HUMAN-TIGER (*Panthera tigris tigris*) CONFLICT IN BARDIA NATIONAL PARK, NEPAL

(A thesis for partial fulfilment of Master of Science in Landscape Ecology and Nature Conservation)

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……..

(Babu Ram Bhattarai)

Abstract

Human-wildlife conflicts are common phenomena from the past and have become significant problems throughout the world. Big cats, which play a vital role in maintaining the ecosystem balance through prey-predator interaction, are now on the verge of extinction since they require large habitats, but much of their habitats have been fragmented and degraded. Therefore, frequent encounters with humans and their livestock have caused human-carnivore conflicts which result in retaliation killings. The high rate of human population growth and the successfully restored habitat in the community forests of Nepal have accelerated the conflicts due to the dispersal of tigers into these forests where they share these resources.

This study aimed at exploring the human-tiger conflict in terms of livestock depredation, human casualties, retaliation killing and poaching of tigers and their prey base. It assessed the tiger conservation perceptions and tolerance level of the local people to losses caused by tigers and the roles of different stakeholders in tiger conservation through mitigating human-tiger conflict. It explored strategies of conflict reduction for tiger conservation. The study was conducted in six Buffer Zone User Committees of The Bardia National Park, Nepal. I interviewed 273 heads of household, 10 nature guides, eight BZUC presidents, nine protected area managers and two local government representatives from March to May of 2009.

The average livestock holding among the respondent households was found to be 6.70 head of animals per household and the depredation rate due to tigers was 0.25 head per household per year. The consequential result was a 6% loss of stock over the past three years. The less-prey density area was associated with a high livestock depredation rate for cows/oxen and goats/sheep. Twelve people were killed and four injured in tiger attacks between 1994 and 2007. The perception relative to tiger conservation was found to be positive and people could tolerate the loss of livestock to some extent but not human loss or casualties. Six tigers were released from the habitat due to human-tiger conflict in between 1989 and April 2009. The interview results demonstrated that the tigers were killed primarily for trade of its body parts. Half of the respondents suggested tigers should be conserved in the national parks and reserves.

The livestock grazing and human intrusion into tiger habitat and poor husbandry are causes of conflict. Conservation education along with adequate and prompt compensation against damages and regular monitoring of tigers may help to reduce human-tiger conflicts. As well, functional coordination between all stakeholders is recommended to conserve tigers.

Key words: *Human-Tiger conflict, Livestock-depredation, Retaliation, Compensation scheme*

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ACRONYMS

BCP	Bardia Conservation Programme
BNP	Bardia National Park
BZ	Buffer Zone
BZCF	Buffer Zone Community Forest
BZMC	Buffer Zone Management Committee
BZUC	Buffer Zone User Committee
BZUG	Buffer zone User Group
CNP	Chitwan National Park
DDC	District Development Committee
DNPWC	Department of National Parks and Wildlife Conservation
DoF	Department of Forest
GDP	Gross Domestic Product
HDI	Human Development Index
IUCN	The World Conservation Union
INGO	International Non Governmental Organization
MoFSC	Ministry of Forest and Soil Conservation
NGO	Non Government Organization
NPWC	National Parks and Wildlife Conservation
NRs	Nepalese Rupees
NTFP	Non Timber Forest Product
NTNC	National Trust for Nature Conservation

PA	Protected Area
PPP	Purchasing Power Parity
UNDP	United Nations Development Project
US	United State
VDC	Village Development Committee
WWF	World Wildlife Fund

Chapter 1

1. Introduction

1.1 Human-Wildlife Conflict

The Human-Wildlife Conflict (HWC) is a common phenomenon from the past and has become a significant problem throughout the world (Wang & Macdonald, 2005). Crop raiding, property damage, livestock depredation and human casualties are the most common forms of conflicts with wildlife (Ogra & Badola, 2008; Inskip & Zimermann, 2009). Human casualties and livestock depredation are the most serious nature of conflict among all.

Human-wildlife conflicts arise when they are compelled to share a common limited resource such as land, game, livestock or fish (Graham, et al., 2005; Schwerdtner & Gruber, 2007). In addition, the followings are also perceived as conflicts between humans and wildlife: when collisions with vehicles and animals occur, when aircraft strikes birds, and when diseased wildlife bites (Messmer, 2000). Broadly speaking, all human caused mortalities of wild animals, including poaching for trade of body parts, can be counted for as human-wildlife conflict (Muhammed, et al., 2007). The ultimate form of human-wildlife conflict is the loss of human life (Gurung, et al., 2008) and the retaliation against wild animals for such (Treves unpublished). Such retaliatory persecution in defence of livestock and protection of agricultural crops threatens the survival of this wildlife that comes into conflict (Mishra, et al., 2003). Many large carnivores have become extinct, for example the Javan tiger and the Bali tiger (Nyhus & Tilson, 2004), and the population of many species such as the Asiatic lion (*Panthera leo*), the Cheetah (*Aconytus jubatus*), and the Bengal tiger (*Panthera tigris tigris*) have declined substantially due to the human-wildlife conflicts (Treves & Karanth, 2003).

Human-wildlife conflicts will be of particular concern when they are associated with big carnivores attacking humans, such as tigers in Asia and lions in Africa. When the people involved are poor, wildlife damage may significantly affect the livelihood of local communities and if the

predators involved in conflicts are of legally protected status or are endangered, the consequences of conflict can be controversial (Thirgood, et al., 2000 cited in Graham, et al., 2005, pp. 159). If damages severely affect the livelihood of local communities, getting their active support, which is essential for conservation, will be difficult (Mishra, 1997).

Wildlife-human conflicts bring many social, economical and ecological consequences. People often migrate from wildlife-conflict areas to non-conflict areas. Crop and property damage and livestock depredation are common effects resulting in huge economic losses worldwide. These effects undermine the political support for conservation in protected areas and may call for eradication of the problem animal (Treves, unpublished). Large carnivores and herbivores which require extensively large habitats frequently come out of national parks/reserves. (Woodroffe, et al., 2005). Consequently, the carnivores which are specialized predators of large ungulates may kill the livestock when opportunities arise (Polisar, et al., 2003). In turn many of these carnivores are killed deliberatively or accidentally, therefore, making the borders as "sink" for those wildlife (Woodroffe & Ginsberg, 1998).

Large carnivores, 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 human population (Graham, et al., 2005). In some parts of the world, increase in conflict is a consequence of the habitat extension due to better management and the conservation of forests surrounding protected areas (Treves & Karanth, 2003). For instance, the rapid success of community forestry programs nationwide and the initiation of conservation of buffer zone forests adjacent to the parks and reserves 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 different locations of the world. However, the nature and extent of HWC is different from place to place (Sillero-Zubiri, Sukumar & Treves, 2007). The Conflict mitigation measures applied in one locality may not fit well in

other areas because socio-political, cultural, economic and geographic situations are not the same for all places (Graham, 2003). Therefore, the principle of one-size-fits-all cannot be applied everywhere. This study provides insight into the existing scenario of human-tiger conflicts in a low land protected area in western Nepal, and suggests conservation and management strategies to reduce human-tiger conflict. The area of study is densely populated by humans in a frontier setting who depend heavily on forest resources like timber, fuel wood, fodder, grasses, and different other non-timber forest products and herbs as food and for use in traditional medicines (Brown, 1997). The livelihood of people is mostly based on agriculture except in very few cases where people have a small income from government employment. Many households are adjacent to national parks and/or buffer zone forests. They are deprived of basic health and adequate sanitation facilities. Each year people die from the simplest disease like diarrhoea and cholera, and from snake bites. An unstable political situation in the region has introduced many obstacles to development. This is one of the areas that have suffered most from insurgency over the past decade.

1.2 Conservation needs of big cats

Large carnivores, which comprise big cats, play an important role in maintaining the ecosystem by way of predation and inter-specific competition (Treves & Karanth, 2003). They regulate or limit the population of their prey consequently altering the structure and the function of the entire ecosystem (Schaller, 1972; Estes, et al., 1998; Berger, et al., 2001; Terborgh, et al., 2002 cited in Treves & Karanth, 2003, p. 1491). In the absence of them, trophic cascade (herbivore populations explode) will occur (Lovejoy, 2006). The presences of big cats lying on top of the trophic level are signs of good ecosystem health and acts as "umbrella species" in conservation. 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 provide, including watershed protection, soil conservation, and water recharge and carbon storage. They also play a key role in a range of ecosystem processes and are often considered as icons of protected areas (Treves, unpublished). Moreover, many carnivores are important flagship species and therefore attract funding and wider conservation benefits (Linkie & Christie, 2007).

Unfortunately, large carnivores are the most threatened predators on the earth and big cats are among the line up of threatened carnivores. Long persecuted as perceived threats to livestock and humans (Lozano, et al., 2003; Mishra, et al., 2003; Duckworth, et al., 2005), hunted for their skins and purported medicinal values (Nowell & Jackson, 1996; Weber & Rabinowitz, 1996), prey depletion by hunting (Karanth & Stith, 1999; Mishra, et al., 2003), and losing critical habitat to deforestation and conversion to agriculture (Weber & Rabinowitz, 1996; Kolowski & Holekamp, 2006), big cat populations have dwindled around the world over the past century. The newest threat may be global warming which compels them to shift their range, nearly impossible, due to unsuitable habitat (corridor) in the present human dominated landscape.

1.3 The Royal Bengal Tiger: ecology, population distribution and conservation status

1.3.1 Ecology

Tigers (*Panthera tigris*) are the largest of all living cats: a typical male can measure up to three meters in length and weigh approximately 200 kg. Tigers are normally solitary, except for females with cubs. Mating takes place year round. Gestation is approximately 103 days and an average litter is two or three cubs. Cubs reach independence at between 18 and 28 months. Females first breed after three year of age and usually reproduce every two years until they are about nine or ten years old. The average breeding life of a female is 6.1 years. Males begin breeding when they are four to five years old. Longevity of tigers in the wild is little studied but some are known to live up to 17 years (Toyne & Hoyle, 1998; Sunquist, et al., 1999).

Tigers are terrestrial and occupy relatively large habitats, the size of which usually depends on the density of their prey. Their wide distribution, covering five bio-regions (the Indian sub-continent, Indo-China, South-east Asia, central and southern China, and the Russian Far East), covers eight important habitats: boreal taiga, temperate broadleaf and mixed conifer forests, alluvial grassland,

subtropical moist deciduous forest, subtropical and temperate upland forest, tropical moist evergreen forest, tropical dry forests and mangroves (Wikaramanayeke, et al., 1999).

Tigers have adapted to living in each different habitat and therefore prey on wide variety of animals. In general, they feed predominately on large deer species and wild boar. Occasionally they will kill larger species such as wild cattle, elephants and rhino calves. They are also opportunistic and will kill monkeys, birds, reptiles and fish as well as more unusual prey such as crocodiles and leopards. Males have been known to kill cubs fathered by other tigers (Sunquist, et al., 1999).

Tiger density depends on the quality of the habitat and the prey it supports. Factors regulating their numbers vary in different regions, so conserving them entails protecting large areas of their habitat and sound management of their prey (Karanth & Stith, 1999).

1.3.2 Tiger conservation status in the world

Wild tigers are in a precarious situation (Damania, et al., 2008). They are living in a small fraction (only seven percent) of their historical range and have lost 40% of their habitats since the 1990s (Dinerstein, et al., 2007; Damania, et al., 2008). The global population of tigers was approximately 100,000 a century before and has declined to less than 4000 now (Damania, et al., 2008). Habitat loss and fragmentation (Wikramanayake, et al., 1998; Dinerstein, et al., 2007), depletion of prey base (Karanth & Stith, 1999; Ranganathan, et al., 2008), poaching (Nowell & Jackson, 1996; Chapron, et al., 2008), and conflict with humans (Nyhus & Tilson, 2004; Gurung, et al., 2008) is known causes of declining populations of tigers. Human-tiger conflict exists throughout its range and the intensity of conflict is high in Asia where the human population surrounding the tiger habitats is dense (McDougal, 1987; Nowell & Jackson, 1996; Nyhus & Tilson, 2004). Curtailing retaliatory killing and restoring wild prey populations are perhaps the most important needs of these big carnivores in their conservation today (Mishra, et al., 2003).

In the last century, three tiger sub species (two from Indonesia, the Javan tiger (*Panthera tigris sondaica)* and the Bali tiger (*Panthera tigris balica*) and one from Central Asia, the Caspian tiger (*Panthera tigris virgata*)) have been extirpated from the wild (Weber & Rabinowitz, 1996; Seidensticker, et al., 1999; Nyhus & Tilson, 2004). The global population of the remaining six sub species are shown in the table below.

Table 1.1 Population status of tiger sub species

English names	**Scientific names**	**Population**
Indo Chinese Tiger	*Panthera tigris corbetti*	1200-1500
Amur /Siberian Tiger	*Panthera tigris altaica*	431-531
Sumatran Tiger	*Panthera tigris sumatrae*	fewer than 400
Bengal Tiger	*Panthera tigris tigris*	around 1800
Malayan Tiger	*Panthera tigris jacksoni*	estimated at least 500
South China Tiger	*Panthera tigris amoyensis*	Perhaps few (possibly extinct?)

(Source: http://www.panda.org/what_we_do/endangered_species/tigers)

1.3.3 Distribution of tiger population and conservation status in Nepal:

Historically, tigers were distributed continuously across the lowland forests (Shrestha, 2004). The government encouraged human settling in this lowland by eradicating malaria with assistance from World Health Organization in 1950s (GoN, 2007). Massive migration of hill people in Terai created habitat conversion and fragmentation (Gurung, 1983). This resulted in the population of tigers becoming isolated. Surveys between 1987 and 1997 documented only three isolated tiger populations in Chitwan National Park, Bardia National Park and Shuklaphanta Wildlife Reserve (Figure 1.1) (Smith, et al., 1998). The tiger census of 1995-1996 revealed 48-49, 30-32 and 15-16 of minimum breeding tiger populations in Chitwan National Park, Bardia National Park and Shuklaphanta Wildlife Reserve respectively. In the census of 1999/2000 it was estimated at between 98 and 123 breeding adults. The recent census conducted from 20 November 2008 to 24 March 2009 estimated 121 breeding tigers throughout the whole of Nepal (MoFSC, 2009). The

detailed scientific report of this census is yet to be made public (see table 1.2). Among these three isolated populations, the Chitwan population occupies the largest geographical area (2543 km²). It includes Chitwan National Park, Parsa Wildlife Reserve, Valmiki Tiger Reserve of Inida and a forest block in the Bara district in Nepal (Figure 1.1) (Smith, eta al., 1998). Seventy five per cent of this land base is in protected areas. The Bardia population, 180 km west of Chitwan, occupies a land base of 1840 km² of which Bardia National Park constitutes 51 percent of it (DNPWC/MoFSC/GoN, 2007). Gurung (2002) mentions a gap of 67 km between the population of Chitwan and Bardia. Between 1987 and 1997, tigers west of the Karnali River became increasingly isolated from the core of the Bardia population (Smith, et al., 1998). A small population exists in the Shuklaphanta Wildlife Reserve of western Nepal. The land base of this population is only 320 km², but the prey density is high. This population was formerly connected with tiger habitat in India, but is now becoming isolated from both the Bardia and the Indian populations (Gurung, 2002; DNPWC/MoFSC/GoN, 2007).

Along with habitat loss and fragmentation, prey depletion and poaching, conflict with humans is also pronounced throughout its range in the country. In Chitwan National Park, tigers killed 88 humans and 3000 livestock between 1979 and 2006 (Gurung, 2008). He further adds that in the same period, authorities removed 25 'problem tigers' from the habitat. In Bardia National Park of western Nepal, at least six people were killed between 2000 and 2004 (Bhatta, et al., 2007). As the populations are continuously decreasing, despite significant regional and international supports for conservation and committed efforts of conservation of the respective government (Dinerstien, et al., 2007), the tiger species has been assigned the category of "endangered" in the red data book of World Conservation Union (IUCN). Because the trade of its body part is one of the primary cause of the depleting population throughout its range, the Convention on International Trade of Endangered Species of Flora and Fauna (CITES) has listed it under appendix I since its inception (Nowell & Jackson, 1996). The trade of live or any specimen of taxa enlisted in this appendix is strictly prohibited. The National Parks and Wildlife Conservation Act, 1973 of Nepal, has recognized the tiger as a protected species listing it under schedule I. According to this act, the taker of a tiger species (either killing or involved in trade) is criminally liable and subject to

imprisonment of 5-15 years and a fine of NRs50,000 to 100,000 or both (DNPWC/MoFSC/GoN, 2007).

Table 1.2 Tiger population distribution in Nepal

Protected Area	**1995/96**	**1999/00**	**2005**	**2008****
Chitwan National Park	48-49	50-60	50-60	95*
Bardia National Park	30-32	32-40	32-40	18
Shukla Wildlife Reserve	15-16	16-23	16-23	8
Outside Protected Area	-	8-10	8-10	-
Total	93-97	106-133	106-133	121

(Source: DNPWC/MoFSC/GoN, 2007)

*Including 4 of Parsa Wildlife Reserve **Press release of MoFSC on 27.09.2009

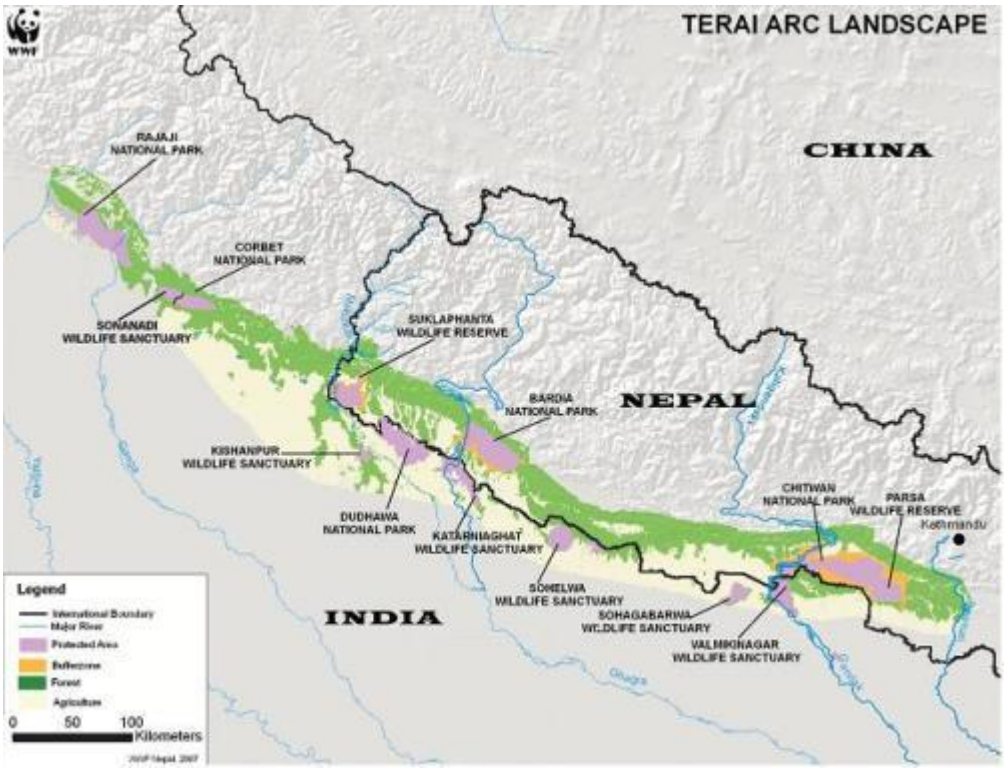


Figure 1.1 Tiger conservation landscape in lower Nepal (Source: DNPWC/MoFSC/GoN, 2007)**.**

1.4 Human-wildlife conflict mitigation in Nepal

Though the history of conservation in Nepal was begun in 1846 by the establishment of a hunting reserve covering tiger habitat in southern Nepal (Smith, et al., 1998), the modern concept of scientific conservation started only after the formulation of The National Parks and Wildlife Conservation (NPWC) Act of 1973 (Wagle, 2009). At the outset, local peoples were totally excluded and the protected areas were shielded from the disturbance of local residents who were also not allowed to collect resources (Sharma, 1990). Land use conflict was perceived to be immense. In subsequent passing of time, it was believed that without the support of the local community, sustainable conservation could not be achieved, so the NPWC Act of 1973 was amended in 1978 to allow local inhabitants surrounding the national park/reserve areas to collect thatch grass (Sharma, 1990). This served as the stepping stone in the Nepalese conservation sector as endorsement of land use conflict mitigation measures were enacted. The World Park Congress held in Durban in 2003 recommended compensation to suffered local communities as a measure to solicit needed support in conservation (Ogra & Badola, 2008). In spite of this recommendation, Nepal had already initiated efforts to recognize the local peoples' problems and grievances of damages by wildlife prior to this date. In the 1980's, Nepal, in fact, launched an integrated conservation and development project which was conceptually a community compensation program. Because people were allowed to collect resources, moreover, they participated in resource management. The Annapurna Conservation Area is a pioneer in this sort of a pro-people conservation model. A participatory conservation approach is the main theme of the model. By the time of the 4th amendment of NPWC act of 1973 in 1993, declaration of a buffer zone was started which envisioned the participation of local people in conservation (Heinin & Mehta, 2000). Many conservationists like to think of it as a new dimension in the conservation model. Allocation of up to fifty percent of the revenue earned by national parks/reserves for community development was a big step and the main initiative of this policy (Bajimaya, 2003). The community can decide budget allocations under some conditions defined in The Buffer Zone Management Guideline 1999 (GoN, 2000). Hence, the buffer zone management committee may allocate some money to mitigate or control the human-wildlife conflict. Such allocations may include money for trench

construction or fencing to prevent wildlife penetrations into crop fields or settlements and a compensation scheme to victims.

