1. INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Human animal conflict should not be taken as a new phenomenon. Human beings and wild animals share common resources to meet daily need in most part of the country. In rural areas, livelihood is mostly dependent on forest resources. It is believed that the conflict is as old as the human civilization. It is still found to be a serious social and environmental problem in the entire lowland areas of the country (Yadav, 2005).

The fight will continue between human beings and others in nature. Both parties have their own reasons, necessity of livelihood, rules to abide by, and duties to perform as far as the forest resource and the protected areas are concerned. However, in the mean time we can also think of better alternatives, which can satisfy the needs of forest authorities as well as the local people. A kind of harmony between forest management and the people at the rim of conservation borders should be established and handled carefully, so that the forests and humans could live together in harmony (Sunday Post, 2000).

As part of conservation practices, National parks in the developing countries, particularly in Asia, were established at the beginning of the second quarter of twenty's century (Mishra, 1991). It has been practiced under different approaches of conservation from ex-situ and in-situ conservation efforts to sustainable conservation through Landscape level Conservation Approach (LCA) at present. As such, Nepal has gone through various stages of experimentation and learning processes in its bids to conserve and manage its rich biological resources.

The dramatic altitudinal variation within the small range has resulted in the greater bio-diversity, within the 10 bio-climatic zones from tropical to nival, within a horizontal span of less than 180 km comprising a total of 118 ecosystems, 75 types of vegetation and 35 forest types of the country, Nepal (HMG 2000). Protected areas system (PAS) in Nepal not only harbors greater biodiversity, but also occupies the major economy generation of the country by means of tourism industry. Nepal comprises about 29 % area as forest, 10.6 % as shrub land & degraded forest, 12 % as grassland, 21% as farmland and 7 % as uncultivated inclusions of total land area of the country (HMG, 2000). The majority of wildlife, for instance, of the total 19 orders of world mammals, Nepal endows with 12 orders of 225 species (Shrestha, 2001) and 859 species of birds (BCN, 2003).

As the population and distribution of wild animals depend upon quality and quantity of food material, the mammals of Nepal are now decreasing due to anthropogenic activities such as hunting, poisoning, forest fires, destruction of habitat, and livestock pressure. Over exploitation of forest resources outside the protected areas is still the main challenge of biodiversity conservation in Nepal (Shrestha, 2001). Large mammals like rhino, elephant and tiger need large area. The increase in number of animals against the limited habitat will lead to increase in the competition for food and space. To maintain their reproduction and decrease in mortality, habitat needs to be increased. Corridor forest is very important for the mammals and birds especially for the migratory species.

1.2 CHITWAN NATIONAL PARK

Although some areas in country had been set aside as hunting reserve by the Rana regime (1846-1950), the concept of conservation first came into existence during the 1950s and the first wildlife law was promulgated in Nepal in 1957. This law was brought in action by establishing a small rhino sanctuary in Chitwan in 1964 to protect the population of one-horned rhinos (*Rhinoceros unicornis*) with the help of a group consisting of soldiers and trained people, and known as GAIDA GASTI (Rhino Patrol). Subsequently in 1969, six Royal hunting reserves in the Terai and one in mountain area were gazetted under the Wildlife Protection Act 2015 (1969), but effective management could not be achieved because of the absence of adequate regulations, organization and staff (HMG, 1988a).

In 1970, His Majesty the King Mahendra approved in principle the establishment of the Royal Chitwan National Park —recently renamed as Chitwan National Park (CNP) by 2006's parliament-proclamation, and Langtang National Park. Since then the conservation movement in Nepal has effectively initiated. In 1973, a National Parks and Wildlife Conservation (NWPC) Act came into force. The 1973 Act provided broad legislation for the establishment of National Parks and Reserves to protect areas and species. Since 1973, the Act has undergone through fourth amendment, one in each 1974, 1982, 1989 and 1994 (HMG, 1995).

Four types of protected areas have been described under section 2 of the NPWC Act of 1973, namely National Park, Wildlife Reserve, Hunting Reserve and Conservation Area. HMG introduced a buffer zone concept through the amendment in National Park and Wildlife Conservation Act 1973, in 1993 (2049 B.S.). The Act defines the buffer zone as: an area designated surrounding (outside) the PAs including the National Parks and Wildlife Reserves. In Nepal, at present there are

altogether 16 protected areas covering about 19 percent of total land of the country. PAs in Nepal correspond to the world conservation Union's (IUCN) international systems of protected areas categories II, IV and VI.

World Heritage Committee of UNESCO included CNP and Sagarmatha National Park as the World Heritage Sites. The Koshi Tappu Wildlife Reserve (KTWR), Bishazari and Ghodaghodi lakes have so far been included in the list of wetlands of International Importance. Of these, Bishazari Lake lies in BCF adjacent to CNP.

1.3 HUMAN-WILDLIFE CONFLICT

It has been a burning issue, at both international and local levels, of preserving wild mega fauna while maintaining the human needs from the surrounding nature at the same time. Human-wildlife conflict is of increasing concern in all parts of the world and has been the focus of recent conservation efforts (see for example Bell, 1984; Else and Lee 1986; Hill, 1998; Hoare, 2000; Infield, 1988, Naughton, 1998; Newmark et al, 1994). (see for example Bell 1984; Else and Lee 1986; Hill 1998; Hoare 2000; Infield 1988; Naughton, 1998; Newmark et al., 1994). With increasing human populations, especially in the developing world, more human and wildlife populations are coming into direct competition (Eudey, 1986; Strum, 1987a, b, 1994; Tchamba, 1996).

In subsistence agricultural societies the nuisance value of wildlife, from crop damage and livestock depredation, is often pronounced in people's minds (Ranjitsinh, 1984). People feel threatened by wildlife, both in terms of crop loss and personal safety (Eley and Else 1984; Hill, 1999; Malic and Johnson, 1994; Priston, 2001). Such losses can be enormous, both in direct economic terms and through indirect costs on time and energy devoted to protection and re-planting after damage (Hill, 1998; 1999), as well as the cost of potential conflicts between activities and less time to complete other work (Lee and Priston submitted).

1.4 PARK-PEOPLE CONFLICT

Wildlife conservation had been quite successful from the view point of habitats of several threatened species (Mishra et al., 1992). Active conservation of habitats has increased wildlife population within protected areas which start causing damage outside the park. The relation

between park-people is imbalanced when the park animals damage outside and disturb the adjacent settlement. Damage of agricultural crop, human harassment, injuries and death, and livestock depredation are the common causes of this imbalance relationship (Sharma, 1996; Jnawali, 1989; Heinen, 1993; Studsord and Wegge, 1995; Shrestha, 1994 and Kashu, 1996).

The local people, who once were enjoying free access to areas henceforth covered by parks and were able to meet their needs from inside resources, now no longer, have legal access. Local people have seen the park as an attempt by the government to curtail their access to their traditional rights of resources use. However, the park has became a very good source for villagers to fulfill their resources needs through venturing into illegal poaching, logging and hunting, all of which are directly conflicting with park's objectives (Mishra, 1991; Milton and Binney, 1980).

With the establishment of the Park, people have been denied the rights to use the resources inside the Park and they have no rights to claim compensation for the damage to their crops by wildlife. Similarly, except in specialized area within buffer zones, the responsibility for managing resources has been taken from people who live in the vicinity and has instead been transferred to a Government agency which is based in the distant capital. The cost of giving up access to the use of the resources falls on the rural people living in the vicinity of the reserve. It is very difficult to villagers to understand why wildlife may damage their crops, while they must not kill any wild animal in return. They are not convinced of the rationale of protecting forest and wildlife, which they have been utilizing for thousands years.

1.5 CROP DAMAGE

Crop damage is very common along the immediate periphery of parks and reserves in the Terai. It is issue of considerable economic and political significance facing administrators of CNP (Mishra, 1991; Upreti, 1985). Not only do the people of the buffer zone lose their crop in a great quantity but also the ratio of damaging of the crops is increasing day by day. According to Milton and Binney (1980), one villager near Chitwan experienced crop loss of 75% in 1978, whereas loss was three times less a decade earlier, before the establishment of the park. Crop depredation by wild animals has adversely affected the economy of the local people and has increased poverty in the region (WMI/IUCN–Nepal, 1994; Kherwar, 1996).

1.6 BUFFER ZONE CONCEPT

Nepal has come a long way in biodiversity conservation and her commitment to nature conservation and the success stories over the years is appreciated widely. In addition to being a signatory to various international Conventions and Treaties including Convention on International Trade of Endangered Species (CITES), Convention on Biodiversity Conservation (CBD) and Ramsar Convention, His Majesty's Government has adopted a more conciliatory and participatory approach in conservation and developed partnership with large number of stakeholders through the legal basis by the formulation of some national acts, policies and legislations like *Jalchar Sanrachhan Ain* - 2017 (Aquatic Life Protection Act - 1961), The NPWC Act - 1973, Royal Chitwan National Park Legislation – 1974, Wildlife Reserve Legislation - 1975, Himalayan National park Legislation - 1979, Khaptad National Park Legislation - 1982, Royal Bardia National Park Legislation - 1984, Buffer Zone Management Regulation (BZMR)– 2052 (1996), Conservation Area Management Regulation – 2053 (1997), National Environment Impact Assessment Policy – 2054 and Wetland Conservation Legislation – 2002 (Maskey, 2006).

The concept of buffer zones is recently developed in Nepal. The declaration of buffer zones in and around the protected areas are aimed at fulfilling local people's need of forest products, while implementing community development activities to win the cooperation and stewardship of local residents in conservation. In Nepal, the Buffer Zone concept, which allows park authorities to share park income with local communities, has been introduced as a key component of the national biodiversity conservation strategy.

Literally, buffer zone has been defined as the area adjacent to national parks and wildlife reserves on which land use is partially restricted to give an added layer of protection to the protected area while providing valued benefits to neighboring rural communities (Mackinnon et al., 1993). Thus, it is an area of controlled and sustainable land use, which separates the protected area from direct human pressure (Ordsol 1987; Nepal and Weber, 1993).

World Parks Conference at Bali in 1982 focused on the relationship between protected areas and human needs and stressed the relevance of integrating protected areas with other major development issues (Mishra, 1991). The message is that the protected areas should respond to the needs of local people (Sayer, 1991). The involvement of local people in the management of the protected areas for mutual benefits is widely accepted today (Oldfield, 1988). This ultimately leads to harmony and

sustainability between the natural heritage and the well being of the people living on the periphery of the park (Anon, 1993). These days, buffer zone concept has been widely accepted in protected area management in order to reduce conflicts between protected area authorities and the local people (Berkmuller et. al., 1990).

As the park and people conflict emerged, the government realized that conservation of wildlife inside the protected areas is not productive in lack of local people's participation. Through the 4th amendment in the NPWC Act of 1973 in 1992, HMG has allowed to create buffer zone surrounding national parks and reserves in order to harmonize the relationship between PAs and local people. HMG introduced a buffer zone concept through the amendment in NPWC Act 1973, in 1993 (2049). The Act defines the buffer zone as: an area designated surrounding (outside) the PAs including the National Parks and Wildlife Reserves in order to provide facility for use and the regular supply of forest products to the local people (Uprety and Uprety, 1995). Following the NPWC Act 1993, BZMR (rules) 1996 (2052 B. S.), and BZM Plan (2058) have been enforced which facilitated to empower the user groups and the local community for the management of buffer zone in view of protecting the endangered wildlife of the PAs concerned, biodiversity conservation and maintain regular supply of forest products, which is one of the main concerns of the parks people conflicts. As per the above mentioned rules and regulation, many Buffer Zone Community Forests (BZCF) are being handed over to the FUGs for the conservation of wildlife, eco-tourism development, corridor protection and formation of green belt outside the park and reserve and fulfillment of basic needs of forest products of the rural people living adjacent to the parks and conservation partner to them.

1.7 RATIONALE AND OBJECTIVES

As protected area and their buffer zones have become isolated and inadequate to provide a land-based connectivity, existing forests outside the PAs are more important now than ever because they may serve as biological corridors. Therefore, the need to ensure maintenance of biodiversity in them, through community-based management, is vital. The strategy behind to mobilize community is to strengthen the subsistence pattern of the local people and to stabilize the pressure on the land especially the existing forest cover (Resources Himalaya, 2001).

The previous studies conducted by Milton and Binney (1980), Jnawali (1989), and Shrestha (1994) had assessed the crop damage by the wildlife, especially the megafauna of CNP, but they were

mainly confined to the Sauraha and the northern areas of CNP. Likewise, crop damage by wildlife in the areas adjacent to the CNP has also been reported as a serious problem by the scholars like Sharma (1991), Upreti (1990), Schultrz (1986), Bahuguna (1986), Shrestha (1997), and Fearnsside and Drew (1984). But almost no study has been carried out on assessment of crop damage problem and its consequences in the adjoining areas of BCF.

Since the corridor joins Mahabharat range with CNP lying within the geographic area of Terai Arc Landscape, requires to promoting landscape level conservation with strong community-based management programmes in order to conserve endangered species. But most of the residents, which are with the subsistence farming around the BCF and CNP boarder, are not happy with the forest/park because of few common problems. Mainly the crop damage due to the wildlife of BCF/Park has resulted in increasing wildlife people conflict in the adjoining areas.

Thus socio-economic and environmental consequences attributed to the crop damage in the adjoining areas need to be addressed for biodiversity / landscape conservation in the area. In this endeavor, this study is intended to assess the extent of crop damage and its consequences, the relevant information on biodiversity and land use assessments, and identification of key threats (the principal focuses of LCA management) in the adjoining areas of BCF including some villages of Bachhauli and Patihani VDCs being commonly shared by the wildlife of both CNP and BCF. Likewise, there is not any recent study and literatures concerning and covering these aspects of BCF, this proposed study seems to be highly essential and time worthy for the sustainable conservation and management of BCF and the CNP as well.

Objectives:

- To estimate actual loss of crops due to depredation by wildlife and its monetary value in total per season in a year.
- To study the preventive measures adopted by the local people and their effectiveness.
- To determine the most destructive wild animal and the frequency of wildlife attack on the crops.
- To assess the views of local people for sharing of benefits and natural resource management, and to recommend the solution to the problems.

2. DESCRIPTION OF STUDY AREA

2.1 LOCATION AND BOUNDARY

The intensive study area is the crop fields and households located within one km distance from the boarder of BCF which is located between 84°22'30" and 84°33'0" East longitude and 27°34'7" and 27°43'30" North latitude, and links the CNP in the south with the Mahabharat hill forest in the north of Chitwan Valley which is situated between 26°22' to 26°46' North latitude and 85°55' to 84°47' East longitude as a part of the subtropical inner Terai lowlands of southern central part of Nepal in Narayani zone.

2.2 PHYSICAL FEATURES

The BCF is a 29 km long and is only remained forest patch in Chitwan district. It covers an area of 87.9 km^2 and bisects the Chitwan district in east and west Chitwan. Barandabhar comes in parts because the Mahendra Highway runs dividing it into two of which 56.9 km^2 area is under the buffer zone of CNP and 31 km^2 is under the district forest office. The buffer zone area of BCF holds 48.016 km^2 forest, 5.018 km^2 grassland, 3.276 km^2 shrub lands and 0.5 km^2 of water bodies collectively called Bishazari tal. The Bishazari Lake, which is located in the middle of jungle having altitude 256 m from sea level, is considered as the second largest natural wetland of Nepal (Yonzon, 2000) and is recently included in Ramsar site in August 2003. The major rivers around the forest are Rapti, Budhi Rapti, and Khageri.

The surrounding five VDCs of this forest are Bachhauli, Gitanagar, Patihani, Jutpani, and Padampur (New), and 2 Municipalities; Ratnanagar (Ward Number 5, 6, 7, 8 and 10), Bharatpur (Ward Number 8, 9, 11 and 12).

2.3 LOCAL INHABITANTS

The oldest and original inhabitants of the region are Tharus, but after the eradication of malaria in 1950's hill people began to migrate to the Terai. The flow was so great that Tharus became the minor community (Bhatt and Shrestha, 1977). Traditionally local people depend up on forest resources for their subsistence economy. People use both timber and non timber forest products such as thatch, grasses and reeds, tree fodder, fibers, forest litter, bamboos, mushrooms, honey, wild vegetables, medicinal herbs and fruits. The surrounding VDCs and Municipalities consist a total of 1,25,652 person and the family size 5.95 including Tharus and other ethnic groups (table 1). It is estimated that 70,000 people are the beneficiaries (KMTNC, 2002 and Resource Himalaya, 2000).

Table 1: Distribution of Community Forests in different Study Zones with their area, FUGs and number of beneficiaries.

Community Forests	Zone	Area Ha	FUGs	Population
Baghmara BZCF	Zone I	215	779	3261
Chitrasen BZCF		483	811	4631
Milijuli BZCF		300	500	2082
Tikauli BZCF		310	547	3282
Total		***1308***	***2637***	***13256***
Panchakanya CF	Zone II	387	1103	6506
Chaturmukhi		288	336	1300
Bhimbali CF		388	518	2590
Padampur WCF		318	408	2040
Thankhola Jaldevi CF		631	1678	7500
Total		***2012***	***4043***	***19936***
Satanchuli CF	Zone III	710	450	2050
Jaldevi		350	350	1750
Navajagrati CF		1500	1700	8500
Rambel CF		300	790	3950
Total		***2860***	***3290***	***16250***
Bandevi Barandabhar BZCF	Zone IV	167	1641	8025
Navajyoti BZCF		44.5	200	1010
Dakshinkali BZCF		102	365	1825
Ujwol BZCF		90	343	1648
Belsar BZCF		95	1643	8035
Total		***498.5***	***4192***	***20543***
Grand Total		**6678.5**	**14162**	**69985**

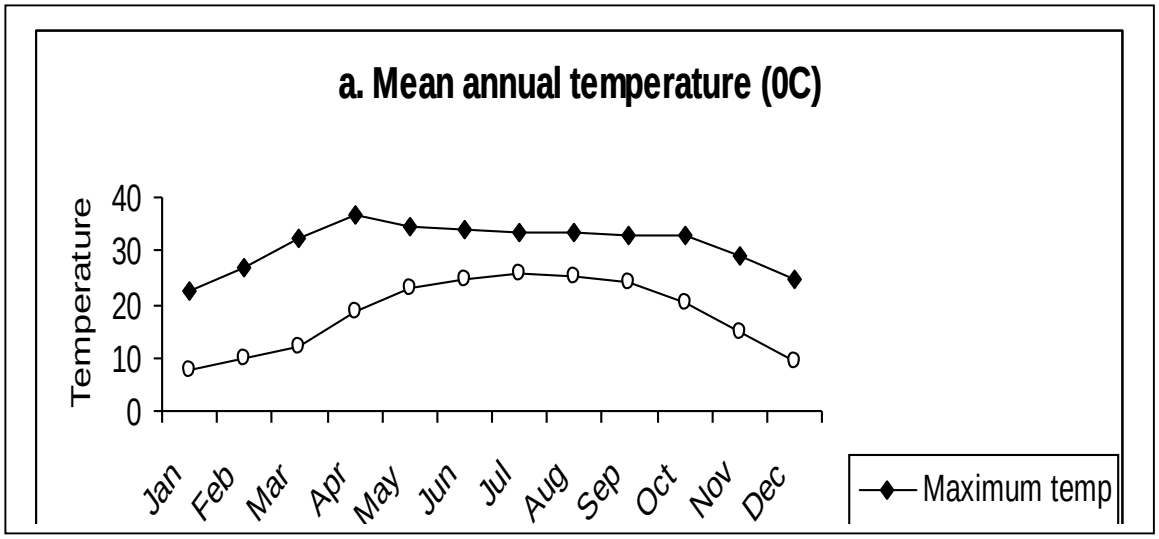
Source: District Forest Office (2004).

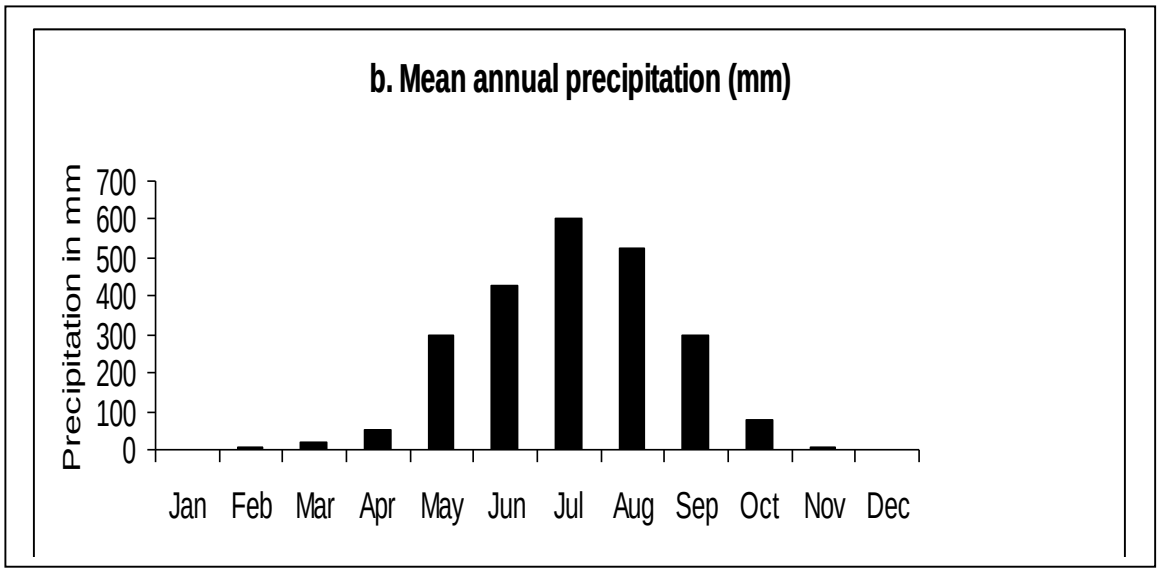
2.4 CLIMATE

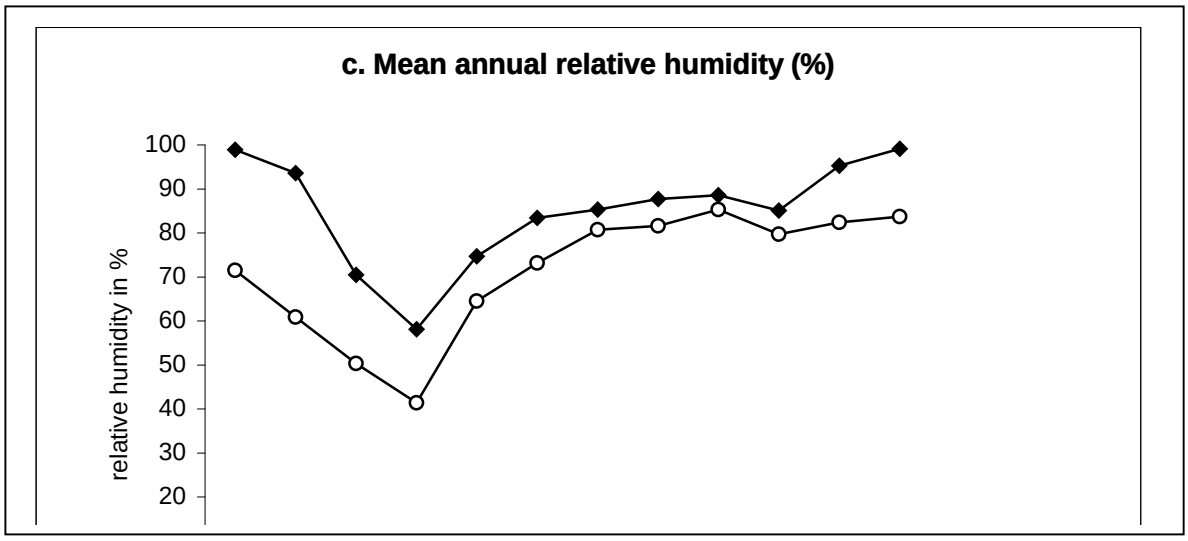
The bioclimatic zone of Barandabhar has subtropical climate with relatively high humidity. The forest has range of climate seasons; winter, spring and monsoon with subtropical climate. The winter season is cool from October to February. The spring begins in March and followed by summer which ends in early June. The summer days are hot with and average 300C.

