Human-Tiger (*Panthera tigris*) Conflict: Status and Trends in the Chitwan National Park, Nepal

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ABSTRACT

This study explores an understanding of human-wildlife conflict (HWC) focused on tiger, particularly the status and trend of human-tiger conflict (HTC), in three major areas of Chitwan National Park (CNP); Ayodhyapuri, Patihani and Meghauli VDCs. A set of questionnaire survey was conducted in 98 households during month of June- July, 2017. It covers 38 surveys in Ayodhyapuri, 30 in Patihani and 30 in Meghauli. Additionally, key informant interviews were conducted. Also, the official records of CNP, National Trust for Nature Conservation (NTNC) and Department of National Park and Wildlife Conservation (DNPWC) were referred. Records from 2003 to 2015 at CNP shows that highest HTC was recorded in the year 2003-2004 (235 cases), out of which human casualties were 22 (4 injured and 18 killed). The trend has declined thereafter with the lowest conflict recorded in the year 2013-2014 (17 cases), out of which human casualties were 6 (4 injured and 2 killed). A significantly higher human-tiger interaction was recorded in Ayodhypuri compared to other two study sites ($\chi 2 = 7.88$; d.f. = 2; $p = 0.02$). However, a contradictory trend was obtained based on our survey owing to the long compensation procedure (51.02%), less compensation (30.61%) and weak information flow (18.36%). Conservation education, awareness programs along with adequate and prompt compensation against damages coupled with regular/timely monitoring of tigers may help to reduce human-tiger conflicts. In addition, a future perspective is drawn based on the impacts of anthropogenic interferences on wildlife and riverine ecosystems of these sensitive conservation and protected areas of the lower reaches.

Keywords: Human-tiger conflict; Compensation; Livestock depredation; Retaliation, Anthropogenic interferences

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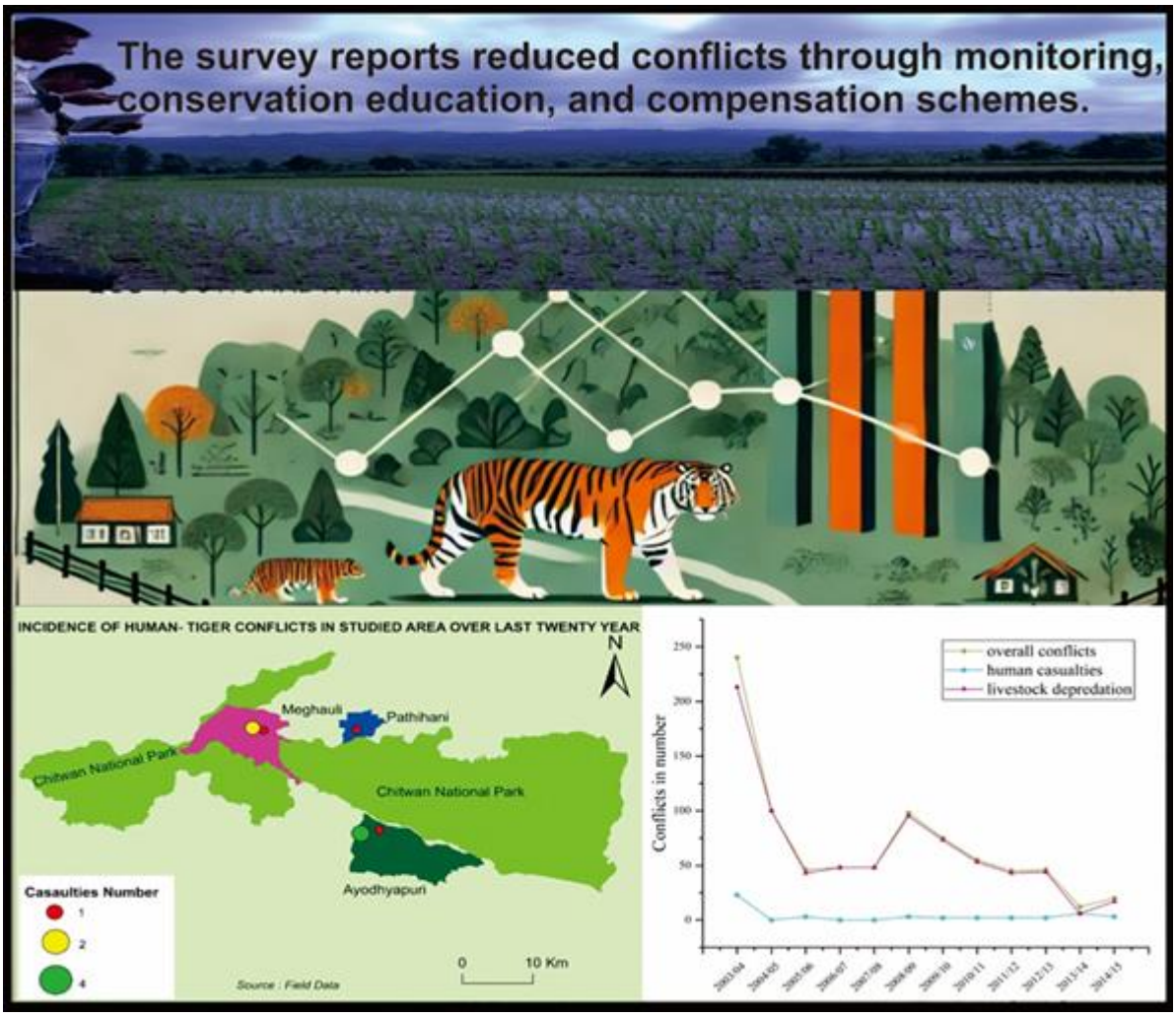
Graphical Abstract