Presently, 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). This funding comes from a part of the revenue generated by the National Park. There are no provisions for compensation against of any sort of wildlife damage in Nepalese conservation laws. Very recently, however, The Ministry of Forest and Soil Conservation prepared a guideline to address compensation against those effecting wildlife damage. This policy guideline has yet to be implemented and a detailed procedure and incorporation into law is yet to happen (http://www.ekantipur.com/kolnepalinews.php?&nid=206843).

To reduce conflict, a problem animal that kills a human or livestock outside of the core zone is either exterminated or taken captive and placed in a zoo (Sharma, 1990; Gurung, et al., 2008). In the case of man-eating tigers, they are categorized as a one-time killer or a serial killer. Serial killers are removed immediately while one-time killers are captured and released into deep forest. Another category label is "aggressive" which is assigned if the man-eating tiger doesn't leave the human body when people come on elephant back to release it from the tiger. Such "aggressive" tigers are also exterminated. To reduce crop raiding (especially by elephants), watch towers (*machan*) are constructed at vantage points in the crop field. Local people guard the crops day and night while sitting in the *machan.* Shortly before harvest season, people spend many nights, some without sleep. In some locations, producing a sound by pulling a long string attached to a stick and some sort of an instrument is a common practice among farmers to keep crop raiding animals at bay. Scare figure-like human effigies are sometimes erected in the crop field as well. Villagers will also make flames of fire to chase a herd of elephants from the cultivated land (Personal observation).

The NPWC Regulation of 1976 has provisioning for the declaration of pest animals which inflict suffering on local communities. Such animals can be exterminated with permission of the National

Park/Reserve game warden (GoN, 1976). Sharma (1990) mentions an example that people are allowed to kill or catch the wild boar (*Sus scrofa*) which penetrates the crop field in the vicinity of the CNP. In the recent decade, the human-wildlife conflict issue is overtly recognized in species conservation action plans of Nepal. These are examples: The Tiger Conservation Action Plan, The Snow Leopard (*Panthera uncia*) Conservation Action Plan and The Rhino (*Rhinoceros unicornis*) Conservation Action Plan.

1.5 Rationale of the study

Many studies have been done on the Chitwan tiger population in southeast Nepal (Smith, et al., 1998). The Tiger Ecological Project was designed as a long term tiger monitoring project in 1970's (Sunquist & Sunquist, 1981; Mishra, et al., 1989). This project studied the ecological and behavioural aspects (Sunquist & Sunquist, 1981) but focused only in core habitat (Gurung, 2008). After success of the community forestry and buffer zone conservation program, additional habitat has been created beyond the protected area. However, in such secondary habitat human and wildlife conflict is high. To understand this problem Gurung (2008) conducted a study in Chitwan National Park, Nepal. His study is pioneer in exploring the dimension of human-tiger conflict in the buffer zone forest of Nepal. The Human-Tiger Conflict study in secondary habitat is very scanty in Nepal. Compared to other Asian regions, research on the human-tiger conflict is less explored in Nepal making this an entirely new research theme for Bardia National Park. The Government of Nepal has been implementing the landscape conservation program the aim of which is to connect the different sub-populations, especially of the tiger, with wildlife dispersal corridors. Many studies have found that human and carnivore conflicts are more severe in such sub-optimal habitat (Nyhus & Tilson, 2004). Therefore, spatial and temporal data on livestock depredation, human casualties and loss of tigers resulting from human-tiger conflict are necessary to address this problem and for the overall success of the project. The Tiger Action Plan (2007-2012) of Nepal recognizes human-tiger conflict as one major cause of limiting the growth of tiger population. As well, it emphasizes the exploration of conflict situation throughout the country and the adoption of necessary mitigation measures for the human-tiger conflict over the long term (DNPWC/MoFSC/GoN, 2007). This study aims to envisage the degree of conflict in the buffer

zone and the core zone of Bardia National Park and understand the perception of local communities residing in the vicinity of tiger habitat. It suggests, further, to better tiger conservation strategies through conflict mitigation.

1.6 Objective of the study

The aim of the study was to explore the human-tiger conflict in Bardia National Park, Nepal, and recommend solutions for an effective future conservation strategy. Moreover, this study envisaged the perception of local inhabitants to tiger conservation and their tolerance to losses of livestock and human casualties caused by the tiger. Similarly, it analyzed the effect of the human-tiger conflict on tiger conservation and explored possibilities for better tiger conservation by means of conflict mitigation. I compared the conflict parameter between high-prey density areas (where high tiger density is present) and low-prey density areas.

The specific objectives of this study were:

- To assess the livestock loss and human casualties by tiger predation
- To assess the loss of tigers due to the human-tiger conflict and causes of tigers being killed
- To understand the perception and level of tolerance of people living in the vicinity of tiger habitats
- To identify the role of different stake holders in mitigating the human-tiger conflict
- To recommend ways of minimizing the human-tiger conflict and adaptation of a suitable compensation scheme.

Chapter 2

2. Study area and methods

2.1 Study area

2.1.1 Geology, hydrology and climate

Bardia National Park (Figure 2.1 & 2.2) is situated in the Bardia district which is located in the south western fringe of the country bordering India on the south and Banke, Kailali and Surkhet districts to the east, west and north respectively. This area is a part of *naya muluk* (meaning 'new state') because it was once grabbed by India (during the colonial period of Britain) but was later returned to Nepal after signing of the treaty of 1947(known as *Sugauli Sandhi*).

The Bardia National Park (28°15' to 28°35.5' N and 80°10' to 81°45' E) is part of the Nepalese low land, or the "arc of terai", which consists of three ecological zones in the southern flank of the Himalayas: (1) the *siwalik hills*, the adjoining (2) *bhabar* areas and (3) the *terai* plains. These three strata are in the form of narrow strips running parallel to the main Himalayan range (Shrestha, 2004). The *siwalik*, which runs along the base of the Himalaya, are an uplifted ridge system formed from the debris brought down from the main Himalaya. The *siwalik* is composed of coarsely bedded stone, crystalline rocks, clays and conglomerates. The soils are young and very shallow and are exposed to a great degree of erosion which is common due to an associated higher degree of slope. Landslides in the area are common and there is little potential for cultivation (Baral, 2005). The coarse material brought down by the Himalayan Rivers is deposited immediately along the foothills of Siwalik to form a pebbly-boulder layer referred to as the *bhabar*, while the finer sediments, or clay, is carried further down forming the *terai*. The *bhabar* is characterized by a low ground water table since the deposits are primarily boulder making them porous. As such, all rivers and streams dissolve into the ground. The streams reappear, however, along the *terai*, which has fine alluvial soil resulting in high ground water tables (Johnsingh, et al., 2004; Shrestha, 2004). The *bhabar* zone is not suitable for agriculture while large tracts of forest are present here. South of *bhabar* is the *terai* flatland, which is the northern extension of the

Gangetic plain. It is an alluvial flood plain in the south and tertiary Siwalik in the north consisting of beds of silts, clay and gravel to great depths and is the most productive agriculture land in Nepal. Hence, it is called the "grain store" of Nepal. Soils in terai are predominantly brown or yellow-brown sandy loams that are mostly calcareous and slightly alkaline (Baral, 2005).

The park is drained by two large rivers, the Geruwa (a tributary of Karnali) in the west and the Babai in the east (Figure 2.1). Khauraha, Kareli and Orahi are other small rivers present in the National Park. Some manmade water holes are scattered in the park for use by wildlife. There are no oxbow lakes inside the park (GoN, 2007).

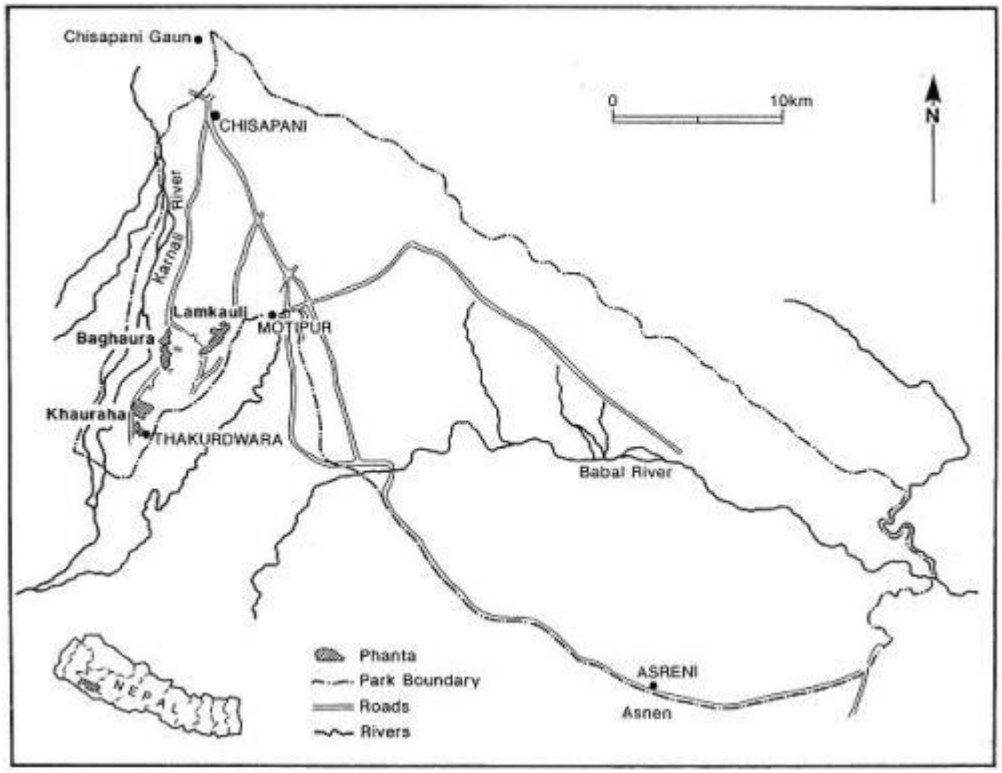


Figure 2.1 River systems in Bardia National Park (source: Brown, 1997)

The climate of the area is subtropical monsoonal type with three distinct seasons: cool-dry (November to February), hot-dry (March to June) and monsoon (July to October). Most of the rains (1560 to 2230 mm) fall between June and September, somewhat later than in the eastern part of the country (Bolton, 1976 in Pradhan, 2007). Annual rainfall varies from about 2000 mm at Chisapani to about 1400 mm at Gularia depending upon the proximity of hills (GoN, 2006).

Rainfall recorded at Chisapani Station adjacent to BNP is highly seasonal; the mean total annual rainfall between the periods 1987–2001 was 2100 mm. Again, most of the rain occurs between the months of June and September, and then followed by 7–8 months of a dry season (Timilsina, et al., 2007). Heavy pre-monsoon rain in April and May is common in western Nepal (Shrestha, 2004). Average annual minimum temperature is estimated at 18.5°C. The absolute minimum temperature may fall to 3°C. Frequent occurrences of cold waves keep the area covered with clouds for about four weeks (GoN, 2007). Average temperature in the cool season drops to 10°C in January while in the hot-dry season temperature may rise up to 41°C in May (Dinerstein, 1979).

2.1.2 Vegetation and wildlife

The natural vegetation of the terai arc Nepal covers around 13,000 km². Broadly, the vegetation here is comprised of a mosaic of dry and wet deciduous forests, alluvial floodplain grass land, and scrub savannah (Shrestha, 2004). Even though the landscape scores a low value for species endemism; it contains the world's most productive ecosystems as Terai-Duar savannah and tropical deciduous forest (Johnsingh, et al., 2004). The Terai-Duar savannah and grassland is listed among the 200 globally important areas, due to its large mammal assemblage (Wikramanayake, et al., 1998). The sal (*Shorea robusta*) forest is the ecologically characteristic climax vegetation of the Terai (Shrestha, 2004). Natural and physical forces such as floods, fires, erosion, and soil aridity contribute to a continually changing mosaic of grasslands, mixed deciduous, dry-thorny and riverine forests in various stages of succession in the Terai. Biogeographically, the Bardia National Park lies in the Indo-Malayan Realm (GoN, 2007). The park is in central point of floristic division of the Himalaya region, hence representing the floral elements from both the eastern and western Himalaya. The mosaic of the matrix has formed a unique landscape. Dinerstein (1979) described the following six types of vegetation from Karnali section which lies in the south western section of the park-

1. *Shorea robusta-Buchanania latifolia* forest = Sal forest
2. *Dalbergia sissoo-Acacia catechu* forest = early riverine forest
3. *Ficus glomerata-Mallotus philippinensis-Eugenia jambolana forest* = mixed

riverine forest

4. *Bombax* savannah/grassland = savannah/grassland
5. Ecotonal secondary open mixed hardwood forest
6. *Sacharum spontaneum-Tamarix* flood plain = tall grass flood plain

Janawali and Wegge (1993) later revised the vegetation described by Dinerstien (1979) into seven types as following-

1. Sal (*Shorea robusta*) forest
2. Khair-sissoo (*Acacia catechu-Dalbergia sissoo*) forest
3. Moist riverine forest
4. Mixed hard wood forest
5. Floodplain grassland
6. Wooded grassland
7. Phanta

The vegetation study of Babai valley which lies in the eastern section of the park is lacking.

The south western part of this National Park created by the Karnali flood plain, equivalent to 100 km², is defined as a bio diversity hot spot (Wegge, at al., 2004). It provides an exceptionally high density of diverse ungulates (for example five species of deers, two species of antelope and one species of *suidae*) and their predators like the tigers and the leopards (Dinerstien, 1979). The translocated rhino (*Rhinoceros unicornis*) from the Chitwan National Park is adapting very well but because of the insurgency and the withdrawal of security posts from the Babai Valley, poachers took advantage of the situation by killing nearly all the rhinos in the valley. A mere 20 rhinos are now in existence. The tiger population here is considered to be one of the highest in density in the world (Stoen, 1994). The other endangered mammals of the region are the dolphin (*Platinista gangetica*), the Asian Elephant (*Elephas maximus*), the four-horned antelope (*Tetraceros quadricornis*), the Swamp deer (*Cervus duvauceli),* the Indian Pangolin (*Manis crassicaudata*) and the Blue bull (*Bocelaphos tragocamelos*). In total, it harbors 53 mammalian species among which 10 are protected under the NPWC Act of 1973. Similarly, the Python

(*Python indica*), the Monitor lizard (*Varanus flavescens*), the Gharial crocodile (*Gavialis gangeticus*) and the Marsh Muggar crocodile (*Crocodylus palustris*) are well preserved within the park. Altogether 25 species of reptiles are found in the park including three species protected by the National Parks and Wildlife Conservation act of 1973. The park is equally rich in avifaunal diversity and is one of the important bird areas in Nepal as defined by the Bird Life International (Baral & Inskipp, 2005). It is also home to some 400 species of birds among which six species are protected under the NPWC act of 1973.

2.1.3 National Park History

The Bardia National Park was established in 1969 as the Royal *Shikar* (Hunting) Reserve (Allendorf, et al., 2007) covering 348 km² area which prominently included the Karnali floodplain. In 1976, it was renamed as The Karnali Wildlife Reserve (Dinerstein, 1979). During the establishment, human settlements (villages) were relocated to the southern border of the reserve. Later in 1984, its area was extended to the present size of 968 km² which includes Babai Valley to the east. During this extension, some 10,000 people were relocated to Taratal which is near District Headquarters at Guleria (Brown, 1997). In the year 1989, the area was upgraded to National Park status (Bhatta, 1994). The national park is administered by a game warden (Chief Conservation Officer-gazetted 2nd class) and he works in association with 120 other subordinates assigned as assistant wardens, park rangers, clerks and game scouts. Two sectors in east and west and around 14 other game posts are spread inside the park to conduct daily conservation and management activities. In addition, one battalion (equivalent to 800 soldiers) plus a company (equivalent to 350) of national army soldiers are deployed for protecting the park boundary, enforcing the acts and regulations against encroachment, poaching and illegal activities inside the park. This protection force is scattered around in some 15 posts in a territory of 968 km² of the National Park. During the period of the insurgency (1996-2006), these posts were merged and very limited patrolling was performed to protect against poaching and to protect the National Park itself. These merged security posts have yet to be fully relocated to all the strategic points since most of the buildings were destroyed during the war period and as yet not renovated.

In 1996, the buffer zone was declared as covering an area of 328 km². The National Park is surrounded by the buffer zone on three sides viz south, east and west. The buffer zone covers 125 villages of 17 VDC[1]s and is an assemblage of forest, agriculture land and settlements. It is covered with 51% forest and the remaining 49% consists of agriculture and settlements. The population was 120,000 during the time of the buffer zone declaration (GoN, 2007). Among these, over 60% is comprised of an aboriginal indigenous *Tharu* ethnic community (GoN, 2007) who are believed to be immune from malaria (Gurung, 1983) the rest migrated from northern hills after the malaria eradication program sponsored by the government in 1954 (Pradhan, 1995). Those immigrants include diverse ethnic groups primarily of *Brahmin, Chhetri, Magars*, and *Kami, Damai* and *Sarkis* descent. The *Kamis, Damais* and *Sarkis* are considered as untouchable cast and they are extensively dominated by a so called "higher cast group". Subsistence agriculture is prevalent in the area with rice, wheat and maize comprising the major crops. Lentils, mustard, linseed and potatoes are also cultivated. Ginger, turmeric and garlic are grown as accessory cash crops. Currently, with the initiation of some development-oriented NGOs (Non Governmental Organization) and other governmental conservation organizations, people are attracted to crops like menthe, chamomile and asparagus which are less susceptible to wildlife damage and yet provide some cash return to farmers. Every household possesses cows and/or buffalo, goats, sheep, and chickens. These animals are an important source of household economy and compost and tract power for agriculture. Cows and buffalo are also a source of milk. The breeds farmers are keeping have a very low productivity rate.

[1] VDC refers to village development committee which is the smallest unit of local government. VDC is divided into nine wards for administration. Chairman is the head of VDC and he is assisted by vice chairman and nine ward presidents. For administrative work of VDC there is one secretary. VDC chairman vice chairman and ward presidents are nominated by election process and their terms are for five years. VDC secretary is a civil servant and is appointed by public service commission.

Box 1: What is Buffer Zone?