The monsoon season begins at end of June and continues until September (Majupuria, 1998). Mean annual minimum and maximum temperature, mean annual precipitation and mean annual relative humidity recorded during the year 1999-2003 at Rampur, approximately 11 km from study area has shown in figure 1. a, b and c respectively. The mean annual rainfall was 192 mm and highest in July (604.8 mm), lowest in January (0.9 mm) and no rainfall in December.

Fig. 1: Mean annual temperature (fig. a), precipitation (fig. b) and relative humidity (fig. c) from 2001 to 2003 recorded at Rampur, Chitwan.







(Source HMG/N, Department of Hydrology and Meteorology)

2.5 BIODIVERSITY

2.5.1 FLORA AND VEGETATION

The flora of BCF is dominated mainly by sal forest and partly by riverine, tall grassland and short grassland. The percentage of vegetation of Chitwan valley consists of (70%) sal forest (a moist deciduous type), grassland (20%), riverine forest (7%) and sal with chirpine (3%) (Majupuria, 1998). The latter type of vegetation is not present in BCF.

a) SAL FOREST: Sal forest is dominated by Sal (*Shorea robusta*) and the associated species with Sal are Barro (*Terminalia belerica*) and Saj (*Terminalia tomentosa*). A large number of other tress, shrubs, creepers, ferns, flowers and grasses grow among or under sal.

b) RIVERINE FOREST: Riverine forests grow along watercourses and their composition varies greatly from place to place. Common species of riverine forest are simal (*Bombax ceiba*), sissoo (*Dalbergia sissoo*), and Bhellar (*Trewia nudiflora*) and in the lower canopy *Clerodendrum viscosum*, *Zizyphus maurintiana* are present.

c) TALL GRASSLAND: The alluvial flood plains support a luxuriant growth of grasses interspersed with patches of riverine forest. These tall and dense stands of grasses are popularly called 'elephant grass'. Tall grassland is dominated by kans (*Saccharum spontaneum*), and distributed along the Rapti and Budhi Rapti riverside.

d) SHORT GRASSLAND: BCF is very important for short grassland, which is mainly dominated by Siru (*Imperata sps.*). It is the most important grass called as Siru Khar in Nepali, which is used by local people for thatching, and is a chief food source of ungulates.

2.5.2 FAUNA

Sal forest dominated BCF contains 22 species of mammals including tiger, rhinoceros, Asian elephant, sloth bear, wild boar, sambar deer, spotted deer, hog deer, barking deer and 280 species of birds including giant hornbill, hill myna and storks. It is a critical habitat for many species of both migratory and resident aquatic birds, and mugger crocodile. More than 45 species of herpetofauna represented by frog, toad, lizards, python and crocodile are found in BCF (Resource Himalaya, 2000 and KMTNC, 2002).

2.5.2.1 MAJOR CROP RAIDING ANIMALS

2.5.2.1.1 UNGULATES

Among the six orders of ungulates, 3 orders are distributed in Nepal, which include Artiodactyla (deer and bovines), perissodactyla (horses and rhinoceros) and proboscidea (elephant) (Majupuria, 1998). Among the ungulate species found in BCF, rhinoceros and wild elephant are listed on APPENDIX I (threatened with extinction) of CITES, Endangered on the IUCN Red list of 1996 and protected by HMG/Nepal under schedule 1 (section 10) of the NPWC Act 2029 (HMGN, 1973), but other 5 species are in common category.

A) SPOTTED DEER (*AXIS AXIS*): Chital is indigenous to Srilanka, India, Bangaladesh and Nepal (Prater, 1998). The main distribution area in Nepal is through out Terai, with major concentrations in parks and reserves. In Chitwan, males averaged 71 kg and female averaged 75 cm at shoulder height and weighed 50 kg (Mishra, 1991) and the rutting period reaches a peak in May when most of the stags have hard antlers (Mishra and Wemmer, 1987). Chital prefer newly burned phatas as feeding habitats (Moe, 1993) and rest in forest habitats during the middle of the day (Naess and Anderson, 1993). Chital are nocturnal, but might feed until late in the morning (Prater, 1998). Their social organization is variable with small groups of 2 - 20 individuals common, but herds of more than fifty animals can be found (Bhattarai, 2003). The herd size varies seasonally, increasing during the monsoon season (75 - 81 individuals) (Schaller, 1967).

B) SAMBAR DEER (*CERVUS UNICOLOR*): The main distribution of sambar deer in Nepal is throughout reserves and parks of Terai (Mishra, 1984). The wooded districts of India, Burma, and Ceylon extend through the Malay countries and eastwards to the Philippines (Prater 1998). Hence sambar deer is widely distributed in the forests of southern Asia, but little studies have been done on its biology. Several short accounts are available on the biology of the species (Schaller 1967; Johnsingh, 1983 and Krishan, 1972). These short accounts together give a good background of the species. The coat is coarse and shaggy. The general colour is brown with a yellowish or grayish tinge. Females are lighter in tone; old stags tend to become very dark, almost black.

Sambar is found in a wide variety of habitats and is an animal of high adaptability. Their food consists of grass, leaves, and various kinds of wild fruit. They feed mainly at night and retire into heavy cover at daybreak and do not usually come out till dusk (Prater, 1998). The group size ranges from 2 to 4 (this study) and rarely found associating in large numbers (Prater, 1998). In disturbed forest, they are found mostly solitary and graze at early morning and late evening (Bhattarai, 2003).

C) HOG DEER (*AXIS PORCINUS*): Hog deer has a much wider distribution than Chital and covers the area through out the alluvial grassland of northern India, extending eastward to southern Nepal, Burma, Thailand, Indo-China, and Srilanka (Prater, 1998). In Nepal, hog deer are mainly concentrated in Chitwan, Karnali-Bardia and Sukla Phantas (Mishra, 1984). Antlers consist of long bony pedicels with a short brow tine and a straight beam with a fork at the top (Prater 1998 and Mishra, 1984). Fawning occurred from January to April in Chitwan (Dhungel and O'Gara, 1991). Mishra and Wemmer (1987) found that the fawning season starts in February and increases until May. Tall grasses along the riverbanks, open phantas are favoured habitats. They are generally solitary but sometimes-small groups may graze together. During the hot hours of the day hog deer shelter in tall grass and they feed early in the morning and in the evening (Dhungel and O'Gara, 1991).

D) BARKING DEER (*MUNTIACUS MUNTJAK*): *Muntjak* is found in Nepal, northern India and Bhutan, from sea level to 3000 meters in the Himalayas (Mishra, 1984). This is the smallest deer of BCF. The antlers are small, consisting of a short brow-tine and an unbranched beam set on bony hair covered pedicels (Prater, 1998). Fawning season has a main peak in November and two smaller in May and August - September (Mishra and Wemmer, 1987). Barking deer are Solitary or exist in small family groups and are most common in dense forest habitats and graze in open forest edges and is fairly diurnal (Prater, 1998).

E) WILD BOAR (*SUS SCROFA*): Wild boar (*Sus scrofa*) is distributed through out India, the southern part of Nepal, Burma and Srilanka. Older boars are grayer than the more brownish young ones. Adults have a more of black bristles from the nape and down the back. Wild boar breeds in all seasons and after breeding, they live together with other individuals at the same size or alone. Wooded grassland, swampy areas, forest and dense bush are preferred habitats, and they build shelters of grass, reeds or brush. The wild boars are omnivorous, eating crops, roots, tubers, insects, snakes etc. (Prater, 1998).

F) RHINOCEROS (*RHINOCEROS UNICORNIS*): The Indian one-horned rhinoceros (*Rhinoceros unicornis*) ranged through out northern India, Myitkina (Burma), and Nepal (southern central Terai to far western Terai) (Prater, 1998). The Indian rhinoceros has also been reported in Sylnet (Bangladesh) and Cacher (Rookmaaker, 1980). It is one of the largest of all existing rhinoceros. The skin of this massive creature is divided into great shields by heavy folds before and behind the shoulders and in front of the thighs. Though it prefers swamp, grass as well as the rhinoceros is also found in wood jungle up ravines and low hills (Prater, 1998). They are recorded in river and lakes as well as grassland and forested area (Bhattarai, 2003). All rhinoceros defecate on old piles and fresh dung is a stimulus to defecate. Usually, calves defecate after their mothers (Laurie, 1979). The population of rhinoceros in Chitwan is considered as the second largest

population in the world. There were altogether 612 rhinoceros in Nepal, with less than 100 rhinoceros in Nepal in the 1960s, the figure has risen to 612 in 2000, with a growth rate of 3.88% per year (DNPWC, 2000). But in contrary with this, rhino's population in Chitwan has dramatically decreased from total 544 in 2000 to 372. All are by poaching except of 11 rhinoceros with natural death (DNPWC, 2005).

G) ASIAN ELEPHANT (*ELEPHAS MAXIMUS*): Elephants (*Elaphas maximus*) are the largest living mammals found on land. The Asiatic or Indian elephant is widely distributed in the Himalayan Terai in northern India, Nepal, Bangaladesh, Srilanka, Burma, South-China, Malaya, and Sumatra. Generally only the males have large tusks. Elephants have very poor sight; the senses of smell and hearing are highly developed. Elephants chiefly frequent areas covered with tall forests of Nepal and India. Elephant sleep during the hot hours of the day, feed early in the morning and evening, in open forest or raid crops, retire to sleep after midnight (Prater, 1998). The exact number of elephants in Nepal is not correctly assessed so far. There are, however, reports of annual fluctuation in their numbers due to their preference of favorable area in Nepal as well as Haldwani forest of India (Singh, 1966). Thagunna (1999) studied about trans-boundary elephant corridor with great emphasis on protecting the wild elephant dispersal patterns of the far western Terai region through corridor linking. According to their current population trends, the elephants are suffering from the adverse effects of mismanaged forests and loss of habitat. They occur in four main populations that exist along the eastern, central, western and far-western Terai belt, which has put their population of around 100 animals in the country, in grave danger.

2.5.2.1.2 PRIMATES (MONKEYS) AND PARAKEETS

There are 185 species list available in the world with 28 species in Madagascar and about 50 each in Africa, S. America and Asia. Among the 52 Asian species, 44 species are recorded in south Asian countries (Sanjaya et al., 2003). In Nepal only three species (Hanuman Langur, Rhesus and Assamese Monkeys) are recorded with their subspecies and densities as a whole is unavailable. Assamese monkeys of Nepal exists in two subspecies (*M. a. assamensis* and *M. a. pelps*) exist in Nepal. Out of eight species of Langurs in South Asia, Nepal hosts clearly three species with *Semnopithecus entellus hector* (Lesser Hill Langur) as critically Endangered *S. e. ajax* (Western Himalaya Grey Langur) as Endangered and *S. e. schistaceus* (Central Himalaya Langur or Nepal Grey Langur) as Near threatened. Rhesus Monkey (*Macaca mulata*) is abundant and possesses larger area distribution in Nepal (Chalise, 2005) and found in Chitwan. Two monkeys found the study area and responsible for the crop depredation are *S. e. schistaceus* and *Macaca mulata*. By and large, lungurs are not usually dependent on agricultural land for their survival. Rhesus distribution in rural areas, however, mostly occurs in the forest-farmland fringe areas. Farmers may suffer (or perceive) economic loss and inconvenience due to the monkeys' frequent forays into

agricultural fields. As a result, man-monkey conflicts are increasing among the private farmland owners living in fringe forest areas. Sahoo and Mohnot (2005) reported that crop damage by these two monkeys has been a matter of serious concern among farmers in rural areas of Himanchal Pradesh.

Despite the mammals, passerine birds responsible for raiding the crops in the area are Rose-ringed parakeet (*Psittacula krameri*), Large parakeet (*P. eupatria*), Rose-breasted parakeet (*P. alexandri*) and Blossom-headed parakeet (*P. cyanocephala*).

2.6 GEOLOGY AND SOIL

Geologically, Barandabhar forest along with CNP is a part of plain and low-lying area of Narayani River system. Its alluvial deposits are mainly composed of thin fine sand, silt and clay which frequently alternate in different proportions (Ohta and Akiba, 1973). The nutrient content in the soil varies greatly, depending upon the time of sedimentation and the establishment of vegetation on it in subsequent years. The Park and Barandabhar forest area is composed of late tertiary Siwalik formation composed of sand stones, conglomerates, quarzites, shales and miccaceous sand stone (HMGN, 1968 and Hagen, 1969 cited in Prasai, 1989). The alluvial plains adjacent to the Rapti, Reu and Narayani Rivers consist of recent deposits of deep, sandy loam. Sandy loams or loams mixed with eroded gravels and dark in colour occur on the higher slopes. Different types of soil viz. sandy, sandy loam, loam, sandy clay loam and clay loam (Pradhan et. al., 1967) are:

SANDY SOIL: The colour of the sandy soil varies from grey-brown to dark grey-brown. The soil is moderately alkaline with the average PH of 8.1. Its nutrient status is low with respect to all the major nutrients, viz. nitrogen, phosphorus, potassium and organic matter.

SANDY LOAM: The colour of the sandy-loam varies from dark grey-brown to light olive. Its PH varies from slightly acidic to moderately alkaline (5.2 to 7.75). The nutrient status is low with respect to nitrogen, and low to medium in phosphorus, potassium and organic matter.

LOAM: The colour of loam found in this region varies from grey-brown to dark olive and its PH ranges between 5.8 to 7.9. The fertility status of the soil varies from low in terms of phosphorus content, medium in potash, low to medium in nitrogen and low to high in organic matter.

SANDY CLAY LOAM AND CLAY LOAM: The soil is dark grey-brown to olive in colour. P^H varies from slightly acidic to slightly alkaline (5.35 to 7.25). The soil is moderately to highly fertile. However, nutrient status is low in terms of phosphorus content medium in potash, low to medium in nitrogen and medium to high in organic matter content.

2.7 FARMING SYSTEM

Paddy, wheat and maize are the major crops in the study area. Non cereal crops such as legumes (mainly mustard), oil seeds, potato, sugarcane and vegetables are also cultivated by most of the households but in low proportions. Kitchen garden plants like potato, tomato, cauliflower, onion, garlic etc. are also grown in their vegetable garden. Vegetable farming is one of the major cash crops in the area. They sell their surplus food grains nearby market Tandi and Bharatpur bazaars.

The cropping pattern in the area consists mostly of either sequential and/or mixed cropping. Sequential cropping or the cropping cycle depends upon the quality of land, irrigation facilities, ability of the farm holders to invest in inputs, credit facilities and extension services. However, in general, the cropping cycle in this area is paddy-wheat-fallow; paddy-oilseeds-lentil; paddy-potato-maize and paddy-fallow-wheat.

Paddy is generally planted in late June to mid-August and harvested in December, and after then wheat and oilseeds are sown in irrigated and non-irrigated land respectively. In the lowlands, a local variety of rice called “Barkhe Dhan,” which has a short life cycle is usually planted in late May and harvested in late August. Such fields are then used to cultivate paddy, wheat, potato or vegetables. The growing season for different crops in the study area is given in table.

Table 2: Showing the Season and Crops cultivated around the Barandabhar Forest.

Season	Crops
Summer (June-August)	Paddy, maize, vegetables, black gram
Autumn (Sept.-November)	Paddy, maize, vegetables
Winter (Dec.- Feb.)	Wheat, lentils, vegetables, maize, mustard and other oil seeds, buck wheat, barley, linseeds
Spring (March-May)	Paddy, maize, vegetables

3. LITERATURE REVIEW

Since the establishment of National Parks and Reserves, conflict has been observed between local people and park. Crop loss by wildlife is a common thing in the adjoining village of park and reserve whereas human activities also exert pressure to the park and reserve. So many protected areas of the country are in crisis due to the expanding human activities and sometimes wild animals also interfere in the crop fields. The management of the protected areas requires people's participation for its sustainability (Upreti, 1995).

The establishment of park and reserve, without provisions to stabilize the cattle population and or to provide fodder and grazing facilities, and to resolve the worsening firewood situation further initiated in incipient conflicts between the park management and the people. As more forest and grassland outside the park were lost such conflicts become more pronounced (Sharma, 1990).

"Forest management should be people oriented and should endeavor to cater to the needs of the rural society" (Desai, 1984). As mentioned, park authority should make effort in presenting the forest as well as understanding the problem of people associated with the park. "Until the rural people are ensured adequate food and shelter and a dignified standard of living, all efforts established and managed by national parks and protected areas will be futile" (Train, 1993). According to him, to stop conflict between the national park/reserve management and local people, as well managed buffer zone around the protected area must be developed. The buffer zone concept has been widely accepted in protected area management in many countries of the world. People's participation in the management of park, mainly on multiple use areas has apparently been applied quite successfully in African countries (Berkmuller and Mukherjee, 1989). "The long term stability of parks in developing countries can be assured it some measurable benefits flow out of the park to the region." (Machils and Ticknell, 1985; Sharma, 1989).

Wildlife management necessitates practices to regulate the abundance of wildlife so that it is beneficial and not harmful to human's interests" (Smith, 1971). Wildlife management policies should also cover providing wildlife education to people. "The old concept of shielding parks from outside wildlife human influences make a large gap between the park and the local people" (McNeely, 1984).

Many researchers, so far, have carried out the several investigations associated with the park and people conflict. Mishra (1971) studied the crop damage by wild elephant in Palamau District, Bihar. He suggested that at least 50% of the value of the damaged crops should be paid as compensation and the rest for the damaged field waived to maintain the brighter future of the elephant in Palamau. Sahoo and Mohnot (2005) reported 30% of total income from selling of the cash crops (average

perceived loss was 5% of the gross annual yield of the cash crops) loss by rhesus monkeys and hanuman langur in Himanchal Pardesh of India. They recommend further studies to identify the areas where crop damage is heaviest and the farmers' perceived estimates of loss.

Milton and Binney (1980), who gave a report on resolving resource conflicts between conservation and agricultural land use in Padampur VDC, discovered that crop loss inflicted by wildlife is the main problem of the inhabitants of the area adjoining the park. His study in Chitwan identifies three zones of crop damage by wildlife. The zone of highest damage suffers from 50% to 100% loss. A larger number of people from such zones either wish to resettle or are deeply concerned that His Majesty's Government takes other effective actions such as fencing or loss compensation.

Upreti (1995) reported crop damage as a cause of conflict. He found that rhino (*Rhinoceros unicornis*) as a major crop raider to wheat and paddy, the Chital (*Axis axis*) on paddy and maize, the wild boar (*Sus scrofa*) raid on potato and the parakeet (*Psittacula sps.*) raid on harvestable maize in CNP.

Jnawali (1989) studied the case of human harassment and crop damage by greater one horned rhinoceros (*Rhinoceros unicornis*) in Sauraha, adjacent to CNP. The economic loss was reported NRs. 1,72,000 of which 68.6% occurred within a distance of 500m. Highest economic loss 27.6% occurred to rice.

Sharma (1991) identified crop and livestock depredation as a cause of conflict in CNP. In 1991, he calculated crop damage by two methods; interview and Net Area Damage (NAD). He found real crop damage was five times less by NAD method than Interview. He also reported that paddy is severely damaged followed by wheat, corn, oil seeds, lentils and vegetables and miscellaneous.

Khatri (1993) reported crop damage by Nilgai (*Boselaphus tragocamelus*) averaged 8.3% of the total crop loss caused by wild animals in Royal Bardiya National Park. Nepal and Weber (1993) found rhinoceros (*Rhinoceros unicornis*), chital (*Axis axis*) and wild boar (*Sus scrofa*) as principal crop raider in CNP. They calculated rhino, wild boar and chital destroyed 60%, 27% and 12.9% of total crop damage, respectively.

Sharma (1995) and Baral (1998) reported that wild buffalo (*Bubalus bubalis*) and wild boar (*Sus scrofa*) are important crop raiders in KTWR. Shrestha (1994) and Upreti (1995) identified park regulation, crop damage, livestock depredation and loss of human life as sources of conflict in CNP. They also identified rhino (*Rhinoceros unicornis*) as principal crop raider in CNP.
Poudyal (1995) conducted a study in Shivapuri Watershed and Wildlife Reserve; designated as Shivapuri National Park (SNP) in 2004; and calculated on average that each affected households

lost approximately NRs. 3132 annually due to crop loss by wild animals in the area.

Kasu (1996) identified two types of problems concerning in Parsa Wildlife Reserve (PWR) that are (a) Problems created due to reserve and (b) Problems created due to local people. He reported that Wild elephant, wild boar (*Sus scrofa*) and chital are the major pest animals. He reported paddy damage was 77.52% followed by wheat and maize. The average economic loss of each household due to crop damage by wild animals was NRs.3,191.48.

Baral (1999) studied wild boar–man interaction in BNP estimated a heavy economic loss of NRs. 20,95,346 of which 52.73% occurred in Thakurdwara and 47.27% in Shivapura. Highest economic loss (28.32%) occurred to paddy crop, followed by potato (15.40%) maize (15.21%) wheat (13.80%), musuro (12.42%) and yam (7.57%).

Gautam (1999) studied crop damage by wild animals in proposed buffer zone of Royal Suklaphanta Wildlife Reserve; recently renamed as Suklaphanta Wildlife Reserve (SWR). He found highest economic loss 74.28% was estimated to paddy crop followed by wheat (17.08%) and maize (8.62%). Among the wild animals, highest economic loss 43.29% was estimated by wild elephant, followed by wild boar (28.67%), Chital (24.09%) and blue bull (3.92%). The reported loss of crop to wild animals ranged from 61.62 kg to 126.33 kg per household.

