HUMAN-TIGER CONFLICT IN AND AROUND THE CHITWAN NATIONAL PARK, NEPAL

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RECOMMENDATIONS

This is to recommend that the thesis entitled **"HUMAN-TIGER CONFLICT IN AND AROUD THE CHITWAN NATIONAL PARK, NEPAL"** has been carried out by **Sarada Thapa** for the partial fulfillment of Master's Degree of Science in Zoology with special paper "Ecology". This is his/her original work and has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree in any institutions.

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LETTER OF APPROVAL

On the recommendation of supervisor Prof. Dr. Tej Bahadur Thapa, this thesis submitted by Miss Sarada Thapa entitled "**HUMAN- TIGER CONFLICT IN AND AROUND THE CHITWAN NATIONAL PARK, NEPAL**" is approved for the examination and submitted to the Tribhuvan University in partial fulfillment of the requirements for **Master's Degree of Science in Zoology** with special paper **Ecology**.

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CERTIFICATE OF ACCEPTANCE

This thesis work submitted by **Sarada Thapa** entitled **"HUMAN-TIGER CONFLICT IN AND AROUND THE CHITWAN NATIONAL PARK"** has been approved as a partial fulfillment for the requirements of Master's Degree of Science in Zoology with special paper Ecology.

EVALUATION COMMITTEE

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DECLARATION

I hereby declare that the work presented in this thesis has been done by myself, and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by reference to the author(s) or institution(s).

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ABSTRACT

Human-tiger conflict is one of the most important concerns in tiger conservation, necessitating a focus on effective mitigation measures. Conflict occurs where Tigers and human utilize the same habitats and resources which posses a great challenge to the wildlife managers and conservationists and local residents alike. The study was conducted in and around the Chitwan National Park to investigate the nature, causes, and effectiveness of conflict mitigation measures. Data were collected by means of compilation of park data, household interviews (n=140), questionnaires, interview, field observation. The nature and extent of human-tiger conflict in the study area had a significant impact on humans and livestock. Of 140 households surveyed, 56% reported 93 livestock losses in between 2013-2018. The study revealed that average livestock depredation was 15.50 (n=87) animals per year and among them goats were highly depredated (42%) animals. Livestock depredation was affected by seasonal variation. More the half (51%) of the depredation was found in summer season where the highest loss was reported in the month of July. A total of 13 people were killed and five got injured by Tiger attacked during six-year of time period. Out of which about 78% of casualties occurred outside the park area. Twenty-three Tigers died within the short period of time from 2013-2018, whereas two got killed as revenge of killing by local and most of species' death were unknown because of poor management of government and related authorities. Although, the eastern sector Bachchhauli lost fewer livestock as compared to the Southern sector of Ayodhyapuri where most of the local people used park area for grazing the livestock. Within six years, the estimated economic loss for human casualties was US$ 64852.48 and US$ 11349.19 for livestock loss. This study also addressed local people's perceptions of the conservation of protected areas and wildlife, allowing them to describe the values they hold for the areas. Higher local values and tolerance were significantly influenced by education, and male younger with access to information and awareness were mostly supportive of Tiger conservation. Furthermore, living close to the forest and utilizing a high level of resources resulted in a lower level of tolerance for Tigers. Conservation education as well as adequate compensation programs for losses, local participatory approaches and regular monitoring and proper park management coordinating with stakeholders, are recommended as conservation techniques that may help to minimize conflicts and increase positivity for the long-term conservation of Tiger.

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOGRAPHS

ABBREVIATION

HTC	:	Human Tiger Conflict
HWC	:	Human Wildlife Conflict
IUCN	:	International Union for Conservation of Nature
DNPWC	:	Department of National Parks and Wildlife Conservation
MoFAGA	:	Ministry of Federal Affairs and General Administration
PA	:	Protected Area
BNP	:	Bardia National Park
BZUC	:	Buffer Zone User Community
WWF	:	World Wide Fund for Nature
CNP	:	Chitwan National Park
VDC	:	Village development committee
TAL	:	Terai Arc Landscape
UNESCO	:	United Nations Educational, Scientific and Cultural Organization
CITES	:	Convention on International Trade in Endangered Species of Wild Fauna and Flora
NPWC	:	National Park and Wildlife Conservation

1. INTRODUCTION

1.1 Background

Human-wildlife conflict (HWC) is defined as the interaction between humans and wildlife where negative consequences, whether perceived or real exists for both parties when action of the one has an adverse effect on the other party (Conover, 2002; Decker *et al*., 2002). Human-wildlife conflict arises when humans and animals compete for the limited resources (Graham *et al.*, 2005; Wang & Macdonald, 2006). Human- carnivore conflicts that leads to direct persecution causing increased mortality and the risk of extinction is one of the best known stumbling blocks in the conservation of the certain carnivores species (Treves and Karanth, 2003). Where wild Tiger populations survive and come into contact with landscape by dominated by humans, they pose a threat by preying on livestock and less commonly on people. Conflicts between people and wildlife have been widely recognized as one of the most challenging issues for wildlife conservation worldwide (Woodroffe *et al*., 2007). The continuous increase in the human population result in competition between people and wildlife for the shared but limited resources, which manifests as various types of conflicts, such as crop raiding, livestock predation, property damage, human death and injury and the retaliatory killing of wildlife (Graham *et al*., 2005; Inskip *et al*., 2009). So, human casualties and livestock depredation are the most serious nature of conflicts.

According to the 2003 International Union for the Conservation of Nature (IUCN) World Parks Congress, human- wildlife conflicts occur when wildlife requirements encroach on those of human populations, with costs both to resident and wild animals (IUCN, 2005).Conflicts have negative impacts on the conservation of wildlife populations or of their environment and social, economic or cultural life of the humans (WWF, 2005). The negative consequences for the local people include attack upon humans (Loe and Roskaf, 2004; Jadhav and Barua, 2012), depredation of livestock (Thirgood *et al*., 2005), destruction of stored harvest or crop raiding (Karanth *et al*., 2012) and spread of the zoonotic diseases to the humans or stock (Daszak *et al*., 2000; Singh and Gajadhar, 2014; Hagglin *et al*., 2015). Large carnivore, humans and their livestock have coexisted for millennia but recent decades have seen a dramatic increase in the frequency of human-carnivore conflicts resulting, primarily,

from the exponential growth of the human population (Graham *et al*., 2005). Human-Tiger conflict (HTC) is prevalent in almost all parts of the Tiger's distribution range already contributing to the extinction of Balinese *(Panthera tigris balica)* and Javan (*P. t. sondaica*) (Saidensticker, 1999). Large carnivores play a significant role in ecosystem functioning, with their absence inducing changes in predator–prey relationships and inter-specific competition (Treves and Karanth, 2003). Many carnivores serve as important umbrella and flagship species, benefiting other threatened species and attracting funding for wider conservation benefits (Linkie and Christie, 2007).

During the recent decades, conflict mitigation measures such as compensation payments, Tiger removal, zoning, insurance schemes, relocation of outside core areas and livestock husbandry improvement have been common in many areas (Seidensticker, 1999; Goodrich *et al*., 2011). Several measures, ranging from the distribution of compensation and the promotion of wildlife deterrents to support the livelihoods of people have been implemented to foster the co-existence of humans and wildlife (Dickman *et al*., 2011). In Chitwan National Park, the problems have been well known for many years. So the conflict become extremely controversial when the people are attacked by those species which are endangered and legally protected which lead people often retaliate by killing the animals involved in such conflicts (Treves *et al*., 2014). The Buffer Zone Management Committee of the Chitwan National Park (CNP) and the Bardia National Park (BNP) are allocating small amounts of money as compensation for livestock depredation and human casualties (Bhatta *et al*., 2007) to support the livelihood of the people and implement the co-existence between both humans and wildlife (Gore *et al*., 2008). In CNP, the compensation scheme which was began in 1998 after the declaration of buffer zone, is an attempt to reduce animosity towards wildlife and economic hardship among the local communities (Dhakal e*t al*., 2015). More systematic compensation payments however began with the promulgation of compensation guidelines in 2009 (GoN, 2013). 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 Protected area of Nepal is typically surrounded by the buffer zones with marginal habitats and high human density (Spiteri and Nepal, 2008; Gurung *et al*., 2008). Human deaths by Tigers in and around CNP

have increased six fold from an average annual death of 1.2 (1979-1998) to 7.2 (1998-2006) (Gurung *et al.,* 2008). Between 2007 & 2014, an average 4 persons have been killed and 2.7 injured per annum. In the same period an average of 44 livestock killed per annum (Dhungana *et al*., 2017).In recent years, increased Tiger population with reduced poaching and forest regeneration in community forests in buffer zones has increased the possibility for human-Tiger conflict (Wegge *et al*., 2016; Chanchani *et al*., 2014; Gurung *et al*., 2008). One of the core Tiger areas in TAL, the Chitwan National Park (CNP), currently supports >100 Tigers (Walston *et al*., 2010; Karki *et al*., 2015). The TAL-Nepal strategy plan 2004–2014 (HMGN/MFSC, 2004) and the second Nepal-Tiger Conservation Action Plan (DNPWC/MFSC/GoN, 2007) identified human–Tiger conflict as a major threat to Tiger conservation**.**

For instance, the rapid success of community forestry programs nationwide and the initiation of conservation of buffer zone forests adjacent to the parks and reserve after the 1990s, created the additional habitat beyond the National Parks and Reserves, and the consequential movement of wildlife in these newly developed habitats resulted in increased frequency of human-wildlife confrontation (Gurung *et al*., 2008). Many studies have been conducted on human- wildlife conflicts in the different location of world. But the nature and extent of conflict is different from place to place (Treves, 2007) whereas mitigation measures applied due to the conflict may be different in different areas because of socio-political, cultural, economic and geographic situations (Graham, 2005). Human-Tiger conflict is prevalent in almost all part of Tigers' distribution range. Mortality caused by the Tiger is one of the greatest threats to the persistence of Tiger population and resolving this conflict is one of the key to their survival (Gurung *et al*., 2008). Chitwan National Park is one of the best priority Tiger conservation which harbors the largest and increasing number of Tiger population of Nepal so it serves as the sources of population of Nepal so it serves as the sources of population for surrounding landscape of Nepal and India (Karki *et al.,* 2015). Most of the protected area in Nepal is surrounded by buffer zone with marginal habitats and high human density (Spiteri & Nepal, 2008; Gurung *et al*., 2008). Tigers need large territory for their survival, though younger and older are often driven out of the core habitats into the nearby buffer zone by mature and dominant resident Tigers (Silwal *et al.*, 2016). Both the older and younger Tiger living in the marginal habitats most likely to come in conflict with human and

livestock reared by local residents (Gurung *et al*., 2008). Most previous studies regarded the entire Tiger population as conflict causing with the general assumption that when the population of Tiger increases, conflict also intensifies. This study provides insight into the existing scenario of human-Tiger conflict in greater depth in the buffer zone and park area and suggests conservation and management strategies to reduce human-Tiger conflicts.

1.2 Conservation of large predators

Large carnivores, which comprise big cats, play important role in maintaining the ecosystem by the way of predation and inter-specific competition (Treves and Karanth, 2003). Loss of apex predators has profound effects on terrestrial ecosystem potentially resulting in destabilization of herbivores- plant interactions, reduction of diversity and loss of resilience within ecosystem (Ripple *et. al*., 2014). The protection of the big cats is consequently vital to the conservation of many other rare and threatened species as well as to sustaining essential ecosystem –services (Graham, 2003) that forests provides, including watershed protection, soil conservation and water recharge and carbon storage.