A buffer zone is defined as an area surrounding a national park or a reserve which has been set aside for perpetual use of the natural resources benefitting local people who are deprived of using the natural resources contained in parks and reserves because of their protected status. The National Parks and Wildlife Conservation Act (NPWC) of 1973 (fourth amendment 1993) defines a buffer zone as that "surrounding area of parks or reserves which have been declared by the Government of Nepal to provide local people use of forest resources on a regular basis." The primary aim of creating buffer zones was to establish social and natural buffering between settlements and the park by reducing pressure on parks from settlements and vice versa so that park and people relations may be improved (Sharma, 1990; Bhatta, 1994; Heinen & Mehta, 2000). The act provisioned the pull back of up to 50% of the revenue generated by parks and reserves for use in support of community development. According to BZ Management Regulation 1996, the Conservation Warden shall make a detailed management plan of the buffer zone in order to implement the buffer zone management program. While making detailed management plan he/she shall incorporate the plans of the Buffer Zone User Committee (BZUC) and the Buffer Zone User Group (BZUG). The Buffer Zone User Group is formed at the very bottom level primarily in small settlements or hamlets. BZUG is comprised of representatives of all the households in the settlement. Buffer zone user committee (BZUC) is formed from among these BZUGs. The BZUC coordinates with all BZUGs and acts as bridge to connect BZUGs and the BZMC (Buffer Zone Management Committee). In general BZUC is formed at the VDC level. There can only be a maximum of 15 BZUCs in a park/reserve. The Buffer Zone Management Committee (BZMC) is at the top of the hierarchy and acts as a decision making body. It is comprised of BGZUCs, local government representatives and the Conservation Warden. Its task is to allocate the budget among different BZUCs and it monitors the overall program. The National Park/Reserve Warden acts as a member secretary in this BZMC. The term for members of the BZMC is five years.

The average size of a household is 6.78. Altogether, 15 buffer zone user committees are formed comprising of 125 villages from 17 VDCs. More than half of the people residing in the buffer zones are illiterate and only 0.81% has completed a university degree (Bachelors & Masters). Their major livelihood strategy is subsistence agriculture. The average land holding is 0.69 bigaha[2] (including *ailani*-government owned land) per household. The average livestock holding is 4.43 (cows/oxen, buffalo, sheep, goats and pigs) (BNP, unpublished data).

Thirty six patches of forests equivalent to 10,000 ha are handed over to local communities as buffer zone community forests (BZCF). Around 60,000 people are benefitted from community forestry practices (BNP unpublished data). Although forest product extraction from national parks is not allowed, with the exception of thatch grass for one week a year, people surrounding the park tend to fetch some forest resources illegally (personal observation). They do, however, enjoy collecting the forest resources from BZCF as provided by the operational plan and constitution (Heinen & Mehta, 2000).

2.2 Methods

The study was carried out in six Buffer Zone User Committees of six Village Development Committees of Bardia National Park Buffer Zone (Figure 2.2). The BZUC is in general, formed at a VDC level (see box 1 also). The studied BZUCs were namely, Thakurbaba (Thakurdwara VDC), Shivapur Ekikrit (Shivapur VDC), Suryapatuwa (Suryapatuwa VDC), Baghkhor (Belwa VDC), Koldanda Milijuli (Deudakala VDC) and Bhada (Dhadawar VDC) The first three Thakurbaba, Shivapur Ekikrit and Suryapatuwa are located in high-prey density areas which enables high tiger density and the later three Baghkhor, Deudakala and Dhadawar are in low-prey density. The former three are in western section while latter three in the eastern section of the park.

[2] Bigaha is a traditional land measurement unit in low land Nepal. 1 bigaha=0.68 hectare.

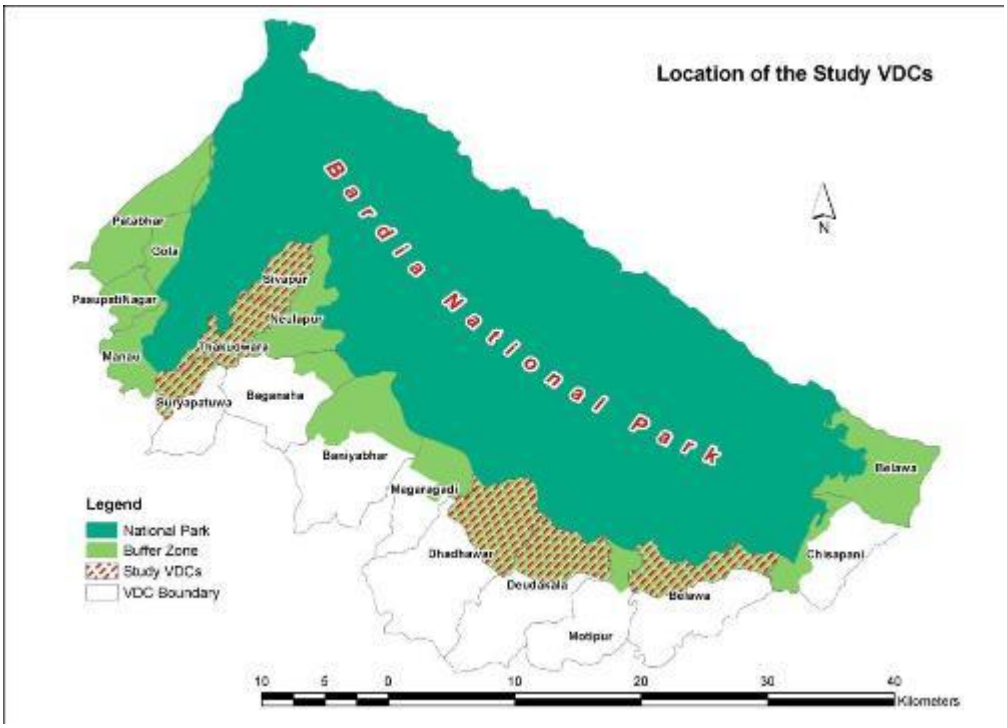


Figure 2.2 study sites showing VDCs

2.2.1 Questionnaire survey

I used a structured self-administered questionnaire survey (Punch, 2006) to collect data on human-tiger conflict. All questions were close ended (closed ended questions have multiple options and respondents are required to choose one from among 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. For designing the questionnaire, I took reference mainly from Gurung (2008) and Oli (1994) and then consulted with my supervisors, Prof. Susanne Stoll-Kleemann and Prof. Klaus Fischer in January of 2009. In the next step, I held discussions with an Ecologist in the Department of National Parks and Wildlife Conservation of Nepal, namely, Mr. Shiva Raj Bhatta and Chief Conservation Officer of the Chitwan National Park, in Nepal, Dr. Narendara Man Babu Pradhan.

In many parts of Nepal tigers and leopards primarily *Panthera pardus* are both termed as *bagh* (tiger). Therefore, to ascertain of which we were speaking, I used the photographs of a tiger and a

leopard so that my interviewees could readily identify which *bagh* was responsible for livestock predation and human casualty. In every question related to tigers, I specifically asked them which *bagh* are you talking about, and they, of course, had a visual from which to positively identify.
To investigate livestock depredation rates, I asked the question, "how many livestock did you lose in past three years due to depredation by tigers and what sort of livestock? ". To assess the attitude of local residents, I asked questions like, "do you like tigers or not, and why?", "do you like tigers living in community forestry?" Similarly, the questionnaire survey was used to know the existing compensation procedure, if in fact, there was any and the expectation of local communities for losses caused by tigers. Hypothetical questions such as, "do you support tiger conservation even if a family member was killed or injured and livestock was lost by tiger predation?" were asked to assess the tolerance level of local people. Causes of tigers being illegally killed were assessed by asking the question, "why tigers are being killed?" In addition, questions for basic information such as age, gender, education, landholding, livestock owned, etc. of the respondent were also included (detailed questionnaire is given in annex D). Before initiating the questionnaire survey, pilot surveys were taken with the Thakurbaba Buffer Zone User Committee. Twenty households were selected randomly for the pilot survey; after which necessary improvements were made in the questionnaire. These pilot questions were not considered in the result analysis.

Single interviews were conducted primarily with the head of the household, of which mostly were male. The exception was where they were absent during the household visit. In many cases, other family members also participated to form a collective response. In order to complete the survey in time, two assistants from the local community who were able to understand both the *Tharu* and *Nepali* languages were hired. These locals had graduated from at least a high school level. The advantage of hiring local people was that they understood local languages and were able to determine if the respondent might be giving false data. Verification by cross checking was done when there was doubt as to the validity of the data being provided. They were trained before they started the job and jointly participated with me during piloting surveys such that when I was confident that they could perform interviews and record data correctly on the protocol sheets, they were permitted to work independently. In light of my employment status with the DNPWC of Nepal, and since I had worked in the Bardia National Park from March, 2004 through July, 2006,

I made efforts to avoid discovery of my identification to avoid receiving fraudulent data on livestock depredation. My primary fear was that people might exaggerate the actual number of livestock depredation in hopes of getting more compensation.

Of the 272 respondents, only 64 (23.4%) were female. The eldest respondent was 75 years of age while the mean age was 40.41 (n=260, SD=13.03). The respondents' age class frequency distribution is given in table 2.1.

Table 2.1 Respondents' age class distribution

Age class	**Female**	**%**	**Male**	**%**	**percentage**
18-27	22	8.46	18	6.92	15.38
28-37	19	7.31	61	23.46	30.77
38-47	13	5.00	59	22.69	27.69
48-57	2	0.77	32	12.31	13.08
58-67	4	1.54	23	8.85	10.38
68-77	1	0.38	6	2.31	2.69
Total	61	23.46	199	76.54	100

Interviewees were met at their home and roughly 45 to 60 minutes of time was required for an interview. If a household member 18 years of age or older was absent during the survey request, that house was skipped and the next house was approached. Assistants met once weekly to solve what, if any, problem appeared. The interview was conducted during March, April and May of 2009. As this was the time of the winter harvesting season (wheat and lintels), it was difficult to catch some farmers at home. Since the season was dry and hot, farmers were in the crop field during the morning hours, 6:00 am to 10:00 am, as well as during afternoon hours from 4:00 pm to 7:00pm. Therefore, a majority of the interviews were conducted from 11:00am to 3.00pm during which time the day temperatures raise to maximum levels.

2.2.2 Key person interview

Key person interviews were conducted exclusively by myself. They consisted primarily of interviewing representatives from the BZUC who were involved at the decision making level. These interviews were conducted to learn of their role in human-tiger conflict mitigation and to understand the causes of such conflicts. I used semi-structured mix of close and open end questions. Similarly, interviews were conducted with nature guides who are involved in guiding visitors inside the National Park and Buffer Zone forest. As nature guides visit the National Park frequently and are from the same community, they are familiar with the socio-ecological scenario of the location. Questions regarding conflict management, causes of conflict, and their role in mitigation of conflict were asked of the nature guides. In addition, I conducted interview with protected area (PA) Managers. PA Managers were asked to share their understanding of the human-tiger conflict management strategy, the compensation scheme of government and problem tiger management. Ten interviewees who are working for managing the protected area at different levels included the chief warden, the national park ranger, the game scout and representative from Conservation NGO were interviewed in this group of PA Managers. Last but not least, I performed the interviews with local government officials from within the buffer zone. Two VDC level officials who were available during the conducting of interviews served as my respondents.

2.2.3 Sampling of household survey

Of the 15 BZUC's, three buffer zone user committees from the eastern sector and three from the western sectors were randomly selected using a lottery. From these six user committees, 5% of the total households were chosen using a random selection process. Each household from the selected six BZUCs, were coded in numbers. These numbers were later selected using a random number table. The lists of households were achieved from the BZMC office of the Bardia National Park. The total numbers of households selected by the random selection process in each BZUC are represented in the following table.

Table 2.2 Household sampling

SN	BZUC	VDC	Sampled household number	Total household	Sampling intensity %
1	Thakurbaba	Thakurdwara	69	1338	5.16
2	Shivapur Ekikrit	Shivapur	63	1219	5.16
3	Suryapatuwa	Suryapatuwa	38	420	9.04
4	Baghkhor	Belwa	40	665	6.01
5	Koldanda Milijuli	Deudakala	33	542	7.61
6	Bhada	Dhadabar	30	999	2.90
	Total		**273**	**5183**	**5.22**

2.2.4 Collection of secondary data

Human casualties (i.e. death and injury) by tiger attacks in and around the National Park were obtained from the National Park Archive of Bardia and were verified through key person interviews with park rangers, nature guides and Buffer Zone User Committee representatives. The National Park Archive had data only from 1992 since human casualty events prior to this were lacking. After declaration of the buffer zone in 1996, the Buffer Zone Management Committee (BZMC) initiated to keep the data since some funds were allocated for compensation as relief for damages caused by wildlife. Similarly, data on the loss of tigers due to the human-tiger conflict was also obtained from the National Park Administration Office and interviews with officials of *mudda fant* (legal section), national park rangers, and game scouts. The poaching data on tiger and its prey was also collected from the legal section of the park bureau. The National Park Archive of Bardia had tiger loss data from 1989 but the data before 1997 was very poorly kept. In addition, compensation disbursement data from the relief fund in BZMC was also obtained from the BZMC office of the Bardia National Park. Data of problem tiger management was lacking.

2.2.5 Data analysis

All quantitative data were analyzed using the statistical software tool SPSS (Statistical Package for Social Science) version 15.0. Before entering the data into Microsoft Office Excel, each questionnaire was given an identity number. Every question and the responses were coded. These codes were saved in the next sheet (MS Excel) of the same file. After completion of the data entry into the "Excel sheet", the data was imported into SPSS. Before analyzing anomalies, typing errors and missing information was corrected by comparing the original data sheet (protocol) with the frequency output table of SPSS. Data was analyzed using descriptive statistics (mean, standard deviation, percentage, frequency and range). To know the difference in the livestock depredation rate between the prey low areas and the prey rich areas, the Mann-Whitney U test (two tailed) was applied. To understand the relationship between the attitude of people in the tiger conservation area and their education level and gender, the Pearson Chi-Square test (two tailed) was applied. Results were presented in bar diagrams, frequency tables and pie charts.

Chapter 3

3. Results

This study answered the research questions such as livestock depredation rate in the low-prey and the high or rich-prey area, human casualties, perception and tolerance of local people regarding tigers, impact on tiger conservation due to the human-tiger conflict management strategies and roles of different stakeholders to reduce conflicts and improve tiger conservation. The details of the results are presented in the following topics.

3.1 Livestock depredation

The farmers in the study area were subsistence level people; every household produced crops such as paddy, maize, wheat, potato and lintels. To sustain this system of farming in general, every household keeps one or two cows and a pair of bulls for plowing, one or two buffalo, four to six goats or sheep, and 10 to12 chickens. The average livestock (cow/ox, buffalo, goat/sheep and pig) holding of sampled households was 6.70 (cow/ox 1.87 (SD=2.56), buffalo 1.10 (SD=1.38), goat/sheep 3.15 (SD=3.83) and pig 0.60 (SD=1.52) (Figure 3.1, and Annex C)). The total number of poultry possessed of all the respondents was 1866. This study clearly showed that local people perceive human-tiger conflict as a problematic issue. Out of 272 respondents, 41 households reported a total loss of 78 cows in the past three years as a result of tiger depredation. Similarly, five households lost five buffaloes in the same period. Forty six respondents lost 112 goats and sheep and five households lost six pigs in this period. In addition, three households reported chicken losses by tigers. The loss percentage for cows/oxen, buffalo, goat/sheep and pigs were 15.4%, 1.7%, 13.1% and 4.3% (of the stock owned) respectively (Figure 3.2). The mean loss of livestock by tiger predation per household was 0.29 (SD=0.05), 0.02 (SD=0.14), 0.41 (SD=1.24), 0.03 (SD=0.20), and 0.04 (SD=0.055) for cows/oxen, buffalo, goats/sheep, pigs and chicken respectively for the past three years (table 6). The total mean loss was 0.75 head of livestock per household excluding poultry in this period. The livestock depredation in the prey-low area was

significantly higher than in the prey-high (or rich) area for cows/oxen (Mann-Whitney U Test, $p<0.001$) and goats/sheep ($p<0.001$). For buffaloes ($p=0.407$), pigs ($p=0.412$) and chickens ($p=0.300$), no significant difference in depredation was found (Figure 3.3 for depredation rates in the prey-low and prey- high (or rich) areas).