Nepal and Weber (1993) studied on the park people conflict in CNP and its adjoining areas. They found that there were five different types of park people conflicts namely, illegal extractions of park resources by people, livestock grazing, hunting and fishing, crop raiding by wild animals and loss of human life due to wild animals. Crop damage is the most serious problem. The worst culprit is rhinoceros, other being boars and deer. Milton and Binney (1980) identified three zones of crop damage by wildlife in Chitwan. The zone of highest damage suffers from 50% to 100% loss.

Adhikari (2000) reported highest crop damage (27.34%) occurred within the area of 1 km followed by the area within 1 to 2.5 km (30-28%) and area farther than 2.5 km (27.34%). Like wise, Laure (1978) found greatest damage occurred within 750 m from the forest. Crop damage by spotted deer and wild boars was most frequent. Crop damage, depredation of livestock, human toll, and difficulties and resentment arising from park regulation are the four basic causes of park-people conflicts, given by Mishra (1980).

Shrestha (1994) studied on park and people conflict in four adjacent villages Bodreni, Baghmara, Sauraha and Padampur of CNP and found that crop damage and harassment was due to park animals. Shrestha (1994) in CNP found Bodreni as the most affected areas with annual loss of 38.5% in its total production. The loss was 50.88% for maize, 25.5% for paddy and 6.6% for mustard, respectively. Where as, total crop loss for Sauraha and Baghmara were 11.53% and 13.98% respectively.

Scholars like Sharma (1991), Upreti (1990), Schultrz (1986), Bahuguna (1986), Shrestha (1997), Fearnsside and Drew (1984) also reported that crop damage was most severe problem in the areas adjacent to the protected areas. Jnawali (1989) reported heavy crop damage of worth of NRs. 172,500 in Sauraha for the year 1988-89. Among the crops, rhinoceros (*Rhinoceros unicornis*) mostly preferred rice, mustard, maize, lentils and vegetables. Highest (27.6%) paddy loss was occurred within a distance of 500m of the park. Jnawali's study (1989) revealed the crop damage by rhinos in Sauraha area.

Bhattarai (2003) reported regular wildlife interferences in 23.7 ha crop field with total value of NRs. 1,167.09 for each household in the eastern part of BCF. Some farmers had lost their total crops. He further reported highest damage of paddy by rhinoceros and chital (33.64%). In eastern side of Barandabhar Corridor Forest, all the respondents reported about regular wildlife interferences in their crop field.

Some of the respondents lost their total crops were grazed by ungulates, mostly rhinoceros. More damage occurred in paddy field showing that paddy was the most preferred crop by ungulates, among which 33.64% damage was caused by rhinoceros and chital. The lowest damage was caused by barking deer. His study further showed that there was 23.7 hectare crop field damaged by wild ungulates, which lost a total value of Rs. 1167.09 per household.

Few other studies on crop damage problems carried out so far in the adjoining areas of CNP and BCF reveal that New Padampur, Gadhuwa, Ratnanagar Municipality (ward numbers 10, 5, 6), Bagmara, Malpur and Bothreni in the east and Patihani and Gitanagr VDCs in the west of BCF are regularly affected areas. Likewise, rhinoceros, wild boar are major crop raiding animals.

4. METHODOLOGY

4.1 RECONNAISSANCE OF THE SITES

The site was visited to have background knowledge of the problem in early March, 2004. It came to know that wild animals affect socio-economic activities of human living nearby the BCF. Among the wild animals rhino and wild boar (*Sus scrofa*) usually visit crop field and cause severe damage to agriculture crops. But their visit along with other wild animals to the crop field varies with the area and the season. For instance wild boar (*Sus scrofa*) visits crop field seasonally (in maize season) mainly more in eastern part of the forest. These two animals are frequent crop raiders and damage large amount of crop. Other crop raiders are parakeets, mongoose and spotted deer etc.

4.2 DATA COLLECTION

This study is entirely based on the both primary and secondary data. The primary data includes information collected from the study area. The different questionnaire (both structured and unstructured) to the local people (the farmers), agriculture type, economic condition, resource conservation, attitude and impact of wildlife was prepared and collected the information visiting the houses selected randomly. Other questionnaire was related with the Park / CNP-Buffer Zone Council officers, junior staffs and community leaders.

Secondary data include records and reports from the different sources and office on different aspect of the study. Maps and photographs are included in the study. Other sources are articles, books and dissertation works on related topics. Some information was such as village headman, local leaders and park authority.

4.3. HOUSEHOLD SURVEY

4.3.1. PRE-FORMAL QUESTIONNAIRE SURVEY

Household questionnaire was developed in Nepali language in order to have necessary correction and greater coverage of data and information so as to incorporate the issues and parameters regarding the crop damage and the causes and consequences of wildlife-people conflict. After the questionnaire-testing phase at the household level, discussion with the key personnel involved in the conservation activities and a pilot survey at the field level, necessary correction was made.

4.3.1.2 SURVEY DESIGN

Households located at one km distance from the forest boarder were interviewed. They were from five VDCs named Bachhauli, Gitanagar, Patihani, Jutpani and Padampur (New), and 2 Municipalities: Ratnanagar (Ward Number 5, 6, 7, 8 and 10), Bharatpur (Ward Number 8, 9, 11 and 12). All the wards of either of the VDC or of the municipality were selected randomly and considered for the study in order to assess the extent of crop damage in the adjoining area irrespective to their political location. Households were selected randomly, with out replacement basis, for the questionnaire survey. A total of 441 households were chosen for the assessment of crop damage by household questionnaire method. All the households within the study area around BCF, considered as the population size for each population, was determined by summing up all the number of households recorded area and applying the equation as:

$$n = \frac{NZ2\ p\ (1\text{-}p)}{Nd2 + Z2\ p\ (1\text{-}p)}$$

Where,
n= sample size; N= total number of households;
p=estimated proportion of the population (0.85);
Z=confidence level (95% level Z=1.96)
d=error limit of 5% (0.05)

4.3.1.3 FIELD SURVEY

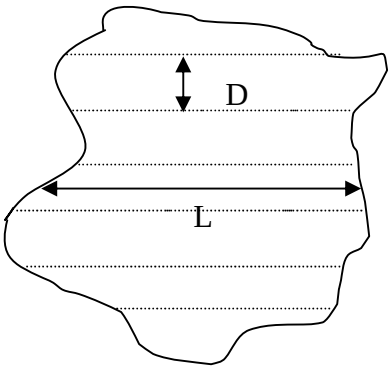
The field survey was initiated from April 2004 to Jun 2005 so as to cover all four seasons. The cultivated lands with the human households with in 0.5 km distance from the forest border was divided into two broad sections as Eastern Section (ES) and Western Section (WS) which lie in east Chitwan and west Chitwan, respectively. Each section was divided into two broad study zones (Zone I and Zone II from ES, and Zone III and Zone IV from WS on the basis of location form Mahendra Highway called East West Mahendra Highway, hereafter referred as Mahendra Highway). 'Zone I' (Baghmara, Sauraha, Chitrasen, and Parasa villages) lies to the north from the Mahendra Highway. Whereas, 'Zone II' (11 and 12 wards of Ratnanagar Municipality and Padampur and Jutpani VDCs) lies to the south. Like wise, 'Zone III' (Bhojad, Naurange, and Godrang villages of Bhatarpur Municipality) lies to the south from EWMHW. Whereas 'Zone IV' (Gaurigunj and Debnagar villages of Bharatpur Municipality and Patihani VDc) lies to the north. The field survey was carried out by using binoculars, camera, measuring tape, questionnaires and field data sheets. A total of 20 days' (10 days' questionnaire and 10 days' field survey) study was conducted in each season.

Sample survey was used to collect sociological and economic information at the household level with the respondents through survey-based personal interview schedule, and focus group discussion. Priority for the interview was given to the experienced household owners/farmers and higher age rank. At the end of household survey and field study, group discussion with local people and the representatives of the wards of respective zone, and local institutions involved in conservation field

was done. Additional sheets were also provided to the social workers/clubs to collect the data even during the gap period of two successive field surveys. Questionnaire forms were distributed to the hotel owners, naturalists, park authorities and army officers to assess the effectiveness of different methods used locally to remedy crop damage. Data collection method was adopted to gather socio-economic and biophysical data. PRA method was employed to depict and understand the pattern of historical changes, their spatial distribution, and major impacts thereof.

Crop damage by wildlife was assessed within a distance of 500 m from the forest boundary in each zone. Extent of damage in mustard, lentil, maize, and vegetables field was taken by interviewing the local people as well as the visits of damage field. In case of rice and wheat, it was done by NAD method (Jnawali, 1989). Damaged plots was outlined and marked with ropes and then was subdivided into parallel transects by ropes and pegs. Damaged area was estimated by using formula;

$A = \sum L \times D$



Where,
A = Area of damaged plot
L = Length of transects
D = Distance between transects

4.3.1.4 ANALYTICAL METHOD

The study is mainly based on descriptive statistics. However, in certain cases, multivariate analysis is also employed in order to examine the association of the factors such as conservation attitudes, willingness to share management responsibility, frequency of visit to the CNP/BCF and volume of crop loss by different wild animals with several socio-economic variables, for example, and household economic status, level of education, age, or employment. Data were stored in SPSS and MS Excel sheets and were analyzed.

Analysis based on statistics such as weighted mean index and point-scale index indicate a definite trend and, thus, provide a clear understanding of the issue. The weighted mean index method is used to examine the preference given to various items by the respondents.

Various weights are assigned accordingly to the rank given by the respondents, and a weighted index is computed by multiplying the rank and weight. Finally a weighted mean index has been calculated for each item which shows various levels of the preference. Higher weights are assigned

to higher ranks. The following equation is used in calculating the overall rank:

$$WI = \sum_{I-1}^{n} Ri\ Wi / F$$

Where, WI = weighted mean index;

Ri = rank of the i^{th} order;

Wi = weight of the i^{th} order;

This method is used in analyzing the household responses regarding the CNP/BCF, suggested criteria for buffer zone development, legal benefits desire from the CNP/BCF, opinion on resolving conflicts, people's perception of CNP/BCF priorities and possible ways to check damage of crops. The point–scale method is used to analyze the conservation attitudes of the respondents who were asked to agree or disagree with prepared statement.

The collected data is quantitatively analyzed by:

1) Correlation analysis to find out the correlation between two variables that is distance and loss

$$r = \frac{\sum xy - \bar{x}\sum y}{\sqrt{(\sum x^2 - \bar{x}\sum x)\,(\sum y^2 - \bar{y}\sum y)}}$$

Where,

x = distance from the boundary of forest edge

y = total loss of crops per unit area

2) Regression analysis to estimate the her. Here x variable is distance and y variable is loss.

To find out the extent of damage in the different areas, the regression equation is symbolically expressed as,

$y = a + bx$ and $a = y - bx$

Where, $\bar{x} = \frac{\sum x}{N}$, $\bar{y} = \frac{\sum y}{n}$, $b = \frac{n\sum xy - \sum x.\sum y}{n\sum x2 - (\sum x)2}$

$\bar{x}$ = assuming mean distance,

$\bar{y}$ = average loss (mean of the losses),

x = standard deviation of distance, x series, and

y = standard deviation of losses, y series.

3) Mean crop loss per household is calculated as,

Mean crop loss = Total crop loss (in kg) divided by total number of households surveyed

By multiplying mean crop loss and total household of the village, the total crop loss of the village is calculated. Local prices of damage crops were known from the local market.

Total economic loss of the village = price of crop (per kg) x total crop loss of the village

4) Loss coefficient to find out the loss per unit land by the causes of wild animals attack in each crop i.e. maize, paddy, wheat, mustard and lentil was calculated by the expression as given by Elehance (1972):

$$X = \frac{Xe - Xa}{RL}$$

Where, x = loss per unit land; XL = total loss

Xe = expected yield before crop loss

XL = Xe – Xa Xa = actual value (field after crop depredation)

RL = total cropping land of that field

This XL is difference between expected and actual production of different crops.

$$\text{Frequency} = \frac{\text{Number of individuals of a species}}{\text{Total number of all individuals of all species}} \times 100$$

$$\text{Relative Frequency} = \frac{\text{Frequency of a particular species}}{\text{Total frequency of all the species}} \times 100$$

5. RESULT

5.1 SOCIO-ECONOMIC CHARACTERISTICS & ANALYSIS OF STUDY AREA

5.1.1 LAND COMPOSITION AND OCCUPATION

Agriculture is the main occupation (81.6%) for the subsistence livelihood of the people living in the adjoining areas of BCF. Major occupations of the local people are office job, labour and business. Occupation of the respondents is shown in table 7. To determine land composition questions were asked to 441 households for five VDCs and two municipalities, 121 households from Zone I, 101 households from Zone II, 108 households from Zone III and 111 households from Zone IV (table 3). Whereas, the number of samples for NAD were 340; 220, 150 and 350 respectively (table 4). On the basis of location from Mahendra Highway, 27.9%, 22.4%, 24.5% and 25.2% sample were from Zone I, Zone II, Zone III and Zone IV respectively (fig. 2). Greatest number of responses was collected from Bharatpur (120) followed by Ratnanagar (102), Padampur (68), Gitanagar (54), Bachhauli (50), Patihani (45) and Jutpani (2) as shown in table 5.

According to their response, there were 8.16%, 11.56%, 24.49%, 19.73%, 25.62%, 7.48%, 1.81% and 1.13% households with land below 1 Kattha, 5 Kattha, 10 Kattha, 1 Bigha, 2 Bigha, 2-4 Bigha, 5-6 Bigha and above 6 Bigha respectively. The highest response recorded at 0-1 Bigha (64%) and the lowest at above five Bigha (2.95%). Per household average landholding capacity is 19.84 Kattha. See table 6.

Table 3: Distribution of VDCs and municipalities with their villages/toles, beneficiaries, as per the division of study zones.

S. N.	Beneficiaries (Village/Tole)	VDC/Municipality and Ward(s)	Location	Study Zones
1.	Bodreni	Bachhauli VDC, 1	East South	**Zone I** (Buffer Zone)
2.	Baghmara and Malpur	Bachhauli VDC, 3		
3.	Baghmara	Ratnanagar, 6		
4.	Lal Parasa	Ratnanagar, 5		
5.	Kaparkhori and Tikauli	Ratnanagar, 7		
6.	Panchakanya and Mangalpur	Ratnanagar, 8	East North	**Zone II**
7.	Jirauna, Salghari	Ratnanagar, 11		
8.	Lankaline	Jutpani VDC, 9		
9.	Padampur	Padampur VDC, 1-9		
10.	Chisapani, Kalika, Kamladevi, Naurange	Bharatpur, 11 and 12	West North	**Zone III**
11.	Godrang	Bharatpur, 12	West South	**Zone IV** (Buffer Zone)
12.	Devnagar, Ujwalnagar	Gitanagar, 4 and 5		
13.	Patihani, Barmapuri	Patihani, 5 and 7		

Table 4: Sample Size for NAD and GAD methods in different study zones and location.

Method	Sample Size in Different Study Zones				Total		
	Zone I	Zone II	Zone III	Zone IV	East BCF	West BCF	Whole BCF
NAD	340	230	150	350	570	500	1070
GAD	121	101	108	111	222	219	441
Total	461	330	258	461	792	719	1511

Fig. 2: Division/location of study zones from Mahendra Highway and forest.

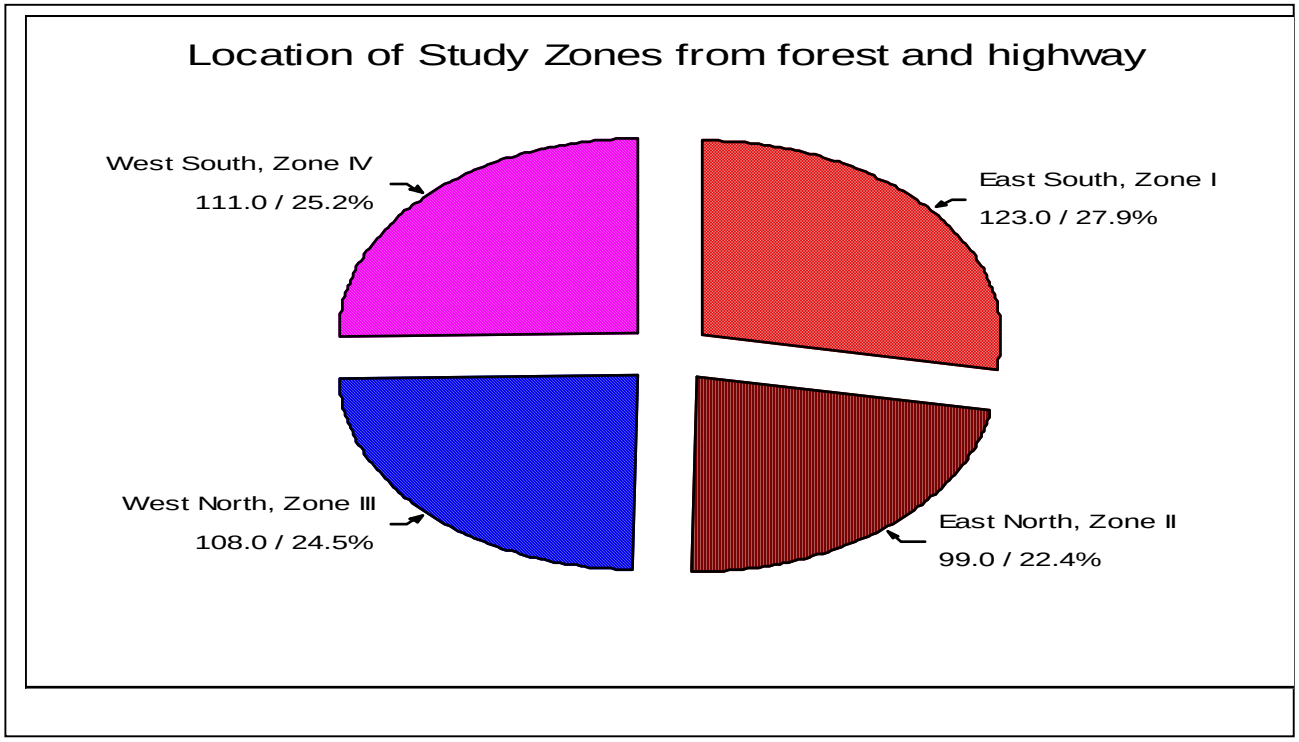


Table 5: Number of respondents considered for questionnaire from different VDCs and Municipalities.

S. N.	VDC/Municipality	Frequency	Percent	Cumulative Percent
1.	Bachhauli	50	11.3	11.3
2.	Gitanagar	54	12.2	23.6
3.	Patihani	45	10.2	33.8
4.	Jutpani	2	0.5	34.2
5.	Padampur	68	15.4	49.7
6.	Bharatpur	120	27.2	76.9
7.	Ratnanagar	102	23.1	100
	Total	441	100	

Fig. 3: Distribution of Respondents in different VDCs and Municipalities.

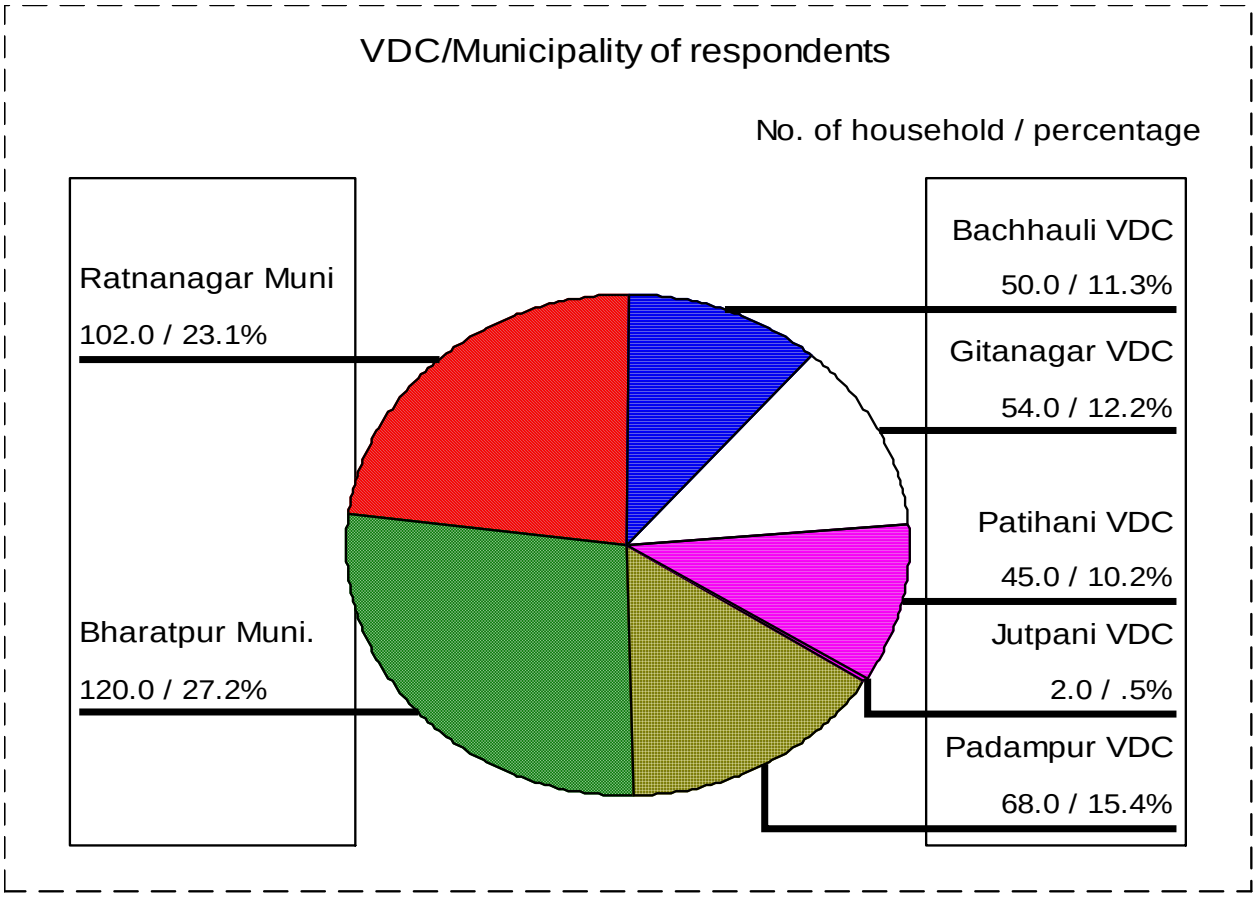


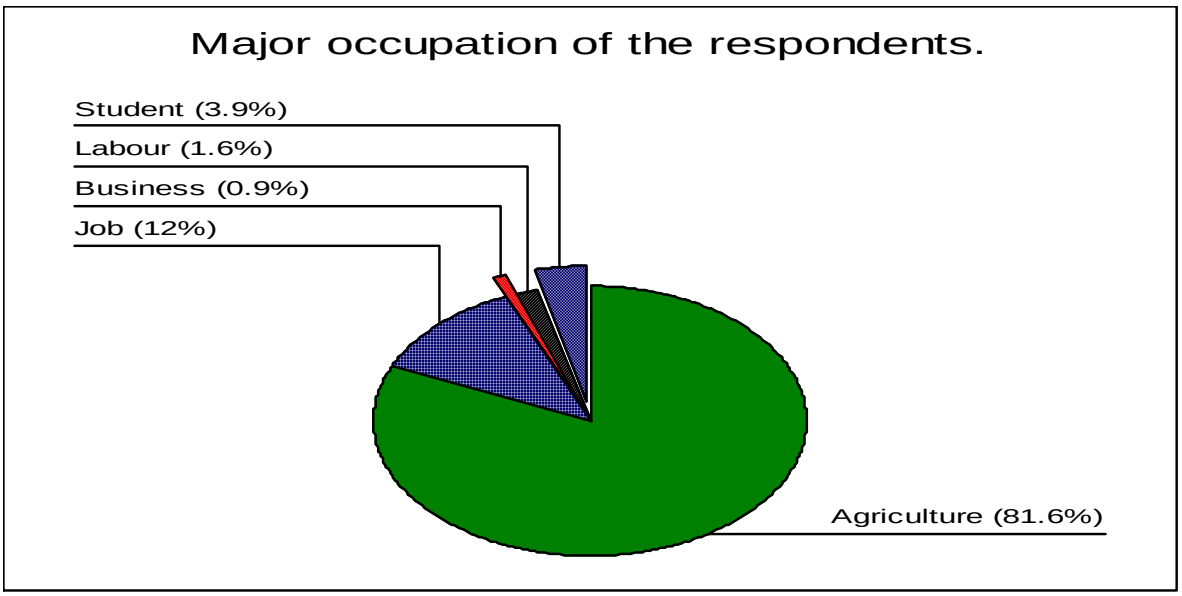
Table 6: Land composition of the respondents. (Total land = 437.61 Bigha, Mean = 0.9923 Bigha and N = 441)

Area of field	No. of response	Percentage	Cumulative percentage
<1 Kattha	36	8.16	8.16
<5 Kattha	51	11.56	19.73
<10 Kattha	108	24.49	44.22
<1 Bigha	87	19.73	63.95
<2 Bigha	113	25.62	89.57
2-4 Bigha	33	7.48	97.05
5-6 Bigha	8	1.81	98.87
>6 Bigha	5	1.13	100.00
Total	441	100	

Table 7: Major occupation of the respondents. (N = 441)

S. N.	Occupation	Frequency	Percent	Valid Percent	Cumulative Percent
1.	Agriculture	360	81.6	81.6	81.6
2.	Job	53	12.0	12.0	93.7
3.	Business	4	0.9	0.9	94.6
4.	Labour	7	1.6	1.6	96.1
5.	Student	17	3.9	3.9	100.0

Fig. 4: Population composition based on occupation. (N = 441)



As indicated above, majority of the people are having subsistence farming for their livelihood.