INTRODUCTION

The conflict between people and animals is hindrance to survival of species and is threat to local human population (Dickman, 2010). Several Human-Wildlife Conflicts (HWCs) are experienced in Nepal from different wild species such as Chital, Wild Boar, Sloth bear, Elephants, Tiger, Rhinoceros, Monkey, Deer species etc. Such conflicts bring negative impacts on people, wild animals and their habitat, the impacts to humans are economic, safety and psychological (Acharya et al., 2016; Decker et al., 2002). These impacts require huge investments of time and resources to mitigate, where social factors are of significant consideration to reduce the conflict intensity itself (Aryal et al., 2016; Carter et al., 2014a; Treves & Karanth 2003).

The interaction between human and the large carnivores, such as tigers are common in and around of the protected areas (Ripple et al., 2014). In some situations, large carnivores have conflicts with human due to the livestock depredation and direct killing. Human-Tiger Conflict (HTC) is particularly intense in small and isolated protected areas with human dominated landscapes; therefore, protection and management of tigers (Panthera tigris) needs support from the local communities (Lamichhane et al., 2017). Additionally, HTC may lead towards the negative attitudes of public for tiger conservation since it is always life-threatening hazard in the buffer zone (Dhungana et al., 2017). Conflict-causing mortality of both human and wild is one of the greatest threats to persistence of tiger populations. Therefore, there is growing trend of efforts towards managing HTCs in ways that decline risks for both humans and tigers through holistic approach in sustainable manner, such as compensation scheme, tiger removal, zoning, insurance schemes, and relocation of people (Dhungana et al., 2016).

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A century ago, global tiger population was approximately 100,000. However, tiger population declined to as low as 3,200 by 2010 (GTRP, 2010) as the consequence of anthropogenic factors, such as habitat destruction, loss of prey, sport hunting, poaching, illegal trade in tiger parts and conflict with humans (Nyhus & Tilson, 2004; Gurung et al., 2008). The number rose to an estimated population of 3967 in 2018 after St. Petersberg declaration to double the tiger population by 2022 between the Tiger Range Countries (TRCs). Human-tiger conflicts exist throughout the tiger range, the conflict intensity is high in Protected Areas (PAs) surrounded by high human population (McDougal, 1987; Nowell & Jackson, 1996; Nyhus & Tilson, 2004). Tigers are now in a precarious situation (Damania et al., 2008), confined to only 7% of their historical range with loss of 40% of their habitats since the 1990s (Dinerstein et al., 2007; Damania et al., 2008). Integrating interventions to secure viable breeding population in the wild along curtailing retaliatory killing and restoring wild prey populations are significant in conserving these big carnivores now (Mishra et al., 2003).