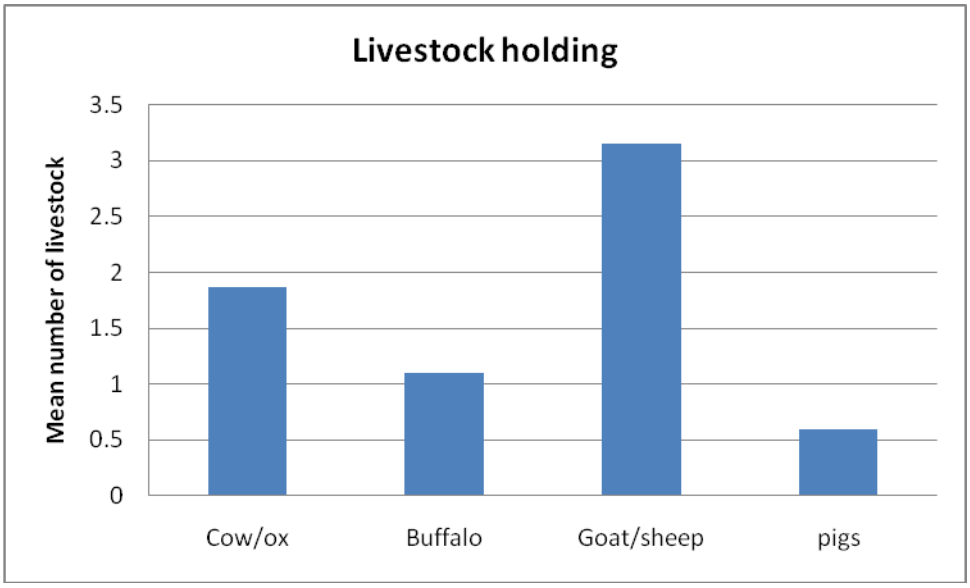


Figure 3.1 Mean livestock holding

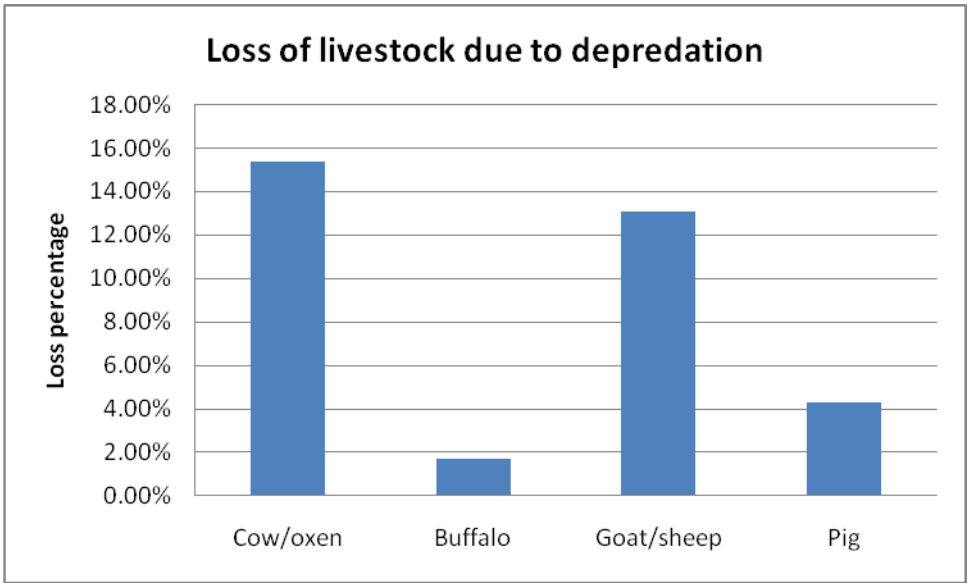


Figure 3.2 Livestock loss due to depredation by tiger

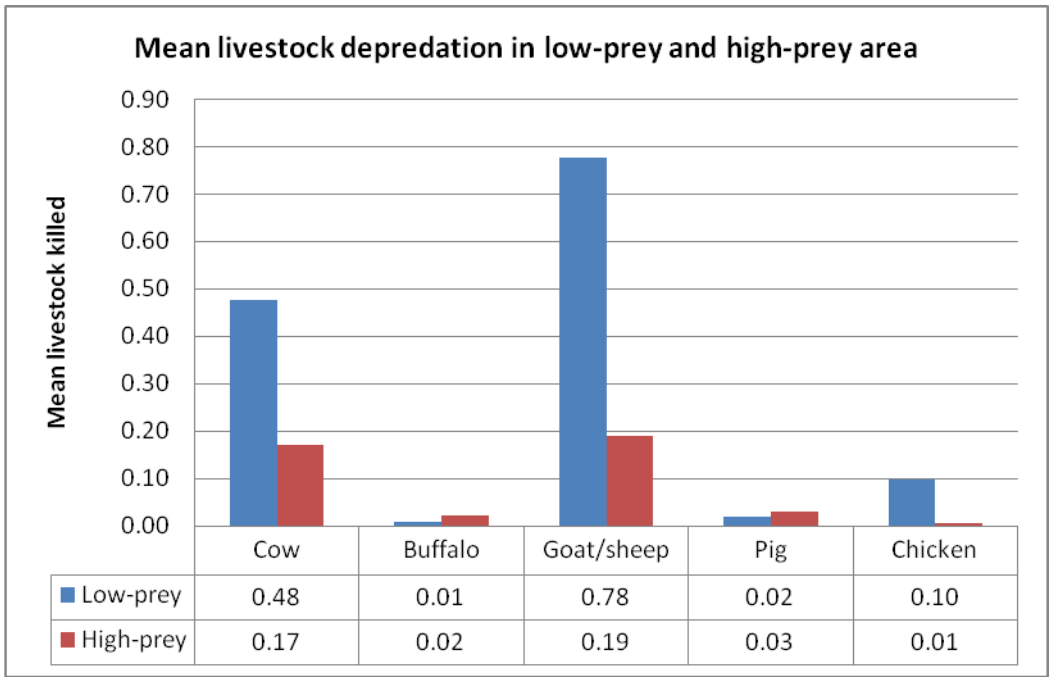


Figure 3.3 Depredation pattern in low-prey and high-prey area

3.2 Livestock management system

Only a few farmers (14.3%, n=259) did not graze their livestock or use stall feeding. Slightly more than one third of the respondent households (35.1%) graze their livestock in the Buffer Zone Community Forest (BZCF), about a quarter (25.9%) in their private agricultural field, and 23.9% in both an agricultural field and BZCF (Figure 3.4). While grazing livestock, 99% (n=223) kept a close watch (watcher with cattle) and 1 % did not keep any watcher (Figure 3.5). Almost all (97%, n=255) livestock stalls for night was not predation proof against big predators like the tiger and the common leopard (Figure 3.6).

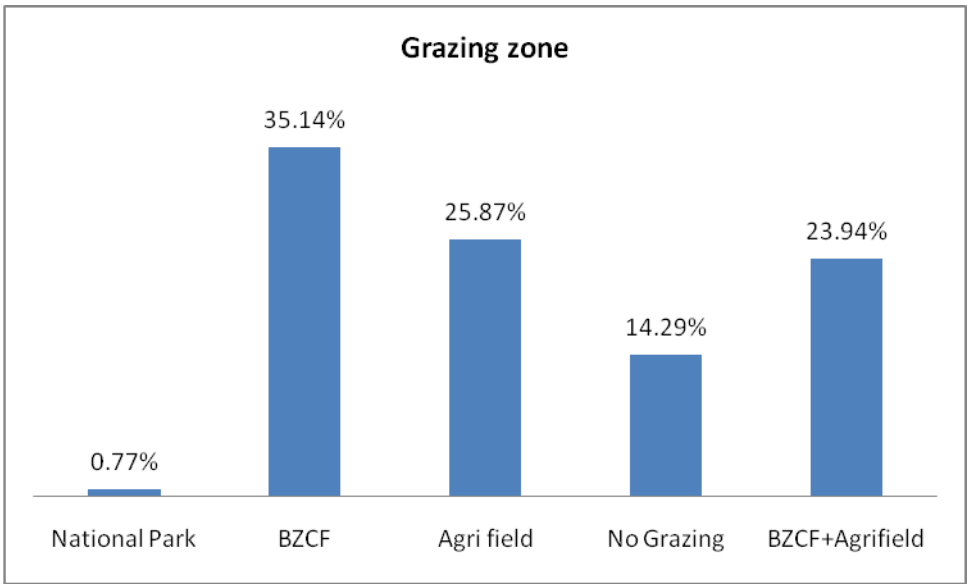


Figure 3.4 Livestock management/grazing zone, n=255

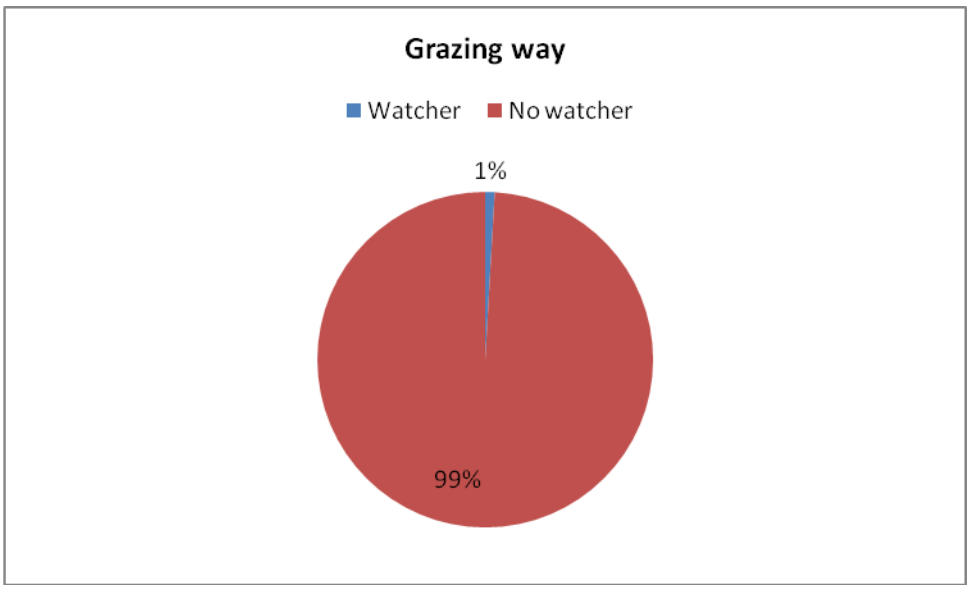


Figure 3.5 Livestock management/grazing way, n=223

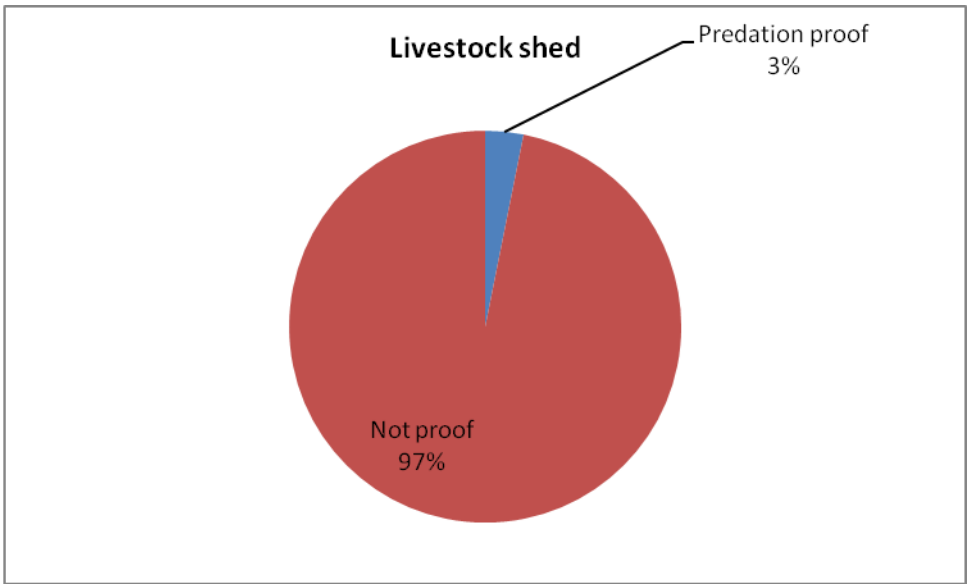


Figure 3.6 Livestock management/Livestock sheds for night, n=255

3.3 Human casualties

I collected the data on human casualties from the National Park Archive and verified it in key-person interviews with BZUC personnel and nature guides. According to the data sheet of the BNP, seven people were killed from 1994 to 2007 and four others were injured due to tiger attacks - one in 2001, one in 2003 and two in 1991/92 (see table 3.1). The data recording system was not systematic. Key-person interviews revealed five other people were killed in areas surrounding the BNP. Among these five, three were killed by a man eater in a Rammapur area in 1994 and two in a Suryapatuwa location in 1999. The total number of people killed and injured may prove to be higher since I did not survey for the whole national park area.

Table 3.1 Human casualties by tiger attacks in BNP and buffer zone from 1994 to 2007

Sn	Name/identity	Age	sex	Activity of victim	Where	Remarks
1	Khusi Ram Tharu	48	M	Grass cutting	National Park	Death
2	Not known	62	F	Toilet	National Park	Death
3	Lamki ko film Sahu	45	M	Travelling on bike	Highway	Death

Sn	Name/identity	Age	sex	Activity of victim	Where	Remarks
4	Mani Ram Sapkota	32	M	Grass cutting	Crop field	Death
5	Not known	29	F	-	National Park	Death
6	Hariram Chaudhary	-	M	-	National Park	Death
7	Nannan Tharu	-	M	-	National Park	Death
8	Laxmi Pd. Gautam	17	M	-	Crop field	Injury
9	Hansa Bdr Bista	-	M	-	-	Injury
10	Devi Ram Paudel	51	M	Toilet	National Park	Injury
11	Bhim Paudel	49	M	Toilet	National Park	Injury

(Source: BNP unpublished data)

3.4 Loss of tiger due to human-tiger conflict

The National Park Office data showed that 26 tigers were killed due to different reasons and one was sent to a zoo between 1989 and March, 2009 (Figure 3.7). According to the data, six (23%) tigers were released from the habitat due to human-tiger conflict. Among those six, three tigers were killed in revenge by local farmers as tigers killed their livestock. One was killed by a professional poacher for illegal trading, one by authorities as this tiger killed local people and one was sent to the zoo. According to the data from BNP, nine criminal cases had been filed and prosecuted from 1999 to 2008 relating to use of tiger parts where snares and weapons had been used for killing them (table 3.2).

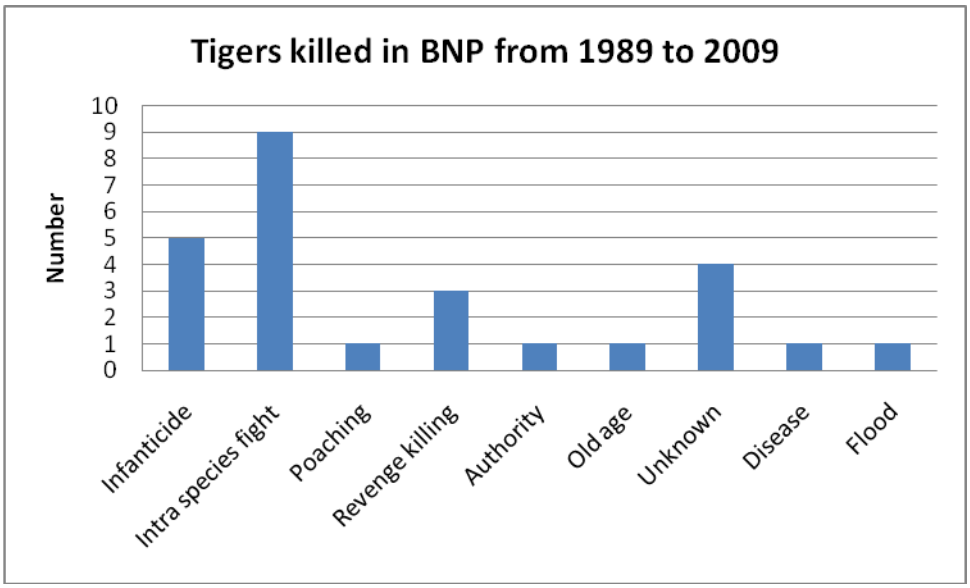


Figure 3.7 Tigers killed in BNP, n=26 (Source: BNP unpublished data)

Table 3.2 Cases filed in BNP from 1998-2008 against tiger poaching

Principal executants	**Place of event**	**Year**	**Nepali date**	**Trophy seized**
Gani Ram Tharu	Baghaura fanta	2000	057/1/25	Bone/5kg
Chirring Lama	Thakurdwara-5 BZ	2000	057/2/13	Skin /1 no
Sitaram Tharu	Karnali Checkpost	2000	057/7/22	4 Skull+10kg bone
Kesh Bahadur GC	Near Karnali Bridge	2000	057/4/3	Skin 1
Gula Ram Tharu	Snaring inside park	1998	054/10/7	Whole body of dead tiger
Dan Singh Badayak	Near Karnali Bridge	2006	063/4/18	Bone
Tej Bdr Gharti	Babai valley	2007	063/11/27	Bone
Lal Bdr Khatri	Unknown	2000	2057/	Skin and bone
Ongoing case	Gola BZ	2008	065/2/20	Bone

(Source: BNP unpublished data)

3.5 Perception of local communities on tiger conservation

The respondents demonstrated positive thinking in tiger conservation. Sixty three percent (n=271) liked tigers while 37% did not like them and wanted to eradicate (Figure 3.8). It means they were positive towards tiger conservation. I asked the question why you liked tigers. The results showed that because tigers bring revenue and jobs through ecotourism (38.4%, n=172), they have ecological value and their presence indicate a healthy ecosystem (26.2%), they are endangered and their number is decreasing (21.5%), they are beautiful and charismatic (11.6%) and they have religious value in Hindu culture and are a symbol of might (2.3%) (Figure 3.9). Out of 99 respondents who didn't like tigers, the majority of them (53%) attributed to tiger attacks against humans, hence they don't like them. The rest said tiger kill livestock and they, too, don't like them (Figure 3.10). Perception on tiger conservation and education were significantly associated (Pearson chi-square=36.36, df =3, $p < 0.001$). More people with high education supported the conservation of tigers. Similarly, perception and gender showed a significant association (Pearson Chi-square = 12.27, df = 1, $p < 0.001$). Male respondents were more positive than female to conserve the tiger (69.4% versus. 45.3%). Fifty two percent (n=197) liked tigers living in community forests and the rest, 48%, didn't like the idea. (Figure 3.11). Ninety eight respondents (49.74%) suggested preserving tigers only in National Park while 47 (23.85%) suggested tigers should be conserved in all possible habitat where, in the future, tigers might be found and 13 (6.59%) suggested preserving them only where they are presently found (Figure 3.12).