1.3 Ecology, population distribution and conservation status of Tiger

1.3.1 Ecology

Tigers are able to persist in a very wide range of habitat conditions such as hot dry forest, tidal mangrove swamps, tropical rain forest and temperate forest zone (Sunquist *et al*., 1999). Tiger populations are not only affected by prey densities but also dependent on prey sizes (Baral, 2005). The pattern of the space used by the Tigers has been determined by radio-tracking in Nepal's Chitwan National Park and the Amur region of Russian Far East (Goodrich, 2010). Adult female Tigers occupy exclusive territories in which they raise their young and the ranges of adult males may overlap several females (Sharma *et al*., 2010). The size of the home range mainly depends on prey abundance, geographic area and sex of the individual and almost exclusively carnivorous, Tiger will occasionally eat vegetation for dietary fiber such as fruit of the slow match tree and they are thought to be mainly nocturnal predators (Jackson and Nowell, 2011).

1.3.2 Population distribution

The Tiger is an iconic, charismatic and umbrella species of certain terrestrial ecosystem which faces threats through habitat loss, human Tiger conflicts liking poaching, illegal trading of the body parts (Dhakal, *et al*., 2015). With incredible strength, imposing appearance and also loud roar with unparallel beauty Tigers are the largest cats in the world, easily recognized by their distinctive coat with the characteristic pattern of dark vertical stripes on reddish –orange fur with a lighter underside (Karanth *et al*., 2017). However, they now face severe threats that could take them to extinction if conservation efforts do not give the results as expected. The Bengal Tiger which was once ranged widely across Asia from eastern Turkey and Transcausia to the Altai Mountains, Lake Baikal and the coast of the Sea of Japan and in the south from the Indian subcontinent across the Southeast Asia to Sunda Island of Sumatra, Java and Bali (Jackson, 1998). Tiger population is essentially associated with forest habitats. And its distribution is closely tied to the density and distribution of ungulates species (Seidensticker *et al*., 1999). In 2008 Nepal had 121 Tigers, which now has reached 235 in number as neared the target of doubling the number of Tigers.

1.3.3 Conservation status

Conservation attempts to prevent the animals from being extinct and preserves its natural habitats. Wild Tigers are in a precarious condition now a day (Damania *et al*., 2008). Destruction and fragmentation of their habitats became the major issue, restricting them to the isolated pockets within their historic range (Dinerstein *et al*., 2007). Poaching Tiger for fur and other body parts has also become increasingly problematic over the last few last decades (Chapron *et al*., 2008), and conflicts with human is known causes of declining the population of Tigers (Nyhus & Tilson, 2004; Gurung *et al*., 2008). Human-Tiger conflict exists throughout the world and the intensity of the conflict is high where the Tiger habitat is surrounded by the human population densely (Nowell & Jackson, 1996; Nyhus & Tilson, 2004). Restoring of wild population and retaliatory killing of Tiger population are the most important needs of these big carnivores in their conservation (Mishra *et al.*, 2009). For Tigers, the 20th century was an extremely bleak time during which they were eliminated from 93% of their historic range. Of the 10 organized Tiger sub species (One of which became

extinct in prehistoric time), three species; the Bali, Java Tigers of Indonesia and more widespread Caspian Tiger were completely wiped out by the late 1970s (Seidensticker *et al*., 1999; Nyhus & Tilson, 2004). Of the six subspecies that remain; Malayan, South China and Sumatran Tigers are Critically Endangered, while Bengal, Indochinese and Siberian Tigers are currently listed as Endangered. The Tiger is a symbol of wilderness and wellbeing of ecosystem. Conservation of Tiger attempts to prevent animals from being extinct and preserve its natural habitat as the Tiger is the apex predator that keeps the food chain in balance by preventing the forest from being grazed. Saving Tiger therefore is analogous to saving the ecosystem, which is crucial for man's own survival. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has played crucial (important) role in improving international efforts for Tiger conservation. One of the biggest threats to the Tiger conservation is habitat fragmentation. Global Tiger Day is also known as International Tiger Day, is an annual celebration to raise awareness for Tiger conservation, held annually on July 29. The main goal of the day is to promote a global system for protecting natural habitats of Tigers and raise the public awareness and support for Tiger conservation issues.

1.4 Conflict mitigation

Nepal has experienced enormous challenges in conserving the country's biodiversity from mountains to the Terai. The modern concepts of scientific conservation started only after the formulation of National Parks and Wildlife Conservation (NPWC) Act of 1973 (Wagle, 2009). By the time of fourth amendment of NPWC Act of 1973 in 1993, declaration of buffer zone was started which envisioned the participation of local people in conservation. Mitigation measures around the buffer zones and adjoining of National parks have ranged from traditional methods of shouting and watch towers to modern barrier such as electric fencing. Measures employed to mitigate HWC in the buffer zones and adjoining areas of the Chitwan National Park (CNP) have ranged from traditional methods of shouting and watch towers to modern barriers such as electric fencing. Several kilometers of these electric fences have been constructed along the boundaries of the park and community forests in the buffer zones and adjoining areas of the CNP to mitigate conflicts from mega fauna such as the elephant and rhino. In Nepal, various conventional and innovative measures have been

practiced in mitigating issue of conflicts associated wild animals. Some important measures are construction of barbed wires with fences, watch tower in the field, power fencing, predator proof canal program etc. Among the policy measures that adapted to the issue of conflict associated wild animals is fourth amendment of NPWC Act 1973, in 1993. Act 1973, in 1993 that plough back of up to 30-50% of revenue generated from the PA to the community. Amendment of Forest Act (2049 BS) second time in 2016 also included relief provision for the wildlife damage. Similarly, Fifth Amendment (2017) of NPWC Act (2029 BS) incorporated provision to establish the wildlife rescue center or hospital for the conflict associated wild animals. Also, the enactment of International Trade in Endangered Wildlife and Plant Control Act (2074 BS) for implementing CITES provisions also facilitated to manage the conflict associated wild animals in Nepal. The government endorsed Wildlife Damage Relief Guidelines (2010) to provide direct support to the victims of conflicts associated wild animal. Currently, 14 species are recognized as conflicts associated wild animal namely Tiger, Rhino, Elephant, Leopard, Snow leopard, Clouded leopard, Wolf, Wild dog, Bear, Water buffalo, Mugger crocodile, Python, Gaur and Wild Pig (GoN, 2074).

1.5 Objectives of study

1.5.1 General objective

- To study the human- Tiger conflict in Chitwan National Park.

1.5.2 Specific objectives

- To assess the temporal loss of livestock and human casualties by Tiger,
- To determine the loss of Tiger due to Human-Tiger conflict and assess the causes of Tiger being killed,
- To understand the perception of local people and the effectiveness of the conflict management through mitigation measures in Chitwan National Park.

1.6 Rationale of study

Human-Tiger conflict is one of the problematic issues world-widely in the field of the conservation. The Tigers are the prominent predator species causing the conflict and are commonly considered as a threat to the human safety and livestock. HTC could result in impact to both humans and Tigers. Livestock predation and attacks on humans by Tigers lead to a negative attitude toward Tigers and their conservation. Therefore, the livestock depredation and human casualties and the loss of the Tiger resulting from HTC are necessary to address for overall success of the study. Moreover, this study provides information about the comparative loss of livestock between Bachchhauli and Ayodhyapuri which was more affected by summer season and human casualties by Tiger in the study period and perception of the local people towards the conservation as well as satisfaction level of the compensation. The possible mitigation strategies for peaceful co-existence between human and Tiger should be created through awareness program and local participation in the field of conservation and reduction of human settlement encroachment into the National Park range and also providing the compensation for the losses. As well as, it emphasizes the exploration of the conflict situation throughout the country and the adaptation of necessary mitigation measures for the HTC over the long period of time.

2. LITERATURE REVIEW

The impact of human-wildlife conflict on people often included depredation on livestock and human injuries and death. The loss of the human life is the greatest in South Asia, especially the Sundarbans in Bangladesh and India, where dozens of people are killed per year (McDougal, 1987; Gurung *et al*., 2008). According to Nyhus and Tilson (2010), 146 people were killed, 30 wounded and 250 Tigers were killed in response to Tiger attacks during the period 1978-1997 on Sumatra. The loss of the life is the Conflicts around the parks are rooted in the premise that the parks are area without human habituation, which is based upon a North American model of conservation (Nelson, 1987; Nepal and Weber, 1993). The introduction of national parks with a strict definition of conservation has entangled people who traditionally maintained control over resources in conflicts. When local people's access to resources is cut off because of national parks, their attitude towards the park authorities turns negative. There are many cases of conflicts between park officials and local people regarding the resource restriction (Shrestha, 1995). Such unenthusiastic relations between parks authorities and local people make more intense about the illegal activities inside the protected area such as hunting, collecting the forest products, burning and poaching (Johnnesen, 2004). It is also the most widespread and complex challenge currently facing conservationists globally (Shrestha *et al*., 2008). Nelson *et al*., (2003) attributed the root causes of the Human-wildlife conflict to lack of or improper land use planning while Fernando *et al*., (2005) argued that Human-wildlife conflict results from the conversion and fragmentation of wildlife habitats by human for agriculture, development projects and animal husbandry. The greater one- horned rhinoceros (*Rhinoceros unicornis*), wild boar (*Susscrofa*), Asian elephant (*Elephus maximus*), Tiger (*Panthera tigris*), and leopard (*Panthera uncia*) are the main wildlife species involved in human-wildlife conflicts in the buffer zones and surrounding areas of Chitwan National Park (Sapkota *et al*., 2014; Silwal *et al*., 2017). And farmers have lost their economic livelihoods because of they had to abandon their crop fields due to persistent wildlife destructions.

2.1 Livestock depredation

Tigers usually attack domestic animals as prey in their territory where wild prey has been depleted usually due to hunting, habitat degradation and competition with livestock (Madhusudan and Karanth, 2002). Livestock depredation is not the recent phenomenon caused by the establishment of protected area and protection laws as commonly believed (Jackson, 1998). Depredations on domestic animals are most common type of HTC. Tigers and leopards were identified as livestock depredators in Chitwan National Park (Mishra *et al*., 2003) and in Bardia National Park. In Chitwan National Park, Jackel (*Canis aureus*), Indian fox (*Vulpes vulpes*), common mongoose (*Herpestesspp*) and Jungle Cat (*Felis chaus*) have been reported as livestock lifter. According to Bhadauria and Singh (1994) the frequency of domestic livestock being killed by Tiger increases during rainy season. Elliot *et al*., (2008) concluded that Human- wildlife conflict is the argumentative situation between humans and wild animals, usually resulting crops and livestock depredation, property damages, human injuries and retaliatory killing or capturing of wildlife. Sijapati *et al.*, (2021) concluded Tiger and leopard as the main livestock depredator by depredating the large number of the hoofed livestock near the Bardia National Park.

2.2 Human casualties

The encounters with wild animals in and around the protected area were common (Nepal and Weber 1993), which included human injuries and loss of property due to elephant in Shuklaphanta Wildlife Reserve and Rhinoceros in Chitwan National Park. Srivastav (1997) recorded 164 man-leopard encounters in Sundarban Tiger Reserve. Treves *et al.* (2003) concluded that Human-carnivore conflict and perspective of carnivore management worldwide. Successful conservation of carnivore depends on tolerant sociopolitical lands cape and favorable ecological because human have caused most of the carnivore mortality worldwide and most of the extirpation of carnivore population. Karanth *et al*. (2015) suggested that offsetting economic loss of the locals and enhance public participation are put in place to meet the integrated conservation and development goals in a landscape where human-wildlife can co-exist.