At present only 6 sub species of tigers remain in the last century. This includes the Javan tiger (Panthera tigris sondaica) and the Bali tiger (Panthera tigris balica), two from Indonesia and the Caspian tiger (Panthera tigris virgata), remaining one from the central of Asia, which have been extirpated from the wild (Weber & Rabinowitz, 1996; Seidensticker et al., 1999; Nyhus & Tilson, 2004). In Nepal, tigers are largely distributed to the lowland habitats of forests in Terai on the slope of Siwalik Range and in area of rich alluvial grasslands, riverine valleys called “duns” (Smith et al., 1998). Historically, tigers were densely distributed continuously across the lowland contiguous forests (Shrestha, 2004). The situation changed during early 1960s as massive migration of hill people in Terai created habitat conversion and fragmentation (Gurung, 1983). Likewise, the malaria eradication campaign by Nepal Government in 1950s initiated a massive resettlement program in Terai with large clearance of forest and destruction of wildlife and habitat. Tiger population declined, and also there were reported cases of tigers captured in highland, Royal Bengal Tiger spotted at record breaking 3,165-meter height in Nepal (WWF Report, Scaling Heights in Nepal) and outside PAs. It was then an urgency for Government of Nepal to overcome this crisis and protect wildlife since early 70s. As of this urgency, the National Park and Wildlife Conservation Act, 1973 was enacted. Conservation conduct continued and surveys were made. Surveys between 1987 and 1997 documented only three isolated tiger populations in Chitwan National Park (CNP), Bardia National Park (BNP) and Shuklaphanta Wildlife Reserve (Smith et al., 1998). However, in the lateral surveys there were reported tiger recovery sites in Terai Arc Landscape (TAL) and other Wildlife Reserves converted into new National Parks (NPs), Parsa NP and Banke NP, Bardiya NP, Shuklaphanta NP. The third “National Tiger and Prey Survey 2018” estimated a total of 235 tigers in all potential tiger habitats in TAL compared to a total of 198 tigers in 2013. This is a rise of around 19% to meet the goal of doubling tiger population by 2022. Out of 235 tigers in Nepal, Chitwan National Park (CNP) bears 93 alone (DNPWC and DFSC 2018).

Having a long persecuted trend as perceived threats to livestock and humans (Lozano et al., 2003; Mishra et al., 2003), often hunted for their skins and purported medicinal values (Nowell & Jackson, 1996; Weber & abinowitz,1996), prey species depletion by hunting (Karanth & Stith, 1999; Mishra et al., 2003), and habitat destruction resulting to deforestation and conversion to agriculture (Weber & Rabinowitz, 1996; Kolowski & Holekamp, 2006), big cats population has dwindled around the world over the past century. In context to Nepal, despite various conflicts in the buffer zones, surprisingly there is an increasing population trend in recent years (Rauniyar and Burke, 2013). With the unprecedented strategical progress, Nepal set a record being the first of all 13 tiger range countries to double its tiger population since 2010 (DNPWC and DFSC 2018).

However, the human-tiger conflict has become a major threat to long-term tiger survival and well-being of local people living around tiger reservation areas. There was a recorded incident of the 235 conflicts in the national park in the year 2003-2004, which is accredited to the livestock depredation, human-killing and retaliatory killing. Mitigation of conflicts is considered critical in multiple use forested areas where tiger ecological needs and human livelihood needs overlap (Bhattarai & Fischer 2014, Carter et al., 2014a). From the recorded data of Chitwan National Park (CNP), it is evident that the trend of human loss increased exponentially from 1.21 persons per year in 1997 to 7.22 person per year since 1998. With this peculiar

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

contrast in rise of tiger population as well as the rise in conflicts in all 21-buffer zone committee in CNP, the study was focused in prolonged areas to figure out the trend from the past to the present. This study, therefore, determines the status and trend of the HTC by analyzing the perception of locals towards tiger conservation over the last twenty years. Also, we aimed at briefly introducing an insight into the impacts of anthropogenic interferences on wildlife and riverine ecosystems of the protected areas of the lower reaches.

MATERIALS AND METHODS

Study Area

The study was conducted in three rural municipality of the park, viz-); Ayodhyapuri, Patihani and Meghauli, lying in the southern part of Central Nepal (Fig. 1). These are the most persistent zones to tiger conflicts and related issues in the region. The Park was declared as the country's first protected area in the year 1973, having an area of 544 km^2. Later, Park extended to the present 952.63 km^2 surrounded by buffer zone that covers 752 km^2. It includes the natural ecosystem supporting critical habitat to some of endangered species like tiger (Panthera tigris) and rhinocerous (Rhinocerotidae). The studied areas are the buffer zones with spatial population around the park. The buffer zones are managed by bufferzone management committee under the guidance of the national park. The buffer zones function to maintain ecological integrity and engage the communities for biodiversity conservation and wildlife protection (Lamichhane et al., 2019).