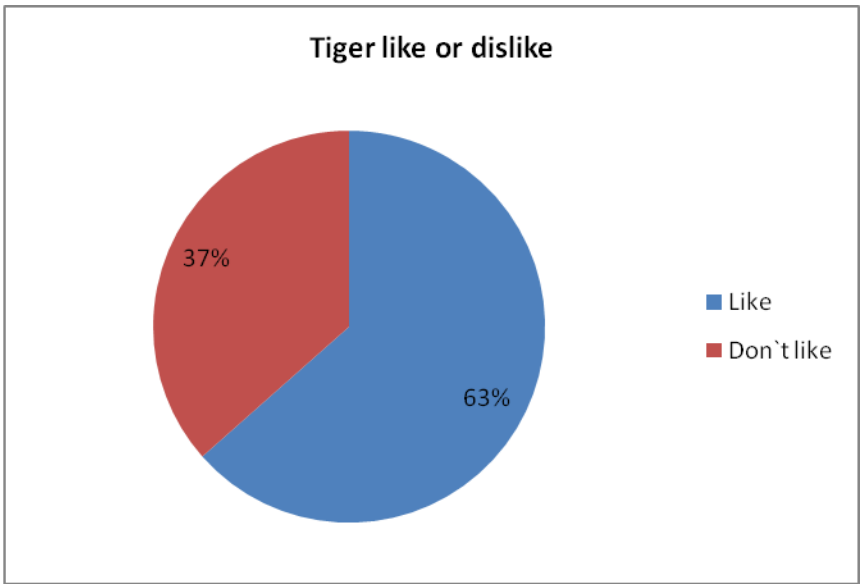


Figure 3.8 Perception of local people/tiger like or dislike, n=271

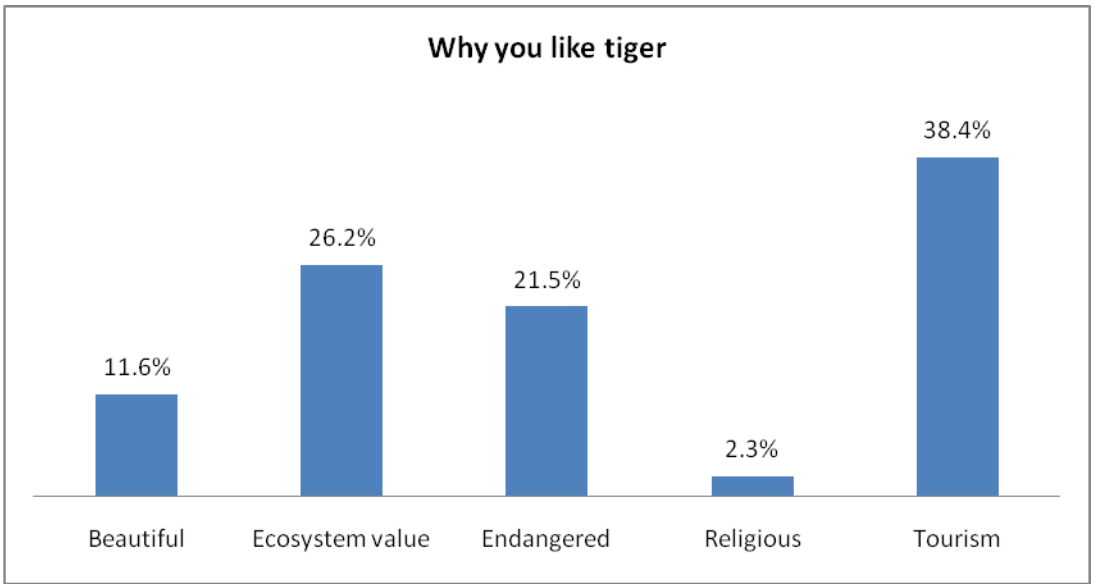


Figure 3.9 Perception of local people/why you like tiger, n=172

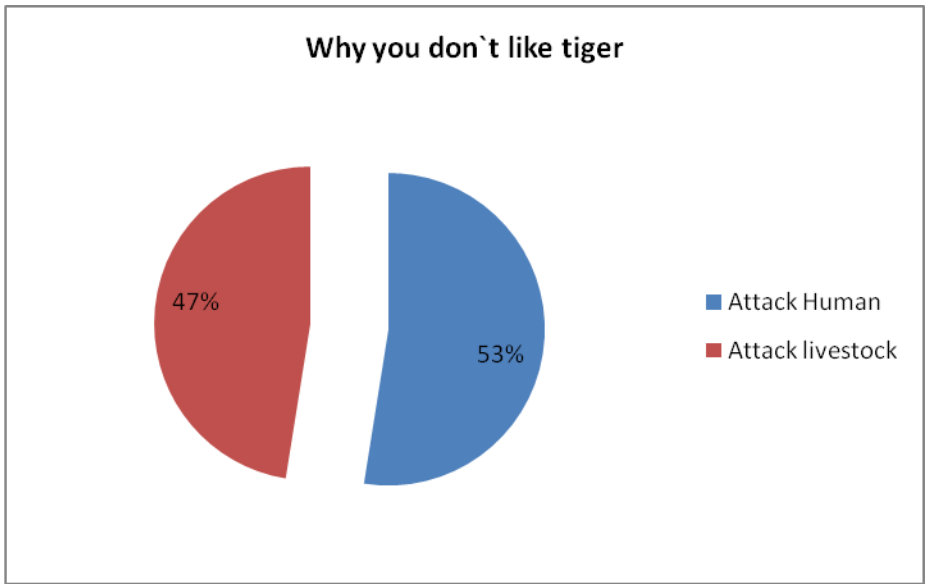


Figure 3.10 Perception of local people/why you don't like tiger, n=99

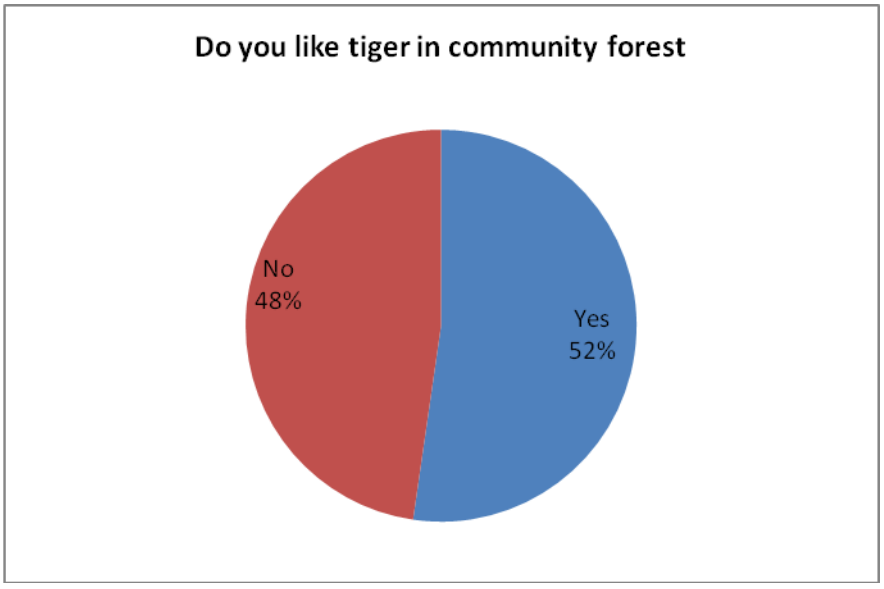


Figure 3.11 Perception of local people/tiger in community forest, n=197

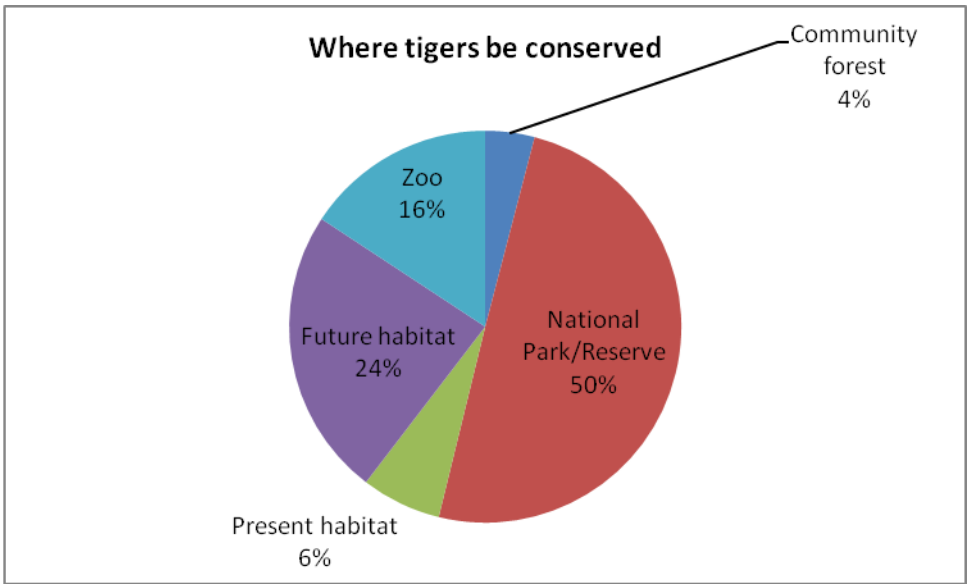


Figure 3.12 Perception of local people/where to conserve tiger, n=197

3.6 Tolerance to loss by tiger

To examine the tolerance level of local residents in the effort to conserve tigers, I asked three hypothetical questions with responses as to whether they agreed, disagreed or were indifferent in supporting tiger conservation if one of their family members had been killed or injured by a tiger attack or if they had lost livestock through tiger predation (see Annex D, Questions 17-19). More than half of the respondents (56%, n=269) were not in agreement with supporting tiger conservation if they had lost a family member in a tiger attack (Figure 3.13). Similarly, 52% (n=270) were found to disagree in supporting tiger conservation when their family member had been injured by a tiger attack (Figure 3.14). Overall, they were found to be positive in supporting tiger conservation (66.3 %,) if they had lost only livestock (Figure 3.15).

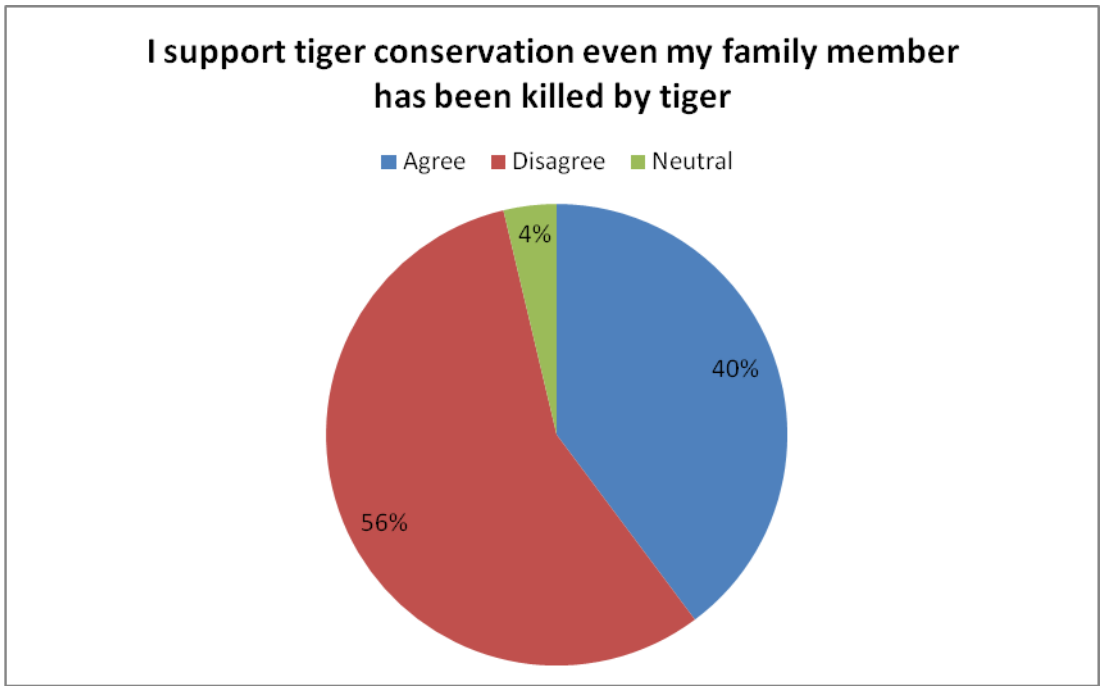


Figure 3.13 Tolerance level/Family member killed, n=269

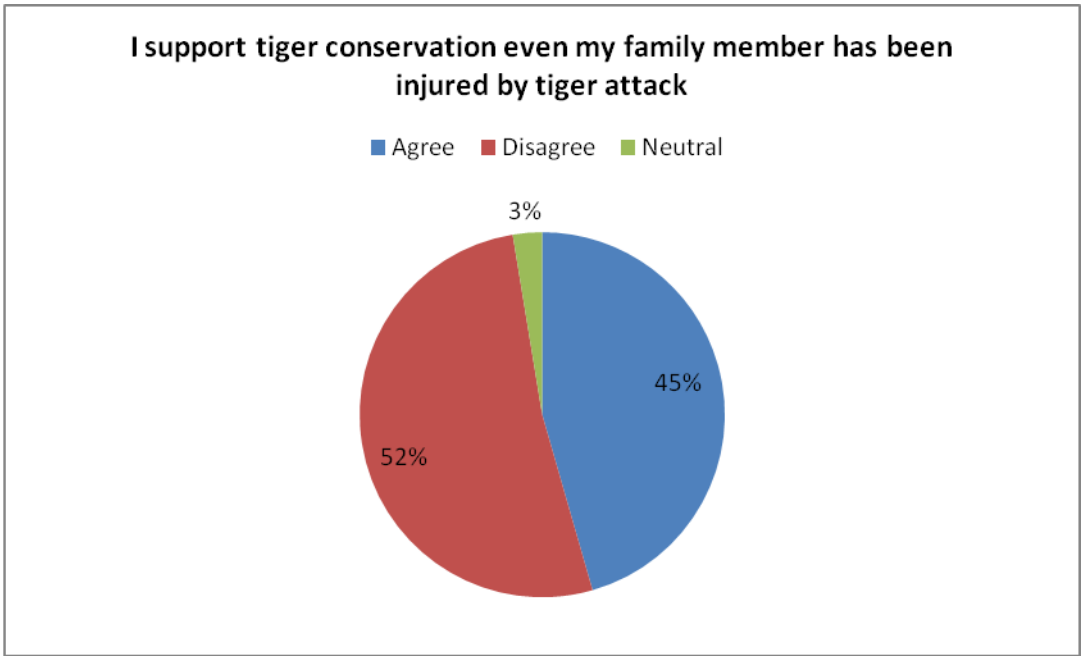


Figure 3.14 Tolerance level/family member injured, n=270

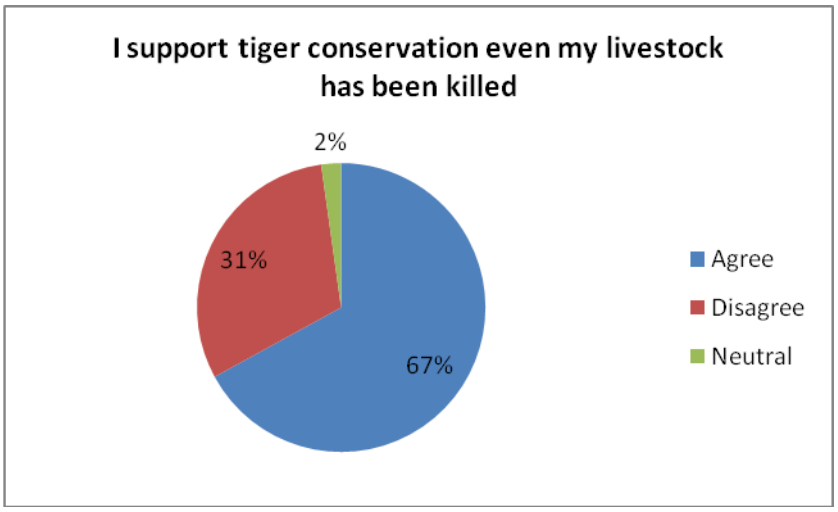


Figure 3.15 Tolerance level/livestock killed, n=270

3.7 Why tigers are being killed?

I asked questions of why tigers are being killed to understand the causes of such. The result showed that, by in large, they were killed for the trade of body parts (66.66%, n=255), followed by revenge killing (21.17%) because tigers kill livestock, and last but not the least, is that they are killed to reduce the potential risk of attack on humans and their livestock (12.15%) (Figure 3.6). In short, the result revealed that professional poachers are the main cause of tiger population declinations in the region because their body parts are in high demand in Asian markets for traditional medicine.

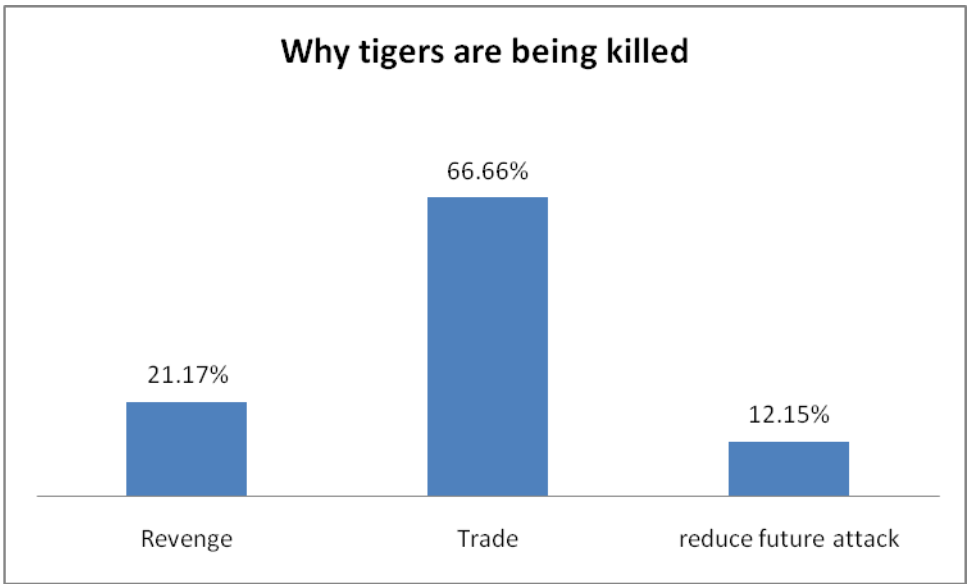


Figure 3.16 Causes of killing tigers, n=255

3.8 Knowledge among local people on tiger behavior/ecology

I found that local people had quite a good understanding on certain aspects of tiger ecology. Above 61% (n=271) of respondents answered that due to the depleted prey base in their habitat, they come out of the forest in search of food. Above one quarter (26.20%) said that tigers prefer domestic livestock over wild prey as they are an easier kill. Above six percent of the respondents expressed that tiger habitat is too dense for predators so they come out of forest. 5.17% are ignorant about why tigers come out of forest (Figure 3.17). Regarding the time when tigers come out, almost all people (94.32%, n=264) indicated that they come out at night time (Figure 3.18).

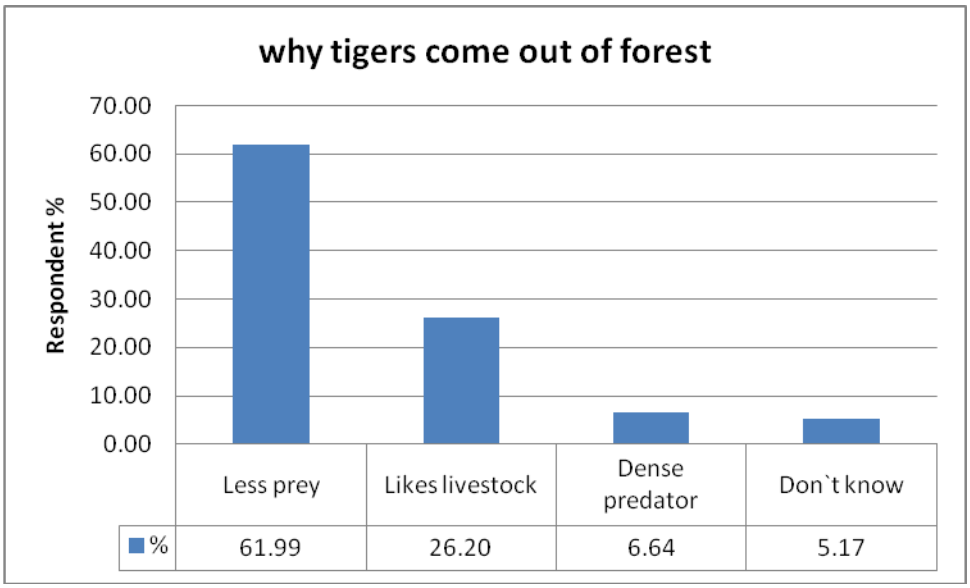


Figure 3.17 Local peoples' knowledge/why tigers come out of forest, n=271

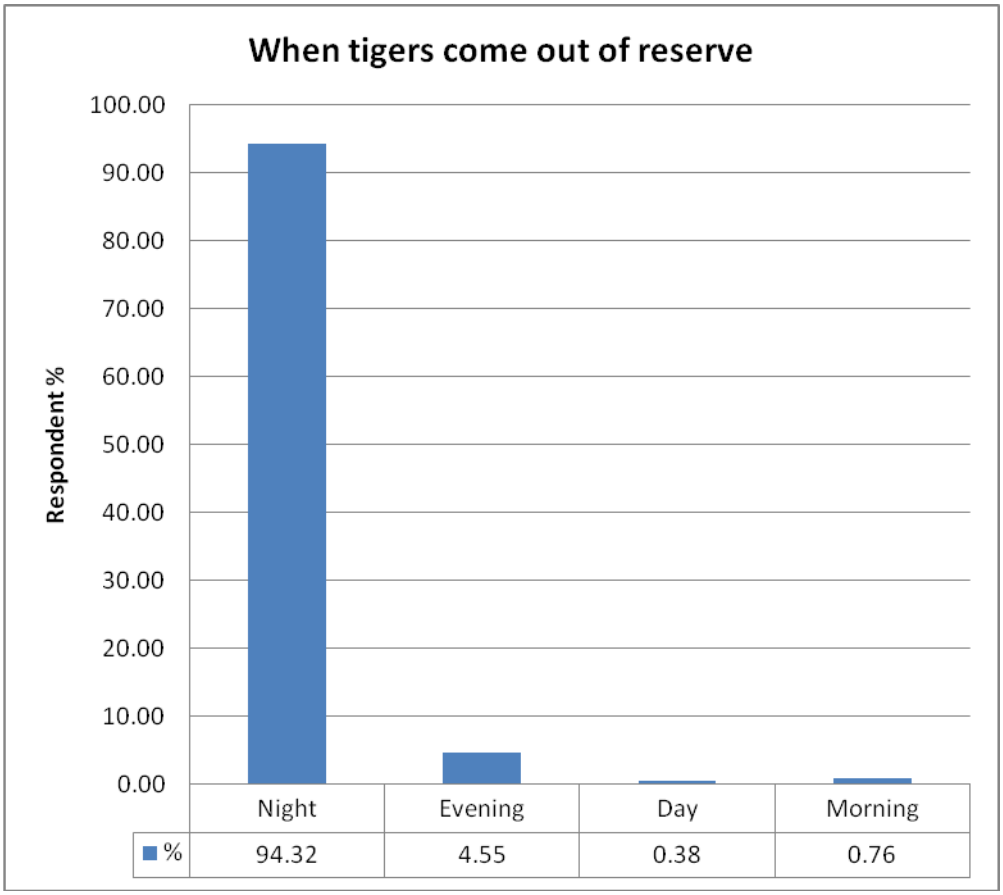


Figure 3.18 local peoples' knowledge/when tigers come out of reserve, n=264

3.9 Conflicting zone

The interview data showed that events of tigers attacking people occur mostly inside the national parks/reserves. More than half (53.41%, n=264) supported this result while 20.45% said it happens more in buffer zones, and almost an equal number of respondents (19.7%) expressed the idea that confrontation happens in transit to and from the park and buffer zone border. Only 6.44% had the view that tigers attack people more outside the buffer zones (Figure 3.19). The human casualty data from the national park showed that out of the nine cases mentioned, seven occurred inside the National Park (Map 3.1).