Treves *et al*., (2007) concluded that vulnerability and access to the benefits of wildlife vary from community to community and delivering the collective community-level benefits alone is not enough to captivate the interest and commitment of all the individuals to tolerate and protect wildlife. Gurung *et al*., (2008) studied that factor associated with human killing Tiger in Chitwan National Park. Human death increased significantly due to the Tiger attack from 1.2 to 7.2 per year from 1998-2006. People mostly killed were grass and fodder collectors within 1 km from the forest due to the sociological and ecological aspects. Bhattarai *et al*., (2014) studied that Human-Tiger conflict and its perception in the Bardia National Park and concluded livestock predation rates were particularly high in the areas with low abundance of the natural prey and also annual loss of the livestock attributable to the Tiger was 0.26 animals per household, amounting to an annual loss of 2 % of livestock.

2.3 Conflict management

Treves *et al*., (2007) concluded that mitigation of human-Tiger conflicts based on the participatory methods and co-management with twin objectivities of wildlife conservation and safeguarding human security. Wildlife corridor must consider the economic and political implications when wildlife forage on crops, attacks livestock, or threaten human. Mishra *et al*., (2009) studied the participatory rural appraisal and compensation intervention with challenges and protocols while managing the large- carnivore-human conflict. Dhungana *et al*., (2016) showed an assessment of the mitigation measure and removal of the Tiger from the National Park and its buffer zone. The compensation payment used in-between 2007-2014 around Chitwan national park included about more than half (65%) for human casualties, (29.3%) payment for livestock depredation and (5.7%) for human injuries of total amount US 93618 per year and during these year 15 Tigers removed from the wild for conflict reason. Thus, to ensure the success of conservation efforts, there is need to ensure the benefits to the local people are panoramic and all, embracing , since dissatisfaction from a single individual living with wildlife can lead to the conservation initiatives (Hazzah *et al*., 2009;Bowen-Jones, 2012). Bhattarai and Fisher (2014) studied the management practices for human-Tiger conflict from Chitwan National Park and Bardia National Park by implementing an innovate solution to prevent conflicts through compensation, community based programs for the conservation of Tigers. Dahal *et al*., *(*2020) showed an assessment of

Human-Tiger conflict and community based mitigation effort in Madi valley of Chitwan District through Predation proof corrals, mesh wire fencing, traditional fencing using white cloths and livelihood diversifications were the major local mitigation efforts adopted by local people. Baral *et al*., (2021) characterized the management of the Human-Tiger conflict in the mid hill outside the protected areas of Gandaki provenance by carrying out habitat management program within forest to increase prey availability to decrease the wildlife invasion into human settlement area, and decreasing dependency of people on forest resources by providing alternative livelihood opportunities. A study conducted by Lamichhane *et al*., (2017) in CNP showed that implementing conflict mitigation measures (solar fence, concrete/mess wire fences), community awareness program, and reduction on forest dependency along with livelihood diversification (increased off-farm household income and reduced grazing on forests) have essentially helped lessen the damage from wildlife including Tigers.

3. MATERIAL AND METHODS

3.1 Study Area

This study has been conducted in the first National Park in Nepal which was established in 1973 and granted the status of World Heritage Site in 1984. National Park covers an area of 952.63 sq.km and is located in the subtropical inner Terai lowland of south-central Nepal in the districts of Nawalparasi, Chitwan, Parsa and Makwanpur. It lies between 27.16.56-27.42.14' latitude and 83.50.23-84.46.25' longitude. The altitudes range from 110-850 meters above sea level. The Park is bounded by the Rapti and Narayani rivers in the north, Parsa Wildlife Reserve in the east and Madi settlements and Indian boarder in south. The physiographic of the park consists of the Terai and Siwaliks. Three major rivers Narayani, Rapti and Reu and their floodplains and several lakes and pools are the major water resources of the protected area. The Park is one of the last surviving natural ecosystem of Terai region that provides critical habitats for several globally endangered species notably; Tiger (*Panthera tigris*), One-horned rhinoceros *(Rhinoceros unicornis*), Gharial crocodile (*Gavialis gangeticus*). Buffer zone management in CNP is regarded as a successful program in Nepal. The Buffer zone concept was developed by United Nations Organization for Education, Science and Culture (UNISCO) to provide an additional layer of protection around protected area as well as to balance the development needs of local people and conservation objectives of protected areas (Bajracharya, 2009). In Nepal, this concept has been adopted as a national strategy to address the issues between the parks adjacent communities to ensure an optimal balance between the long-term conservation objectives and immediate needs of local residents (DNPWC, 1966). The buffer zone has population about 260,352. The majority of inhabitants depend on the forests resources for farming and livestock rearing. In CNP, buffer zone has been divided in 21 user communities and one sub-user community as management units, which together form buffer zone management communities as the apex of body. These communities are instrumental in mobilizing funds and involving people in conservation. Buffer zone is an area in and around protected area that can be considered as an impact zone, and includes the area directly affected by use of forest prohibited use of forest products of protected area, grazing in the protected area and wildlife of protected area regularly or occasionally. Additionally, legislation has provided for benefits of sharing mechanism for

implementation of conservation and community development programs related to institutional development, alternative natural resources development, capacity building, financial management, conservation education and awareness, gender and special target group mainstreaming (DNPWC, 2015).

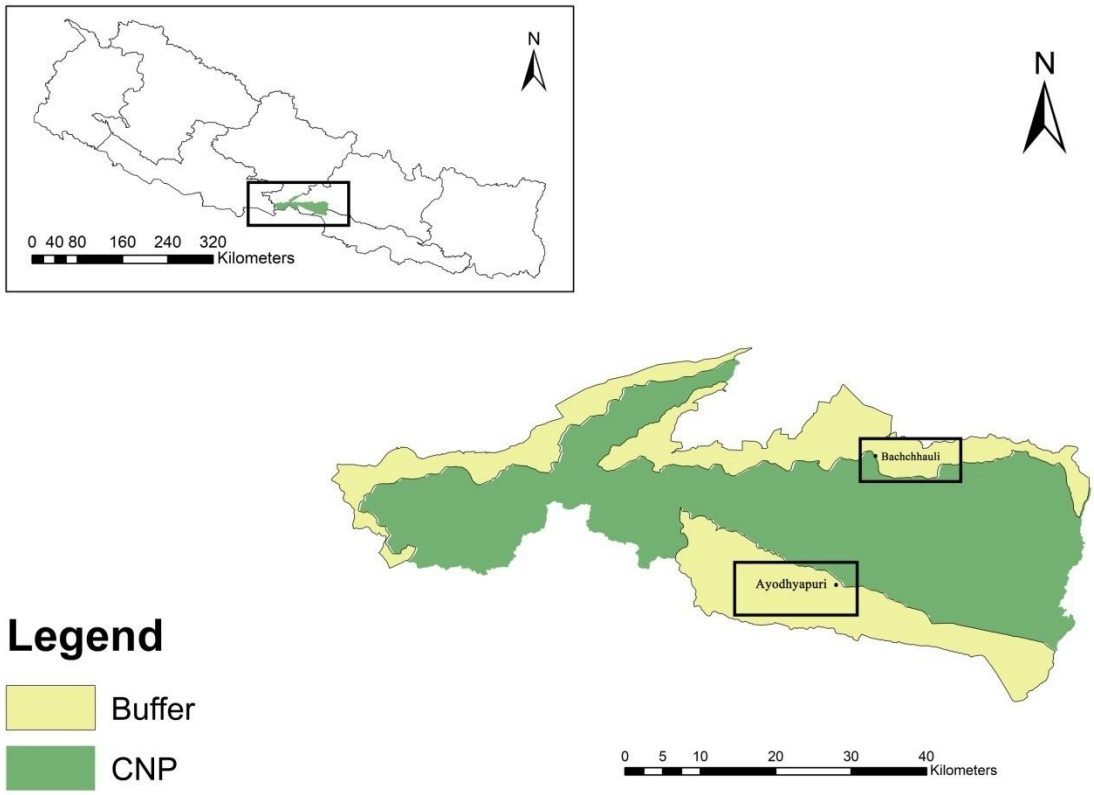

Figure 1: Map of the study area (Source: DNPWC)

3.1.1 Geology, hydrology and ecology

The Park has a range of climatic season each offering unique experience. Chitwan has tropical monsoon climate with high humidity all through the year (Gurung, 1983). The area is located in the central climatic zone of Himalayas where monsoon starts in the mid-June and eases off in the late September when rivers become flooded and most of the roads are virtually impossible. During these 14-15 weeks, most of the 2500 mm yearly precipitation falls, it is pouring with rain. Also between September and November, and February and April, migratory birds join the residential birds and create spectacular bird watching

opportunities. While the monsoon rains bring lush vegetation, most trees flower in late winter. The Palash (*Butea monosperma*) tree, known as the "flame of the forest" and silk of cotton tree have spectacular crimson flowers that can be seen from a distance.

3.1.2 Wildlife and vegetation

The Chitwan National Park is characterized by tropical and subtropical forests. The typical vegetation of Inner Terai is Himalayan subtropical broadleaf forests with predominantly Sal (*Shorea robusta*) tress covering about 70% of National Park area .Grasslands cover 20%, riverine forests 7% and mixed forest 3% (UNESCO/IUCN, 2005). The remaining vegetation types include Sal with Chir pine (*Pinus roxburghi*). The riverine forests consist of Khair (*Acacia catechu*), Sissoo (*Dalbergia sissoo*) and Simal (*Bombax ceiba*). The grasslands are mainly located in the floodplains of the rivers and form diverse and complex community with over 50 different species of grasses including elephant grass (*Saccharaum spp*), rewoned for its immense height up to 8meter in height. Kans grass (*Saccharum spontaneum*) is one of the first grasses to colonize new sand banks and to be washed away by the yearly monsoon floods (Shrestha *et al*., 2008).Seasonal bushfires, flooding and erosion evoke an ever-changing mosaic of riverine forest and grasslands along the river banks. On recently deposited alluvium and in lowland areas groups of catechu with rosewood predominate, followed by groups of kapok with rhino apple trees (*Trewia nudiflora*), the fruits of which rhinos savour so much (Dinerstein *et al*., 2007).

CNP consists of a diversity of ecosystem including the Churia hills oxbow lakes and the flood plain of the Rapti, Reu and Narayani rivers. CNP is a dense forest in the south of central Nepal with taste of wilderness and rich in ecosystem which is in subtropical low land of Terai and is a homeland to various species of animals. It is actually a wildlife sanctuary that treasures the numbers of rare species of birds and animals. It offers wide varieties of mammals, birds, reptile and water animals and many more. As being the heart of the jungle, it treasures a number of endangered species of animals like one horned Rhino, Bengal Tiger etc. An area includes other animal species like Languor monkeys, wild boar, sloth bear jungle cats, pythons, crocodiles, elephants and different species of deer and over 500 species

of birds. CNP is included under the list of UNESCO heritage sites therefore hold the pride of visiting the UNESCO listed sites in its natural and undisturbed habitats.