5.1.2 POPULATION COMPOSITION AND CASTE/ETHNICITY

Of total 70,000 beneficiaries estimated to be incorporated in 14162 FUGs around the Barandabhar Forest Corridor from 0 m to few km distances from the forest boarder, 441 households were selected randomly for questionnaire to know the attitude and impacts on/of forest, and estimate the crop loss due to wild animals within 1 km distance from the forest. Of those, Brahimin and Chhetri comprised 58.5% and DAG consisted of 41.5% population of total population. Of the DAG population Tharu, the indigenous people alone occupied 10.2% population of total population. Likewise, of the total DAG population; Tharu, Dalit (Kami and Damai), Lama, Gurung, Newar, Kumal, Darai, Magar and Rai occupied 24.59%, 12.02%, 21.31%, 16.39, 13.11, 4.92%, 4.37%, 2.73%, and 0.55% population respectively.

Fig. 5: Ethnic composition of the study area based on present study. (N=441)

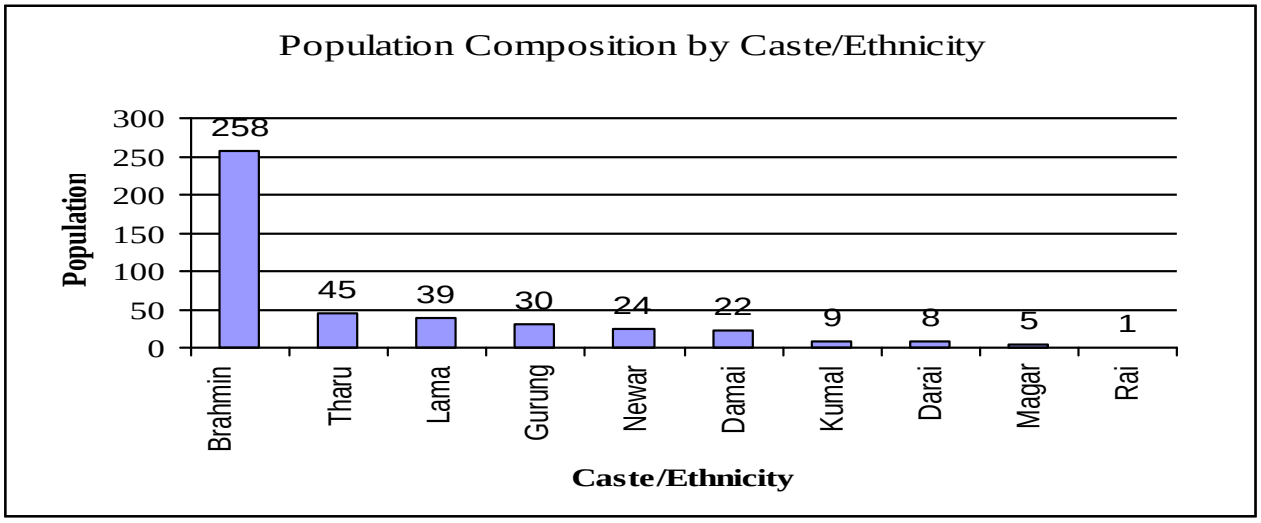
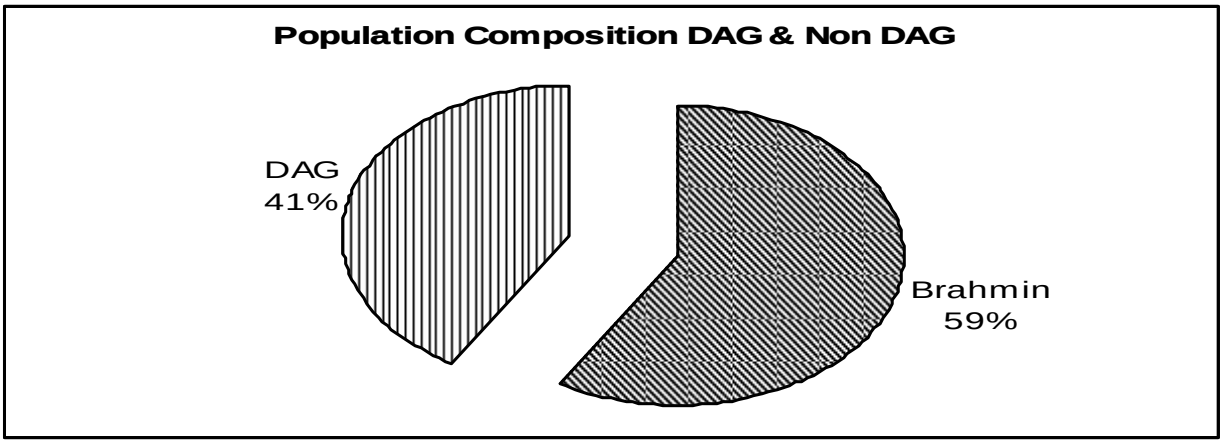


Fig. 6: population composition by DAG and Non DAG. (N = 441)



Note: Caste/ethnic groups categorized as DAG in this study are Tharu, Lama, Gurung, Newar, Damai, Kami, Kumal, Darai, Magar and Rai; Non DAG means Brahmin and Chhetri.

Fig.7: Composition of total DAG population by ethnic groups. (N = 183)

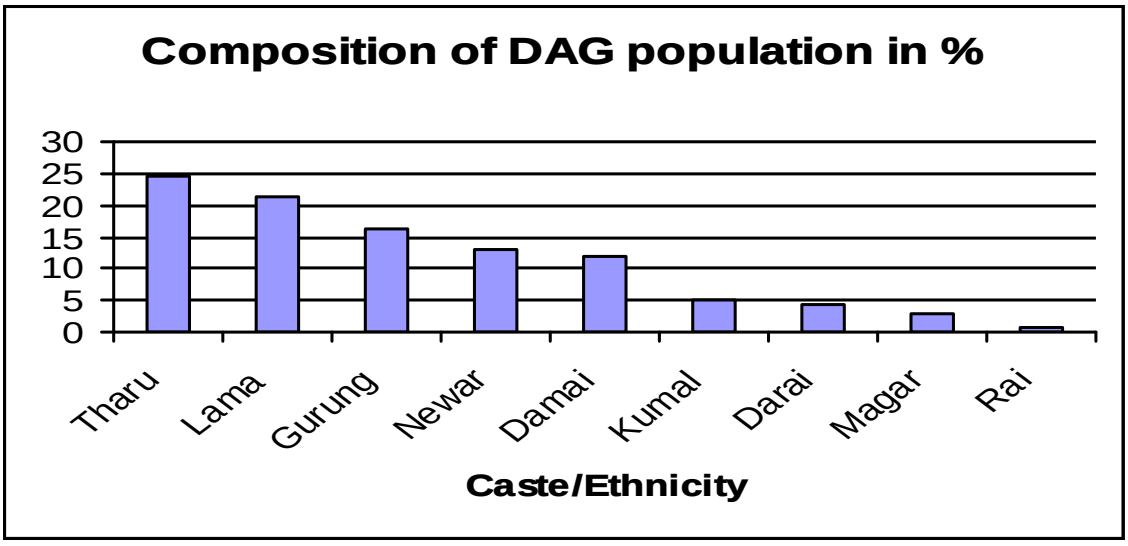
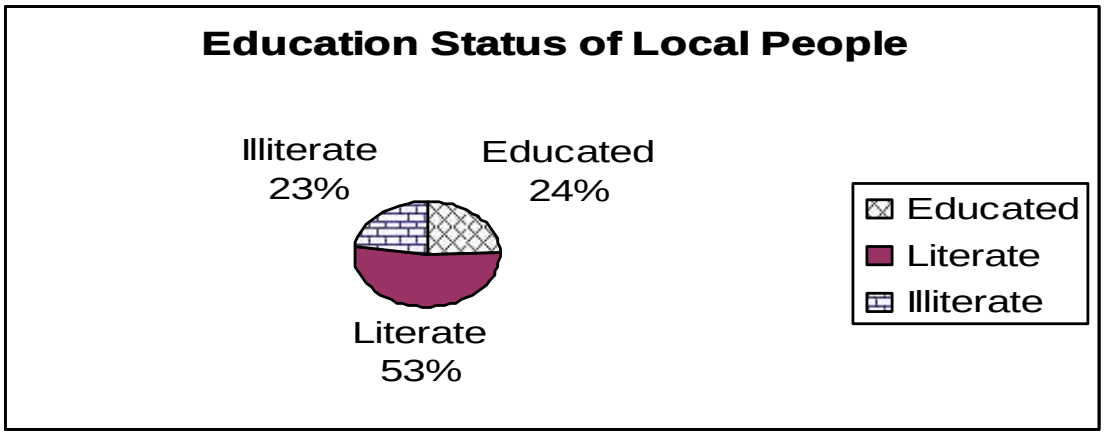
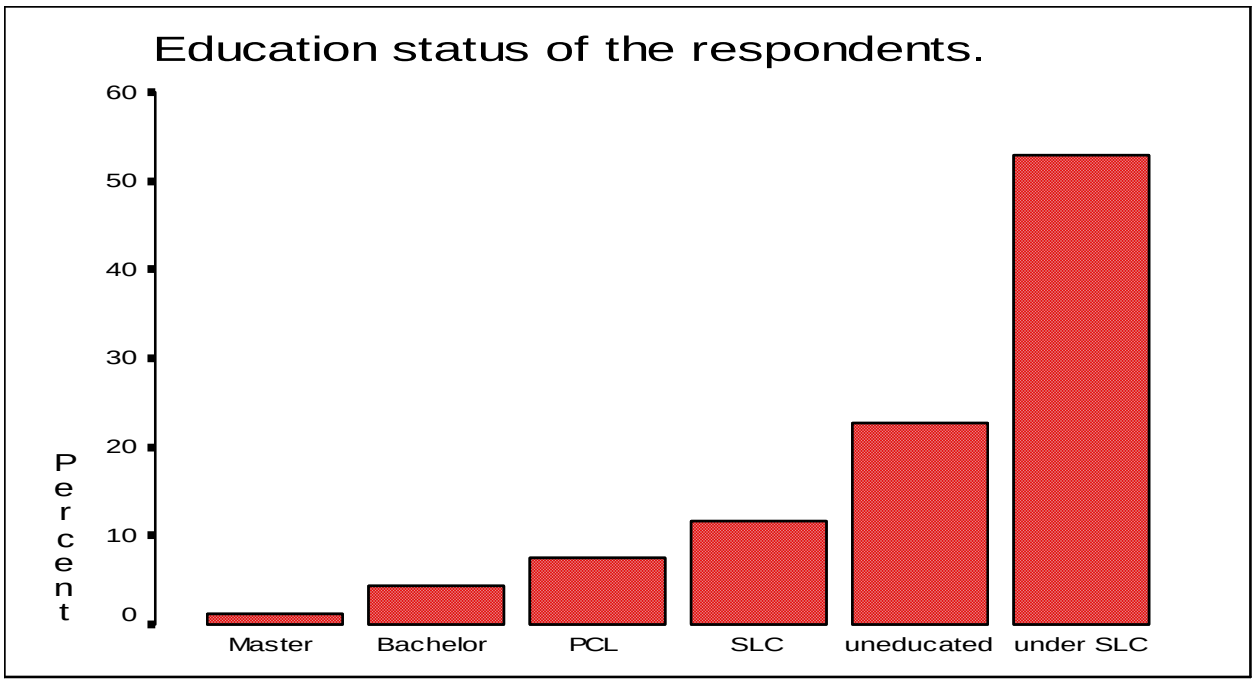


Fig. 8: Literacy composition of local people (in Percentage). (N = 441)



Note: Literate means people under S. L. C. but can read and write well.

Fig. 9: Population Composition of Local People (in Percentage) by grade.



5.1.2 IMPACT OF BARANDABHAR CORRIDOR FOREST ON LOCAL PEOPLE

BCF provides an ideal habitat for wild mega fauna especially for large mammalian and migratory species. Though the present population status of these megafauna within the CNP and the BCF is not known, and has not been considered under the scope of this study, the findings on the extent of crop damage around the BCF and their mobility along the adjoining crop fields are attributed to both the residential individuals and the individuals of CNP that either migrate/move or share the BCF-habitat.

According to Bhattarai (2003), the number and density of ungulates inside the buffer zone of the corridor (forest patch between Mahendra Highway and the northern boundary, the Rapti, of CNP) was higher than outside it. It might be due to the successful community forest programs (e.g., Baghmara Buffer Zone Community Forest and Chitrasen Buffer Zone Community Forest (CBZCF) which rank the most successful community forests in the area, and primarily occupy larger portion of the forest) and reduced livestock and human pressure.

But this doesn't attribute to the crop depredation as there is increasing mobility of the wild animals into the adjoining areas in recent years. Since Hog deer (*Axis porcinus*) has not been recorded since September 2002 (Bhattarai, 2003) due to the loss of tall grasses by annual flood and forest fire, the habitat quality and vegetation are also attributed to the increasing crop damage problem in the adjoining areas.

Respondents from all the study zones, except from Zone III, reported the regular wildlife

interferences in their crop fields. Some of the respondents' total crops were grazed by ungulates, mostly paddy by rhinoceros and maize by wild boar. But, only 63% households can sustain their family from agriculture. 4.1% families can hardly sustain their families. Of total 145 households (32.9% of total sampled households) who could not sustain their families from agriculture through out the year, 12.5% households' food crisis (insufficiency of crop production) was attributed to the crop damage by wildlife. Where as, 24.5 % households are under the absolute poverty. It seems that 32.9% population is more prone to be relied on forest resources, and they should be duly considered for IGAs in order to reduce their dependency of forest.

Fig. 10: Response of local people on crop damage by wildlife. (N = 441)

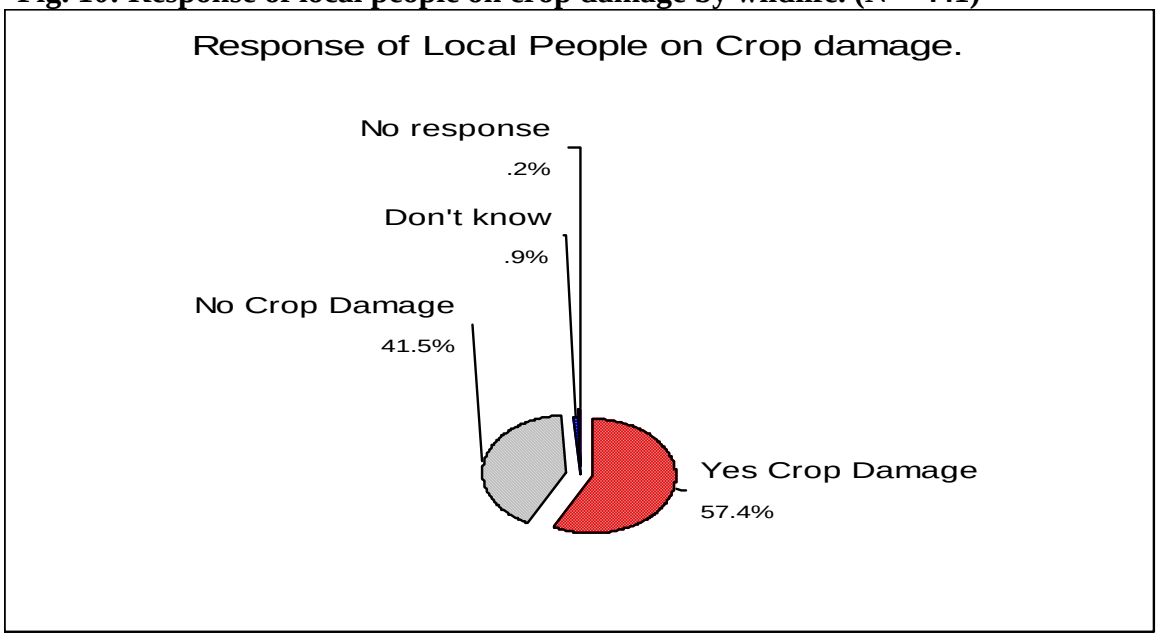


Fig. 11: People's response on type of wildlife harassment in the adjoining areas.

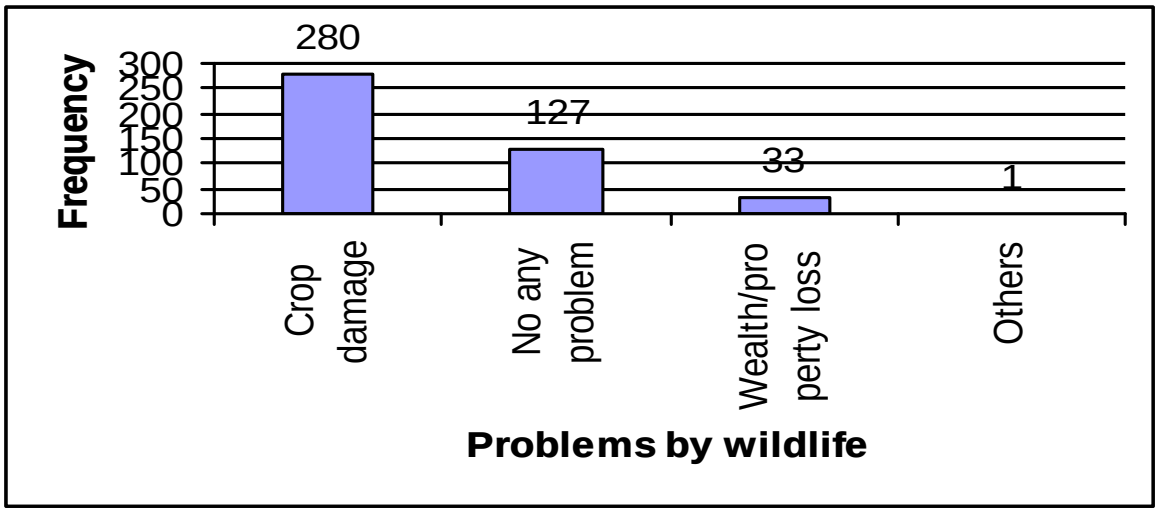
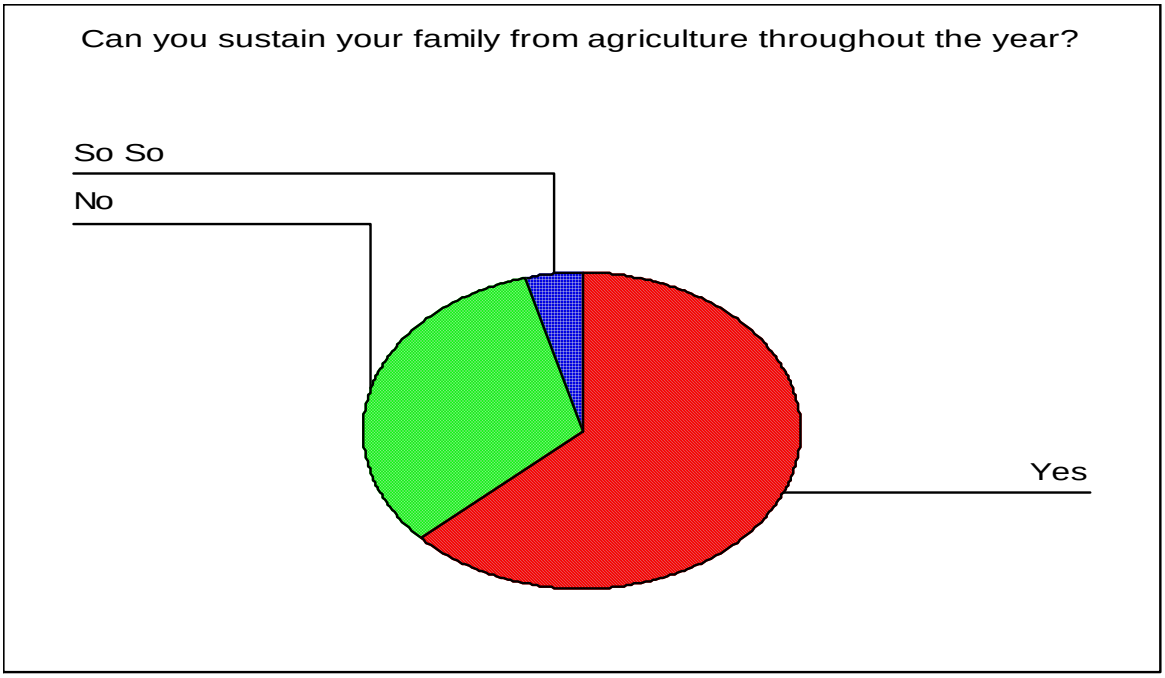


Fig. 12: Food sufficiency and dependency of livelihood on agriculture.