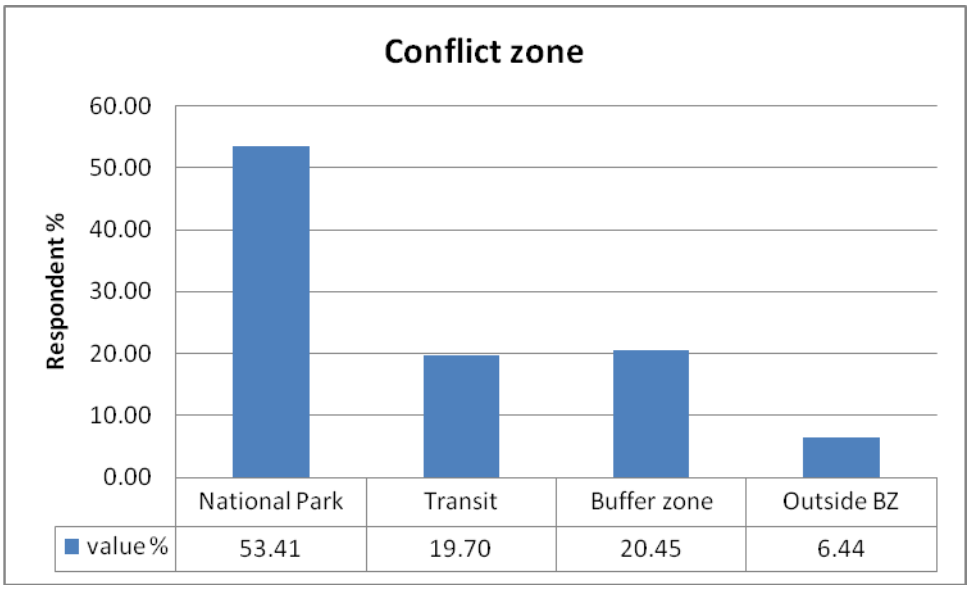
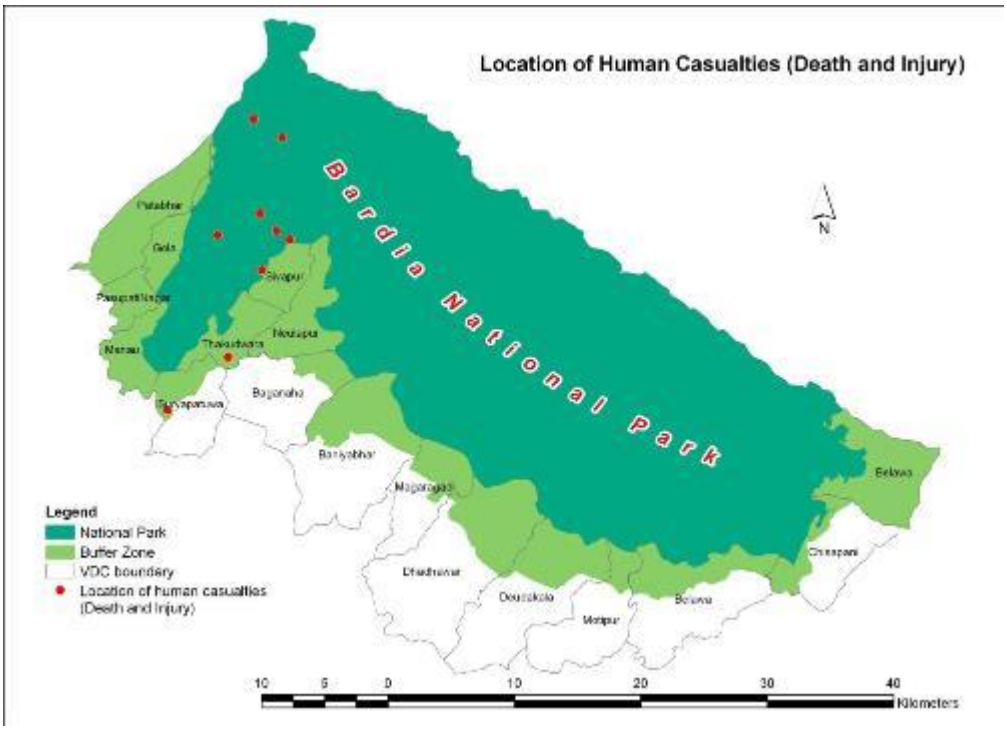


Figure 3.19 Human-tiger confrontation zone, n=264



Map 3.1 Human-tiger confrontation hotspot

3.10 Compensation scheme

The percentage of people not satisfied with present compensation amount was found to be high (94.44%, n=54). Only 5.55% answered that they were satisfied with the compensation amount (Figure 3.20). They expected that the dependants of tiger victims should be entitled to free education and employment opportunities (60.82%, n=268) (Figure 3.21). More than one third of the respondents expected NRs 150,000-200,000 (US$1923-2564) as suitable compensation which is almost 6-8 times higher than the present compensation allocation. As for livestock killed, people expected compensation at the market price of livestock (81%, n=270) (Figure 3.22). When I asked, “are you satisfied with the compensation process?” people expressed strong dissatisfaction (87 %, n=255) (Figure 3.23) with the present process stating that it was a long process (58.74% n=223)”. Secondly, they expressed dissatisfaction with the service provided by BZUC/BZUG members (22.42%) and thirdly they blamed authorities of the national park for not playing in good

faith in their roles for assisting in the compensation process. They would like better information provisioning and damage verification (18.83%) (Figure 3.24).

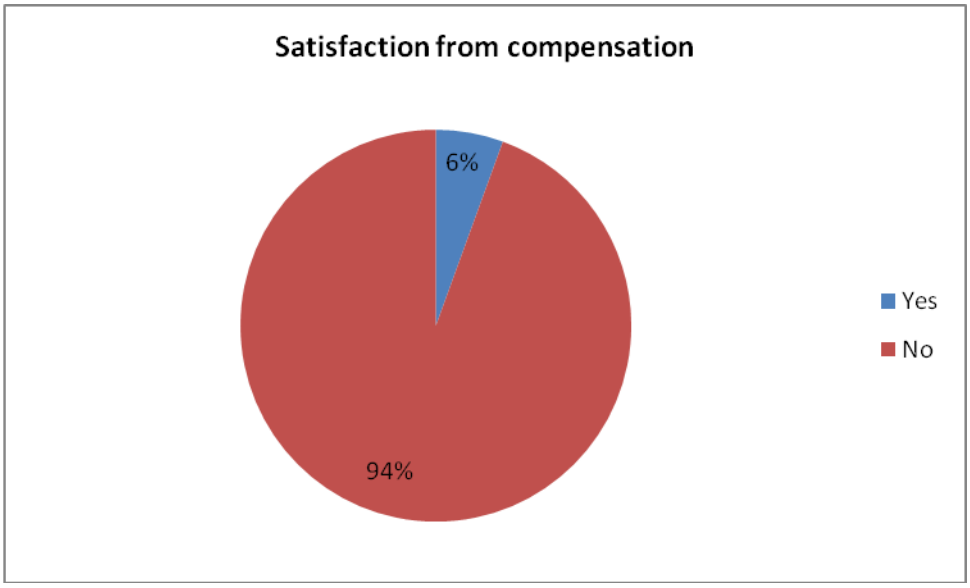


Figure 3.20 compensation scheme/satisfaction from compensation, n=54

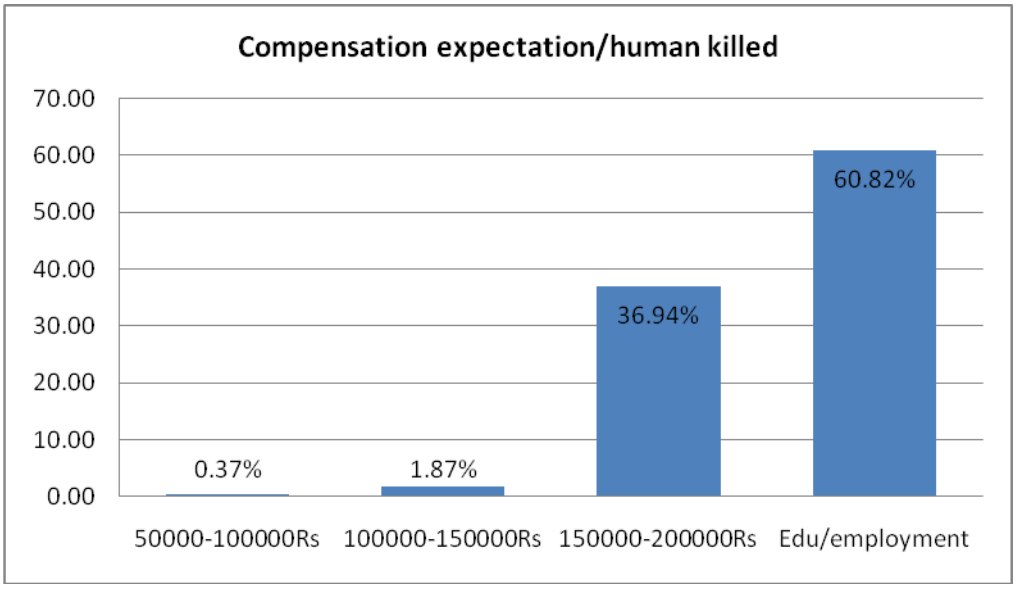


Figure 3.21 Compensation expectation/human killed, n=268

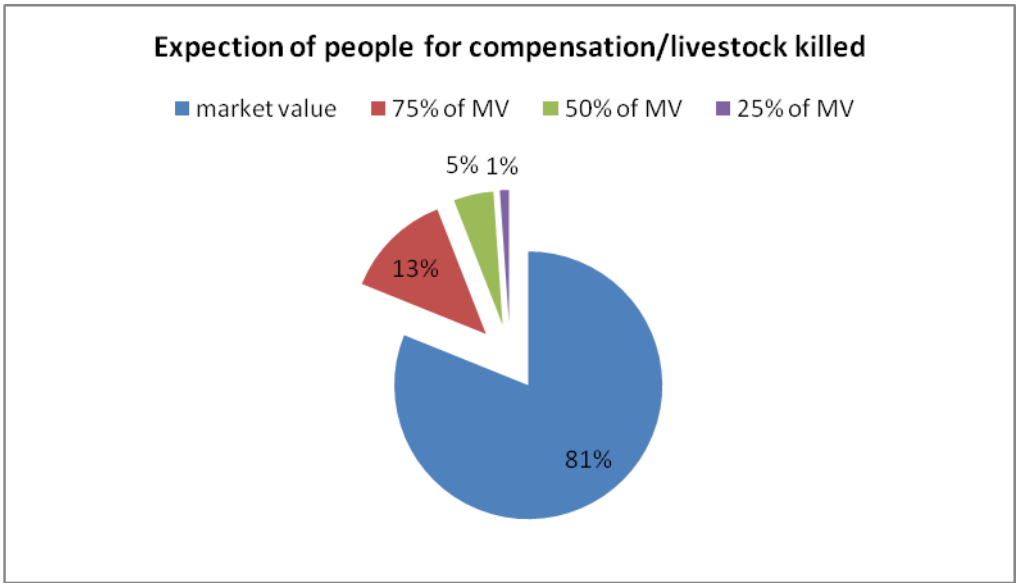


Figure 3.22 Compensation expectation/livestock killed, n=270

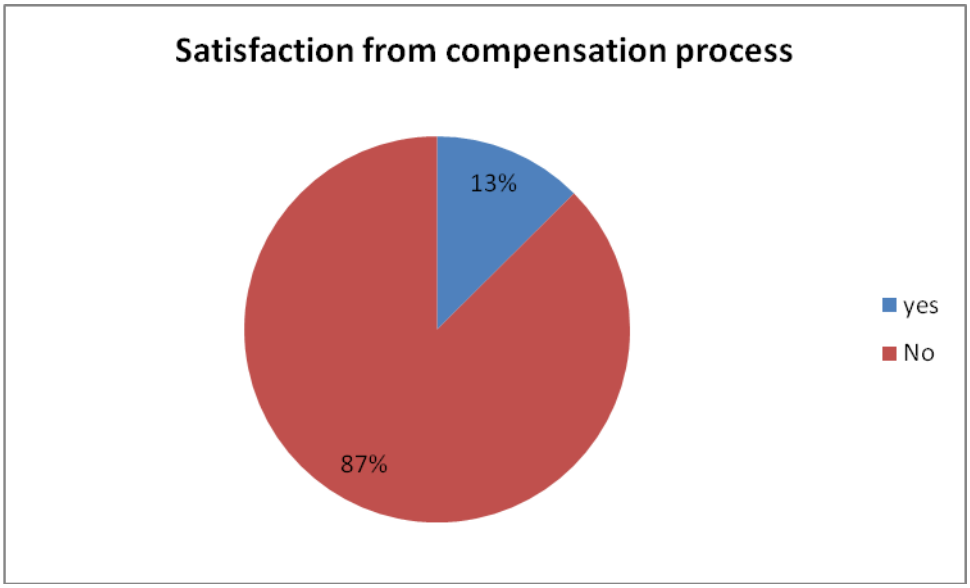


Figure 3.23 Compensation scheme/satisfaction from process, n=255

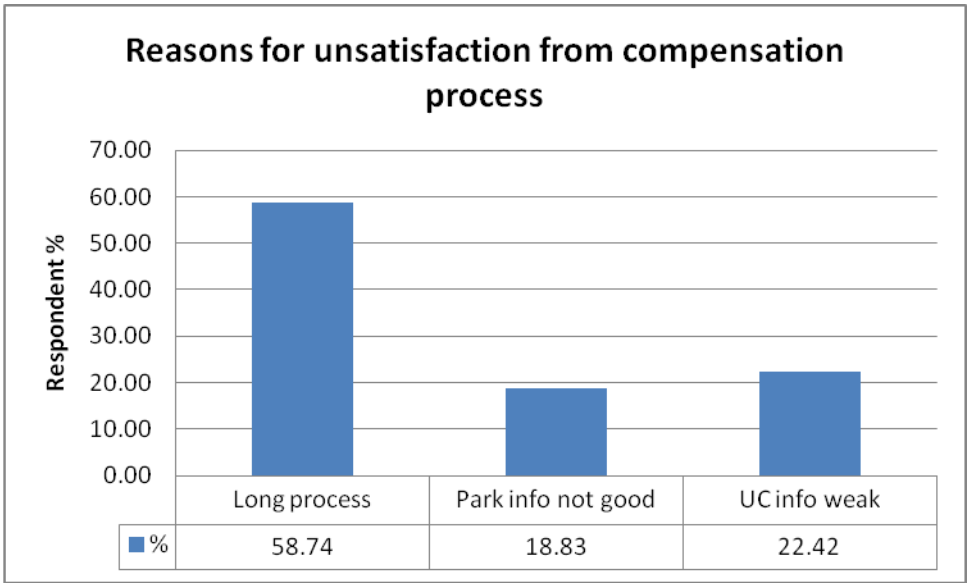


Figure 3.24 Compensation scheme/why not satisfied from process, n=223

3.11 Conflict management

Respondents showed strong dissatisfaction (79%, n=272) over problem tiger management. Only 21 % of households expressed satisfaction with the National Park Authority's problem tiger management (Figure 3.25). Concerning how problem tigers should be managed, they replied that they should be captured and incarcerated or put in zoos (76.4%, n=216), followed by translocating them into less dense tiger areas (13.0%), and that they should be killed (10.7%) (Figure 3.26). I asked how conflict can be reduced. The respondents said "conservation education to educate people about the conservation value of tigers and its behaviour (44.9%, n=272), provide compensation to victims or their family (29.4%) and do monitoring to make people aware of where problem tigers are (25.7%)," (Figure 3.27).

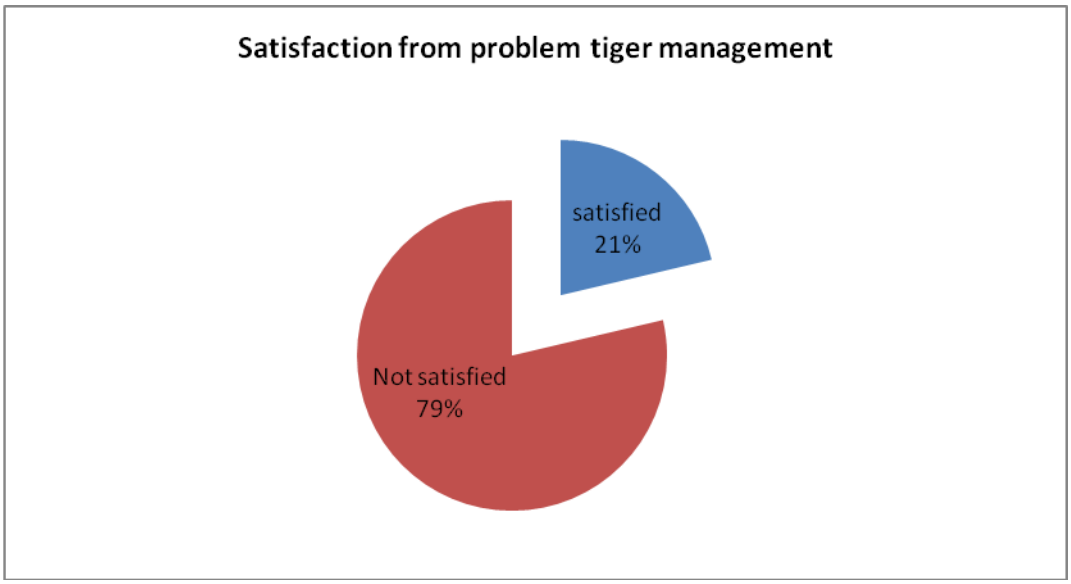


Figure 3.25 Satisfaction from problem tiger management, n=272

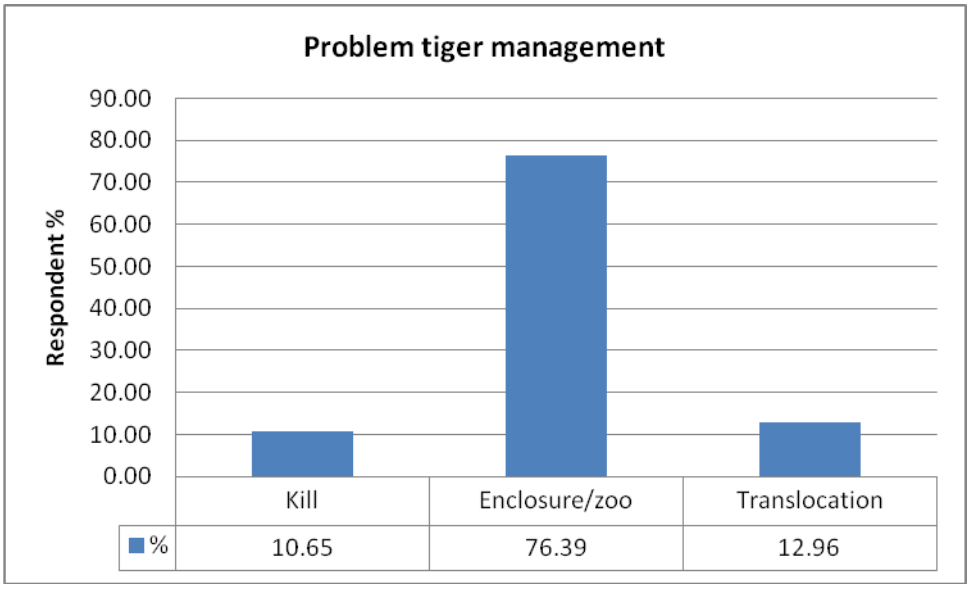


Figure 3.26 Management of problem tiger, n= 216

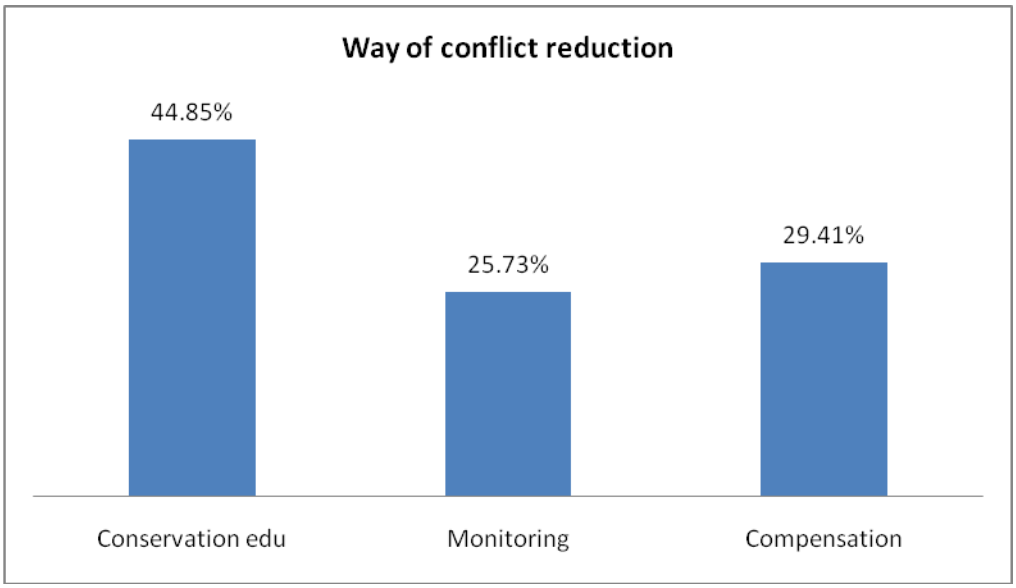


Figure 3.27 Way of reducing conflict, n=272

Chapter 4

4. Discussion

From this study it is come to know that, human-tiger conflicts are in effect in study area and have three primary consequences-Livestock depredation, human casualties and loss of tigers caused by revenge killing or by commercial poaching. All of these aspects are discussed in the following topics.