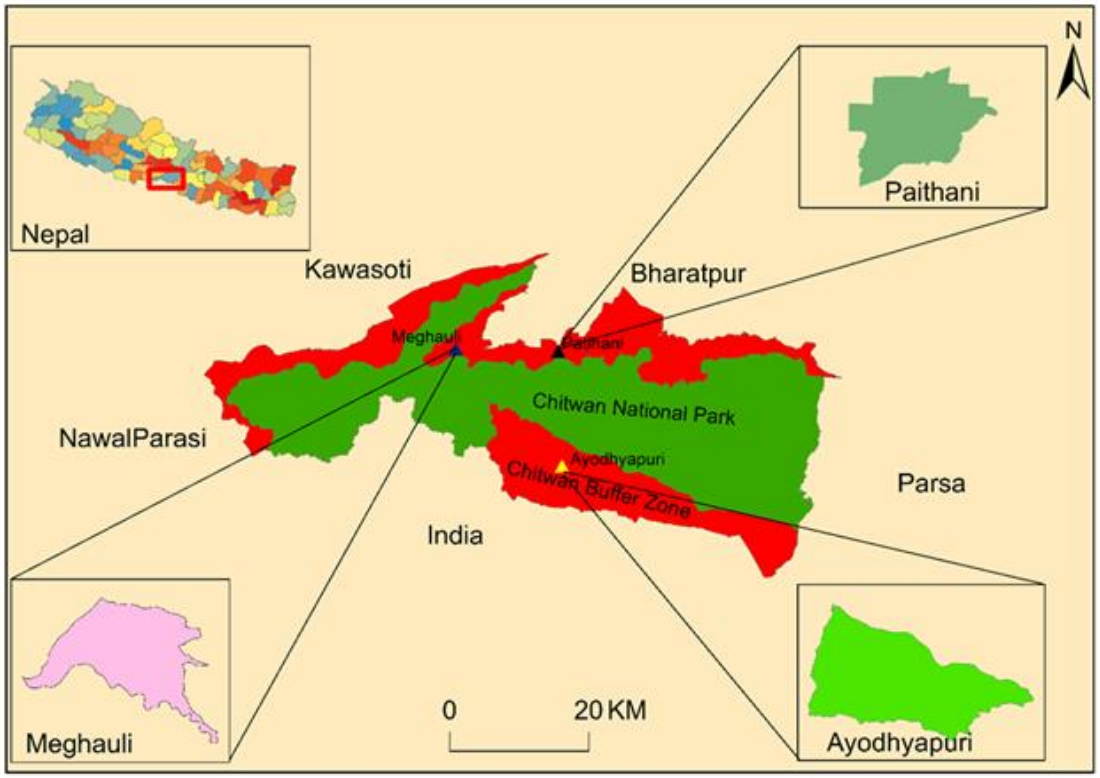

Figure 1. Map showing the study areas in the buffer zone of the Chitwan National Park. Also shown in the map are three villages, namely Ayodhyapuri, Meghauli, and Patihani

Meghauli is a village and former Village Development Committee (VDC), now a part of Bharatpur Metropolitan City in Bagmati province of central Nepal. It touches over 25 km then of the borders of the park and is located on the banks of the Rapti and Narayani River. Rivers are the border between the core and the bufferzone, and Meghauli borders these rivers, and hence is a potential human-wildlife conflict area. In the east there is Dibyanagar and Sukranagar VDC. The Meghauli has 3086 number of households; 14,149 populations with 7,808 female and 6,341 males. There are altogether 9 wards in Meghauli. Except ward no. 7 and 8, all the wards touch the bank of the Rapti or Narayani River. The literacy rate here is 75.56% and more than 85% of HHs still uses firewood for cooking.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

Similarly, Patihani is a part of Metropolitan Bharatpur in Chitwan district in Bagmati province of Southern Nepal. Being a former VDC, now a rural metropolitan part, is has an estimated total population of 11,995 living in 2410 households.

Ayodhyapuri, being a former VDC next to Ayodhyapuri now is part of Madi Municipality in southern Chitwan. It is a significant conflict related area, having a length of 0.34 kilometers. It has a total of 2,555 households and the total population recorded is 10,693(**CBS, 2011**).

Data Collection and Analysis:

A set of questionnaires was designed to get perception of people exposed to the conflict with the tigers following the information and questionnaire designing from previous literatures (Gurung 2008, Thapa 2012). The age group for the questionnaire survey was between 18-89 years, out of which 56 were males and 42 females. So, in total 98 households were surveyed (Ayodhyapuri 38, Patihani 30 and Meghauli 38), one respondent from each house. The survey was conducted in the month of June-July; 2017.

The sample size (n) for the questionnaire survey was determined by using the given formula (when standard deviation is unknown).

Sample Size (n) = P (1-P) (Z α/2 / E) 2

Where,

Z2 = (1.96)2 for 95% confidence (i.e., α= 0.05)

E= maximum tolerable error (0.097)

P = estimated population proportion (0.5)

Statistical Package for the Social Science (SPSS) version 19 (IBM SPSS STATISTICS 19) was used for the statistical analysis. To understand the relationship between the attitude of people in the tiger conservation and their education level along gender, the Pearson Chi-Square test (two tailed) was applied. GIS software (Arc View 10.2.2) was used to represent the incidence of human casualties in the studied area over last twenty years from the secondary data to tack the record of incident. The Global Positioning System (GPS) location was recorded to indicate the position of the area where the human casualties by tiger were found at the studied areas over last twenty years from the secondary data of national park official records. The level of conflicts on the basis of this secondary data on number of casualties recorded and illustrated in the map.