Note: So So means hardly sufficient to feed family from agriculture. (N = 441)

Table 8: Response on: whether the agriculture could sustain their family year around?

S. N.	Response	Frequency	Percent	Valid Percent	Cumulative Percent
1.	Yes	278	63.0	63.0	63.0
2.	No	145	32.9	32.9	95.9
3.	So-So	18	4.1	4.1	100.0
Total		441	100.0	100.0	

Note: So-So means hardly sufficient the agricultural product for family.

Table 9: Frequency and percentage of households suffering from food crisis due to crop damage. (Question: If agriculture can not support your family through out the year, is that because of damage of crops by wildlife?)

S. N.	Response	Frequency	Percent	Valid Percent	Cumulative Percent
1.	*	278	63.0	63.0	63.0
2.	No	108	24.5	24.5	87.5
3.	Yes	55	12.5	12.5	100.0
Total		441	100.0	100.0	

Note: * Households not considerable to the food crisis and crop damage.

5.1.3 TOTAL CULTIVATED LAND AND LANDHOLDING PER FAMILY

Total land owned by 441 households was 437.61 Bigha. Some households were recorded with no land at all and some were with 15 Bigha. Comparatively, minimum landholding capacity was found in Zone III (13.74 Kattha) and maximum average landholding capacity was found to be 23.34 Kattha in Zone IV. It is calculated by dividing total cultivated land by total number of households. Status of land composition is given in table 10.

Table 10: Zone wise distribution of total land and landholding per family.

S. N.	Particulars	Zone I	Zone II	Zone III	Zone IV	Total

1.	Total Land in Bigha	118.87	114.98	74.21	129.56	437.61
2.	No. of Households	121	101	108	111	441
3.	Average Land	0.9824	1.1384	0.6871	1.1672	0.9923

Note: 1 Hectare = 29.5 Kattha and 20 Kattha = 1 Bigha.

5.2 THE MAGNITUDE OF CROP DAMAGE

The estimation of crop damage by Gross Area Damage (GAD) method is liable to some error as it is based on the respondents' estimation (Adhikari, 2000). Since it doesn't correspond to the exact assessment of crop damage by wildlife and thus was not given the priority by some previous investigators like Sharma (1991), Jnawali (1989), Upreti (1995), Baral (1999) and Bhattarai (2003), NAD method was also adopted in order to estimate the actual crop lost by wildlife in this study. Similar studies on crop damage by wild animals of CNP in Gitanagar and Patihani VDCs and around KTWR carried out by Subedi (1998) and Adhikari (2000) respectively were entirely based on GAD method. In addition, GAD method was also adopted in this study in order to compare the results of the both methods and their comparative interpretation. The NAD study has assessed the crop damage by wildlife in the year 2004/2005 (from April 2004 to March 2005), and this method is solely considered to have estimated the actual loss by the wildlife during the study period.

Like wise, crop loss in the previous year was estimated by GAD method through questionnaire. Data thus collected are analysed separately and assessed them comparatively wherever applicable. The proportion of the total loss estimated separately from NAD and GAD to be 1.5 means that crop damage from GAD estimation corresponds to the estimation by NAD method (table 22).

5.2.1 QUANTITY OF CROP LOSS

NAD study showed that there were 54.81 hectares crop field damaged by wild life which lost a total value of NRs. 1774438.46 and NRs. 1658.35 per household (Table 11). Likewise, the average loss per household in east BCF and west BCF are 1951.91 and NRs. 1323.69 respectively. It indicates that there is more crop damage problem in eastern part (total loss of NRs. 1112593.208 for 570 households) than in the western part (total loss of NRs. 661845.26 for 500 households). Similarly, though there is more crop damage problem in buffer zone (Study Zones I and IV) than in non buffer zone (Zones II and III) with average economic loss per household in NRs.1955 and NRs. 1119.22 respectively. Members (users) of community forests of northern BCF, those out of the buffer zone of CNP, fro example people of zone II are willing to be benefited from buffer zone policy. This is due to more crop damage problem (average loss NRs. per household = 1719.89) in the area.

Among the major crops, more damage occurred in paddy field showing that paddy was the most preferred crop (29.45% damage) followed by maize (17.6%), lentil (11.26%), mustard (11.05%)

and wheat (2.78%). Like wise, 27.84% damage occurred for vegetables and others, the minor crops like banana, yam, sweet potato etc. Though the wheat was the most preferred crop by most of the crop pests, there seems the lowest damage caused to wheat (2.78%) because this crop was replaced and not preferential to the farmers as there is almost cent percent probability to be damaged / lost by the wildlife in the area. Farmers are obligated to grow other alternative crop species which are at least not impossible to protect from wildlife.

But, farmers do not have any better alternative crop species than the mustard which also falls on top category of damage by the wild animals after the maize. Thus non palatable crop species, if provided, would be advantageous to them. Similar is the case of potato and even the mustard as well. The regular conflicting-areas were New Padampur (ward numbers 5, 6, 7, 9), Ratnanagar Municipality (ward numbers 10, 5, 6), Baghmara, Malpur and Bodreni in the east and Patihani and Gitanagar VDCs in the west.

The most damage was caused by rhinoceros and wild boar, recorded highest in the eastern part (Zone-I and Zone-II) and western part (Zone IV). Wild boars, which damaged mostly maize and vegetable crops, were causing serious problem in Zone I and Zone IV. It is note able that Bachhauli (especially Bodreni village) VDC in the eastern part and Gitanagar and Patihani VDCs in the west are severely affected areas, since they are commonly shared by wild animals of both BCF and CNP.

Table 11: Monetary values of all crops lost by wildlife around BCF.

Crops	East of BCF Zone I & Zone II		West of BCF Zone III & Zone IV		Total NRs.	Damaged Area around BCF	
	Ha.	NRs.	Ha.	NRs.		Ha.	%
Paddy	10.6	322081.00	6.60	200541.00	522622.00	17.2	29.45
Maize	10.64	234562.50	3.53	77820.09	312382.60	14.17	17.60
Lentil	3.50	132011.32	1.80	67891.54	199902.90	5.3	11.26
Wheat	2.4	44822.06	0.24	4482.20	49304.27	2.64	2.78
Mustard	5	113616.30	3.63	82485.43	196101.70	8.63	11.05
Veg. & others	3.6	265500.00	3.1	228625.00	494125.00	6.7	27.84
Total	35.74	1112593.18	19.07	661845.3	1774438.47	54.64	100

Source: Present NAD Study.

Table 12: Crop Field Area damaged, crop types and total loss of crops by wildlife with their monetary-loss value in Eastern site, based on NAD.

Crop type in Zone I & II	Damaged area		Estimated prod^{n}/Kattha in Kg	Market price/Kg	Total economic loss	
	Hectare	Kattha			NRs.	%
Paddy	10.6	312.7	100.00	10.30	322081.00	28.95
Maize	10.64	313.88	70.50	10.60	234562.50	21.08
Lentil	3.50	103.25	52.40	24.40	132011.32	11.87
Wheat	2.40	70.80	64.60	9.80	44822.06	4.03
Mustard	5.00	147.50	26.20	29.40	113616.30	10.21
Veg. & others	3.60	106.20	-	-	265500.00	23.86
Total	35.74	1054.33	-		1112593.21	100.00

Estimated production: 1ha=29.5 Kattha (1 Kattha Vegetable = NRs. 2500)

Table 13: Area damaged, crop types and total loss of crops by wildlife with their monetary loss-value from Zone I.

Crop type	Damaged area		Estimated prod^{n}/Kattha in Kg	Market price/Kg	Total economic loss	
	Hectare	Kattha			NRs	%
Paddy	6.90	203.55	100.0	10.30	209656.50	29.24
Maize	5.44	160.48	70.5	10.60	119926.70	16.73
Lentil	2.10	61.95	52.4	24.40	79206.79	11.05
Wheat	2.10	61.95	64.6	9.80	39219.30	5.47
Mustard	3.40	100.30	26.2	29.40	77259.08	10.78
Veg. & Others	2.60	76.70	-	-	191750.00	26.74
Total	22.54	664.93	-	-	717018.38	100.00

Table 14: Damaged area, crop types and total loss of crops by wildlife with their monetary loss-value from Zone II.

Crop type in Zone II	Damaged area		Estimated prod^{n}/Kattha in Kg	Market price/Kg	Total economic loss	
	Hectare	Kattha			NRs.	%
Paddy	3.7	109.15	100.0	10.3	112424.5	28.42
Maize	5.2	153.4	70.5	10.6	114635.8	28.98
Lentil	1.4	41.3	52.4	24.4	52804.53	13.35
Wheat	0.3	8.85	64.6	9.8	5602.758	1.42
Mustard	1.6	47.2	26.2	29.4	36357.22	9.19
Veg. and Others	1	29.5	-	-	73750.00	18.64
Total	13.2	389.4	-	-	395574.81	100.00

Table 15: Area damaged, crop types and total loss of crops by wildlife with their monetary loss-value from Western site.

Crop type in Zone III & IV (Western Site)	Damaged area		Estimated prod^{n}/Kattha in Kg	Market price/Kg	Total economic loss	
	Hectare	Kattha			NRs	%
Paddy	6.6	194.70	100.0	10.3	200541.00	30.30
Maize	3.53	104.14	70.5	10.6	77820.08	11.76
Lentil	1.8	53.10	52.4	24.4	67891.53	10.26
Wheat	0.24	7.08	64.6	9.8	4482.20	0.68
Mustard	3.63	107.08	26.2	29.4	82485.43	12.46
Veg. and Others	3.1	91.45	-	-	228625.00	34.54
Total	18.9	557.55	-	-	661845.26	100.00

Table 16: Damaged area, crop types and total loss of crops by wildlife with their monetary-loss value from Zone III.

Crop type in Zone III	Damaged area		Estimated prod^{n}/Kattha in Kg	Market price/Kg	Total economic loss	
	Hectare	Kattha			NRs.	%
Paddy	0.2	5.9	100	10.3	6077	20.44
Maize	0.03	0.885	70.5	10.6	661.3605	2.22
Lentil	0	0	52.4	24.4	0	0.00
Wheat	0.01	0.295	64.6	9.8	186.7586	0.63
Mustard	0.03	0.885	26.2	29.4	681.6978	2.29
Veg. & others	0.3	8.85	-	-	22125	74.42
Total	0.57	16.82	-	-	29731.82	100.00

Table 17: Damaged area, crop types and total loss of crops by wildlife with their monetary value from Zone IV.

Crop type in Zone IV	Damaged area		Estimated Prod^{n}/Kattha in Kg	Market price/Kg	Total economic loss	
	Hectare	Kattha			NRs.	%
Paddy	6.4	188.8	100	10.3	194464	30.76
Maize	3.5	103.25	70.5	10.6	77158.7	12.21
Lentil	1.8	53.1	52.4	24.4	67891.5	10.74
Wheat	0.23	6.785	64.6	9.8	4295.45	0.68
Mustard	3.6	106.2	26.2	29.4	81803.7	12.94
Veg. & others	2.8	82.6	-	-	206500	32.67
Total	18.33	540.735	-	-	632113.44	100.00

Note: Total numbers of households under crop damage in study area were 1070 for NAD and 441 for GAD. Production rate per Kattha are adopted from local people at the time of interview. Market price adopted from local markets (Tandi and Bharatpur). Losses of vegetables are estimated as NRs. 2500/Kattha based on local information.

Despite this scenario, heavy economic loss is estimated to be of net worth NRs. 1779580 around the BCF for the year 2003-2004 from this study. Where as, Bhattarai (2003) estimated the total crop

loss of NRs. 645403 east of BCF. This study revealed the total loss of NRs. 1027688 and NRs. 751892 from eastern and western parts of BCF respectively. This indicates the increasing trend of crop loss in the adjoining areas of the forest.

Crop damage in the north from the Mahendra Highway is from the north-east part of the forest i.e. New Padampur, Jutpani and Ratnanagar [Zone II]. Likewise, southern BCF endorsed as buffer zone suffered from wildlife of both Barandabhar and CNP. Comparatively Zone I (net NRs. 1349131.79 alone) is less affected (NRs. 84905) than the Zone II (total NRs. 717018.38). The eastern part (NRs. 1027688) has more damage (comparatively NRs. 275796.29 more) than the western site (NRs. 751891.71). The highest damage occurred in Zone I followed by Zone IV, Zone II and Zone III. The lowest/no crop damage in zone III (outside the buffer zone) was mainly due to low abundance of ungulates.

Crop preferences varied in different growing stages, and loss varied with the distance from the forest, i.e. highest damage occurred at the boundary of the forest. Although paddy damage occurred from growing to mature stage but the highest damage was at the mature stage. Paddy and mustard damage was occurred both by grazing and trampling. Wheat was damaged during early stage of growth; mature stage was not preferred as it becomes coarser. Its damage was the lowest in this study because the area of wheat farming at the adjoining area of forests was low.

Economically, highest loss (29.37%) occurred to paddy followed by vegetables (27.77), maize (17.55), mustard (11.24), Lentil (11.23) and wheat (2.88). The loss of crops per household per annum is NRs. 6244.14. Among the crop pest species (megafauna), rhinoceros was rated the highest (70.7%) followed by chital (14.8%), wild boar (10.6%), wild elephant (3%), sambar deer (0.7%) and barking deer (0.2%).

From the key personnel and the local farmers, it was known that a little money as a compensation of the seed-value money of damaged crops had been provided by CNP/BZC. But, this money/scheme was neither enough to attract the farmers, nor was easily accessible due to its ineffective mechanism. Farmers who are living close to the forest boarder are busy either in crop fields or in rearing their cattle through out the year for their subsistence livelihood. Although they must be the first target group of compensation scheme in fact, they did not like to report the assessment of damage to the concerned authority which would take two days to many days. People who were almost not busy in agriculture and were supporting their family from other sources of income like job or business are still benefiting the seed value compensation attraction. Bsides the seed-value money, money value covering some part (at least 60% at the beginning) of damaged crop has to be increased along with the enhancement of assessment procedure and the dissemination mechanism.

Table 18: Different crops lost (in kg) due to wild animals in different study zones.

S.N.	Crop type	Crop lost due to wildlife of BCF in kg			
		Zone I	Zone II	Zone IV	Total in kg
1.	Paddy	12272.5	33100.00	13880.00	59252.50
2.	Maize	30854.7	41744.01	11329.59	83928.30
3.	Wheat	184.2	383.25	947.70	1515.15
4.	Mustard	5968.6	744.00	2847.24	9559.84
5.	Lentil	10210.4	2243.12	364.00	12817.52
6.	Potato	5423.0	15213.00	5800.00	26436.00
	Grand Total	64913.4	93427.38	35168.53	193509.31

Source: Present Study, GAD.

Crop preferences of different wild animals varied with different cropping system in different seasons, growing stages of crops, crop types, and also upon distance from the forest. Hence, mobility of crop pests was different in different season and places. Early to mature stages were mostly preferred by ungulates in case of paddy crops. Ungulates preferred mature and flowering stage of lentils, juvenile and medium stage of wheat and tasseling and mature stage of maize. Mustard was damaged by rhinoceros mainly by trampling and grazing on mature and juvenile stage respectively.

Detail crop damage by wildlife, and total economic loss in each zone varied significantly in different zones (Table 11 to Table 16). The greatest damage of crops occurred in zone I and the lowest in Zone III. There were 22.54 ha in Zone I, 13.2 ha in Zone II, 0.57 ha in Zone III, and 18.33 ha in Zone IV. Of total 54.81 ha area of crops fields damaged, a total of 8624.12 metric tones (Mt) of crop-damage viz. 5228.715 Mt in Zone I, 2983.382 Mt in II, 193.413 Mt in Zone III, and 4373.094 Mt in Zone III (Figure 19) in terms of money it amounted to NRs 717018.386, 395574.8, 29731.81, and 632113.44 in Zone I, II, III and IV respectively.

Fig. 13: Crops lost by wildlife in different study zones around BCF.

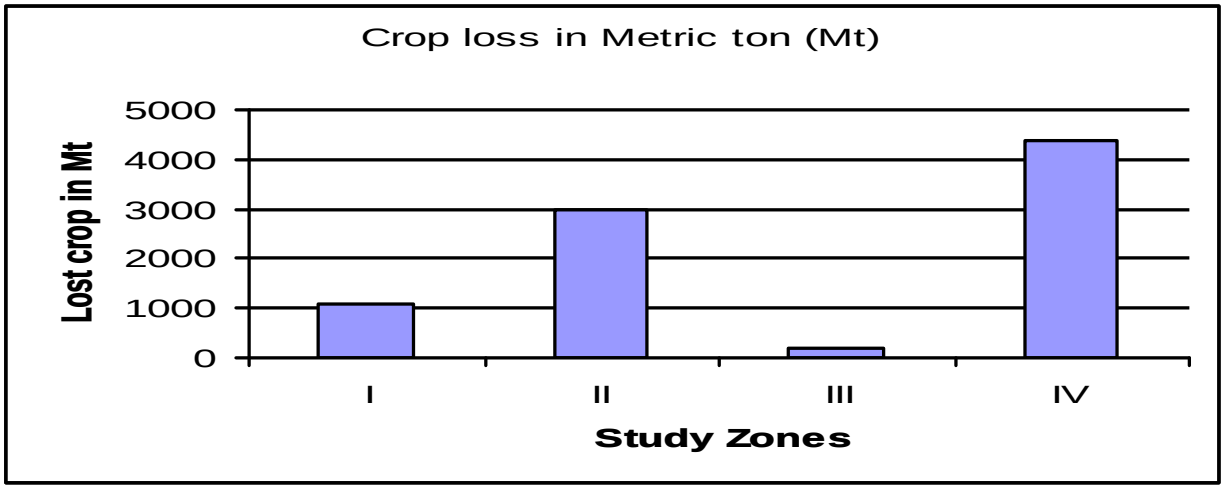
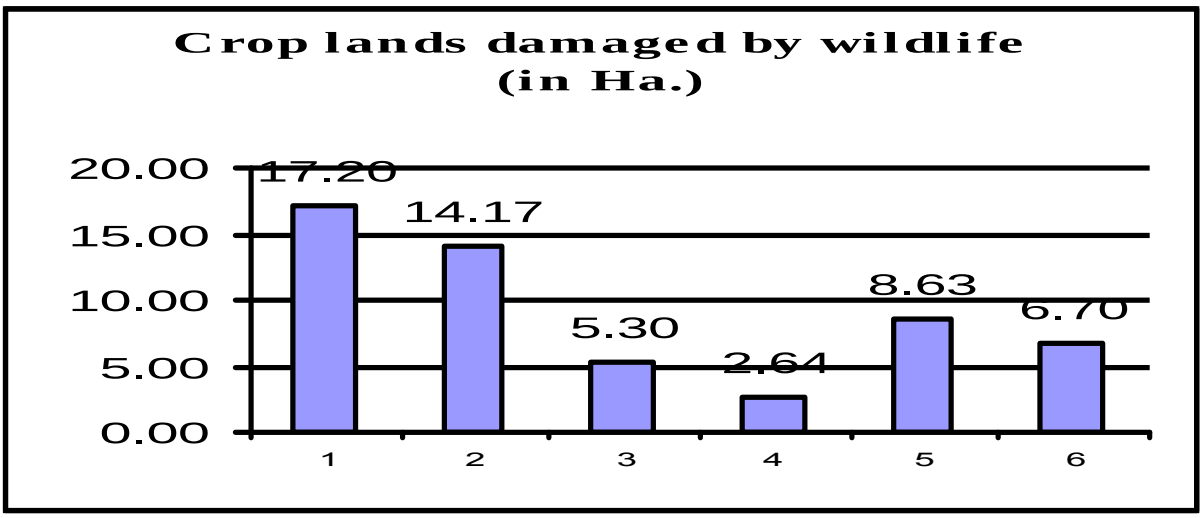


Fig. 14: Crops land damaged by wildlife in different study zones around BCF.



Note: 1 = Rhino, 2 = Wild boar, 3 = Deer, 4 = Elephant, 5 = Parrot, 6 = Others.

Table 19: Estimation of crop damage by wildlife in the adjoining crop fields based on NAD and GAD methods.

Study Zones	Crop loss in Metric ton (Mt)		Remarks
	NAD Estimation	GAD Estimation	* Only 2.7% household reported crop damage
I	52.28	64.91	
II	29.83	93.42	
III	1.93	No crop damage*	
IV	43.73	35.17	
Total	127.77	193.50	

Table 20: Total crop loss, mean loss & average loss in kg per household based on GAD.

Crop type	Zone I			Zone II			Zone IV		
	Loss in kg	Valid cases	Mean loss kg	Loss in kg	Valid cases	Mean loss	Loss in kg	Valid cases	Mean loss in kg
Paddy	12272.50	104	118.00	33100.00	90	367.78	13880.00	103	134.76
Maize	30854.70	96	321.40	41744.01	96	434.83	11329.59	49	231.22
Wheat	184.20	7	26.31	383.25	5	76.65	947.70	36	26.32
Mustard	5968.60	75	79.58	744.00	70	10.63	2847.24	9	316.36
Lentil	10210.40	23	443.93	2243.12	11	203.92	364.00	5	72.80
Potato	5423.00	23	235.78	15213.00	29	524.59	5800.00	5	1160.00
Total	64913.40	328		93427.38	301		35168.53	207	
Average loss in kg/Hh			197.91			310.39			169.90

Note: Grand total loss = 193509.31 kg; Total valid cases N = 836; Loss in kg per household = 231.47

Table 21: Total loss of crop, mean & average loss in NRs. per household based on GAD.