The sight of animals walking together in their own herd, monkeys feeding their babies monkeys, rhino drinking water in the bank of Rapti river, are the best attraction of National Park. The wide range of vegetation types in the CNP is territory of more than 700 species of animals. Among them, Chitwan boasts 68 different types of mammals including Rhino (*Rhinoceros unicornis*), Tiger (*Panthera tigris*), three types Deer, Elephant (*Elephus maximus*), Leopards (*Panthera pardus*), Sloth bears (*Melursusur sinus*), Wild boar (*Susscrofa*) and Hyenas (*Hyaenas)* as large species (CNP Office 2015). Apart from the King Cobra and Rock Python, 17 other species of snakes, starred tortoises and monitor lizards occur.

3.2 Methods

The study was carried out in two buffer zones user committees of two village development committees of CNP (figure 1). Two municipalities were randomly chosen around the park. The Park is being divided into four management sectors: Eastern sector, Central, Western and Southern sectors. From eastern sector, Bachchhauli site having an area of 2111.12 ha with the population of 10,905 and 2321 households (National population census, 2011) which is the closest to the CNP and also has mixed community predominantly of consisting of Tharus, Brahmins and Chhetri. It is the major trade areas which are recognized as the famous tourists' hub in the Eastern sector of CNP. The majority of the residents are Tharus who are indigenous and have predominantly live in Terai lowland plain regions. The communities are culturally vibrant and agriculture is the main occupation with wheat, maize, rice and sugarcane as the major crops cultivated. From Southern sector of Madi, the study area Ayodhyapuri was selected with the population of 10693 and 2555 individual households (National population census, 2011). Madi valley is interesting area because it is completely surrounded by the park in the north-east and BZCF to the south-west which created an isolated human settlement. The area of Chitwan belt with heavy forests resources was cleared for settlement about 50/55 years ago (Bhattarai, 2004).

3.2.1 Analysis of complaints records

The time series of data on human casualties and livestock depredation by Tiger were obtained from the government records of national parks , news reports and confirmed through key person interviews with park authorities, nature guides and buffer zone user committees' representatives. Similarly data on the loss of Tiger due to conflict was also obtained from the national park administration office and other park officers.

3.2.2 Sampling of household

The study area focused on the two sectors of buffer zones where electric fences have been installed along the boundaries of CNP, farmlands, community forest with settlements. There are seven municipalities in Chitwan, from which two municipalities one from eastern sector and one from southern sector were selected using lottery methods. From eastern sector, Bachchhauli area, two ward, smallest unit as village and from Ayodhyapuri two ward, smallest unit as villages were selected for questionnaire survey. A total of 140 households, 70 from each municipality each 3rd of the house was selected randomly and all these names of households were provided by the municipality office. Total 70 households were chosen randomly from each area for survey.

3.2.3 Questionnaire

Before conducting the formal survey, the questionnaires were tested in randomly selected households in the study area and necessary modifications were made. The structural self-administered questionnaire survey was used to collect data on HTC. All questions were close ended (closed ended questions have multiple options and respondents required to choose one from these options, therefore respondents are directed to the interviewers own set response, whereas open ended questions have no options and respondents are required to answer themselves) for simplicity in quantitative analysis (Annex A). The questionnaire comprised three sections: household information, buffer zone activities and wildlife depredation issues. The interviews were conducted in Nepali and responses were translated into English and verified prior to statistical analysis.

3.2.4 Key person interview

Key informant interviews were conducted with selected informants who were related on park resources. Interview was held with park manager, nature guides and local community, and also with local officials within buffer zone and community forest to explore the nature of human-Tiger conflict. These community experts, with their particular knowledge and understanding, could provide insight on the nature of problems and give recommendations for solutions. The questions regarding the conflict management, causes of conflict and their role in the mitigation of conflict were asked with them personally (Annex B). In addition, an interview was organized with protected area managers to share their understanding of human Tiger conflict management strategies, compensation scheme and management of Tiger problem related with study.

3.2.5 Data analysis

All the raw data obtained from various sources were analyzed qualitatively and quantitatively to summarize the output. The data obtained from the study was interpreted based on the survey questionnaire, interview and field observation. Before entering to the data into the Microsoft excel, each questionnaire was given an identity number. After completion of data entry into the Excel sheet, the data was imported into SPSS (Statistical Package for Social Science) to analyze all the quantitative data. The data was analyzed by using simple descriptive statistics such as mean percentage and the data was present on tables, charts, picture and percentage also further represented by using graphs and other diagram in order to analyses more information about research study. To understand the relationship between the attitude of the people in the Tiger conservation and education level, the Pearson Chi-Square applied. All the information obtained through primary, secondary sources were complied, processed, analyzed and well interpreted and finally included in to the results of the report.

4. RESULTS

4.1 Livestock depredation

The local people in the study area were mostly farmers who harvested crops such as paddy, maize, wheat, potato, lentils. In general, every household keeps one or two cows or buffalo, goats and chickens. Mainly four types of livestock were reared in the study area. Households in Bachchhauli reared more cow and buffalo whereas, in Ayodhyapuri more goats were reared and only few people reared pig in both areas. The study showed that local people perceived human-Tiger conflict as problematic issue in CNP. According to the park data, 87households lost one or more types of livestock in between 2013-2018. A total of 93 livestock like cow, buffalo, goat and pig were lost to due to Tiger. Both area lost significantly more goats than other livestock (Pearson chi-square=8.484, df= 3, $p < 0.001$).

Ayodhyapuri area had higher loss than that of Bachchhauli area. The result showed the highest number of losses were goat(42%) followed by cow (28%) buffalo (22%), and pig (8%) in Bachchhauli area whereas the highest number of losses were Goat (56%) followed by buffalo(21%), cow (19%) and pig (4%)in Ayodhyapuri(Table 1).

Table 1: Number of livestock killed by the Tiger in Bachchhauli and Ayodhyapuri area

Livestock type	**Bachchhauli**	**Ayodhyapuri**
Cow	10	11
Buffalo	8	12
Goat	15	32
Pig	3	2
Total	36(39%)	57 (61%)

The loss of livestock due to the Tiger widely differing from year to year in which the highest loss of livestock occurred in 2013 whereas goats were the most commonly killed livestock type in every year (Figure 2).

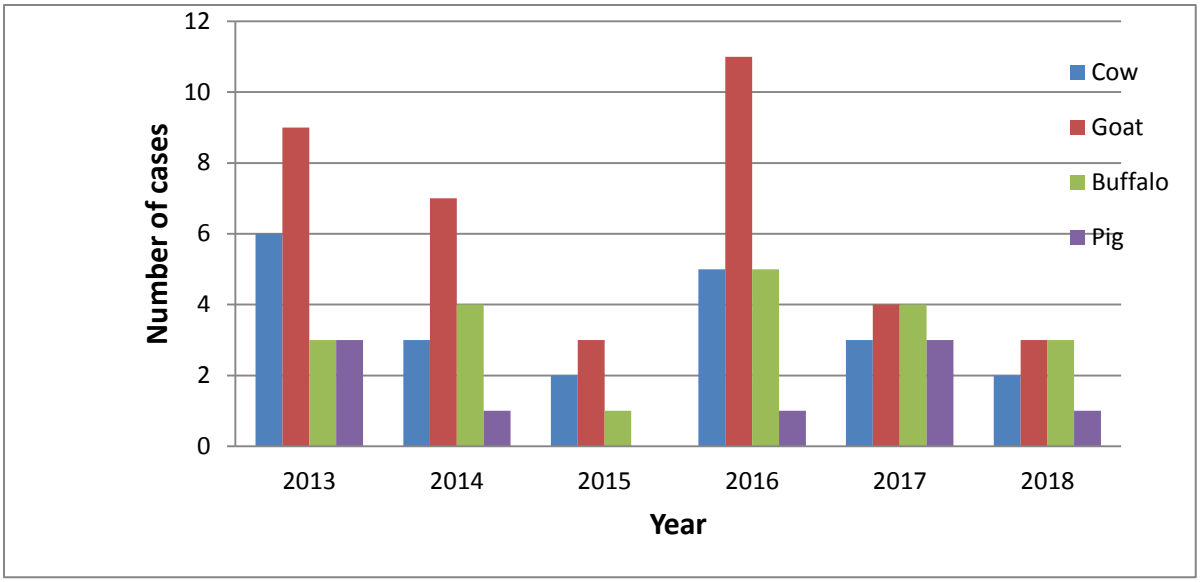

Figure 2: Temporal livestock depredation patterns in two study area.

4.2 Seasonal pattern of livestock depredation by Tiger

The majority of livestock death (51%) by Tiger occurred in summer season followed by winter season (24%), spring (13%) and autumn (12%). More than half of the livestock depredation was found in summer season whereas depredation was found relatively lower in autumn season reported from the national park office (Table 2).

Table 2: Seasonal livestock in Bachchhauli and Ayodhyapuri area

Types of season	**Bachchhauli**	**Ayodhyapuri**
Summer	18	32
Winter	6	14
Spring	7	5
Autumn	5	6
Total	36(39%)	57(61%)

The livestock depredation by Tiger showed monthly variation in which the highest and lowest number of the depredation was reported in the month of July and September respectively in Ayodhyapuri while from the highest and lowest number of depredation was reported during August and May respectively (Figure 3).

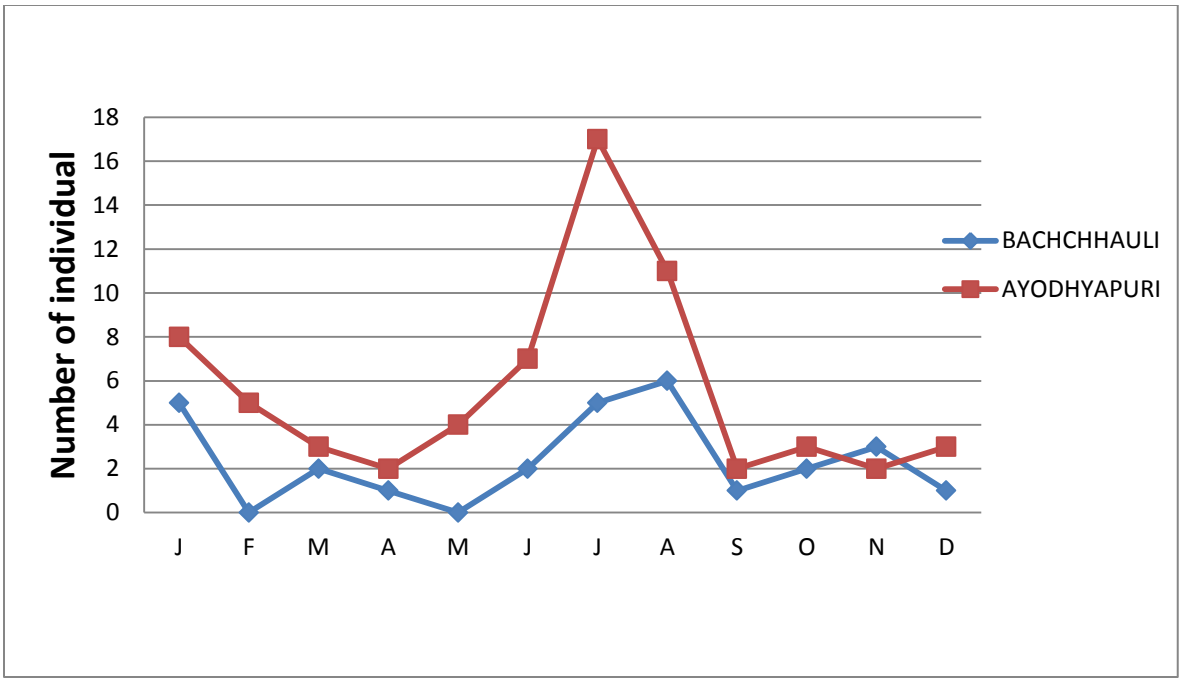

Figure 3: Monthly variation in livestock depredation by Tiger in Bachchhauli and Ayodhyapuri area.