RESULTS

Social Structure

The respondents surveyed were either single or maximum upto 22 family members, the average family size was 6 persons. Majority of them were literate (~ 92%), they were significantly positive towards tiger conservation (χ2 = 25.8; d.f. = 4; p = 0.005). However, no significant difference was observed on the basis of gender. Livestock rearing was the most important agricultural source of income as 70.4% (n=69) of the households had one or multiple livestock, e.g. 18.4% had cow/ox, 51.0% had goat/sheep, 22.4% had buffalo (n=22), and the remaining 8.2% held poultry. Majority of local people (71.4%; n=70) enter into the community forest in the buffer zone for resource collection of which 53.1% (n=52) enter for firewood and 36.7% for fodder collection, respectively. The Park authorities give permission to collect thatches during the grass cutting periods only, which is normally 11:00 am to 2:00 pm. Therefore, conflict-based compensation is provided to the locals only if the conflicts are recorded during this period. However, majority of the respondents 69.4% (n= 68) find this timing inappropriate due to their work pressure and other household activities at that time.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

Human -tiger conflict

During our survey, the data depicted that a total of 22 conflict causing tigers were reported between 2007 and 2016 in the BZ of national park, out of which 13 were killed and 4 were relocated as indicated in Lamichhane et al. (2017) as well. Likewise, as reported during our survey, a tiger was recorded killed in retaliation in Ayodhyapuri. The most depredated livestock according to the local people was goat. In context to human casualties, they were mostly occurred inside the community forest and National Park, which resonated to study by Gurung et al. (2008) that relates to the restoration of forests in Buffer Zone of PAs in the Chitwan National Park. Human casualties were recorded as human use was privileged in this zone. People were heavily dependent on forest resources for their livelihood especially for purpose of cooking, fodders, and grass for livestock and construction material like poles and thatch grass similar to the reasons figured out by (Upadhyay 2013). Our study revealed data from the year 2003-2015, 791 conflicts by tiger were reported, 88 of them were related to human casualties; out of which fatal killing was 53 and 35 injured. The record was contrasting as the park office showed a declining trend of HTC, whereas the locals believed that the trend of conflicts is increasing day by day. The possible reasons behind such contrasting perception could be due to the conflict in the park that went unreported. Another crucial reason was dense community forest that increased conflicts in recent time as reported by the respondents.

Respondents reported that their cattle and goats among other domestic animals are attacked by wild animals, mainly carnivores like tiger (Panthera tigris) and leopard (Panthera pardus). Record from the National Park Office stated that altogether 17 livestock depredations have been recorded in the study area during last three years (2014-2017); 15 in Ayodhyapuri, 2 in Meghauli and none in Patihani. Similarly, one human casualty was reported at Ayodhyapuri in 2014, the VDC having the maximum number of conflicts. A total of nine human casualties by tiger were reported for the last 20 years in the study area. Based on this survey, Ayodhyapuri is highly susceptible to the conflict compared to Meghauli and Patihani as illustrated in the **Fig. 2** ($\chi 2 = 7.88$; d.f. = 2; $p = 0.02$).