Crop type	Zone I			Zone II			Zone IV		
	Loss in NRs	Cases	Mean loss	Loss in NRs	Cases	Mean loss	Loss in NRs	Cases	Mean loss in
Paddy	126406.75	104	1215.45	340930.00	90	3788.11	142964.	103	1388.00
Maize	327059.82	96	3406.87	442486.51	96	4609.23	120093	49	2450.89
Wheat	1805.16	7	257.88	3755.85	5	751.17	9287.46	36	257.98
Mustard	175476.84	75	2339.69	21873.60	70	312.48	83708.8	9	9300.98
Lentil	249133.76	23	10831.9	54732.13	11	4975.65	8881.60	5	1776.32
Potato	81345.00	23	3536.74	228195.00	29	7868.79	87000.0	5	17400.0
Total	961227.33	328	21588.5	1091973.1	301	22305.4	451935	207	32574.2
Average loss NRs/Hh			2930.57			3627.82			2183.26

Note: Grand total loss = NRs. 2505135.98; Total valid cases N = 836; Average loss in NRs/Household = NRs. 2996.57

Table 22: GAD vs NAD: Average loss of crop in NRs per HH in different study zones.

Study Zones	By GAD Method		By NAD Method	
	NRs/Hh	No. of Hhs.	NRs/Hh	No. of Hhs.
Zone I	2930.57	328	2108.87	340
Zone II	3627.82	301	1719.89	230
Zone III	-	-	198.21	150
Zone IV	2183.26	207	1806.03	350
Average loss in NRs/Hh	**2996.57**		**1658.35**	

Note Box:

Crop type (Ci) mean loss = Total NRs loss for crop (Ci) divided by valid cases; Valid case = number of Hhs practicing the respective crop (Ci) type; Total Hhs (Ni) = sum of (Ci): (Cn). Where i = Study zone

NRs./Hh = Mean loss = Total loss of (Ci) divided by (Ni)

Total N = Sum of (Ni); Average loss for zone (i) = sum of total loss (Ti) of (Ci:Cn) for the zone(i) divided by (Ni); Average loss NRs/Hh = Sum of (Ti:Tn) divided by (N).

Table 23: Crop damage in kg, based on GAD, in different three study zones.

Crops	Zone I	Zone II	Zone IV	Total in kg
Paddy	12272.5	33100.00	13880.00	59252.50
Maize	30854.7	41744.01	11329.59	83928.30
Wheat	184.2	383.25	947.70	1515.15
Mustard	5968.6	744.00	2847.24	9559.84
Lentil	10210.4	2243.12	364.00	12817.52
Potato	5423.0	15213.00	5800.00	26436.00
Total in kg	64913.4	93427.38	35168.53	193509.31
In Metric ton	64.9134	93.42738	35.16853	193.50931

The estimated total value of crop damage by NAD correspond the estimation by GAD method.

Upreti (1995) had estimated the crop damage by GAD two times the NAD estimation. But, it seems to be the GAD estimation 1.5 times the NAD estimation which shows the GAD method comparable to the NAD method.

5.2.2 FREQUENCY OF VISIT AND CROP DAMAGE BY WILD ANIMALS

After the management of community forests in/around the BCF by the local people, the number of wildlife began to increase, especially in the recent years. As a result, frequency of visit of wildlife in the agricultural field also increased. The frequency of visit by wild animals in the agricultural fields depends on the barrier between the agricultural land and BCF.

Since the fencing itself is not the effective barrier and mainly works for restricting the mobility of average body-sized mammals like deer species (reported by local people and the NAD survey). Similarly, the open boundary between CNP and the agricultural land is attributed to the increasing wildlife mobility in the northern part of BCF.

In this study, the highest relative percentage frequency of rhinoceros was 42.02 (the highest of all crop pests) in zone I followed by 33.48 in zone II and 28.19 in zone IV. Likewise, the relative frequency (in %) of wild boar was the highest in zone IV (44.41) followed by 20.6 in zone II and 14.98 in zone I. While analyzing the frequency of crop pests in zone I, the frequency of elephant was noted 15.97% only from Bachhauli area of zone I where it occupied third rank frequency position among all crop pests with rhino to be first (40.63) and wild boar (19.97) to be second. Bhattarai (2003) also reported the elephant in BCF at Khorshor which is the forest near to Bodreni and Baghmara villages. Comparatively among eight categories in all study zones, the relative frequency of elephant occupies sixth position (8.95%). Similarly, chital did have relative frequency 16.54%, 16.31% and 13.56% in zone I, II and IV respectively. See table 38.

Table 24: Loss of different crops in kg by wild animals around BCF based on frequency.

Crop type	Crop loss								
	Rhino (34.56)	Boar (26.67)	Sambar (2.79)	Chital (15.47)	Elephant (2.98)	Parrot (10.48)	Monkey (2.09)	Others* (4.95)	Total (100)
Paddy	20479.88	15799.94	1654.74	9166.32	1767.58	6212.04	1239.85	2932.14	59252.49
Maize	29008.76	22379.84	2343.86	12983.65	2503.70	8799.05	1756.19	4153.24	83928.29
Wheat	523.69	404.02	42.31	234.39	45.20	158.85	31.70	74.98	1515.14
Mustard	3304.24	2549.17	266.98	1478.90	285.18	1002.25	200.04	473.07	9559.83
Lentil	4430.21	3417.85	357.95	1982.86	382.36	1343.79	268.20	634.28	12817.5
Potato	9137.27	7049.27	738.28	4089.63	788.62	2771.55	553.17	1308.20	26435.99
Total	66884.06	51600.09	5404.13	29935.77	5772.65	20287.54	4049.15	9575.92	193509.24

Source: Present study based on GAD method. *Others means jackal (*Canis aureus*), porcupine (*Hystrix indica*) etc.

Table 25: Crops types and economic loss by wild animals around BCF based on NAD.

Crop	Rhino	Boar	Sambar	Chital	Elephant	Parrot	Monkey	Others	Total loss

Paddy	180618.16	139383.29	14581.15	80849.62	15574.14	54770.79	10975.06	25869.79	522622.00
Maize	107959.42	83312.43	8715.47	48325.59	9309.00	32737.69	6560.03	15462.94	312382.58
Wheat	69086.42	53314.09	5577.29	30924.97	5957.10	20949.82	4197.96	9895.19	199902.85
Mustard	17039.55	13149.45	1375.59	7627.37	1469.27	5167.09	1035.39	2440.56	49304.26
Lentil	67772.76	52300.33	5471.24	30336.94	5843.83	20551.46	4118.14	9707.04	196101.73
Potato	170769.60	131783.14	13786.09	76441.14	14724.93	51784.30	10376.63	24459.19	494125.00
Total	613245.94	473242.74	49506.83	274505.63	52878.27	185961.15	37263.21	87834.70	1774438.47

GAD estimation and frequency shows that rhinoceros cause the highest damage (66884.06 kg) followed by wild boar (51600.09 kg) and chital (29935.77 kg). Details of crop loss by different animals as per the GAD and NAD estimation are given in table 24 and 25.

5.2.2.1 RHINOCEROS AND TYPE OF CROP DAMAGED

Table 26: Types of crops lost due to rhino in different zones.

Crop types	Crops loss in kg			Total loss in kg	Total loss in NRs
	Zone I	Zone II	Zone IV		
Paddy	5156.90	11081.88	3912.77	20151.56	207561.03
Maize	12965.14	13975.89	3193.81	30134.85	319429.42
Wheat	77.40	128.31	267.16	472.87	4634.12
Mustard	2508.01	249.09	802.64	3559.73	104656.18
Lentil	4290.41	751.00	102.61	5144.02	125514.05
Veg. & Others	2278.74	5093.31	1635.02	9007.08	135106.16
Total	27276.61	31279.49	9914.01	68470.11	896900.95

Rhinoceros (*Rhinoceros unicornis*) alone was responsible for damaging 34.56% of crops of which 20479.88 kg paddy of total damage of 59252.5 kg paddy damage estimated from GAD and 50740 kg from NAD methods.

NAD showed the highest damage on paddy 20355 kg in zone I, 18880 kg in zone IV, 10915 kg in zone II, and 590 kg in zone III with monetary value of NRs. 209656.5, 194464, 112424.5 and 6077 respectively by all animals. Whereas, GAD showed the highest crop damage was recorded in zone II (33100 kg) followed by 13880 kg in zone IV and 12272.5 in zone I that amounted NRs. 340930, NRs. 142964, NRs. 126406.8 respectively. Likewise, rhinoceros (*Rhinoceros unicornis*) damaged 29008.76 kg maize, 523.69 kg wheat, 3304.24kg mustard, 4430.21kg lentil, and 9137.27 kg vegetable and others. See tables 26, 33 and 34.

5.2.2.2 WILD BOAR AND TYPE OF CROP DAMAGED

Based on frequency, wild boar alone was alone responsible for damaging 26.6% of crops of which paddy of 5156.94 kg from zone I, 11081.88 kg from zone II and 3912.77 kg from zone IV (total 20151.56 kg and NRs. 207561.03). Highest damage was to maize (22379.84 kg) followed by paddy, potato and others (7049 kg), lentil (3417.85 kg), mustard (2549.17 kg), and wheat (404.02 kg). See

tables 25, 33 and 34. Highest maize damage was in zone II (8599.27 kg) followed by zone IV (5031.47 kg) and zone I (4622.03 kg) with total loss of NRs. 193479.37. See tables 27, 33 and 34.

Table 27: Types of crops lost due to wild boar in different zones.

Crop type	Lost crops by wild boar (in kg) in			Total loss in kg	Total loss in NRs
	Zone I	Zone II	Zone IV		
Paddy	1838.42	6818.60	6164.11	14821.13	152657.62
Maize	4622.03	8599.27	5031.47	18252.77	193479.37
Wheat	27.59	78.95	420.87	527.42	5168.68
Mustard	894.10	153.26	1264.46	2311.82	67967.50
Lentil	1529.52	462.08	161.65	2153.25	52539.37
Veg. & Others	812.37	3133.88	2575.78	6522.02	97830.35
Total	9724.03	19246.04	15618.34	44588.41	569642.90

Source: Present Study, GAD.

5.2.2.3 SAMBAR AND TYPE OF CROP DAMAGED

Table 28: Types of crops lost due to sambar in different zones.

Crop type	Lost crops by Sambar (in kg) in			Total loss in kg	Total loss in NRs
	Zone I	Zone II	Zone IV		
Paddy	262.63	569.32	627.38	1459.33	15031.07
Maize	660.29	718.00	512.10	1890.39	20038.08
Wheat	3.94	6.59	42.84	53.37	523.02
Mustard	127.73	12.80	128.70	269.22	7915.07
Lentil	218.50	38.58	16.45	273.54	6674.30
Veg. & Others	116.05	261.66	262.16	639.88	9598.14
Total	1389.15	1606.95	1589.62	4585.72	59779.69

Sambar alone was responsible for damaging 2.79% of crops of which paddy of 1654.74 kg, maize 2343.86 kg, wheat 42.31 kg, mustard 266.98 kg, lentil 357.95 kg, and potato and vegetable 738.28 kg. It damaged maximum the maize 1890.39 kg followed by paddy 1459.33 kg, vegetables and others 639.88 kg, lentil 273.54 kg, mustard 269.22 kg and wheat 53.37 kg.

Highest damage of crops by it was in zone II (1606.95 kg) followed by 1589.62 kg and 1389.15 kg in zone IV and zone I respectively. See tables 28, 33 and 34.

5.2.2.4 CHITAL AND TYPE OF CROP DAMAGED

Chital occupied 15.47% of crops of which highest damage was to maize (13448.11 kg) followed by paddy (9310.61 kg), potato and vegetable (4164.68 kg), lentil (2104.01 kg), mustard (1494.64 kg) and wheat (221.48 kg). Highest damage of crops by it was in zone II (5398.61 kg) followed by 2029.87 kg and 1882.13 kg in zone I and zone IV respectively. See tables 29, 33 and 34.

Table 29: Types of crops lost due to chital in different zones.

Crop type	Lost crops by chital in kg			Total loss in kg	Total loss in NRs
	Zone I	Zone II	Zone IV		
Paddy	2029.87	5398.61	1882.13	9310.61	95899.28
Maize	5103.37	6808.45	1536.29	13448.11	142549.94
Wheat	30.47	62.51	128.51	221.48	2170.53
Mustard	987.21	121.35	386.09	1494.64	43942.37
Lentil	1688.80	365.85	49.36	2104.01	51337.88
Veg. & others	896.96	2481.24	786.48	4164.68	62470.27
Total	10736.68	15238.01	4768.85	30743.53	398370.27

5.2.2.5 ELEPHANT AND TYPE OF CROP DAMAGED

Table 30: Types of crops lost due to elephant in different zones.

Crop type	Lost crops by sambar (in kg) in			Total loss in kg	Total loss in NRs
	Zone I	Zone II	Zone IV		
Paddy	1098.39	-	-	1098.39	11313.40
Maize	2761.50	-	-	2761.50	29271.85
Wheat	16.49	-	-	16.49	161.56
Mustard	534.19	-	-	534.19	15705.18
Lentil	913.83	-	-	913.83	22297.47
Veg. & Others	485.36	-	-	485.36	7280.38
Total	5809.75	-	-	5809.75	86029.85

Elephant occupied 2.98% of crops of which highest damage was to maize (2761.50 kg) followed by paddy (1098.39 kg), lentil (913.83 kg), mustard (534.19 kg), potato and vegetable (485.36 kg) and wheat (16.49 kg). Highest damage of crops by it was only in zone I. See tables 30, 33 and 34.

5.2.2.6 PARAKEETS AND TYPE OF CROPS DAMAGED

Table 31: Types of crops lost due to parakeets in different zones.

Crop type	Lost crops by parakeets (in kg) in			Total loss in kg	Total loss In NRs
	Zone I	Zone II	Zone IV		
Paddy	1694.83	5395.30	185.99	7276.12	74944.08
Maize	4261.03	6804.27	151.82	11217.12	118901.52
Wheat	25.44	62.47	12.70	100.61	985.95
Mustard	824.26	121.27	38.15	983.69	28920.45
Lentil	1410.06	365.63	4.88	1780.56	43445.72
Veg. & Others	748.92	2479.72	77.72	3306.36	49595.33
Total	8964.54	15228.66	471.26	24664.46	316793.04

Since parakeets occupied 10.48% of crops of which highest damage was to maize (11217.12 kg) followed by paddy (7276.12 kg), vegetable and others (3306.36 kg), lentil (1780.56 kg), mustard (983.69 kg) and wheat (100.61 kg), they can not be said as minor pests in the area. Even though no area around the forest mainly in Terai region are free from parakeet unlike other animals as in other

study zones in this study, it is not assessed the crop damage by parakeet in zone III. When people in the area (zone III) reported no crop damage (only 2.77% households reported), it made the data on crop damage by parakeet from the zone unavailable. Since the crop damage in the area has been estimated by NAD method, it represents the crop loss from the area. See table 15, 16 and 33. Highest damage of crops by the parakeets was in zone II (15228.66 kg) followed by 8964.54 kg and 471.26 kg in Zone I and Zone IV respectively. See tables 31, 33 and 34.

5.2.2.7 MONKEY AND TYPE OF CROP DAMAGED

Table 32: Types of crops lost due to monkey in different zones.

Crop type	Lost crops by parakeets in kg			Total loss in kg	Total loss in NRs
	Zone I	Zone II	Zone IV		
Paddy	191.45	1562.32	-	1753.77	18063.84
Maize	481.33	1970.32	-	2451.65	25987.50
Wheat	2.87	18.09	-	20.96	205.44
Mustard	93.11	35.12	-	128.23	3769.87
Lentil	159.28	105.88	-	265.16	6469.84
Veg. & Others	84.60	718.05	-	802.65	12039.79
Total	1012.65	4409.77	-	5422.42	66536.28

Monkeys were responsible for damaging 1.56% and 4.72% of total crops lost in zone I and II respectively. This corresponds the result of study by Sahoo and Mohnot (2005) in Himanchal Pradesh where these two monkeys are responsible for 5% of the loss gross annual yield of the cash crops. In this stuffy, maize was severely affected (2451.65 kg in total) with highest loss in zone II (1970.32 kg) and lowest loss in Zone I (481.33 kg). See tables 32, 33 and 34.

5.2.2.8 OTHER WILD ANIMALS AND TYPE OF CROPS DAMAGED

Table 33: Types of crops lost due to other animals in different zones.

Crop type	Crops lost by parakeets in kg			Total loss in kg	Total loss in NRs
	Zone I	Zone II	Zone IV		
Paddy	-	2273.97	1107.62	3381.59	34830.42
Maize	-	2867.81	904.10	3771.91	39982.30
Wheat	-	26.33	75.63	101.96	999.17
Mustard	-	51.11	227.21	278.32	8182.68
Lentil	-	154.10	29.05	183.15	4468.85
Veg. & Others	-	1045.13	462.84	1507.97	22619.60
Total	-	6418.46	2806.45	9224.91	111083.01

Other animals include minor crop pests like porcupine, mongoose, rabbit, peacock etc. They were responsible for damaging 6.86% and 7.98% of total crops lost in zone II and IV respectively. They were mainly found damaging the maize, paddy and the vegetables. See tables 33, 34 and 35.

5.2.3.1 MEAN CROP LOSS OF CROPS PER HOUSEHOLD IN DIFFERENT STUDY ZONES

Table 34: Mean loss of crops in kg per household based on NAD.

Crop type	Total loss in kg				Mean loss in kg per household			
	Zone I (n=340)	Zone II (n=230)	Zone III (n=150)	Zone IV (n=350)	Mean (Zone I)	Mean (Zone II)	Mean (Zone III)	Mean (Zone IV)
Paddy	20355.00	10915.00	590.00	18880.00	59.87	47.46	3.93	53.94
Maize	11313.84	10814.70	62.39	7279.13	33.28	47.02	0.42	20.80
Lentil	3246.18	2164.12		2782.44	9.55	9.41	0.00	7.95
Wheat	4001.97	571.71	19.00	438.31	11.77	2.49	0.13	1.25
Mustard	2627.86	1236.64	23.19	2782.44	7.73	5.38	0.15	7.95
Veg. & others	10738.00	4130.00	1239.00	11564.00	31.58	17.96	8.26	33.04

NAD estimation shows the highest mean crop damaged per household was in zone I (59.87 kg) followed by zone IV (53.94 kg), zone II (47.46) and zone III (47.46 kg) for paddy. Likewise, highest mean paddy damaged per household in zone I was 59.87 kg followed by maize (33.28 kg), vegetables and others (31.58 kg), wheat (11.77 kg), mustard (7.73 kg) and lentil (9.55 kg). Similar was the trend for the respective crops in zone II as well. In zone III, mean loss of paddy per household (3.93 kg) came after the mean damage of vegetable and others. Details of mean crop damaged per household both by NAD and GAD estimation are given in tables 33 and 34. This data showed that the highest impact due to wild animals was in zone I followed by zone IV and zone II with least impact in zone III. It is note able that GAD estimation showed the highest damage to maize in zones I and II, whereas zone IV corresponds the result of NAD. See table 34 and 35.

Table 35: Mean loss of crops in kg per household based on GAD.

Crop type	Total loss in kg			Mean loss in kg per household		
	Zone I	Zone II	Zone IV	Mean (Zone I)	Mean (Zone II)	Mean (Zone IV)
Paddy	12272.50	33100.00	13880.00	101.43	143.91	39.66
Maize	30854.70	41744.01	11329.59	255.00	181.50	32.37
Wheat	184.20	383.25	947.70	1.52	1.67	1.10
Mustard	5968.60	744.00	2847.24	49.33	3.23	8.13
Lentil	10210.40	2243.12	364.00	84.38	9.75	1.04
Potato & others	5423.00	15213.00	5800.00	44.82	66.14	16.57

5.2.3.2 PERCENTAGE OF CROP DAMAGED IN STUDY ZONES

In all study zones, except zone II where maize was affected more, paddy was the most frequently damaged. But aggregately around the whole BCF, paddy was severely damaged (29.45%) followed by maize (17.6%), lentil (11.26%), mustard (11.05%) and wheat (2.78%) among the major crops. Damage to the vegetable and others was also remarkable (table 36).

Table 36: Percentage of crop damaged in study zones based on NAD.

Crop type	Location		Study Zones				Relative % of total loss
	East	West	I	II	III	IV	

	Damage	Damage	Damage	Damage	Damage	Damage	
Paddy	28.95	20.44	29.24	28.42	20.44	30.76	29.45
Maize	21.08	2.22	16.73	28.98	2.22	12.21	17.6
Lentil	11.87	0.00	11.05	13.35	0.00	10.74	11.26
Wheat	4.03	0.63	5.47	1.42	0.63	0.68	2.78
Mustard	10.21	2.29	10.78	9.19	2.29	12.94	11.05
Veg. & others	23.86	74.42	26.74	18.64	74.42	32.67	27.84
Total	100	100	100	100	100	100	100

Table 37: Percentage of Crop Damaged in Study Zones based on GAD.

S.N.	Crop type	Zone I	Zone II	Zone IV	Relative % of total loss
		Damage	Damage	Damage	
1.	Paddy kg	30.62	18.91	35.43	30.62
2.	Maize	43.37	47.53	44.68	43.37
3.	Wheat	0.78	0.28	0.41	0.78
4.	Mustard	4.94	9.19	0.80	4.94
5.	Lentil	6.62	15.73	2.40	6.62
6.	Potato	13.66	8.35	16.28	13.66
	Total	100	100	100	100

GAD estimation also showed the maximum damage to the paddy (43.37%). Both the data by NAD and GAD methods revealed the remarkable damage to maize, paddy and vegetables and others. Though there seemed less damage to wheat, it does not illustrate the real scenario as almost wheat was not possible to protect from the wild animals. Thus, farmers were not liable to grow wheat in their crops fields.

5.3 FREQUENCY OF CROP DAMAGE BY DIFFERENT WILD ANIMALS

In the study area, frequency of crop damage was highest of rhinoceros (*Rhinoceros unicornis*) (34.56%) followed by wild boar (26.67%), chital (15.47%), parakeets (10.48%) and other animals (26.59%). Frequency of each crop damage by different wild animals is given in table 38.

Table 38: Percentage Frequency of visit by wild animals in different villages / study zones.

Villages	Frequency of visit of wild animals in different villages								Total
	Rhino	Boar	Sambar	Chital	Elephant	Parrot	Monkey	Others	
Bachhauli VDC[+]	40.63	19.79	2.78	10.07	15.97	9.03	1.74		100
Kaparkhori village	43.81	8.85	1.33	24.78		19.91	1.33		100
Padampur VDC	22.64	28.30	0.00	9.43		20.75	10.38	8.49	100
Jirauna & Jutpani	42.52	14.17	3.15	22.05		12.60		5.51	100
Gitanagar &Patihani VDCs	28.19	44.41	4.52	13.56		1.33		7.98	100
Frequency of visit of wild animals in different study zones									
Zone I	42.02	14.98	2.14	16.54	8.95	13.81	1.56		100
Zone II	33.48	20.60	1.72	16.31		16.31	4.72	6.87	100
Zone IV	28.19	44.41	4.52	13.56		1.33		7.98	100
Zone Total	103.69	80.00	8.38	46.41	8.95	31.45	6.28	14.85	300
BCF*	34.56	26.67	2.79	15.47	2.98	10.48	2.09	4.95	100

Note: *Relative frequency around BCF; [+]Bachhauli VDC includes Malpur, Bodreni and Baghmara villages.

