political transition after promulgation of a new constitution in 2015 establishing a federal democratic republic. Subsequently, a range of policies and institutional reforms has been ongoing within the framework of the new constitution. The position of national parks and wildlife reserves are well defined under the responsibility of the federal government, whereas the status of buffer zone management is not clear. As the buffer zone is part of an integrated system of the protected area, its close association with the respective park is important. However, the buffer zone may fall under the jurisdiction of the state government and the local government (municipalities) based on the constitutional provisions. This could impact implementation of the buffer zone programs.

Along with institutional arrangement, buffer zone management guidelines also need a prioritization of activities. Our study shows the need for increasing investment in direct intervention to reduce human-wildlife impacts. Local residents of the buffer zone in our study suggested prioritizing the buffer zone activities to minimize wildlife impacts on people and increase access to forest products rather than emphasizing community development. There are various government line agencies to carry out the development works. Thus, we recommend amendment of the buffer zone management guidelines with the provision of 25 – 50% of the buffer zone budget in direct interventions of conflict prevention and mitigation. Recently, Shivapuri-Nagarjun National Park next to Kathmandu (capital city of Nepal) has developed separate guidelines for its buffer zone management allocating 25% for the prevention and mitigation measures of human-wildlife impacts. This could be adopted by other buffer zones of the national parks and reserves in Nepal.

5.5. Conclusion

Our study has several implications for conservation policy particularly on designating buffer zones and prioritizing actions. First, prioritizing the buffer zones programs in

direct interventions to reduce wildlife impacts by provisioning a certain portion (25 – 50%) of buffer zone funds will benefit the local community as well as reduce the conflict. The communities preferred to construct the 5 – 7 feet tall mesh wire fences with 2 – 3 feet concrete base along forest-settlement border through buffer zone funds. Second, improving the benefit-sharing mechanism by targeting the most affected communities will result in the intended benefits of the buffer zone programs (Spiteri & Nepal, 2008). Similarly, compensation payment should be revised to cover all conflict-causing wildlife and payment procedures should be simplified by giving more responsibility to buffer zone user committees, local government bodies like municipalities or the respective protected areas. We also recommend a systematic review of the current implementation of buffer zone programs to understand existing problems and design improved strategies for local engagement in wildlife management and conservation in the changing national and global context.

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A human dummy constructed on the pole of electric fence to scare animals away (Photo by Pabitra Gotame/NTNC-BCC).