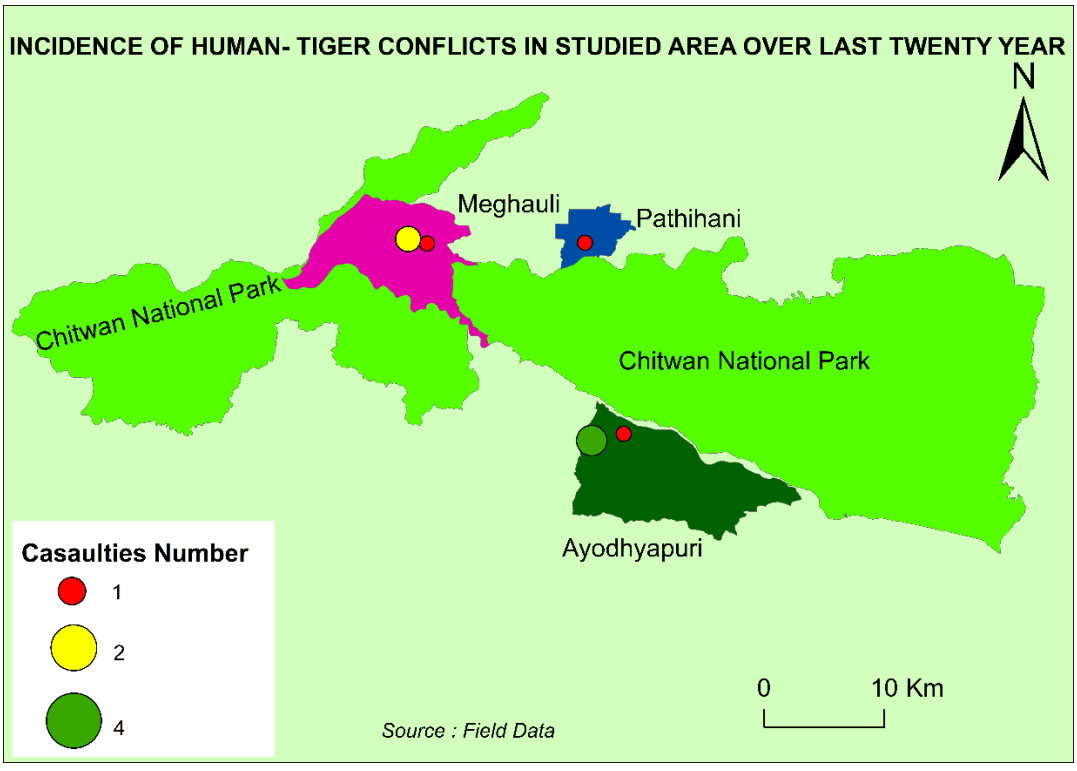

Figure 2. Incidence of conflicts resulting in death by tiger over last twenty years in the surveyed area marked with circle; each circle represents a kill.

It is evident that the highest tiger conflicts were recorded in the early year 2003/04, however there was the steepest decline in conflicts over the following years (**Fig. 3**). That year accounted 29.7% of overall conflicts

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

with highest human casualties (22) and livestock depredation (213) in the same year. The lowest conflicts were recorded in the year 2013/2014. Although this marked for merely 2.1% of overall conflicts, the number of human casualties rose up (6), comparatively higher than the previous years. As a whole, it is evident that there was tremendous decline in the conflicts except for human-casualties that were moderate even after12 years. The plausible explanation to seemingly significant decline in livestock depredation whilst constant human casualties could be restoration and expansion of the community forests, which enhances the dependent of locals in the forest for livelihood and others usages of the forest resources.

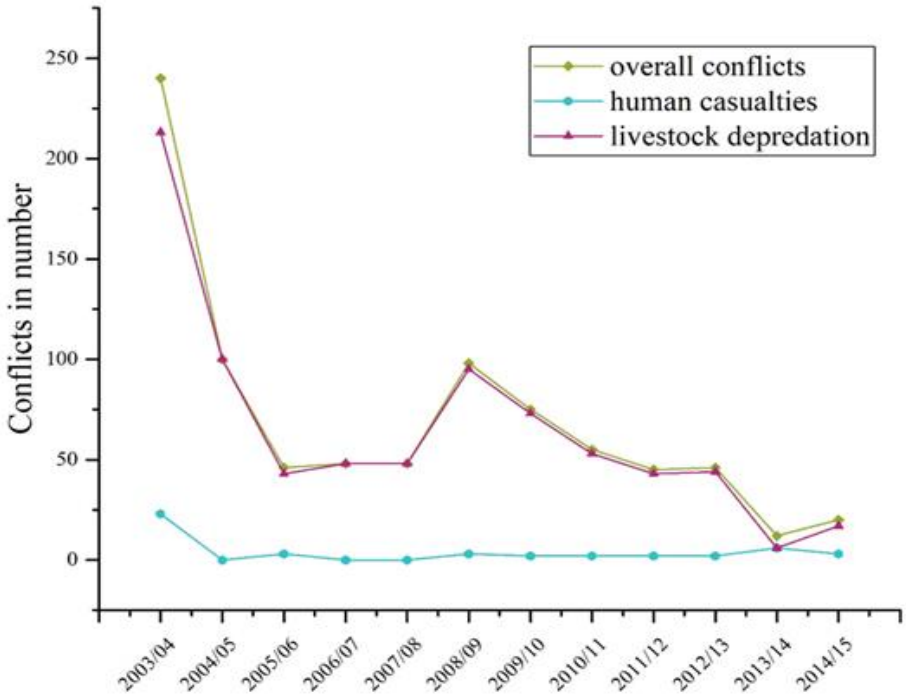

Figure 3. Trend of tiger conflicts in the study area (Chitwan National Park Area) from 2003 to 2015.