5.4 ECONOMIC LOSS

Total crop damage per zone was multiplied by local market price NRs/kg to assess the economic loss. Heavy economic loss of agricultural crops was obtained by NAD to be NRs 1774438.47. Among the major crops, highest economic loss occurred in paddy (30.3%) followed by maize (17.6%), lentil (11.27%), mustard (11.05%) and wheat (2.75%) with 27.85% loss to vegetables and other crops. The reported economic loss was NRs. 1658.35 per household.

In zone I, total economic loss was estimated 717018.38 with average household loss of NRs. 2108.87 (highest of all the zones). Likewise, second total highest loss was found to be NRs. 63211.44 in zone IV with average household loss or NRs. 1806.03 followed by NRs. 395574.8 with average household loss NRs. 1719.89 and NRs. 29731.82 with average household loss NRs. 198.21 in zone III. Detail is given in tables 11 to 18 and 39 and 40.

Table 39: Total economic loss of crops raided by wild animals.

Crops	Total economic loss in NRs.			
	Zone I	Zone II	Zone III	Zone IV
Paddy	209656.50 (29.24)	112424.5 (28.42)	6077 (20.44)	194464 (30.76)
Maize	119926.70 (16.73)	114635.8 (28.98)	661.3605 (2.22)	77158.7 (12.21)
Lentil	79206.79 (11.05)	52804.53 (13.35)	0.00 (0.00)	67891.5 (10.74)
Wheat	39219.30 (5.47)	5602.758 (1.42)	186.7586 (0.63)	4295.45 (0.68)
Mustard	77259.08 (10.78)	36357.22 (9.19)	681.6978 (2.29)	81803.7 (12.94)
Others	191750.00 (26.74)	73750 (18.64)	22125 (74.42)	206500 (32.67)
Total	717018.38 (100)	395574.81 (100)	29731.82 (100)	632113.44 (100)

Note: Figure in parentheses are in percentage. Source: This Study, NAD**.**

Table 40: Total economic loss of crops raided by wild animals based on GAD.

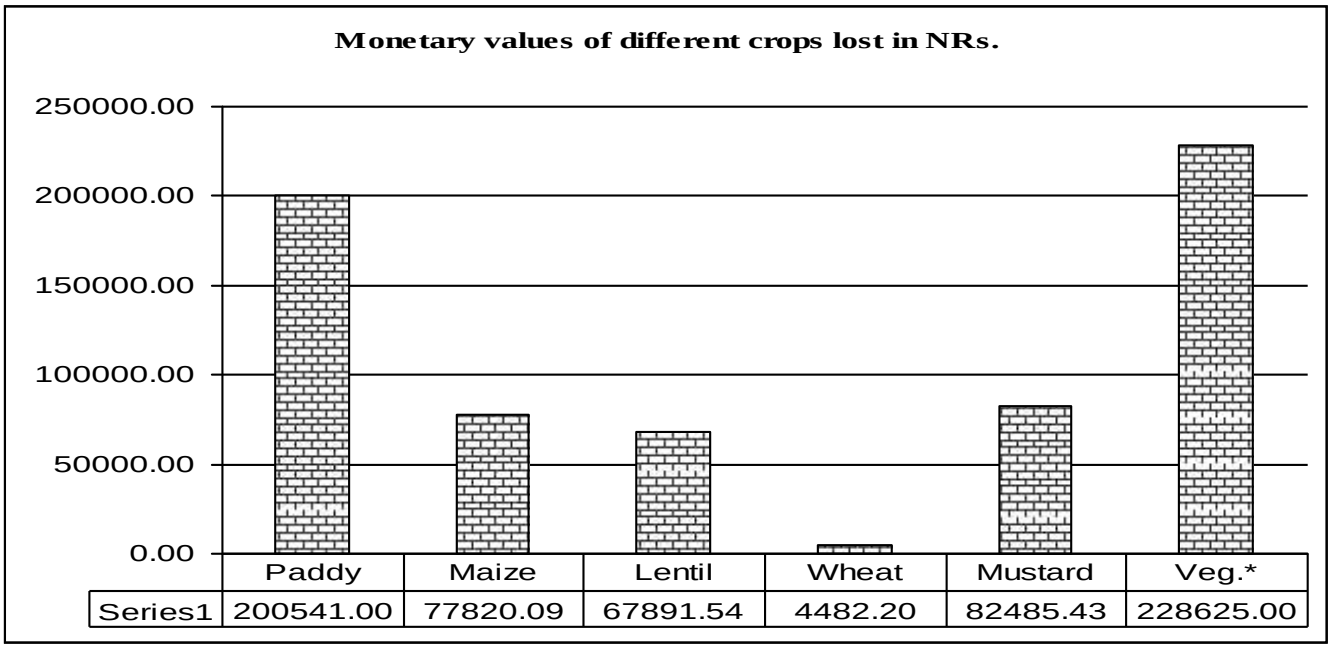
Crops	Zone I	Zone II	Zone IV	Total in NRs
Paddy	126406.80	340930.00	142964.00	610300.80
Maize	327059.80	442486.50	120093.70	889640.00
Wheat	1805.16	3755.85	9287.46	14848.47
Mustard	175476.80	21873.60	83708.86	281059.30
Lentil	249133.80	54732.13	8881.60	312747.50
Potato	81345.00	228195.00	87000.00	396540.00

Table 41: Monetary value of crop loss in NRs by interference of different wild animals.

Crop	Monetary value of crop loss in NRs by interference of								
	Rhino (34.56)	Boar (26.67)	Sambar (2.79)	Chital (15.47)	Elephant (2.98)	Parrot (10.48)	Monkey (2.09)	Others (4.95)	Total
1	210942.8	162739.3	17043.85	94413.13	18206.12	63983.99	12770.44	30201.09	610300.75
2	307492.8	237226.35	24844.95	137626.73	26539.20	93269.94	18615.57	44024.36	889639.98
3	5132.19	3959.41	414.67	2297.05	442.95	1556.72	310.70	734.79	14848.47
4	97144.61	74945.68	7849.14	43479.69	8384.39	29466.28	5881.12	13908.38	281059.30
5	108097.2	83395.47	8734.09	48381.84	9329.69	32788.48	6544.19	15476.49	312747.49
6	137059.1	105739.11	11074.16	61344.48	11829.34	41573.29	8297.53	19623.01	396540.00

Total Loss: 2505135.98 Figure in the parentheses are in percentage. (Source: Present Study, GAD)
Note: 1: Paddy; 2: Maize; 3: Wheat; 4: Mustard; 5: Lentil; and 6: Potato

Fig. 15: Comparison of total monetary value of different crops damaged by wildlife.



Note: Veg.* = Vegetables and Other. Source: Present NAD Study.

Fig. 16: Comparison of paddy loss around BCF.

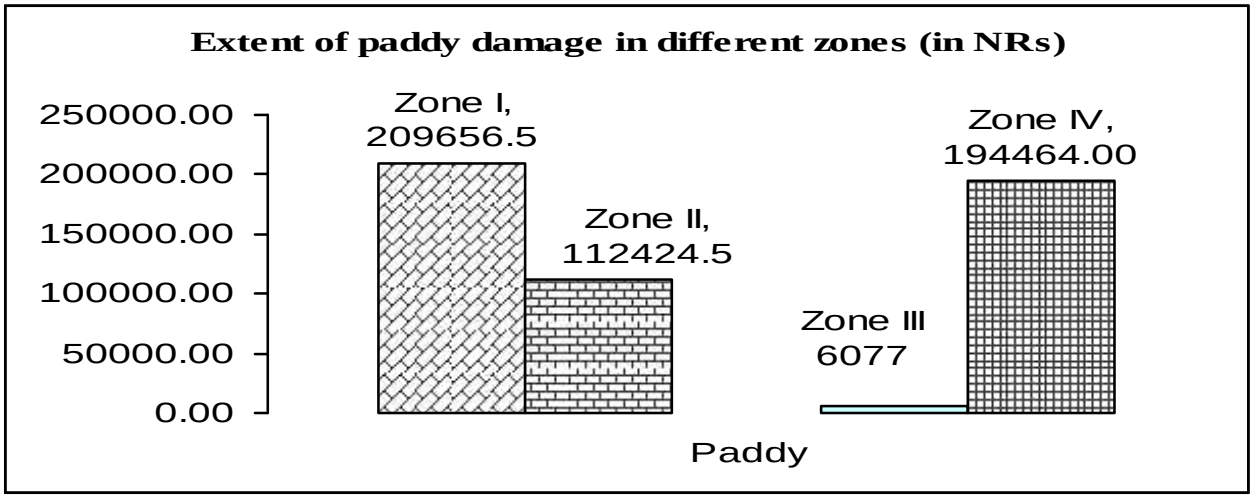


Fig. 17: Comparison of maize loss around BCF.

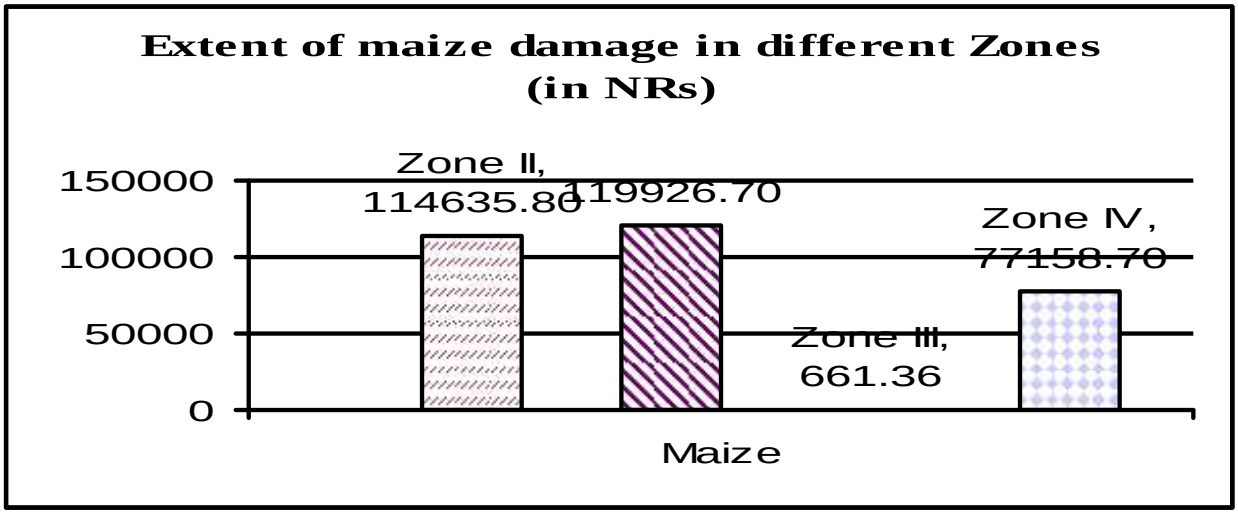


Fig. 18: Comparison of lentil loss around BCF.

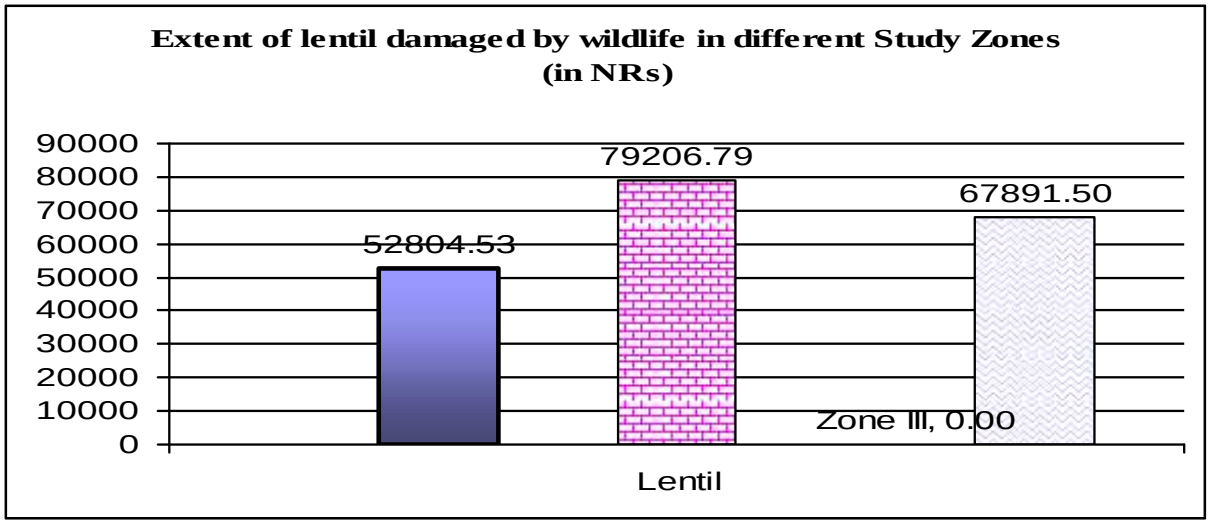


Fig. 19: Comparison of wheat loss around BCF.

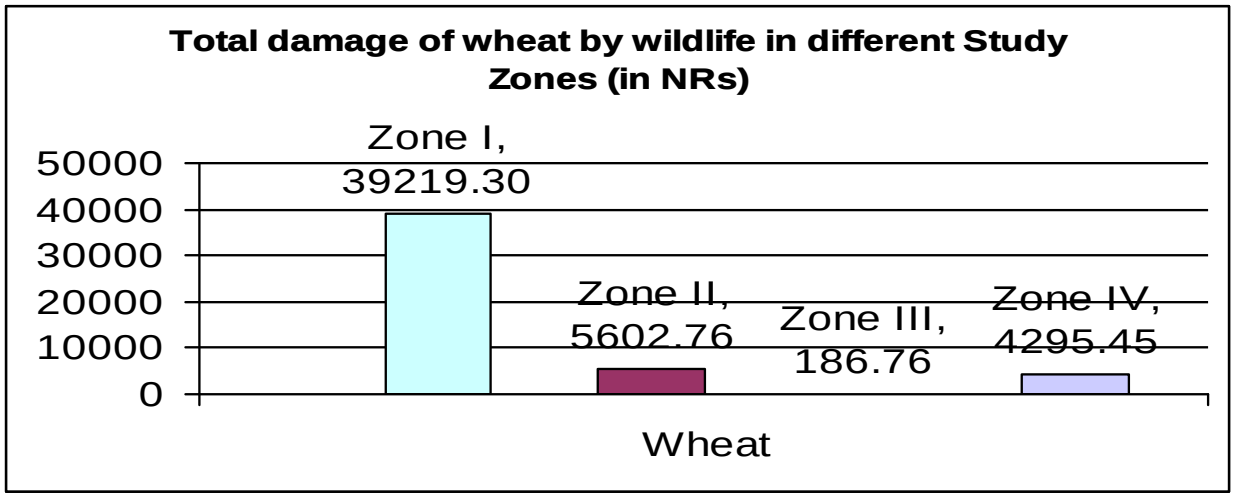


Fig. 20: Different crops loss by rhinoceros, wild boar and sambar.

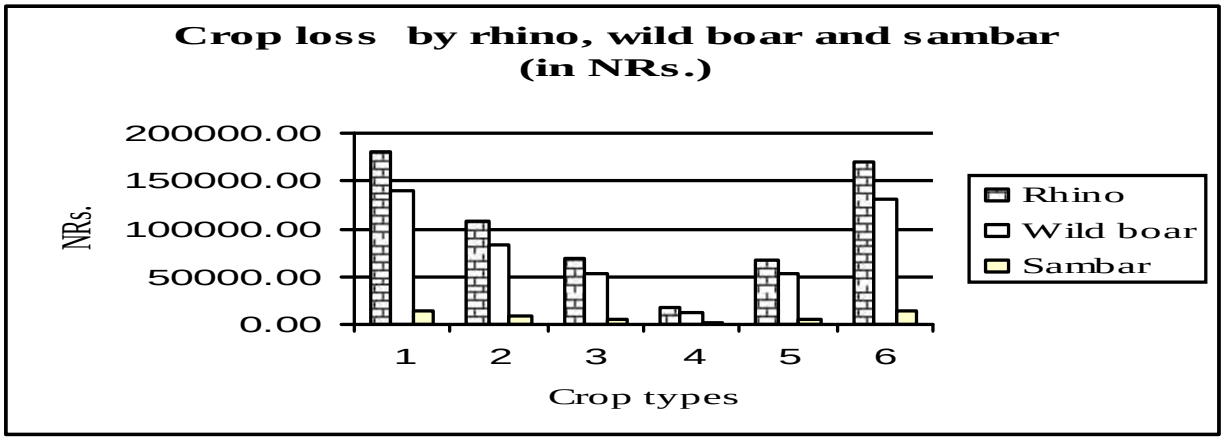
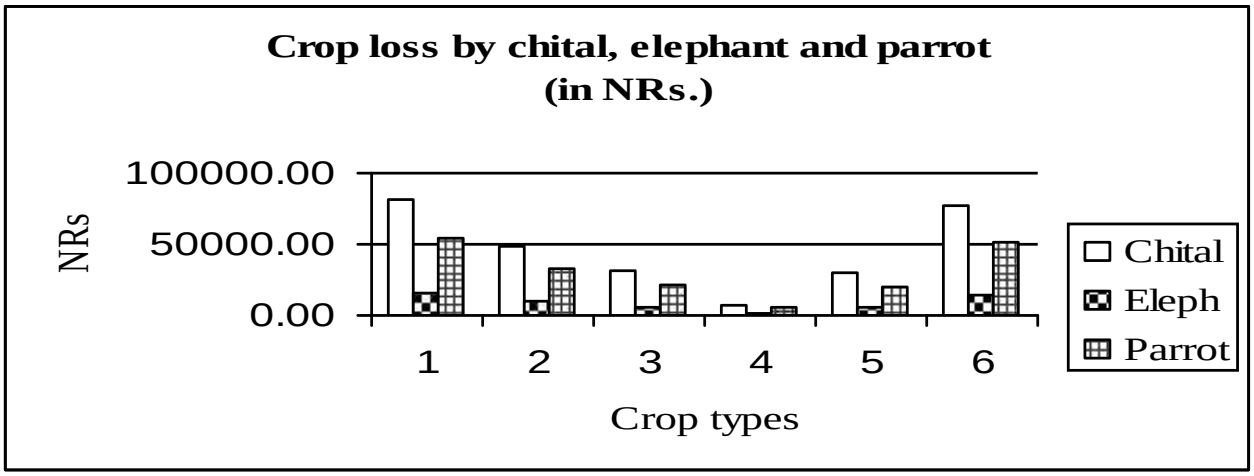
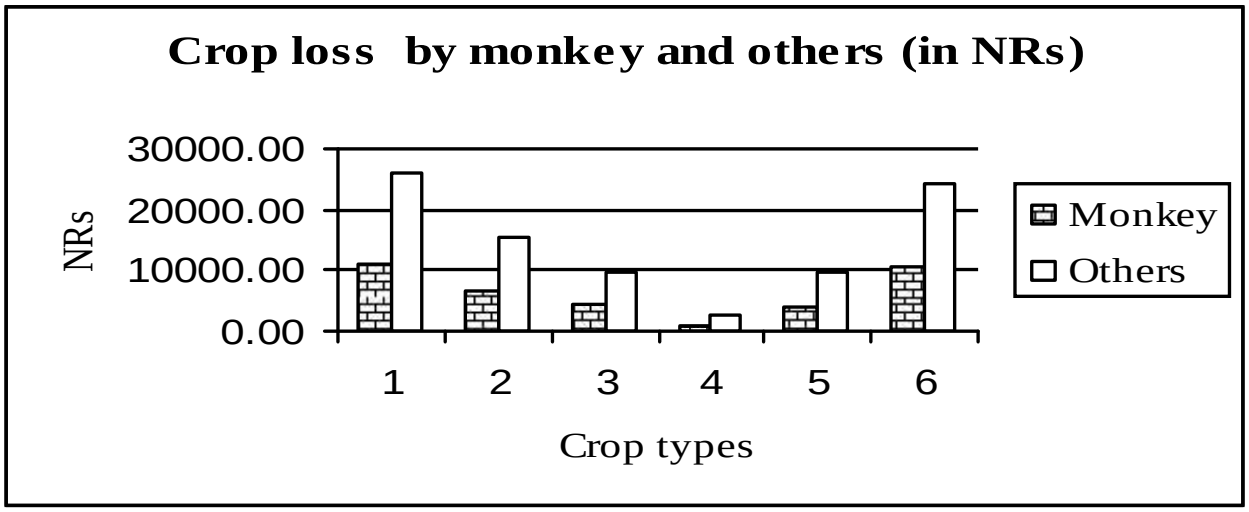


Fig. 21: Different crops loss by chital, elephant and parrot.



Note: 1 = Paddy; 2 = Maize; 3 = Lentil; 4 = Wheat; 5 = Mustard; 6 = Vegetable and others. NRs. = Nepalese Rupees

Fig. 22: Different crops loss by monkey and other animals.



Note: 1 = Paddy; 2 = Maize; 3 = Lentil; 4 = Wheat; 5 = Mustard; 6 = Vegetable and others. NRs. = Nepalese Rupees

5.2 IMPACT OF FOREST

5.1 TYPE AND TREND OF WILDLIFE HARASSMENT (PEOPLE'S PERCEPTION)

Table 42 shows that there was increasing the wildlife problems like crop damage and wealth/property loss mainly due to livestock depredation, which is beyond the scope of this study, in recent years than in previous years. This is mainly attributed to the expanding forest area and its vegetation along with the wildlife species, mainly the leopard (Pers. comm. with local people).

Crop damage problem is also considerably increasing in recent years. To be 63.9 % and 28.8% people's response on 'no crop damage' for the last year (2003) and this year (2004/5) is mainly due to 'no crop damage' situation in Study Zone III where only 2.77% households reported crop damage. Despite it, the crop damage problem is considerable in other study zones.

Table 42: Wildlife-harassment type, frequency and percentage of people's for last / this year.

Problems last year		Problem this year	
Response	Percent	Response	Percent
Crop damage	33.7	Crop damage	63.5
No crop damage	63.9*	No crop damage	28.8*
		Wealth/property loss	7.5
No response	2.4	No response	0.2
Total	100.0	Total	100

* Mainly from Bharatpur (Study Zone III)

Table 43: People's perception on crop damage problem growing every year.

S. N.	Response	Frequency	Percent	Valid Percent	Cumulative Percent

1.	Yes	261	59.2	59.2	59.2
2.	No	170	38.5	38.5	97.7
3.	Don't know	10	2.3	2.3	100.0
Total		441	100.0	100.0	

Fig. 23: People's response on wildlife-harassment type and percentage.