During the survey of study area, a total of 21 deaths of livestock by Tiger were recorded within one year of duration in 2018. Only 71% of livestock depredation data was collected in the park where as 29% of data was not recorded in the park office. The data which were not recorded in the park office were mostly collected from the hilly reason of the Ayodhyapuri. From the comparison, the surveyed data was found higher as compared to the data collected from CNP (Table 3).

Table 3: Comparison of Park and surveyed data on Livestock depredation by the Tiger in 2018

Livestock type	**Surveyed data**	**Park data**	**Data not recorded in the park**
Cow	3	3	0
Buffalo	6	5	1
Goat	10	4	6
Pig	2	2	0
Total	21	14	7

4.3 Temporal distributions of human casualties by Tiger

According to the recorded data from the CNP, there were 17 human casualties caused by the Tiger within six-year period of time from 2013-2018. During these periods, 13 deaths of individuals were recorded and 5 got injured by Tiger (Figure 4).

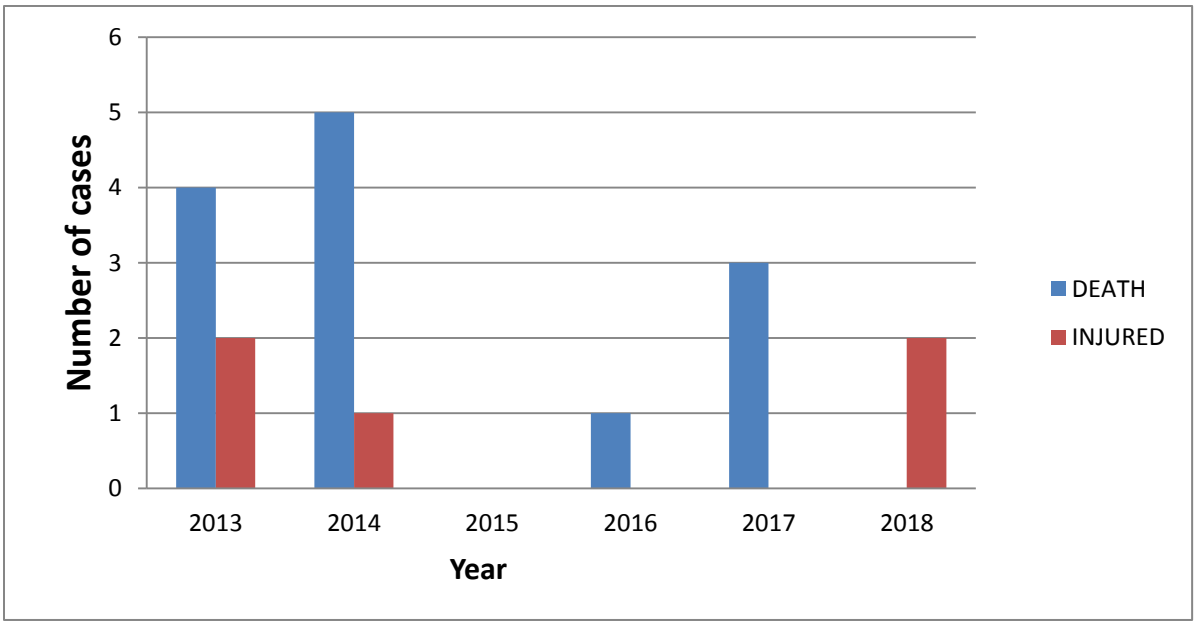

Figure 4: Human casualties by Tiger.

A total of 14 people were attacked by Tiger outside the park whereas four individuals were attacked by Tigers inside the park (Figure 6).According to the recorded data from CNP, more males (67%) than female (33%) were killed by the Tigers (Annex C).

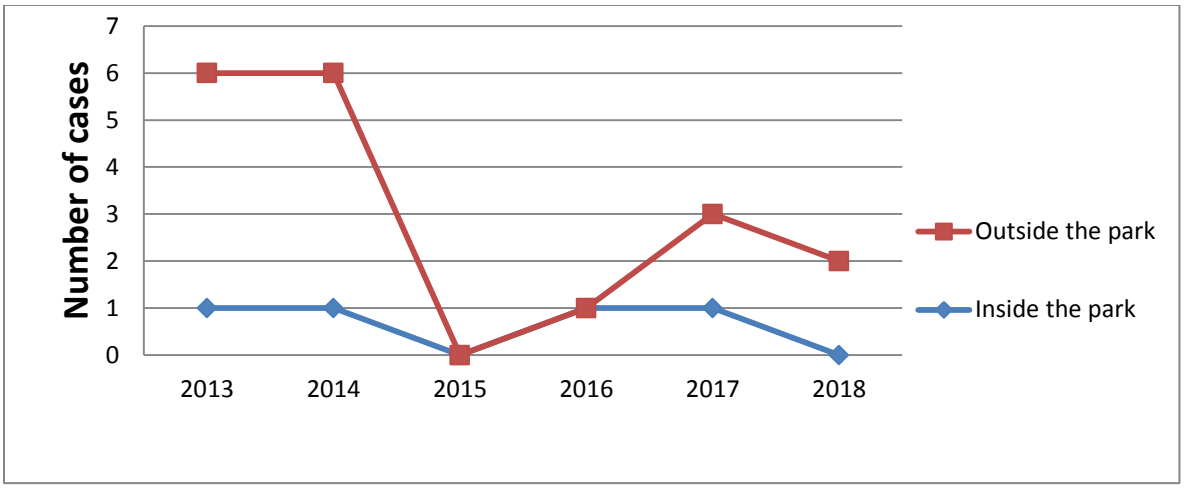

Figure 5: Distributions of human casualties by Tiger in and outside the park.

4.4 Death and Rescue of Tiger

From the data of Chitwan National Park, 23deaths of the Tiger was found from 2013- 2018 including male (39%), female (26%), and other (35%) were unknown. The majority of death (26%) was recorded in 2018 and 2014 followed by 2016(21%)(Figure 6). A total of 4 individual of Tigers were rescued during these years from different areas like Ayodhyapuri, Bagauda, Kumroj and Lothar area.

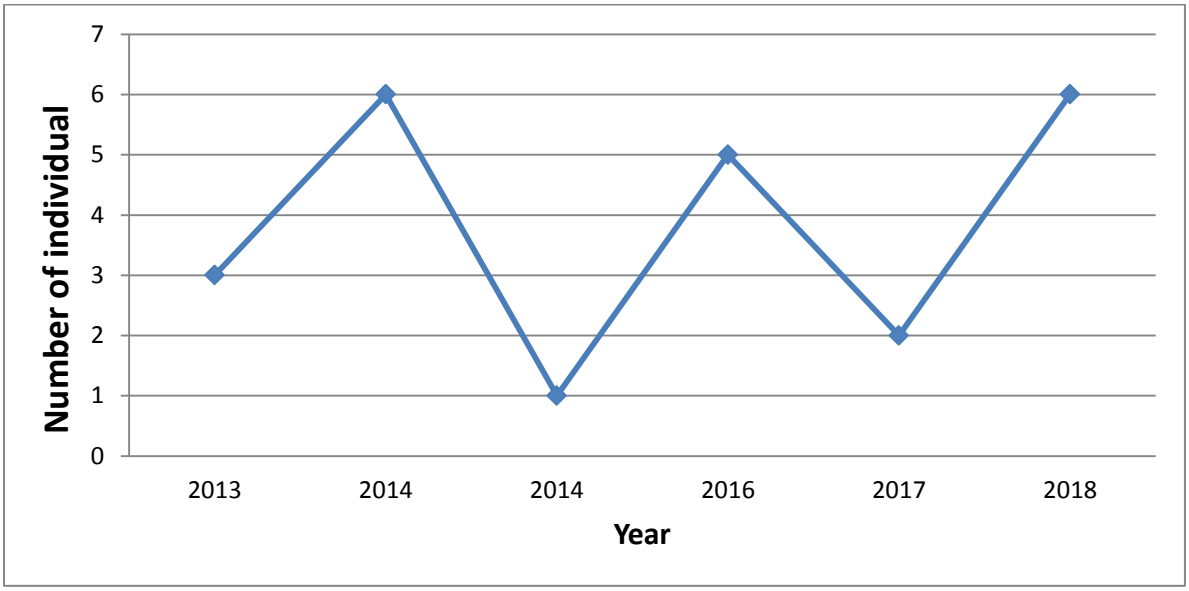

Figure 6: Annual loss of Tiger in and around the Chitwan National Park

4.5 Causes of death of Tiger

According to the report collected from CNP, the majority of deaths (8) were naturally followed by intra specific fighting (5), retaliation (2), 4 number of Tigers for unknown reason and one weak and old individual due to attack of wild boar which was not included during the six-year period in the figure (Figure 7).

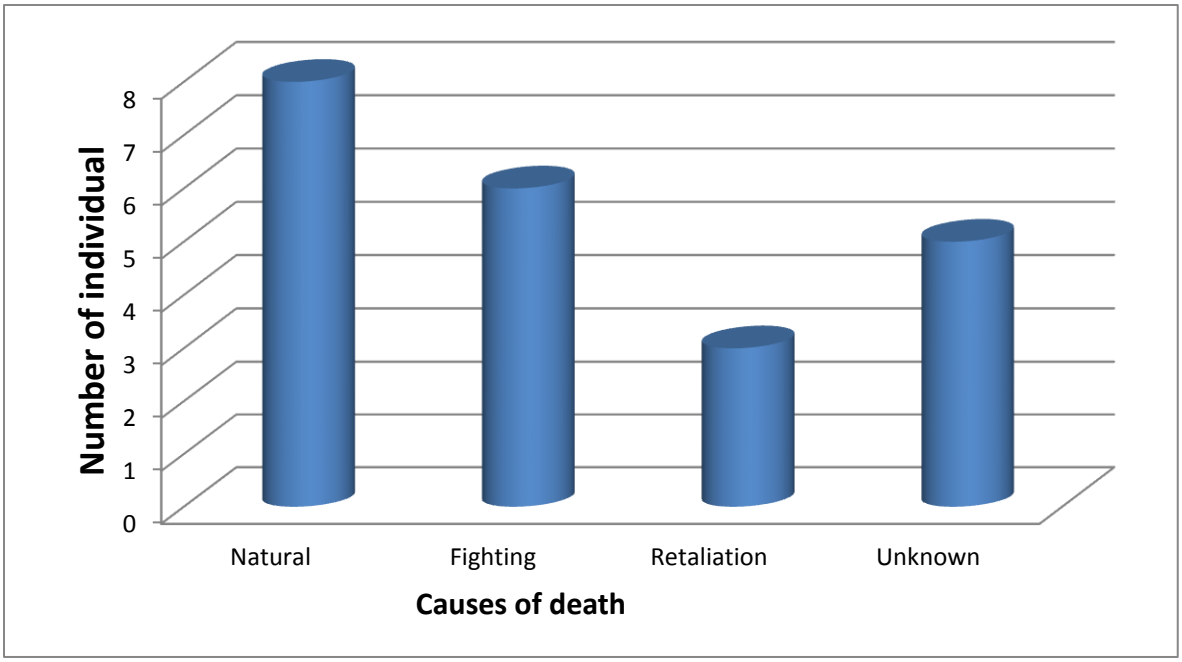

Figure 7: Death of Tigers in and around the Chitwan National Park due various reasons

4.6 Perception of local people on Tiger conservation

Perception on Tiger conservation and education were significantly associated with each other (Pearson chi-square = 24.398, df = 3, p <0.001). More people with high education supported the Tiger conservation. The result indicated that more than half of the respondent (59%) showed positive response towards Tiger conservation. Those people who had a negative attitude towards Tiger conservation were concerned about human casualties and livestock depredation. Local people from Bachchhauli were more positive than Ayodhyapuri. Males (69%) had a more positive attitude towards Tiger conservation than females (31%).