Out of 98 respondents [49.9% (n=45)] suggested conservation education as solution to the human tiger conflict while 23.5% (n=23) suggested on monitoring and alarming and the remaining 30.6% (n=30) on compensation of loss by tiger. The study shows that local people have positive tolerance towards HTC. They agreed that park and wildlife are important as many people are dependent upon these resources for their livelihood, infrastructure and community development. However, a small proportion 8.2% (n=8) showed negative attitude towards tiger conservation. Likewise, of all 98 respondents, 80.6% (n=79) were not satisfied with compensation, long procedure 63.3% (n=50) and less compensation 36.7% (n=29). So, it is evident that just 19.4% (n=19) of the respondents were satisfied with the compensation. Also, notable 42.9% (n=42) respondents (forest users) are not satisfied with the Buffer Zone User Committee (BZUC). This incorporates weak information flow, 45.2% (n=19) and complicated institutional structure 54.8% (n=23). These crucial conclusions illustrate negative impacts to the conservation conduct as well as management and structure of local institutions and concerned bodies.

Wildlife conservation benefits such as yearly grass cutting, community development and tourism were considered by the respondents as the reason for having a positive attitude towards the park and park authorities (Upadhyay 2013). Many findings reported positive attitude of people towards wildlife in different protected areas (Bhattarai 2009, Bhattarai & Fischer 2014, Shrestha 200, Thapa 2010). Such attitudes of people are dependent in many factors including the education level (Carter et al. 2014b) as the present study also indicated that literate people have significantly positive attitude towards tiger conservation compared to the illiterate. Nevertheless, people are compelled to tolerate the conflicts because most of the people living in the Buffer Zone (BZ) area have no other options. From the national park, they are benefited in several ways like employment opportunities, development activities, infrastructure development and compensation schemes from the revenue collected. Therefore, people could tolerate losses from conflict to some extent as

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

they are benefited from the wildlife and national park. A study by Pant and Bhatta (2012) also has shown that people can tolerate certain level of damage by wildlife. However, some studies such as Bhattarai (2009) showed that local people were not in agreement with tolerating the losses from the tiger attack.

A study by Thapa (2012) revealed that leopard prefers to kill smaller livestock (primarily goats) while tiger prefers to kill both larger and medium body sized wild prey and livestock such as goats, cattle and buffaloes (Lamichhane & Jha 2015). In addition, the decline in natural prey population also attracts tigers towards livestock depredation. Also, the livestock depredations are occurred in case of practice of livestock grazing inside the forest persist (Bhattarai & Fischer 2014). Though conflict is prevailing and losses had occurred, most of the people still believed that tigers are endangered species of nation, they are nation's pride. They are the umbrella species and are important for ecosystem balance (WWF, why tigers, 2020), it is necessary to conserve them and their habitat for future generation. Similar kind of results were revealed in Chitwan National Park and in Kariba Town, Zimbabwe where local people have positive attitude toward the wildlife conservation despite of the conflicts and problems encountered (Lamsal 2012, Mhlanga 2001). However, present situation may get reversed and people may develop a negative attitude towards wildlife, this will have a great impact on wildlife and ecosystem with the destruction of natural habitat and killing of wild animals (Barlow et al. 2013). This is a challenge to continue conservation conduct even a minor portion, 8.2% (n=8) showed negative attitude towards tiger conservation. At present, community forest BZ users committee are being successful to conserve and manage wildlife but if the conflict continues to rise, it can affect the institutional structure of community forest users' group and BZUC.

In order to prevent probable negative situations, different measures are adopted to mitigate HTC by National Park (Thapa 2010) such as electric fence, trenches or pit, barbed wire, woven wire and gabion wall. National Park works through BZUC at the local level. It has implemented different physical preventive measures to mitigate the conflicts and address locals' issues. To the real time scenario, still traditional mechanism of mitigating wildlife damage is in practice to date. Most of the people applied one or more measures to cope with HTC. Trapping and hunting are not in the practice according to the local informants but holds the historic records of tiger relation killing. The major mitigation measures implied against tiger in the study area were producing/making noise, chasing with fire, fencing the house white colors, metal/wire fencing, stopping entry of people and the livestock inside the park and buffer zone community forest (except when allowed by park authorities), proper management of problem tigers (policy to relocate them), and mobilizing volunteer anti-poaching youth groups for conservation and awareness activities. Appropriate conservation measures such as education, monetary compensation and monitoring of tigers are some of the primary areas to be considered for major strategies (Bhattarai & Fischer 2014).