4.1 Livestock depredation

The mean loss of domestic stock (cows/oxen, buffalo, goats/sheep and pigs) due to tiger predation was found to be comparatively low (0.25 head per year per household; the sum of three years loss is approximately 6% of the total stock) as compared to the study in Manang, of the Annapurna Conservation Area, where the loss of livestock, due to snow leopard (*Panthera uncia*) depredation is 0.70 head per household per year (Oli, 1994) and 0.55 in the Pin Valley National Park, India (Bagchi & Miahra, 2006). This rate of predation, however, is higher in comparison to the study of

the Jigme Singye Wangchuck National Park of Bhutan where the predation rate for the year 2000 was 0.07 (Wang & Macdonald, 2006). The depredation rate was found to be higher in the low-prey density area than in the high (or rich)-prey density area for cows/oxen, goats/sheep and chickens, however, for buffalo and pigs, it was smaller.

The question is, how reliable is the data for depredation based on the questionnaire survey? If respondents are honest, such as to not giving fraudulent data with the intent of merely getting money or other material consideration, then the questionnaire survey data would be reliable. The other issue is the identification of involved predator species since it is not readily available and it is not wise to blame the predator without supporting evidence. In light of this, it is hardly possible to directly observe an elusive animal like tigers. However, if attack episodes are carefully and timely inspected, then it is possible to identify the species involved from the signs left in the spot. In the study area, local people use the word, *bagh* to refer to both tigers and leopards. During my questioning of villagers, I showed photos of tigers and leopards as a means to positively confirm the responsible species involved in livestock predation. I asked them the number of livestock killed by leopards as well, so that there would be no discrepancy of data.

The predation-prone livestock sheds might be one responsible factor contributing to livestock depredation. All the livestock stalls for night-time corralling were found to be exceptionally open having no walls (see Annex E Photo 5) and with only a few people having put their goats and sheep in a closed corral. Another reason may be due to the grazing of livestock inside the Buffer Zone forest and the National Park. In many observations, I experienced seeing livestock grazing inside the park.

Though the predation rate is low compared with the other studies mentioned above, the impact of depredation on the household economy may be substantial since the contribution of livestock to the household economy is approximately 20% and nearly the entire household depends on subsistence agriculture. Since Nepalese agriculture depends on domestic animals for tract and draught power and for compost manure (Gurung, 2008); its contribution cannot be underestimated. The agricultural sector contributes nearly one third (32.5%) in Gross Domestic

Product (GDP) of the country (http//indexmundi.com/nepali/gdp_composition_by_sector.htm). If a farmer loses an ox or a bull buffalo during the plowing season, it will have a profound adverse effect on him as his agricultural activity will be seriously affected. One pair of ploughing bull oxen or buffalo costs approximately NRs 33,000 (US$ 425) which is equivalent to 220 unskilled man-earning days. In such conditions, the retaliation of the killing of involved predators is inevitable. On the other hand, only 42% of households have sufficient production from their crops and livestock (including poultry) to provide subsistence for a whole year. Others have to rely on *majduri* (labor work) or other non-farm activities to supplement their subsistence. The Human Development Index (HDI) of Nepal is 0.553 with the rank of 144$^{th.}$ The GDP per capita in the year 2007 was US$ 367 (PPP) and 55.1% of the population has an income of US$ 1.25 per day. The average annual economic growth rate for the period 2000-2007 is 1.46%. Approximately one third (30.9%) of the people are below the national poverty line (2000-2006). The total population of the year 2007 was 28.3 million and the natural rate of increase in population is 1.9% per year (http://hdr.undp.org/en/media/HDR_2009_EN_Complete.pdf). In such an underdeveloped and poor area, even a low level of livestock depredation may create antagonism between the pastoralist and the predator involved (Bagchi & Mishra, 2006).

The cause of livestock depredation may also be attributed to the loss of prey species in the reserve which was revealed in the interview with nature guides and was supported by BZUC members. Sharma (2006) estimates an 80% loss of spotted deer (*Axis axis*) population in comparison to the 1993 population in the Bardia National Park. This species is most abundant here (Wegge, et al., 2009) and is the major food source of tigers (Støen & Wegge, 1996) in this National Park. Their results show that in the scat of tigers from the Karnali flood plain, 74.9% comprises the remains of spotted deer. Livestock are not the natural prey of big cats. They are specialized to prey on wild ungulates but when the opportunity arises, they may seize on the opportunity (Treves & Karanth, 2003). Domestic livestock has lost their anti-predatory behavior; hence, they are easy to kill with little effort. Depleted prey species forces predators to switch to livestock as their food source (McDougal 1987; Gusset et, al., 2009; Kolowski & Holekamp, 2006). In this study, protected area managers have also accepted the loss of prey species in the park and BZMC members attributed following reasons, in priority order, as the causes of livestock killing by tigers in study area-

1. People graze their cattle in tiger habitat
2. Physical impairment of tigers force them to shift to domestic prey as they are easier to kill than wild prey
3. Prey depletion by excessive hunting and less prey due to lower habitat quality
4. Small habitat may compel them to transcend their border frequently to kill livestock

Livestock depredation can also be verified by scat analysis. Eliassen (2003) found 4.15% of the hair of bigger domestic stock (cows and buffalo) in the scat of tigers of the Karnali Floodplain of BNP.

4.2 Human casualties

Human casualties by tiger in the area of this study were not as serious as that represented in other studies. In this study, the average number of humans killed between 1994 and 2007 was only 0.93 per year while Gurung, et al. (2008) found 7.2 per year for the period of 1998-2006 in the Chitwan National Park. The CNP is similar in size to this study area. Similarly, in Sumatra Island of Indonesia, 7.3 people were killed per year in tiger attacks between 1978 and 1997 (Nyhus & Tilson, 2004). The annual average of 21 humans have been killed in the Sundarban Tiger Reserve (ca 3542 km² lies in Bangladesh and ca 2461km² in India) of Bangladesh (Muhammed, et al., 2007). Gurung, et al. (2008) credits the cause of high human casualties in the Chitwan National Park as related to the restoration of Buffer Zone forests. After restoration of habitat in buffer zones, movement of tigers increased and the casualties happened as human use is privileged in this zone. Unlike in the CNP, the buffer zone forest of the BNP is little used as extended habitat by tigers. Eliassen (2003) found no tiger scat except occasional pugmarks in a survey of 65 km transect in the buffer zone of the Bardia National Park in the Karnali flood plain location. Human casualty data also proves this statement. In the CNP, almost an equal number of humans has been killed in the buffer zone and in the core of the National Park (Gurung, et al., 2008), while in the BNP (this study), about 82% of human casualties had occurred inside the core area. 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 significant implication in conservation. If people do not support a tiger conservation program, the aim of conservation cannot be achieved. Therefore, it is necessary to understand why tigers kill human beings before implementing any tiger conservation action plan. Muhammed, et al. (2007) points out the following reasons for tigers being man-eaters-

- Age factor: old tiger can't prey effectively on wild prey species
- When a tiger eats a person after killing him, the tiger generally turns into man-eater
- Impairment due to injury or tooth problems
- Over hunting of prey base of tigers by human beings
- Loss of ecosystem resulting in a smaller home range perhaps forcing tigers to come into the border edge and inflict human casualties and livestock killings

The above causes of killing humans in the BNP are supported in the interviews with BZMC members (this study). According to these interviews, the causes of tigers killing humans were as follows (in priority order)-

- Human enters tiger habitat for resource collection such as grass, herbs, firewood and for livestock grazing
- Physical impairment of tiger
- Depleted prey base
- If a tiger eats a person once, it may turn into a man-eater

4.3 Attitude of local people in tiger conservation

The extent of support and participation of people in the conservation of carnivores largely depends on how they place value on these predators (Gusset, et al., 2009). In my study, even though tigers preyed upon livestock and threatened the human life, the majority of people liked tigers. This essentially means they wanted to conserve it. They believed that the tiger is a charismatic species and promotes tourism in the local environment and, in turn, expands the economic activities. Due

to its endangered status, many national and international organizations invest money towards the conservation of this charismatic species which, again, eventually creates jobs in the local market. In this study, people valued tigers from ecological point of view as well. In the absence of tigers, prey species populations will explode and crop raiding in the vicinity will increase sharply. The religious value has also a role towards contributing to positive attitudes in tiger conservation. People in the region are Hindu fundamentalists and believe that the tiger is the vehicle of goddess *Durga* (goddess of mighty). Therefore, to kill a tiger is considered as to disobey the god and it is a matter of morality and ethics. This local society dislikes persons who kill tigers.

The more important reason behind developing positive attitudes in the local people in tiger conservation might be the allocation of revenues earned and shared by the National Park for development activities in the Buffer Zone. The local people should involve in Buffer Zone management programs such as, conservation education and awareness, community development and conservation activities (e.g. community forest management and non-timber forest product cultivation-NTFP). If the local community has a role in management and conservation of Buffer Zones, they may feel that this program is of their making and for their benefit. Up to 2007, US$256,410 of national park revenue has been contributed for community development (GoN, 2008). In addition, the Bardia Conservation Programme and Terai Arc Landscape Project are contributing to local development and conservation activities. The role of the UNDP funded project in the past, from 1995 to 2005, cannot be undervalued in bringing the peoples' positive attitude in line with conservation values. Other factors associated with their positive attitude may be in the consideration of local peoples' needs such as provisions for collection of thatch grass from the National Park and involvement of local people in management of natural resources in buffer zones from where they can get these resources at very low prices or free of charge. Similar to my result, in a study by Gurung (2008) in the Chitwan National Park of Nepal, positive attitudes among local people towards tiger conservation is found prevalent. In contrast to this study, there are many cases of negative attitudes towards predators. In the study of Oli, et al. (1994), Bagchi & Mishra (2006) and Lucherini & Merino (2008), negative attitude towards large carnivores are discovered. Oli, et al. (1994) further mentions that the cause of negative attitudes toward snow leopards is only due to the depredation of livestock. Similarly, Bagchi & Mishra (2006) mention that the reason for negative attitudes is the loss of more valuable livestock such as horses.

People with lower education had more negative attitudes towards tigers and they were more likely to want to eradicate it from the National Park. Women were less positive toward tiger conservation. This might be due to the fact that women go to forests more than men to fetch forest products.

4.4 Loss of tigers and conservation impact due to human-tiger conflict

Conflict driven mortality of large carnivores is documented throughout the country, for example, snow leopards in north central Nepal (Oli, et al., 1994) and tigers in south central and western Nepal (Bhatta, et al., 2007; Gurung, 2008). In the BNP, three tigers were reported killed as revenge killings in the past which is equivalent to more than 10% of the total tiger loss. The cause of retaliation was due to killing of domestic cows and buffalo. In all the events, outraged farmers poisoned livestock carcasses which, in turn, of course, killed these tigers. The events of these poisonings occurred on the edge of the National Park border and in the community forest where humans should ordinarily co-exist with tigers. Such revenge killings of predators are common throughout the world (Ahearn, et al., 2001; Madhusudan, 2003; Nyhus & Tilson, 2004; Gurung, et al., 2008) and most of them are in suboptimal habitat.

The archival data of the National Park showed that only one tiger was killed by a poacher (poacher is defined here as people who are involved in the illegal killing of wild animals for the purpose of trade) between 1989 and 2008. But the data from the legal section revealed that the number of criminal cases filed between 2000 and 2008 against tiger poaching was nine (see chapter 3.4, table 3.2). This indicates that actual mortality due to poaching is hardly known because unlike the poaching of rhinos and elephants (*Elephas maximus*), the parts of dead tigers were not left in the forest. In May 2009 (during my study period), a local informant notified an authority of the poaching of one tiger in Khata corridor which adjoins the BNP and the Katarniaghat Wildlife Sanctuary of India. But the National Park Authority found no trace of it at the spot when the search operation was conducted. By this, it can reasonably be concluded that the loss of actual tigers might be more than predicted. Substantial cases of tiger poaching are registered in the

region. For example, three cases were registered in the District Forest Office in Banke, (whose administrative jurisdiction adjoins the BNP Forest), during my period of work in 2005. In these cases it was difficult to predict the origin of these tiger trophies (skin and bone).

Sharma (2006) found the poisoning of spotted deer (*Axis axis*) during his study in the BNP. I found that 79 cases had been registered in the Bardia National Park for poaching of ungulate species from 1993 to 2009. The interviews with nature guides and PA managers also substantiated the poaching problem as being a threat to tiger conservation in the BNP. Nature guides blamed the problem of sharp prey base declination as being associated with illegal hunting during the insurgency when anti-poaching operations were reduced practically to nothing. They claimed, also, that sighting events of tigers had decreased over the past three years. This may be due to the decreased number of tigers in the study area. The census of tigers (camera trapping) in 2008 revealed only 18 adult tigers in the BNP which is half of the 2005 census (see chapter 2) result. This validates the claim of a nature guide about decreased numbers of tigers in the study area. In general, tigers are killed for profit (Nyhus & Tilson, 2004), which was supported by questionnaire survey data in this study. Respondents attributed illegal trade as being the main cause of tigers being killed. Poaching of tigers for illegal trade is considered the most severe short term threat for its extinction (Nowell & Jackson, 1996). In my study interview with Protected Area Managers, it was revealed that the poaching of tigers and its prey base to be a genuine threat in this region. In the interview with a national park ranger, it was learned that a new method of poaching was being used by poachers. Poachers in Babai valley poisoned tigers using carcasses of samber deer (*Cervus unicolor*) which had already been killed by a tiger. This would compare in similar fashion with what the farmers are doing by poisoning tigers through livestock carcasses as retaliation. In the Lao PDR, farmers opportunistically use livestock for baiting tigers more so than as retaliation for livestock attacks (Johnson, et al., 2006). Killing of tigers as a result of conflict occurs primarily in the suboptimal habitat such as the corridor (Nyhus & Tilson, 2004). This restricts the dispersal and exchange of genes between different sub-populations. Therefore, it may have detrimental effect on demographics and enhances the probability of stochastic processes which may cause the extinction of species (Wikramanayeke, et al., 1998).

4.5 Conflict management

Local communities were highly unsatisfied with the present practice of the problem-tiger management of the National Park Authority. They thought that the authority should immediately capture and incarcerate or place subject animals in zoos. A significant problem with that solution is that there is only one zoo located in the capital city and it only has capacity for a single pair of tigers. Even if there were to be more space in the zoo, it would take a longer time to arrange all the necessary managerial tasks in order to make this happen. Tigers are listed in schedule 1 (protected) of the National Parks and Wildlife Conservation Act, 1973 of Nepal. In section 9 of the act, there is provision for the killing of man-eater tigers and problem animals but the definition of a man-eater tiger remains unclear. The customary practice is that if a tiger kills a man entering a settlement area, then it is categorized as a man-eater and it is generally shot. The prescribed procedure that must be followed is: First of all, permission must be secured from the Ministry of Forest and Soil Conservation (MoFSC), then arranging for darting equipment and technicians, including at least four domestic elephants and their staffs. Darting technicians and equipment are located in the CNP which is some four hundred kilometers distant. After securing a travel order from DNPWC, it will then take at least 10 hours of travel to reach the search area. The work then begins next day. Locating the exact tiger is also time consuming and it is not unusual for that process to take more than a week. By this time, a man-eater or problem tiger may have already done considerable damage elsewhere. It is not an unreasonable assumption that due to this lengthy process, the local people harbor their dissatisfaction with the process.

Conservation education can change the attitude and behavior of people (Matarasso, 2004) and increases the tolerance of losses (Sillero-Zubiri, et al., 2007). In my study, respondents expressed that conservation education can reduce the human-tiger conflict. Many other studies have also suggested conservation education as a tool to reduce human-wildlife conflict, for example Oli, et al. (1994); Ahearn, et al. (2001); Nyhus & Tilson (2004); Gurung, et al. (2008); Conservation education focusing on tiger behavior and ecology may also reduce the human-tiger confrontation. It may help people to avoid dangerous situations such as avoiding areas where a female with cubs is frequenting, those times and places where a tiger is with kill, and during tiger mating times, etc.

Awareness and a conservation education program should be the primary focus, in fact, in my study, other stakeholders such as nature guides, local government officials, BZMC members, and protected area managers insisted on it. This study found 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 attitudes towards tiger conservation also increased. A human-wildlife conflict reduction strategy will be effective when conservation education coupled with other tools such as monitoring "dangerous" and "aggressive" animals and fair and timely compensation for losses. To lessen the conflict intensity, Gurung, et al. (2008) suggests the long term monitoring of problem animals jointly with conservation NGOs, the National Park and the local community. This monitoring arrangement will help to locate villagers relative to dangerous and aggressive tigers and their movements so that people can better avoid contact with such wild life.

Compensation of losses is a fundamental strategy to reduce the human-wildlife conflict through the increased tolerance level of the community towards wildlife (Ogra & Badola, 2008). In many countries, already, this strategy is in full practice. The compensations are in the form of direct cash payments or stocks, implements and grain, or other forms of incentives with value such as community outreach programs. The Buffer Zone Management Program in this study area is such an outreach program whose aim is to reduce park and people conflict. Compensating for wildlife damage is crucial for the conservation of endangered species (Nyhus, et al., 2005). Conservation and restoration of such wildlife has been successful, for example, with the wolf (*Canis lupus*) and grizzly bear (*Ursus arctos*) in Yellow Stone National Park, USA (Nyhus, et al., 2003) and the snow leopard in Kibber Wildlife Sanctuary, India (Mishra, et al., 2003). In the BNP, there exists a small compensation scheme. The program is run under the heading of "damage relief" because it fails to compensate for the full value of the loss by paying for only a fraction of it. In cases of human death, the dependant receives NRs 25,000 (US$ 320) and for injury, NRs 10,000 (US$ 192). For livestock losses, it is a mere 5-8 % of the market value. The compensation money in the BNP is paid from the interest of fixed deposits from the endowment fund and annually the BZMC also allocates some money for compensation of wildlife damage. To receive, compensation the damage should be verified by members of the BZUC, local villagers and representatives of the

National Park Office. The event needs to be inspected on the spot by staff of the National Park in order to identify the responsible wildlife species causing the damage. In all cases it is not possible, and in many cases evidences (such as pug marks and incision of teeth) have already been destroyed. After receiving the compensation claim, the National Park Office sends the document to the BZMC office and in a meeting of the BZMC, which is held four to six times a year; it will render a decision in the case. In general, cases of compensation for livestock losses are decided at the end of the fiscal year. On the one hand, farmers receive the compensation too late and on other hand, they get much less than the perceived loss. Compensating too little for a human death or injury does little to reducing negative attitudes toward wildlife (Nyhus, et al., 2005). Inadequate compensation proves ineffective in reducing retaliation episodes. Despite these negative features there are some positive aspects of the present compensation procedures. The BZMC decides the cases and BZUC prepares the report and sends it to the National Park Office. The user himself/herself is relieved of having to endure this procedural nuisance. Second, it is participatory and a principle of good governance. The BZMC/BZUC, which is formed by users/farmers themselves, completes all the procedures. Unlike in India (Madhusudan, 2003; Ogra & Badola, 2008), there is no corruption and comparatively no long bureaucratic processes to endure. This makes the process somewhat transparent as well. As locals are required to sign as eye witnesses and experts from the National Park verify the involved predator species, there will be much less of a chance of fraudulent reports on depredation due to these cross checks with one other.