4.6 Compensation / relief fund

According to the report from the CNP, the total compensation/ relief fund of US$81065.62 (US$ 13510.93 per year) was made for Tiger attacks during six- year period. Of this, 80% was paid for human killings, 6% for human injuries and 14 % for livestock killings. The average compensation payment per household to the loss of livestock was US$ 25.48 from 2013-2018. The total number of death of livestock caused economic loss about US$ 11349.19 that was paid as compensation in six years (Figure 7). The highest amount 47.82% was paid for the loss of Buffalo followed by Cow (24.1%), Goat (23.25%) and Pig (4.82%)(Figure 8).

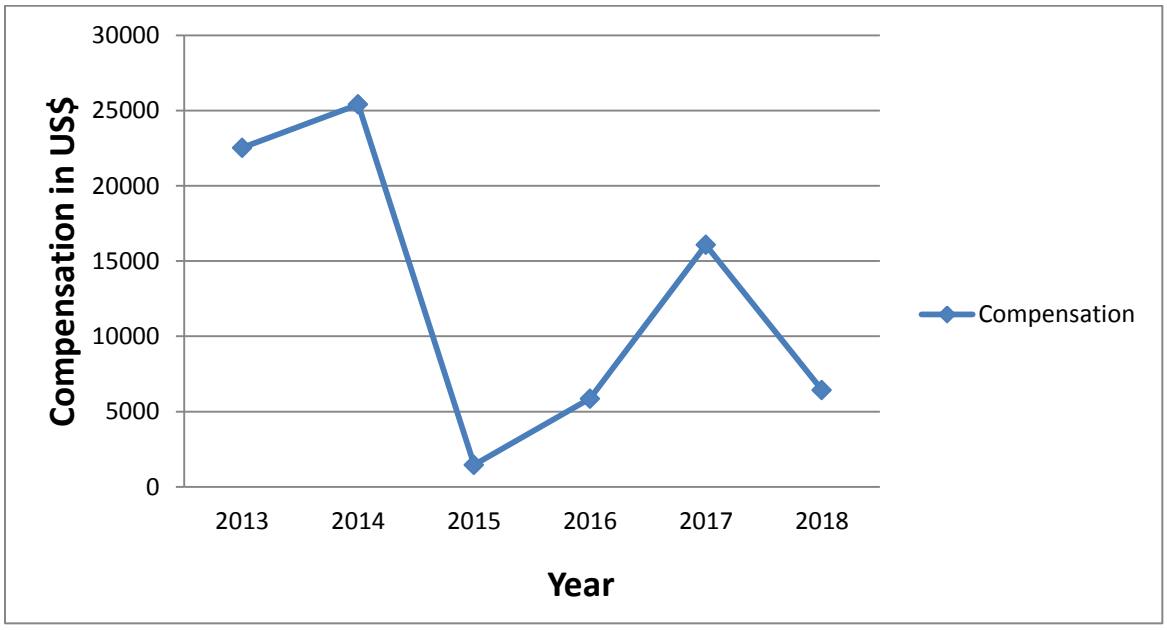

Figure 8: Annual compensation payment/ relief fund for casualties caused by Tiger from 2013-2018.

The proportional share of payment varied among the livestock types with buffalo bringing (37%) of the total payments of livestock depredation followed by cow (29%), goat (30%) and pig (4%). As the highest number of loss of the lives of animals in Ayodhyapuri area, the compensation payment was also found higher (69%) in that area as compared to Bachchhauli area (31%)(Figure 9).

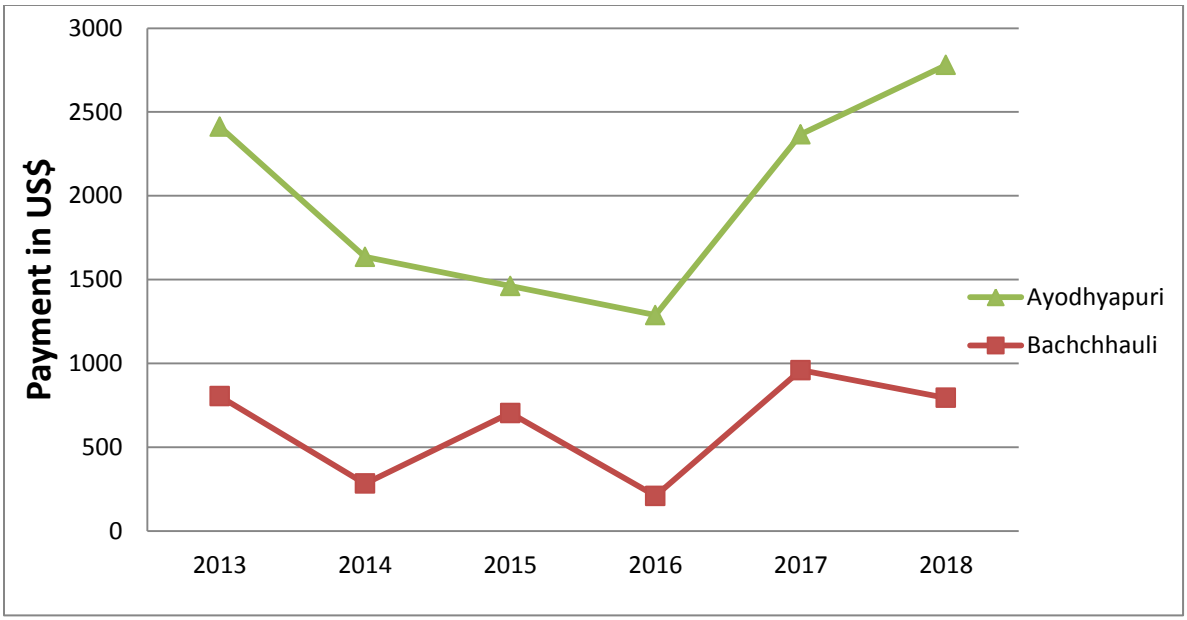

Figure 9: Comparative payment for livestock depredation in Bachchhauli and Ayodhyapuri area .

The total payment for human casualties caused by the Tiger was found US$ 64852.48 in six years from 2013-2018 from the park report. About 30% of total amount was paid in 2013 which indicated highest compensated year in comparison to other annual year (Figure 10).

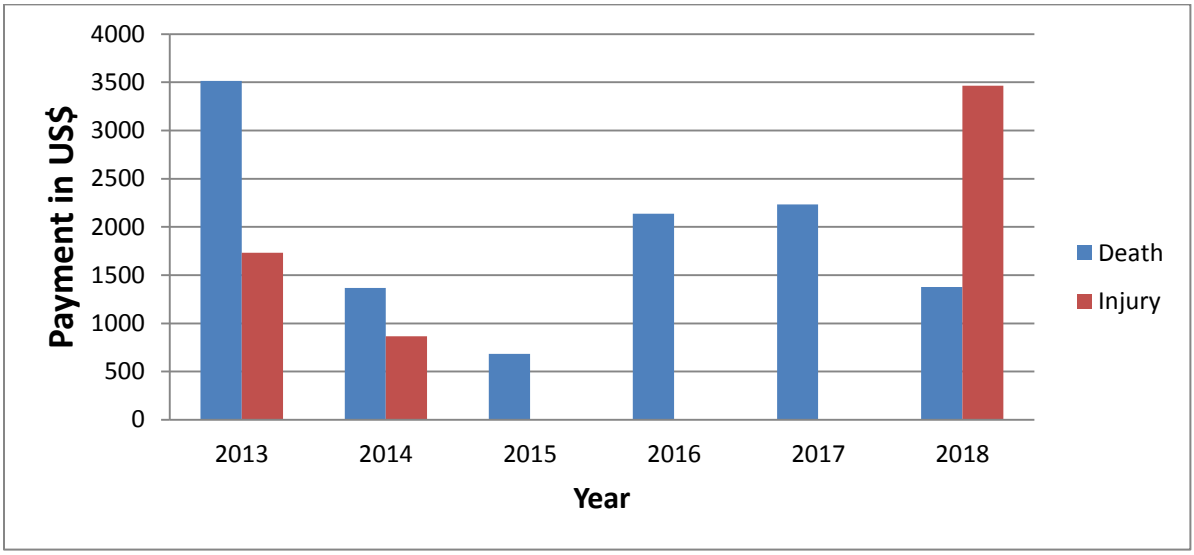

Figure 10: Relief fund for human casualties caused by Tiger.

5. DISCUSSION

5.1 Livestock depredation

Most of the areas surrounded by the protected areas in Nepal have witnessed livestock killing by the Tigers. The study revealed that a total of 93 livestock killed by Tiger in CNP during six period of time between 2013 and 2018. The annual loss of livestock attributable to Tiger was 0.16 animals per household per year, which was less as compared (0.26 animals per household per year) to the study in BNP which indicated that livestock predation rates were particularly high in areas with low abundance of natural prey (Bhattarai and Fischer, 2014). In between two sites of the study area, the southern sector Ayodhyapuri had significantly lost more livestock than Bachchhauli, such differences could be due to the closeness to the forest edges which increased the probability of periodic contact with Tiger and livestock and grazing activity because people's livelihoods often depended on access to grazing lands (Gurung, 2008). Livestock grazing practices also helped to explain this contradiction.

The mean loss of domestic animal such as cow, buffalo, goat and pig by local people due to Tiger predation was 15.50 animals per year which was relatively lower than the study conducted by Dhungana *et al*., (2017) in and around CNP including Madi valley between 2007 and 2014 (an average of 44 livestock killed per annum) and also study conducted by Dahal *et al.*, (2018) in Madi valley was found 15.60 livestock killed annually. The highest number of livestock depredation occurred in the areas of Ayodhyapuri of Madi valley, which was consistent with the study conducted by Gurung *et al*., (2008) in CNP. It could be the reason that Ayodhyapuri area has the longest adjoining boundary with the National Park. The study found that goats were most frequently depredated animal (42%) in the study area, which is similar to the finding of the study conducted by Dhungana *et al*., (2017). It might be for the reason that most of local people prefer goat rearing in the study area. The study conducted by Miller *et al*., (2015) found that goats were killed closer to field and villages.