Conservation education and awareness can improve the attitude and behavior of people (Matarasso 2004) than tolerance towards animal loss (Sillero-Zubiri et al. 2007). Our respondents suggested conservation education as an effective means to reduce HTC. The result was consistent to the findings of (Bhattarai & Fischer 2014, Gurung et al. 2008, Lamichhane et al. 2017, Nyhus & Tilson 2004). More the conservation education, more hands-on conservation and protection of the species. In addition, a long-term monitoring of the problematic animals in collaboration with the concerned organization, such an National Park and DNPWC to reduce the intensity of conflict and to provide suitable habitats for the expanding population of tigers are becoming very necessary (Gurung et al 2008, Aryal et al. 2016). Nevertheless, the wildlife victims have bitter experiences of relief fund due to lengthy procedure and nominal relief amounts (Silwal et al. 2012). The money which is provided by the DNPWC through BZUC is not enough for them and the marginalized people have not yet benefited from this scheme. Lamsal (2012) in her study in Chitwan National Park found that only 4% of the respondents received compensation and the compensation was not sufficient enough to cover their losses. For instance, for human injury a person gets maximum NRs. 50,000 which is insufficient to hospitalize and get proper treatment. Consequently, compensation scheme is not completely trustworthy and almost the entire incident goes unreported. Although Bowen (2012) has mentioned about the success of compensation schemes to mitigate conflict in CNP, this survey indicates dissatisfaction of the local people with the compensation scheme for different reasons such as long procedure

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

(51 %), less compensations (30.6 %) and weak information flow (18.4 %). Therefore, effective alternative income generating activities for locals should be in place to reduce the conflicts because the conservation efforts would certainly increase the population of wild animals (Ayadi 2011) including tigers (Goodrich 2010).

Despite the widespread application of measures and compensation/ relief schemes, they were not considered to be effective in mitigating HTC in a long term. All these set of measures are temporal and less effective as there are hidden dimensions of HWC such as diminished psychosocial wellbeing, disruption of livelihoods, and food insecurity (Barua et al. 2013). This is why the conflicts are reduced to some extend only. Nevertheless, there are acute campaigns and measures on reduction of the conflicts. Tiger monitoring and alarming system in case of tiger entry to the buffer zone can be a good way for mitigating the conflicts as has also been suggested by Barlow et al. (2013) in Sundarbans of Bangladesh where long history of human casualties by tiger attacks is recorded. Moreover, holistic approach and scientific study on mitigation measures are to be made in the area. Better understanding, cooperation and coordination among local bodies, groups, and government can help to dwell in the core of the scientific study.

In conclusion, the trend of human-tiger conflicts has dropped around the Chitwan National Park area amid increased tiger population. However, long compensation procedures and less amount of compensation are still maintaining aggression of local people against conservation efforts of the government. Local people have highly positive attitude towards wildlife, including tigers. However, this could change over time if conflicts escalate due to increased tiger population and locals do not get proper and timely compensation. Therefore, government should give focus on conservation education, awareness programs, adequate and prompt compensation actions, and long-term monitoring of human-tiger conflicts for the success of conservation of tigers in CNP, one of the best natural habitats in TAL.

Human activities in buffer zones significantly impact river water quality, with profound consequences for wildlife, particularly in the lower reaches of Himalayan rivers intersecting sensitive conservation areas. Urbanization, construction, agriculture, sewage discharge, and other disturbances degrade riverine ecosystems, leading to pollution-induced stress, reduced reproduction, high mortality, and abnormalities in aquatic life (Blacksmith Institute, 2013; Vörösmarty et al., 2010; Rabalais et al., 2002; Paul & Meyer, 2001; Carpenter et al., 1998). Metal contamination, for instance, compromises fish larvae survival (Jezierska et al., 2009) and facilitates toxin bioaccumulation in terrestrial predators, threatening birds and mammals reliant on riverine habitats (Evers et al., 2005). Kandel et al. (2024) provide comprehensive evidence of human footprints in these fragile zones, characterized by dense populations and intensive agriculture. Understanding these interconnections is essential for developing integrated and sustainable management strategies to protect this ecologically critical region. The degradation of agricultural land and freshwater systems in Nepal-driven by unregulated pesticide use, industrial emissions, and expanding anthropogenic activities such as the proliferation of agro-veterinary suppliers-illustrates the mounting human pressures on essential ecosystems, and underscores the urgent need for comprehensive regulation, enhanced environmental monitoring, and sustained research to protect soil and water resources of this fragile region (Kandel et al., 2025).

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Data availability: All data analyzed during this study are included in this published article and the data are not publicly available, they can be obtained from the corresponding author upon reasonable request.

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DECLARATIONS

Ethics approval: This study did not require ethical approval.

Consent to participate: All authors listed in the manuscript have agreed to the authorship and have read and approved the manuscript.

Consent for publication: All authors listed in the manuscript have provided consent for submission and subsequent publication of the manuscript.

Competing interests: The authors declare that there are no competing interests.

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