Recently the MoFSC, Nepal, prepared the wildlife damage compensation guideline. This guideline contains the provisions for monetary compensation of damages. It is a right step in the conservation of endangered species because it increases the tolerance level of the local community. It ensures the payment of 150,000 NRs (US$ 1925) for human deaths, 50,000 NRs (US$ 641) for injuries and up to 10,000 NRs (US$ 128) for livestock losses. The procedure involving damage verification and budget release, however, seems to be getting longer and more bureaucratic. The compensation distribution committee for cases involving the National Parks and Reserves is not suitable since two of its members are based in district headquarters, hence, to establish a common meeting time is difficult. As the compensation is to be disbursed from the Regional Forest Directorate, it seems very impracticable because it would be too far for many

people to travel. Transaction costs to receive compensation would be high. In this study, people had expected free education and employment opportunities for the victim's family and full reimbursement of livestock losses by predators as adequate compensation which seems genuine. Presently the BCP has been financing some of the costs of education for the victim's family in the form of scholarships. Continuation of such a program may prove productive towards increasing the willingness of people in conservation efforts. Jobs to the victim's family in conservation oriented NGOs and INGOs may also have a positive result in conflict mitigation. A good example (in this study site) of this was the case of a person who lost an eye by a tiger attack and was given a job in an INGO doing tiger conservation work. The interviews with Protected Area Managers also suggested monetary compensation as a top priority in resolving human-tiger conflict as well as other community outreach programs including involvement of the local people in resource management, local development and health care and livestock management. Many researchers and wildlife managers believe that monetary compensation is not the solution of the HWC. It is their belief, as an example, that where there is compensation, people will not attempt to protect their livestock and crops from wildlife (Nyhus, et al., 2005). Further, habitat improvements, control of the poaching of prey species and conservation education are necessary to curb the human-tiger conflict in the BNP. Poor people simply cannot bear the cost of conservation; therefore, compensation programs should also go hand in hand with other activities mentioned above.

If inclusion of stakeholders is pursued, it will be a participatory and more inclusive effort with, however, the possibility of requiring a bit more time to bring to conclusion. To make the compensation program effective, some conditional liabilities on the part of local people are needed such as predation-proof night stalls for livestock, careful and close monitoring while grazing and not allowing grazing of livestock in predator habitats. These factors will decrease the depredation rate and consequently the cost of compensation will be lowered. But the disadvantage is in not knowing who will monitor these activities for providing proof that livestock owners completed their responsibilities. Consequently, the monitoring costs may increase the transaction costs. Therefore, a livestock insurance program in which owners contribute some portion of the cost along with other conservation agencies (NGOs and INGOs) and government, would prove to be effective. Nepal is a multilingual and multicultural country. Despite its small size, it is

characterized by a cultural assortment of religions, languages, caste, ethnic groups and indigenous people. At present 101 ethnic and caste groups and subgroups and 93 living languages have been documented (CBS, 2002). These diverse groups have different cultural norms and social value settings which influences the resource use patterns. Therefore, while implementing or designing the program for compensation, these points must be considered. It would be ideal if the local communities such as BZUCs would lead such insurance programs in coordination with the BZMC. Wildlife damage itself cannot be totally avoided, only a reduction is possible and it will not completely be halted over the years. Hence, the source of compensation should be sustainable. If not, and if programs are discontinued, there will be constant frustration with the people.

4.6 Role of stakeholders in conflict mitigation

Human-wildlife conflicts touch not only a single group or profession; it transcends a broader spectrum of stakeholders. Each stakeholder has their own values and norms shaped by the political, social, cultural and geographical settings. Therefore, the human-tiger conflict mitigation approach is guided by the objectives and activities of these stakeholders. The key person interviews with nature guides, BZUC members and local government representatives helped in determining what the role of the different stakeholders in reduction of human casualties, livestock depredation and revenge killing of tigers should be. Nature guides can reduce human-tiger encounters since they usually know where females with cubs are, which area has dangerous tigers present and consequently can guide tourists accordingly. In addition, they are committed to make the local community aware of tiger conservation and fund raising efforts of conservation lovers who come to visit the park. They can help in the enforcement of applicable laws by providing authorities with information about illegal activities such as poisoning and snaring in the park. Members of user committees (BZMC) can conduct conservation campaigns and conservation education programs from the budget of the Buffer Zone Program, stopping entry of people and the livestock inside the park and buffer zone forest, raise a voice for proper management of problem animals, form and mobilize volunteer anti-poaching youth groups, assist with the timely processing of compensation (relief) claim applications and play as mediator between park authorities and the affected people (reducing their antagonism). In the conflict mitigation model,

the mediator has an important role in bringing the issue to the table as discussion agenda, suggest ways of conflict reduction, and facilitate compromise, etc. In addition, BZUC members can maintain and provide records of livestock depredation and human casualty data to researchers and the Park Management Authority.

The local government can allocate expenditure for conservation, alternate energy sources to alleviate peoples' dependence on and intrusion into the forests for energy provisioning, skill development training, NTFP cultivation so that, again, people will depend less on the forest and reduce subsequent interface with tigers and other dangerous animals. They can help, as well, in target group identification for livelihood improvements; inclusion of marginally influential people from among the sufferers of HWC in decision making bodies. Up to this point, the money of local governments has not been used in such conservation planning and related endeavours. In the BZMC, representatives from local governments are also members; however their active participation is not yet functional. The park and reserve warden, who is also a member secretary of the BZMC, can improve this situation by better coordination.

There may be a stake for the local tourism entrepreneurs such as hoteliers and restaurant owners since they are most benefited in terms of cash income from tourism. The concept of 'benefit sharing', if established, can help provide resources towards reducing the conflict. In the BNP, the first attraction for tourists is tigers, followed by rhinos (*Rhinoceros unicornis*) and then elephants, (interviews with nature guides in this study), so if they were to donate money to the endowment fund, this would help in human-tiger conflict mitigation.

Chapter 5

5. Conclusions

The livestock depredation rate was found to be 0.25 head of livestock per household per year and the sum of past three years loss is 6% of the total stock. The causes of livestock depredation might be associated with grazing of livestock in the buffer zone forest and the National Park where tigers present. Night time predation can be result of non predation proof livestock stalls. The rate of depredation in prey-rich area was found lower than in the prey-low area for cows (0.17 versus 0.48) and goats (0.19 versus 0.78) but was similar for buffalo and pigs. Due to less availability of wild prey in the low-prey area, tigers possibly switched to domestic livestock.

Human casualties were also noticed in the study area. Total 12 people were killed and four others were injured by the attacks of tiger in last three decades. Human casualties were mostly occurred inside the National Park. People enters in the National Park forest, which is the reason to happen casualties, to fetch forest resources because they are heavily dependent on these for their livelihood especially for cooking energy, fodders and grass for livestock and construction material like poles and thatch grass. Government's declaration of "free bonded labor" and the people displaced by war during insurgency had put additional pressures such as encroachment of forests which consequently increased human-tiger encounters. Equally important, restored buffer zone forest in recent decades had decreased the physical distance between predators such as tigers and humans and their livestock which in turn human-tiger conflict increased.

Human-tiger conflict had impacted the conservation. Due to this, six tigers had been released from habitat between 1989 and 2009. This data might be higher since tigers killed by professional poachers cannot all be traced. Revenge killing and killing tigers for trades are primarily occurring in the sub optimal habitat like corridors where national park security is absent henceforth restricting the genetic exchange by means of dispersal in meta populations.

Though majority of local peoples were found positive towards tiger conservation, it is important to consider that plenty of people (more than one third) were against the tiger conservation. It should be bear in mind while formulating conservation plans. Since the local people are very poor, mere 42% of respondents had foods to sustain the life for the whole year, incentive measures such as monetary compensation and material support, to increase the tolerance of them towards losses by tiger are to be employed.

Conservation education to make the people aware about tiger behavior or tiger ecology, regular monitoring of problem tigers to alarm the people and compensation to losses can be helpful in human-tiger conflict reduction.

Tigers, as are main predator species, their conservation for the sake of human beings are a must in deed. If we act on better conservation efforts on today, it can be saved for long term so that the next generation will not be deprived of from the ecological services produced from their presence in the natural habitat in the future.

From my data, I concluded that following research questions are to be solved in the future:

- Livestock depredation rates using field verification methods
- Prey-predator interactions especially in the eastern section of the park
- Why eastern section of the park where prey density is low has higher depredation rate
- Identification of age and sex of tigers involved in livestock depredation and human casualties

Chapter 6

6. Recommendations

People should avoid livestock grazing in the National Park. Stall feeding, forage production in crop fields and a reduced number of a more highly productive livestock breed are recommended. Any sort of poaching should immediately be put in check through good networking of information in collaboration with national police, local informants, the park protection unit, forestry agencies and custom offices. Transborder meetings with Indian officials to aid in the control of poaching are necessary. Reward and punishments should be applied in parallel. Some of the provisions in the NPWC act of 1973 are outdated and timely amendments for example increase in penalties and changes in the protected species list on the ground of scientific research is recommended. Guard posts that were abandoned during the insurgency in the Babai Valley should be reinforced soon. Habitat improvement in the eastern section of the park through grass land management and waterhole construction should be done.

Illegal entry into the National Park for collection of forest products should be stopped. Conservation education and public awareness are useful tools in changing the behavior of people, for example, as a measure of increasing their willingness to tolerate damage by wildlife. Conservation education programs about tiger ecology/behaviour should be conducted throughout the Buffer Zone area and should be included as priority in the annual program of BZUC/BZUG. It should target all groups (the Community Forest User Group, women groups, the Buffer Zone User Group, school teachers and students). Monitoring of aggressive and problem animals (radio collaring and tracking) and informing of local people about these animals is recommended. Recommendations against walking inside or at the edge of the forest during night-time hours, and at dawn or dusk should also be avoided to reduce human-tiger encounters.

Alternative energy such as bio gas plants and solar energy should be installed in collaboration with conservation partners such as NTNC, WWF, IUCN, and UNDP so that people’s need to strip the

forest of firewood is abated. Some of the budget from the BZMC should also be allocated to this endeavor. Likewise, training on poultry farming, pig keeping and goat keeping may help to fulfill the animal protein requirements of the poor community and also increase income thereby contributing to reduction in poaching of the prey base. Increasing government business subsidies such as zero-interest loan rates would be beneficial for the ultra poor class of people. If the buffer zone development program focused on uplifting poor people, it would contribute as a help in this regard. The promotion of farming wild prey species on private land would fulfill local demands as well as provide help for the people who desire deer meat as luxury. Social rejection of the people who illegally use wild meat can be a beneficial measure of keeping the poaching of wild deer in check.

For problem-tiger management, regular training on proper darting techniques should be provided to veterinary staff, national park rangers, and game guards from the BNP and wildlife technicians from the Bardia Conservation Program which will reduce damage as a result of delayed action. A team (fully equipped) for managing problem animals should be organized/established in the BNP Administration.

Economic development activities which ensure sustainability and economic growth should be encouraged. For that, ecotourism would play a positive role to some extent. The park entrance in Babai Valley should be opened for tourism. Trophy hunting of over-abundant prey species would promote tourism; however it should be based on principles of conservation biology. Small scale cottage industries based on the sustainable harvest of forest and agriculture products would contribute to local economies.

The livestock depredation record should be more accurately maintained. The entire compensation claim should be verified by an expert so that the responsible predator species can be identified and distinguished. Conflict mitigation measures without sufficient data can be counterproductive.

A subsidized livestock insurance system in collaboration with conservation agencies and the BZMC would be a good model for compensation. However, a willingness to pay of the local

people for their losses is to be ascertained first. Other outreach programs should also be continued. Immediate and proper compensation for livestock loss may prevent retaliatory practices. Establishment of a basket fund for immediate relief to a victim's family would be advantageous. The Buffer Zone Community Forest can contribute some of the assets to this basket fund from the sale of excess forest products. Similarly, conservation oriented NGOs and INGOs should have flexible plans on conservation by allocating budget for compensation.

A strong political commitment is needed to control the encroachment on forest land which deters the dispersal of tigers and brings about the conflict between tiger and human. A policy of not using forest land for non-forestry purposes should be strongly stated and implemented. While formulating plans to mitigate the human-tiger conflict, local people must be involved since they have the 'know how' about local conditions.

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Annex A. Chi-square test

1. Perception/attitude and education

Education 4 groups * tiger like Cross tabulation

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Edu	251	1.11	.921	0	4
tiglike	251	.36	.481	0	1

Education 4 groups * tiger like Cross tabulation

Count		tiglike		Total
		yes	no	yes
Education 4 groups	illiterate	34	40	74
	primary	58	36	94
	secondary	53	14	67
	Higher secondary/university	16	0	16
Total		161	90	251
N of Valid Cases		251		

2. Gender and perception

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Gen * tiger like	270	98.9%	3	1.1%	273	100.0%

Gen * tiger like Cross tabulation

		Tiger like		Total
		yes	no	yes
Gen	0	143	63	206
	1	29	35	64
Total		172	98	270

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	12.271(b)	1	.000		
Continuity Correction(a)	11.250	1	.001		
Likelihood Ratio	11.920	1	.001		
Fisher's Exact Test				.001	.000
Linear-by-Linear Association	12.225	1	.000		
N of Valid Cases	270				

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 23.23.

Annex B. Mann-Whitney U Test

1. Depredation in prey rich and prey low area

Ranks

	Prey density	N	Mean Rank	Sum of Ranks
cow	high prey density area	169	128.08	21645.00
	low prey density area	103	150.32	15483.00
	Total	272		
buff	high prey density area	169	137.22	23190.00
	low prey density area	103	135.32	13938.00
	Total	272		
goat	high prey density area	169	122.44	20693.00
	low prey density area	103	159.56	16435.00
	Total	272		
pig	high prey density area	169	137.21	23188.50
	low prey density area	103	135.33	13939.50
	Total	272		
chick	high prey density area	169	135.80	22950.50
	low prey density area	103	137.65	14177.50
	Total	272		

Test Statistics (a)

	cow-t	buff-t	goat-t	pig-t	chick-t
Mann-Whitney U	7280.000	8582.000	6328.000	8583.500	8585.500
Wilcoxon W	21645.000	13938.000	20693.000	13939.500	22950.500
Z	-3.637	-.830	-5.784	-.820	-1.037
Asymp. Sig. (2-tailed)	.000	.407	.000	.412	.300

A Grouping Variable: Prey density

Annex C. Livestock holding/descriptive statistics

Statistics

		cow	buff	goat	pig	chick
N	Valid	271	271	271	271	271
	Missing	2	2	2	2	2
Mean		1.87	1.10	3.15	.60	6.96
Median		2.00	.00	2.00	.00	4.00
Mode		0	0	0	0	0
Sum		507	299	855	163	1886

Descriptive Statistics for livestock depredation

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Cow	272	0	6	.29	.051	.837
Buff	272	0	1	.02	.008	.135
Goat	272	0	10	.41	.075	1.236
Pig	272	0	2	.03	.012	.200
Chick	272	0	9	.04	.033	.552
Valid N (listwise)	272					

Annex D. 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. Land owned: with irrigation: without irrigation:

6. Livestock holding

cow/ox:	buffalo:	goat/sheep:	pig:	poultry:	others:

7. Please indicate how long your life can be sustained from loss of crops and livestock.

a. less than 3 months b. 3-6 months c. 6-9 months d. 9-12 months

8. Sources of livelihood (in %)

crop	livestock	employment/labor work	others (specify)

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

	place (GPS)	date and time	sex and age of victim
injury			
kill			

10. Where do you go for resource collection?

	wood	fuel wood	fodder	grass	others
national park					
buffer zone					
community forest					
from own land					

Attitude and tolerance to tiger loss

11. Do you like tigers? yes (conserve) no (eradicate)

12. If yes, why do you like them? (If no, skip to question 1**3**)

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

13. Why don't you like tigers?

a. kills livestock b. attacks human.

14. Do you like tigers in community forestry?

yes no

15. 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

16. I support tiger conservation even if a family member is killed

a. agree b. neutral c. disagree

17. I support tiger conservation even if a family member is attacked and injured

a. agree b. neutral c. disagree

18. I support tiger conservation even if my livestock are killed

a. agree b. neutral c. disagree

Local people's knowledge on tiger ecology

19. 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

20. When do tigers come out of forest?

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

21. 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

22. Are you satisfied with problem-tiger management?

yes no

23. If no, what should be the problem tiger management strategy?

a. killing b. capture and keep in enclosure c. capture and release

24. Why are tigers being killed?

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

25. How can we minimize the human-tiger conflict?

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

Livestock depredation

26. Where do you graze your livestock?

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

27. Grazing system

grazing without herder	grazing with herder

28. Is livestock shed predation-proof against tiger?

yes no

29. Livestock loss by predation in last 3 years

	by tiger			by leopard		
	no	when	where	no	when	where
cow						
buffalo						
goat						
pig						
poultry						
others						

Compensation

30. Are you getting any compensation for these losses? (if no skip to 32)

yes no

31. Are you satisfied with the amount of compensation?

yes no

32. In your opinion, how much compensation should be given to victim or his family?

For human killed:

a. 50,000-100,000 b. 100,000-150,000 c. 150,000-200,000 d. bear education cost of dependent

For Livestock kill:

a. market value of livestock b. 75% of value c. 50% of value d. 25% of value

33. Are you satisfied with present compensation process?

a. yes c. no

34. If not, why?

a. it is too lengthy b. information and service from park authority is not adequate.

c. information/service from BZUG/BZUC is not sufficient.

2. For Nature Guide/tourism enterpriser

1. Why tourists visit the BNP? (Give 0 to 8)

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?

3. For User Committee Members

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

yes no

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

yes no

3. If yes, when and where?

4. 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. Are there provisions of compensation in the Bufferzone Management Committee against losses by tigers?

a. yes b. no

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

a. yes b. no

8. If not, why?

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

9. Does user committee involve themselves in solving the human-tiger conflict?

a. yes b. no

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

a. Yes b. no

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

12. Please mention other ways to minimize conflict:

4. 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?

5 . What measures can be adopted to increase tolerance of people to losses by tigers? (Please give 0 for least priority and 4 for highest priority):

a. conservation education/awareness

b. timely monetary compensation against losses

c. effective local participation in management and conservation activities

d. implement ICDP

e. others (specify):

6. Do you have any record of revenge killing of tigers? Please give details (no., where, when)

7. How problem tigers can be managed? (you can choose multiple options)

a. killing b. sending to zoo c. capturing and releasing into deep forest d. translocating into less-tiger density area

8. Have you have faced any problems in tiger conservation due to human-tiger conflict? Please specify:

8. How can tigers be conserved in a better way?

9. How can involvement of local people in tiger poaching be minimized?

10. How can we stop/minimize the hunting/poaching of tiger-prey species?

Annex E. Some Photos

Photo 1 Household survey: Household head accompanied by other family members

Photo 2 Key-person interview

Photo 3 Gathering data from clerk, Namaraj Pokharel, of the legal section at BNP

Photo 4 Cattle grazing inside the national park

Photo 5 Typical night time livestock shed