As Tiger was found the major predator in the both study area because most of the large domesticated animals like cow buffalo and goats were killed by the Tigers and also those areas were suitable habitat where population of Tiger sustain well (Bhattarai and Fischer,

2014). Most of the livestock sheds for corralling at nighttime were usually open; only a few people have put their livestock (goats and pigs) in predation proof corrals. Furthermore, decrease of natural prey species in the National Park and Buffer Zone forests might be forcing the Tigers to kill livestock (Kolowski and Holekamp, 2006; Gusset *et al*., 2009). The loss of livestock by the Tigers was affected by seasonal variation. The frequency of livestock depredation by Tiger was more prevalent in summer season which is similar to the study reported from BNP by Leopards and Tigers (Tamang and Baral, 2008) where the highest livestock loss occurred in the hot dry season, just before the rainy monsoon, this could ascribe the fact that more livestock grazed nearby the park in the hot and dry season (Regmi 1998). Another study reported from CNP by Tiger and Leopard where livestock depredation was mostly found in summer season (Dhungana *et al.,* 2019) whereas, more livestock depredations by Leopard and Tiger reported during winter season in BNP (Sijapati *et al*., 2021). Such differences could be due to the fact that increased vulnerability and crowding of livestock during winter season likely facilitated the increased frequency of reported attacks, especially by Tigers (Tamang and Baral, 2008).

According to the surveyed data on death of livestock by the Tigers, 29% of data was not recorded in park office which indicated low reporting rates of the incidents and unavailability of complete evidences. These data were collected from the hilly area of Ayodhyapuri from where local victims had to travel by foot just to report their incident and spent whole day. Because of lack of proper evidence as well they stopped reporting the incidents to the park office. The reported data was unable to discern whether these risk distributions were shaped more by carnivores or by livestock and people; so, it is suggested future studies to directly pursue the reasons behind depredation, prey-predator density and herd size and livestock husbandry management for better and long term conservation.

5.2 Human casualties/ injuries

According to the data of CNP, 13 people were killed from 2013- 2018 and five were injured by Tiger attacks. Though, human death in this study was minimal, as this is the most serious and ultimate form of human-Tiger conflict, it may have a major implication for long term conservation. In this study, average number of human killed between 2013- 2018 was found

higher (2.6 per year) than the study carried out in BNP by Bhattarai, (2009) in between 1994 to 2007 where the average number of human casualties was found 0.93 per year and similarly 0.72 per year for the period of 1998-2006 in CNP by Gurung *et al*., (2008). Such differences could be due to the human disturbances such as the human invading the forest for fodder and firewood collection (Gurung *et al*., 2008).

Based on data from park, there was gender difference in the activities of the people in which more males were killed than female. The similar data set on human-killing by Lions in Uganda and Tanzania (Treves & Naughton, 1999); and also human-killing by Tiger from Chitwan (Packer *et al.*, 2007) provided interesting comparisons where male humans were killed than females. The women were the primary gender that reared livestock, including gathering of fodder but this male bias could reflect the fact that males spend more time in the forest for hunting in Uganda and Tanzania and more livestock herding in Nepal (Gurung *et al.*, 2008). Similarly, the most comprehensive study of deaths due to Tiger attack estimated that at least 373,000 people died due to the Tiger attacks between 1800 and 2009, the majority of attacks occurring in the South and Southeast Asia (Nyhus *et al*., 2005). The finding indicated that more than half of the people killed by the Tiger in and around the National Park were grass and fodder collectors. Collecting fodder for livestock is one of the most important forest activities for farmers in Chitwan (Shivakoti *et al.*, 1999). Fodder collection might become more intensive in recent year due to restriction in the buffer zone; community forest, as well as local people were engaged with rearing of more livestock. After the restoration of buffer zone forests, the movement of Tiger increased and the casualties happened as the human use is privileged in this zone. In CNP, almost an equal number of human has been killed in the buffer zone and in the core area of park (Gurung *et al.*, 2008) while in BNP, about 82% of human casualties occurred inside the core area (Bhattarai, 2009). Furthermore, people entering the dense vegetation to collect the grass and fodder when such areas could hold higher risk of encountering with Tiger while resting during the day. Therefore, it is necessary to understand the reason why the Tigers kill humans before implementing conservation actions for the long period of time.

5.3 Perception of local residents on Tiger conservation

The local people were agro-pastoralists and pastoralists and most of their household depended on agricultural and livestock production as the source of the economy for their living. According to the survey data, mostly the local residents depended on the land to generate income making but competition with wildlife has become more direct and intense. The extent of support and participation of local people in the conservation of carnivores largely depends on how they place the value on the predators (Gusset *et al.*, 2009). In this study, people from the both areas showed different types of attitude towards the conservation of Tigers. In Bachchhauli, tourism is one of the largest industries which benefits in income creation and generation of jobs for the local residents. They believed that the Tiger is a charismatic species and promotes the tourism in local environment and intern economic activities. While in Ayodhyapuri, most of the respondents had negative thoughts towards Tiger and their conservation. Similar to the finding, the study conducted by Bhattarai (2009) in BNP of Nepal and by Gurung (2008) in CNP positive attitude towards the conservation of Tiger was found prevalent. While, there were many cases of negative thoughts towards large carnivores. Lucherni and Merino (2008) discovered the negative attitudes towards predators due to the loss of livestock. Such type of perception like positive or negative could be due to lack of education and low economic status as well as people who lost human life had more negative attitudes towards Tiger and they were more like to eradicate it from CNP and surrounding area. Furthermore, there were many complaints by local people about the continuing problem related to their restriction of use of resources within the park area. Here some of local people had to rely on labor work or other non-farm work to supplement their subsistence. People with lower income who lived nearby park areas were more likely to resists rules and regulation and continue to encroach wildlife habitats (Conover, 2002). If the local resident could play role in management and conservation of buffer zone, they believed organized program is for their benefits to. Support for conservation was positively correlated with the level of education attainments of the respondents where women were less positive towards the Tiger conservation than men.

5.4 Loss of Tiger and conservation impact

Tigers are facing many threats like illegal killing and poaching because of their pelts and body parts which are used in traditional Asian medicines and they are seen as threats to human communities (Nyhus and Tilson, 2004). According to the data collected from the CNP, 23 deaths of Tigers were reported because of different reasons like natural deaths, fighting and retaliation in between 2013-2018. During that period of time, two Tigers were killed as revenge by poisoning the livestock carcasses in CNP by the local, which was similar to the study conducted in BNP, where, three Tigers were killed as revenge killing by local residents (Bhattarai, 2009). Such type of conflict could be due to the due to the killing of their livestock like cows, buffalos and goats. Similarly, twenty-five Tigers (17 killed people and eight threatened people) were removed in and adjacent to CNP in between 1979 to 2006 (Gurung *et al*., 2008).The revenge of killing of predators was common throughout the world (Madhusudan and Karanth, 2002) and most of them in the suboptimal habitats. Human encroachment into Tiger habitat decreases prey animals which resulted the loss of Tiger from their natural habitats (Gurung *et al*., 2008).The interviews with nature guides and PA managers also substantiated the problem as being threats to the Tiger conservation in CNP. They claimed that that sighting events of Tigers had decreased over this year due to the decreased number of Tigers in the study area. The census of Tigers (camera trapping) in 2008 revealed by 2018, the population of Tiger decreased in CNP. Killing of Tigers as a result of conflict occurs primarily in the suboptimal habitats such as the corridor (Nyhus and Tilson, 2004). Therefore, it may have detrimental effects on demographic and enhances the probability of stochastic processes which may cause the extinction of species (Wikramanayeke *et al*., 1998). Furthermore, mortality event could have consequences beyond the loss of individuals. Removal of the adult males might result in infanticide by immigrating the males and reduced in reproductive rates (Goodrich *et al*., 2008). High mortality rate of the female might also lead reduced reproductive rates, survival of cub and sub- adult and population growth rate (Goodrich, 2010). Therefore, conservation education program is needed to inform local people about Tigers' behavior. Strong involvement of local people who work as partners with wildlife staff to address the issue of human-killing Tiger is based on the belief that villagers have local knowledge that can contribute in reducing human–Tiger conflicts.

5.5 Conflict management

Conflict management through the compensation payment was the process of the limiting the negative aspect of conflict while increasing the positive aspects of conflicts. On the basis of the people perception to the questionnaire survey and economic judgments, the scale of compensation payments in CNP was inappropriate to provide reasonable financial support throughout the time period to the families who were suffering from human killing, human injuries and livestock depredations. A total compensation payment of US$ 81065.62 ($13510.94 per yearly) was noted for the Tiger attacks during six period of time which was relatively higher annually than compensation US$ 93,618 ($11,702.3 per year) paid for Tiger attacks in between 2007-2014 (Dhungana *et al.,* 2019). Even though temporal analysis showed the increasing trend of total compensation payments for the casualties by the Tiger, local people near by the park area still suffering from the losses caused by the Tiger.

The payments in CNP was made on a fixed basis, although health economists and insurance companies in most developed countries value human life based on variables such as duration of life, future life compared with the present life, and economic or social productivity (Treves *et al.,* 2003), which might better address the socio-economic impacts of Tiger conflicts. It is notable that inadequate compensation for the death or injury of the principal bread-earner, especially in low-income communities, leads to increased poverty and hardships, and might generate more animosity toward wildlife (Gubbi, 2012; Nelson *et al.,* 2003).Though, annual monetary loss to livestock depredations in the study ($1891.53 per year) was relatively lower than the study carried out in between 2007-2014 (Dhungana *et al.,* 2017). Therefore, insufficient compensation for livestock losses may have significant impacts on poor communities, because livestock are the main source of cash income and socio-economic capital. For example, loss of one pair of plugging oxen or buffalo is equivalent to 220 days of earnings for an unskilled man (Bhattarai and Fischer, 2014). However, compensation schemes might raise expectations and hostility as consequences of frustration when requests are poorly dealt with (Treves *et al.,* 2003). Sometimes inadequate payment and perceived threats could even drive people to retaliatory killings and reduce support for the Tiger conservation (Graham *et al.,* 2005; Goodrich, 2010). Conservation education could change the attitude and behavior of people and increases the tolerance of losses (Sillero-Zubiri *et al*.,

2007). Many other studies have also suggested conservation education as a tool to reduce human- wildlife conflicts, for example, Nyhus and Tilson (2004); Gurung *et al*., (2008); conservation education focusing on Tiger behavior and ecology may also reduce the human-Tiger confrontation. The payment in CNP were made on the fixed basis, although health economists and insurance companies in the most developed countries values human life based on the variables such as duration of life, which might better address the socio-economic impact of Tiger conflict. It is notable that inadequate compensation for death and injury of the principal bread-earner, especially in low-income communities which leads increased poverty and hardship and might generate more animosity towards the wildlife (Gubbi, 2012; Treves *et al*., 2003). Yet, in some area, provision of compensation payments was debated and sometimes discouraged to avoid negative outcomes such as neglecting preventive measure and increased dependency (Goodrich, 2010). Therefore, there was necessity to maintain the balance between fair financial compensation and reduced financial liabilities. The outcomes of the study also noted the issues of delaying payment during questionnaire survey. Local people were highly unsatisfied with the present practice of problem Tiger management of national park authority. Most of the residents thought that the authority should immediately capture predators and incarcerate in the zoo. A significant problem with that solution is that there is only one zoo in Nepal which is located in capital city, has capacity for a single pair of Tiger. The local people showed their dissatisfaction with this measure due to the lengthy process. As the cow and buffalo are economically important to the local residents because they fetch higher prices in the market and they are the sources of manure, milk etc. Since the livestock like cow, buffalo, goats and pigs killed in the area, the local people suffered the substantial economic losses.

The study noted that education had a highly significant relationship with human attitudes towards Tiger conservation. As the level of education increased the number of people developing positive attitude towards Tiger conservation also increased. The buffer zone management program in this study area was an outreach program whose aim was to reduce park and people conflict. Compensating amount for a human death or injury reduced negative attitude towards wildlife in some extents (Nyhus *et al*., 2005). Recently the MoFSC, Nepal, prepared the wildlife damage compensation guideline. The guideline contains the provision for monetary compensation damages. It ensures the payment of 1000000 for human death,

200000 for human injuries and 20000 NRs for livestock losses. Preventive measures were designed to prevent conflict before it occurs (Goodrich, 2011) by changing the behavior and improve habitat and wildlife management. Studies to the prevention of human-felid conflicts by Woodroffe *et al.,* (2007) showed that improved livestock husbandry is generally effective; however, the success of the technique varied between species. Conflict mitigation was an approach applied to a range of strategies and activities undertaken in a situation of crisis, or an immediate emergency to address causes of conflict and change the way those involved act and perceives the issues. The successful resolution of human-wildlife conflicts required the participation of local communities and other stakeholder groups in formulating the management decisions. It was increasingly recognized that local communities and other stakeholder groups must be involved in the decision making about conservation policies, particularly when these decision affects economic and social well-being of local people (Western and Wright, 1994). What should be main role of different stakeholder in the reduction of human casualties, livestock depredation and revenge of killing Tigers, was determined through the key person interview with nature guides, BZUC members and the local government representative. Nature guide can reduce the conflicts between human and Tiger, since they usually know where the females with the cubs are and which areas are more dangerous for visiting. And members of user communities could conduct conservation campaign and conservation education and proper management of problem animals, and anti-poaching and awareness program. During the interview with nature guide, first attraction for the tourists was Tiger, Rhino followed by Elephants and other animals in CNP. Tourism is one of the most beneficial in term of economy that's why we need to conserve wild animals and their habitats.

6. CONCLUSION AND RECOMMENDATIONS

The findings demonstrated that there was a conflict between human and Tiger in the study area. The annual livestock depredation rate was determined to be 0.16 head of livestock per household. The causes of livestock depredation may be related to livestock grazing in National Parks where Tigers are present. Tiger predation affects livestock such as cows, buffaloes, goats, and pigs, with goats being the most vulnerable. Because the predation was affected by seasonal variation, more livestock were killed during the summer season. Human casualties were also observed in the study area over a six-year period, with males being killed at a higher rate than females. The majority of human casualties occurred outside of the National Park. People enter the National Park because their livelihood is heavily reliant on forest resources, particularly cooking energy, fodders and grass for livestock, and construction materials such as poles and thatch grass. Equally important, restored buffer zone forest in recent decades has reduced the physical distance between predators such as Tigers and humans and their livestock, increasing human-Tiger conflict. Twenty-three deaths of Tiger were recorded, with two of them killed as a result of retaliation by the locals. Four Tigers were rescued from their natural habitat due to their advanced age and injuries. This figure could be higher because not all Tigers killed by professional poachers can be identified. The majority of local people were found to be positive about Tiger conservation, implying that level education is highly associated with long-term Tiger conservation. Because the local people are extremely poor, incentive measures such as monetary compensation and material assistance must be used to increase their tolerance for Tiger losses.

Based on the obtained results of the present study, the following points are recommended in the study area:

i. ***Awareness program***- Awareness program should be launched about Tiger ecology and preparedness of the potential consequences on living near by the Tigers' habitats. An ecological role of Tiger and preventative measure to reduce HTC should be designed and implemented in the buffer zone of the protected areas.

ii. ***Livestock management-***The design and implementation of predator proof corals, livestock guarding practices and deterrents can reduce the loss. Financial compensation for losses for livestock predation can be the final step and a way to encourage local people to tolerate Tiger. It should be managed in a proper way.

iii. ***Compensation / Relief fund-*** Compensation or relief schemes are intended to prevent people who bear the costs of living with wildlife from becoming enemies of animals. Therefore, the entire financial compensation for losses for livestock predation can be the final step and a way to encourage local people to tolerate leopards. It should be managed in a proper way.

iv. ***Management of problem Tiger-*** Problem Tiger should be translocated to natural habitat, but consideration must be given to the destination. Killers of humans are destroyed whenever possible. Lethal control should be last option for problem Tiger management.

v. ***Prey population management-*** Increasing the availability of wild prey will reduce the number of livestock lost; therefore, conservation program should be launch for effective conservation of habitats. Monitoring of Tiger and prey population is essential to understand dynamics of HTC. Government must develop Tiger conservation plan that must identify various programs for conservation, research and management of HTC.

vi. ***Development of rescue and rehabilitation center:*** Wildlife rescue and rehabilitation center for rescuing, treatment and care for injured and sick or orphan animals should be managed properly. Depending on the desired outcomes, rehabilitation efforts should be directed toward specific threats or taxa to maximize success of the desired outcomes.

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8. APPENDICES

ANNEX-A

For Questionnaire

1. For household interview

Basic information

1. Name of the respondent

2. Age and sex

3. Address: Ward: VDC: District:

GPS Location:

4. Education: illiterate pre primary, primary, secondary, higher secondary, university

5. Livestock holding cow/ox: buffalo: goat/sheep: pig: poultry: others:

6. Sources of livelihood (in %) crop livestock employment/labor work

others (specify)

7. Any casualties with Tiger in your family in last 20 years? If yes, please give info as below.

8. Where do you go for resource collection?

a.buffer zone b. community forest c.from own land

Attitude and tolerance to Tiger loss

9. Do you like Tigers?

a. yes (conserve) b. no (eradicate)

10. If yes, why do you like them?

a. beautiful species b. endangered species c. maintains ecosystem d. religious e. revenue from tourism

11. Why don't you like Tigers?

a. kills livestock b. attacks human.

12. Do you like Tigers in community forestry?

a. yes b. no

13. Where should Tigers be conserved?

a. National Park/Reserve b. BZCF c. where they are found now d. where they can be in the future e. zoo

14. I support Tiger conservation even if a family member is killed

a. agree b. neutral c. disagree

15. I support Tiger conservation even if a family member is attacked and injured

a. agree b. neutral c. disagree

16. I support Tiger conservation even if my livestock are killed

a. agree b. neutral c. disagree

Local people's knowledge on Tiger ecology

17. Why do Tigers come out of the forest?

a. no sufficient prey in forest b. they like livestock more c. no sufficient place to live (dense predator) d. don`t know

18. When do Tigers come out of forest?

a. during night b. evening c. mid-day d. morning

19. Where does the human-Tiger conflict (Tiger attacking human) occur more frequently?

a. inside the park b. boarder of NP and BZ c. buffer zone d. outside the buffer zone

Conflict management

20. Are you satisfied with problem-Tiger management?

a. yes b. no

21. Why are Tigers being killed?

a. retaliation b. trade of body parts c. to minimize risk of livestock kill and attacks on humans

22. How can we minimize the human-Tiger conflict?

a. conservation education b. monitoring and alarming c. compensation of loss

Livestock depredation

23. Where do you graze your livestock?

a. national park b. BZCF c. national forest d. private land d. stall feeding

Compensation

24. Are you getting any compensation for these losses?

a. yes b. no

25. Are you satisfied with the amount of compensation?

a. yes b. no

ANNEX- B

For Nature Guide/park officials

1. Why tourists visit the CNP?

a. Tiger b. rhino c. elephant c. dolphin d. birds e. forest g. rafting h. culture i. education and research

2. What are major threats to Tigers?

3. Please mention whether Tiger sightings are increasing or decreasing in the past 5 years?

5. Has number of prey species of Tiger (increased/decreased/similar/don`t know) in comparison to last 5 years?

6. Causes of decreasing/increasing:

7. What may be the role of nature guide in human-Tiger conflict mitigation?

8. How can human-Tiger conflict be minimized?

For User Committee Members

1. Have you heard of human casualties/or livestock depredation by Bengal Tiger?

a. yes b. no

2. Have you seen/heard of Tigers being poisoned by livestock carcass?

a. yes b. no

3. Why Tigers kill livestock? Please rank:

a. livestock graze in Tiger habitat b. excessive poaching of Tiger prey species c. Tigers like livestock very much d. inability of Tigers to prey natural prey species e. others (specify)

5. Why human beings are killed by Tigers? Please rank: a. human enters Tiger habitat for collecting forest products b. excessive hunting of Tiger prey base c. Tigers like human when it tastes once d. due to old age Tigers can`t prey on natural prey species e. others (specify):

6 . If so, are people satisfied from this compensation?

a. yes b. no

7. If not, why?

a. less compensation b. long process c. weak information flow

8. Does user committee involve themselves in solving the human-Tiger conflict?

a. yes b. no

9. Does the National Park Authority coordinate with user committees in reducing such conflict?

a. Yes b. no

10. What are the roles of user committees in minimizing the conflict?

11. Please mention other ways to minimize conflict:

For Protected Area Managers

1. What type of human-Tiger conflict occurs in this PA? Which one is a more serious threat for conservation?

2. How are these conflicts mitigated/ minimized?

3. How are problem Tigers handled/managed?

4. Can you suggest other better ways of minimizing conflict?

ANNEX-C

Human casualties by Tiger

NAME/IDENTITY	SEX	BUFFER ZONE	DATE	ACTIVITY OF VICTIM	WHERE	REMARKS
Hanuman Sharki	Male	Barandabhar	1/26/2070	Cutting grass	Buffer zone	Death
Bhim Bahadur Ale Magar	Male	Barandabhar	1/26/2070	Cutting grass	Crop Field	Death
Lal Bahadur Gurung	Male	Barandabhar	2/10/2070	Toilet	National park	Death
SukramBote	Male	Kalabanjar	6/22/2071	Cutting grass	National park	Death
Harish Chandra Bote	Male	Panchpandav	5/3/2071	Travelling	Buffer zone	Death
Panch Maya Gurung	Female	Ayodhyapuri	4/11/2071	Cutting grass	Crop Field	Death
ChhetramanShrish Magar	Male	Tribeni	3/30/2071	Cutting grass	Buffer zone	Death
DilKumariSinjali	Female	Rewa	2/23/2071	Cutting grass	Transit	Injury
Alina BoteMahato	Female	Budhirapti	6/16/2074	Cutting grass	Community Forest	Death
Dol Bahadur Khatri	Male	Budhirapti	6/10/2072	Cutting grass	National park	Death
Bhim Prasad Sharma	Male	Kalabanjar	11/11/2073	Visiting	Buffer zone	Death
AshamatiMashrangi Magar	Female	Daunne Devi	7/10/2073	Cutting grass	National park	Death
Ganesh Chaulagai	Male	Lothar	11/24/2074	Cutting grass	Buffer zone	Injury
BholaRaut	Male	ayodhyapuri	11/21/2074	Cutting grass	Community Forest	Injury
Bbishnu Prasad Neupane	Male	Barandabhar	1/26/2070	Travelling	Crop Field	Injury
BijayaPoudel	Male	Rewa	2/7/2070	Cutting grass	Community Forest	Injury
Ram PiyariPariyar	Female	Kalabanjar	2/10/2070	Cutting grass	Buffer zone	Death
SukmayaTamang	Female	Kalabanjar	10/20/2070	Cutting grass	Buffer zone	Death

9. LIST OF PHOTOGRAPHS

Photo 1: Livestock grazing by local people

Photo 2: Grass and fodder collection by local villagers

Photo 3: Typical open livestock shed

Photo 4: Interview with nature guides