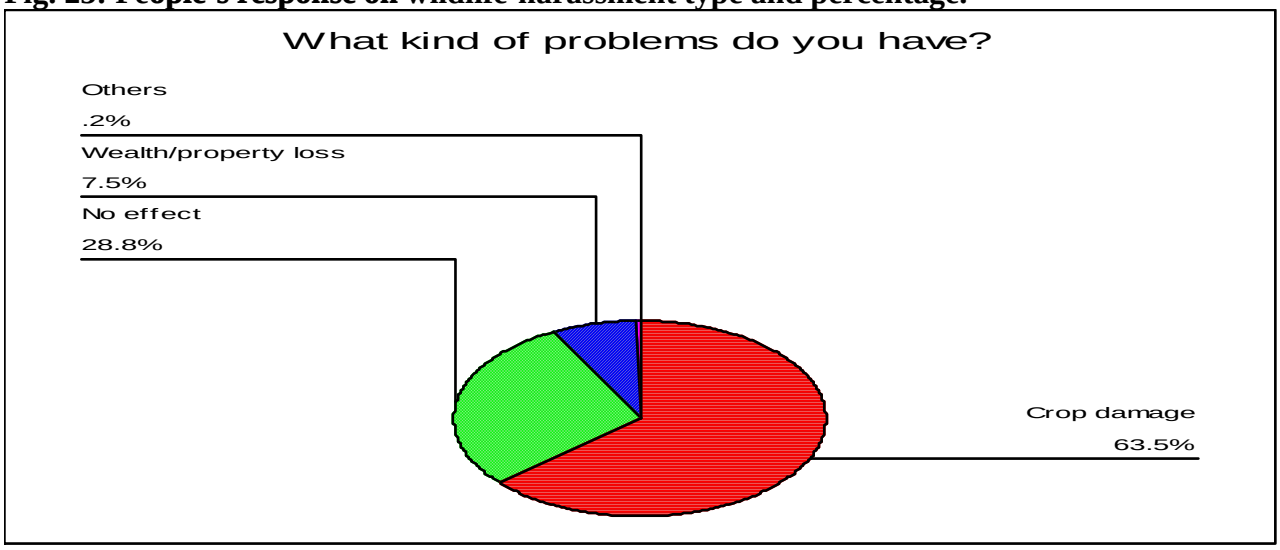


Fig. 24: People's perception on crop damage problem growing every year.

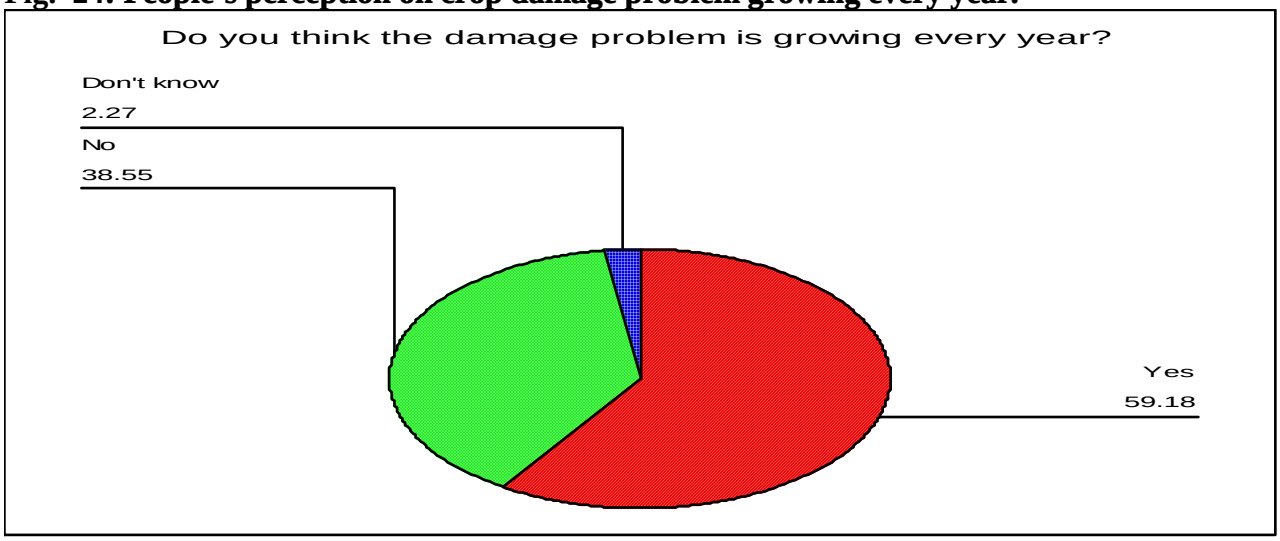
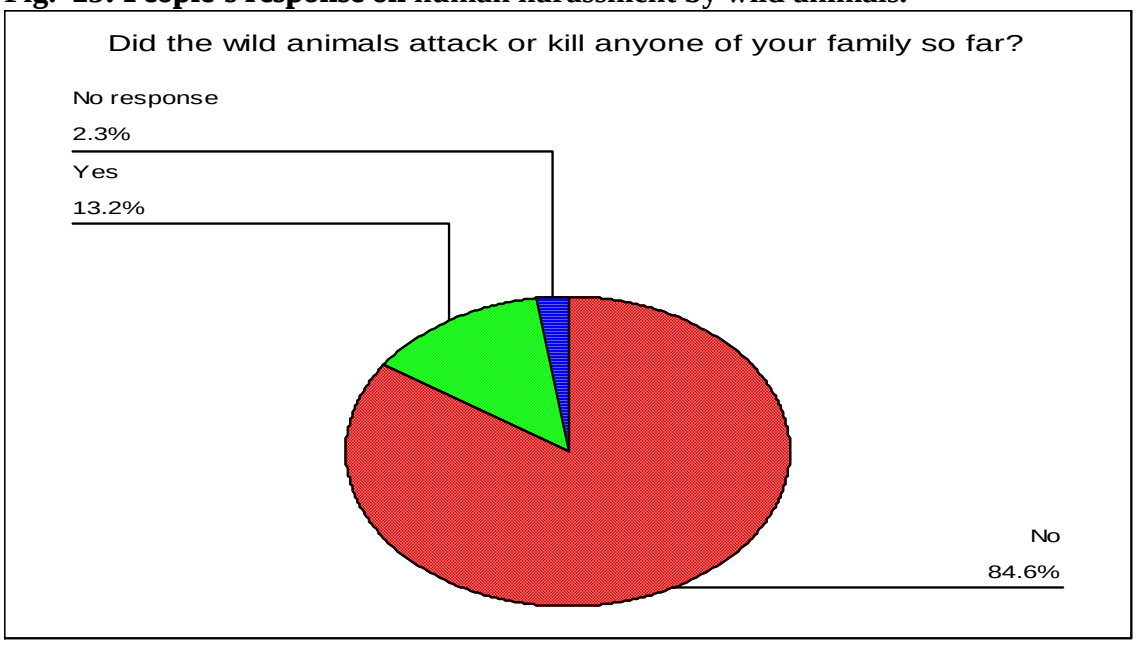


Table 44: People's response on Human Harassment by wild animals.

Question: Did the wild animals attack or kill anyone in your family so far?

S. N.	Response	Frequency	Percent	Valid Percent	Cumulative Percent
1.	No	373	84.6	84.6	84.6
2.	Yes	58	13.2	13.2	97.7
3.	No Response	10	2.3	2.3	100.0
Total		441	100.0	100.0	

Fig. 25: People's response on human harassment by wild animals.



5.5.2 CAUSES OF CROP DAMAGE

The field study (NAD) and questionnaire survey (GAD) indicate following are major causes of crop damage.

5.5.2.1 LACK OF EFFECTIVE PHYSICAL BARRIER

Strong physical barrier is important to check crop damage from wild animals. In the study area, it was observed that fences, the principal barriers, were broken in many places which were the way for their entrance into the agricultural field. Local people's view was that rigid brick wall would be very effective which check the wild animals to come outside the forest and the domestic animals to enter into the forest.

5.5.2.2 LACK OF SUFFICIENT FOOD INSIDE THE BCF AND CNP

According to the Bhattarai (2003), there are more than 2400 domestic cattle inside the forest in the year. On the one hand, there may be high competition between wild animals and domestic cattle both inside the BCF & CNP for their subsistence. On the other hand, the open boundary/access between the CNP and the agricultural land is also a major factor to be the frequency of wild animals more in the southern part of BCF; Bachhauli, Patihani and Gitanagar. So wild animals, mainly the ungulates, might have come out of the forest and damage the agricultural crops.

5.5.2.3 FLOOD

Both the BCF and CNP lie in the alluvial floodplains of the Rapti and Narayani rivers with frequent annual flood in them and their tributaries like Dhungre, Budhirapti and Khageri. The percentage of damage increases in the year when the flood is severe in those tributaries.

5.5.2.4 TASTE OF AGRICULTURAL CROPS

It is unusual to see why animals of the protected areas are attracted to areas with grain or other crops. Ripening crops are richer in protein and carbohydrates as well as some mineral nutrients than most of the wild plants available in the adjacent forests. Agricultural crops may be testier than wild plant species. In spring season, wild animals come less frequently outside the forest, BCG and CNP, because they find nutritious food inside the forest. Unlike forest plant species, many of which grow in isolated stands or scattered though out the forest, agricultural crops occur in relatively large, concentrated stands. Thus the animals of the protected areas to have such items do not have to expend much energy searching for foods.

5.6 WILDLIFE PEST RANKING

Present study attempted to rank the status of some pest species. People were asked to rank their view, which they consider or serious wildlife pest species. The findings are given in the table 45.

Table 45: Wildlife pest ranking in different VDCs or villages around BCF.

Area and Village	Rating *	Wildlife Pest Species							
		Rhino	Boar	Sambar	Spotted deer	Barking	Eleph	Parrot	Others+
Zone I: Tikauli N = 53 TP = 212	Rating	168	93	104	138	38	2	146	3
	% of Rating	**79.24**	43.86	49.057	65.1	18	0.94	68.87	1.41
Zone I: Bachhauli N=68 TP = 272	Rating	217	169	118	116	13	57	189	2
	% of Rating	**79.77**	62.13	43.38	42.6	4.8	20.95	69.49	0.735
Zone II: Padampur N=68 TP = 272	Rating	82	129	65	61	25	7	161	54
	% of Rating	30.14	**47.42**	23.89	22.4	9.2	2.57	59.19	19.85
Zone II: Jutpani & Ratnanagar N=33 TP = 132	Rating	108	66	47	68	22	6	101	30
	% of Rating	**81.81**	50	35.60	51.5	16	4.54	76.52	22.73
Zone IV N = 111 TP = 144	Rating	197	338	75	43	5	3	43	23
	% of Rating	44.36	**76.12**	16.89	9.68	1.1	0.67	9.68	5.18

TP = Total Points; + includes animals: jackal, monkeys, porcupine etc. N = number of household sampled. * The figure refer number of total points given by respondents, for each response rank 1:4 points 2:3 and 3:2. Thus, the total point for each response with N = 53 is 212, N = 68 is 272, N = 33 is 132 and N = 111 is 444. The percentage is calculated as ration divided by total points in each response.

From the table 45, it is clear that rhinoceros (*Rhinoceros unicornis*) is the main wildlife pest species followed by wild boar (*Sus scrofa*) and the deer species. In some areas their mobility was found different in different sites and the villages. That was mainly attributed to their seasonal behaviour as per the crop types in the adjoining crop fields, and their population status in the respective

community forests. Other animals including monkey, sloth bear, jackal, birds (parrots), porcupine, occupy the last rank.

In this study, rhinoceros (*Rhinoceros unicornis*) became the first major pest with 79.24 %, 79.77% and 81.81% in Zone I (Tikauli village of Ratnanagar municipality and Bachhauli), Zone II (Jutpani and Ratnanagar municipality's few wards north from the Mahendra Highway). Where as wild boar (*Sus scrofa*) with 47.42% in Zone II (New Padampur VDC) and 76.12% in Zone IV (Gitanagar VDC and Patihani VDC) was found the most serious crop pest. Like wise among the deer species, spotted deer's first rank in Zone I was noted to be 65.1% and 51.5% in Tikauli and in Jutpani and Ratnanagar areas.

Similarly Sambar deer alone occupied the first-rank position with 43.38% Zone I (Bachhauli VDC's Malpur and Bodreni villages) and 16.89% in Zone IV. Besides note able rank presence (20.95%) of elephant in Bachhauli, its affect was found nominal in other areas.

Despite the above fact, the contribution of parrots also can't be underestimated as its rank was noted to be 68.87%, 69.49%, 59.19%, 9.68% and 76.52% in Tikauli and Bachhauli of Zone I, Zone II (Padampur VDC) and Zone IV respectively. See table 46.

Table 46: Zone wise rating of megafauna.

Wildlife Pest Species	Zone I (n = 121)			Zone II (n = 101)			Zone IV (n = 111)		
	Rating	Total Points	% of Rating	Rating	Total Points	% of Rating	Rating	Total Points	% of Rating
Rhino	385	484	**79.54**	190	404	47.03	197	444	44.369
Wild Boar	262	484	54.13	195	404	**48.27**	338	444	**76.13**
Deer Species	527	1452	36.29	288	1212	23.76	123	1332	9.23
Others	399	1452	27.5	359	1212	29.6	69	1332	5.18

5.7 LIVESTOCK POPULATION

Animal husbandry, an important on farm activity, plays a vital role in human economy. In the past, keeping large herds of different animals was a symbol or high status and prestige. Even today it is considered as a matter of prestige in Tharu communities (Jnawali, 1989). The majority of the people in the study area are subsistence farmers, where livestock is the important component of their farming system. So people were asked about their total number of livestock of different types in order to estimate mean number of livestock per household. Mean number of livestock per household observed during the present study is given in the table 47.

Table 47: Livestock type, their population and number of households.

Cattle	Population	% of population	Household	%Household	Mean

Cow	364	20.19	179	24.76	2.03
Buffalo	605	33.56	314	43.43	1.93
Goat	737	40.88	207	28.63	3.56
Pig	97	5.38	23	3.18	4.22
Total	1803	100	723	100	

Fig. 26: Livestock population and number of households around BCF.

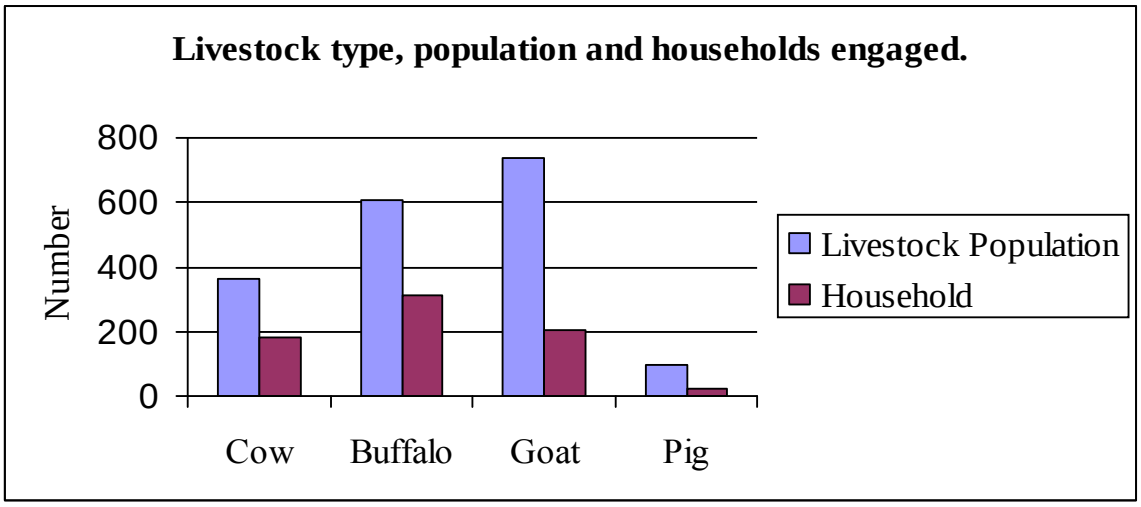
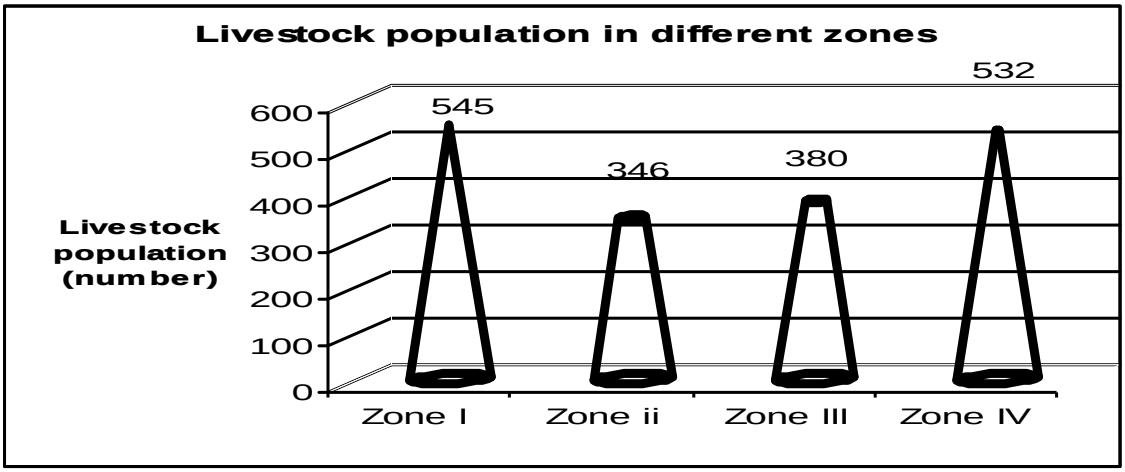


Fig. 27: Zone wise distribution of livestock population.



The most popular animals are cattle and other animals include buffaloes, goats, which are common. At present on the average, a household owns 2.49 animals. Farmers need livestock to plough their fields and also to pull bullock-carts by very few people in Chitwan district in recent days. But the later is still found greatly practiced in almost Terai region of the country, as mentioned by Adhikari (2000), and has become the only means of carrying loads in rural dirt roads, to provide dairy products for household needs, to produce manure for fertilizer and as security, since animals can be sold in time of need. Crop by-product can be utilized to feed the animals.

In the villages around BCF most of the households who practice farming also raise livestock. Households which do not have farmland raise livestock as their main means of livelihood. The area

around BCF is relatively important in terms of livestock rearing because majority of the population, the poor and marginalized groups, living around the forest are found to have adopted it as the major supplementary IGA since they have no any option to be engaging during the off season of their cropping system. Next fact is that the Tharus are traditional cow-herders (Majupuria, 1991), and thus they are more associated with the forest resources via this occupation.

Bhattarai (2003) had found from the interview with the local people in the year from eastern part of BCF that 72.7% respondents had agreed that livestock were using the same habitat used by wild ungulates. He had further noted that there were 2432 numbers of livestock regularly grazing inside the forest mainly along the village forest border.

But, after the innovation of successful community programme and buffer zone policy where being implemented in recent years, the fencing of the forest edges, restriction to take their cattle into the forest and the consumption of forest resources including the collection of fire wood, thatch and fodder, few/no cattle were observed grazing in side the forest. As a result, the forest at the moment is found dense. This has on the one hand further intensified the forest vegetation along with the increasing population of the ungulate and prey species (KMTNC, 2004). On the other hand the existing mechanism is not found to be effective to harmonize the conservation practices and to reduce the wildlife-people conflict (Pers. com. with the villagers and the key personnel).

5.8 SOURCE OF CONFLICT

Protection of natural environment through the establishment of reserves and parks are of great importance to mankind. But the establishment of national parks and reserve became a matter of conflict in developing countries as well as in most developed countries. National parks and wildlife reserves of Nepal are no exception to this. The conflict is due to problem arisen between reserve and local people. There are two types of problem concerning the conflict in and around BCF as problem created due to forest and problem created due to local people.

5.8 PROBLEM CREATED DUE TO FOREST

5.8.1. Human Harassment and Crop Damage

Crop damage due to wildlife is very serious problem in the study area. The wild animals like rhinoceros (Rhinoceros unicornis) and wild boar (*Sus scrofa*) are the most destructive animals. Major crops like paddy, wheat, mustard, potato and kitchen garden plants are affected severely. They do not destroy the crops by eating only, but also by their heavy trampling through a single line during the night time. Wild boars raid on potato and maize during night time. Most of the villagers had spent overnight in a Machan built in the central part of the crop field to avoid crop damage by wild animals. Although their crop is damaged by wild animals, they do not get compensation from the park and the BZC. This study showed a heavy economic loss of NRs. 1774438.46 based on

NAD method. Similarly, the reported economic loss was NRs. 1658.35 per household on the average. Likewise, GAD estimation revealed the loss of crops of total worth NRs. 2505135.98 with average household loss of NRs. 2996.57.

5.8.1.2 Human Harassment

Every year, people are killed or injured by the wild animals. During the collection of thatch grass, many people are injured due to attack of rhinoceros (*Rhinoceros unicornis*), tiger and sloth bear. People are also killed during harvesting period. Sometimes, rhinoceros (*Rhinoceros unicornis*) and wild boar (*Sus scrofa*) may stay in the field overnight and it may kill during the encounter to man. Therefore, risk for people is in night duty.

Two dozens persons were killed by wild animals in and around CNP. Of these two persons were killed while working in their private field and 6 persons were killed while collecting firewood/grass from community forest (Bhatta, 2005). The scenario is same every year not only in and around CNP, but also is common in other protected areas of Nepal.

5.8.1.3 Human Harassment Lack of co-ordination and consideration of people's voice.

Livestock inside the CNP are occasionally impounded by park staff and fines are imposed on owners. Similar is the case for the community forests. The community forests which are handed over the CFUGs are ruled by the respective CFUG. But the community forests which are not still handed over the CFUGs and are under the jurisdiction of DFO are neither responsible to the management nor are satisfied with the mandate and the DFO's procedure.

Like wise, community forests which are designated at BZCFs and affiliated are under BZC, they are also not satisfied with the dual and tedious procedural mechanism of both authorities. Since people are restricted to their rights that they had been enjoying, they are not made liable to be benefited with the facilities (like compensation to the casualty/death and crop damage by wildlife) about which the authorities are proud of talking with the people and the media. Local people are so far not convinced that they would benefit or compensate their loss to some extent. There lacks working mechanism to know and address the voice of the local people. Few units or cells yet formulated if they expose to the community and thus collect and attempt once to facilitate the compensation procedure by communicating with the concerned authority, the effort simply remains to be attempted in most case. In return they can't attempt to proceed ahead again. The people who spend their whole night in their own field do have demand of raw materials to build the Machan and fence their crop field. They say that "We don't know where to go and how to go to demand the compensation which is thought to be nominal as it hardly covers just the seed money. We can simply at least can sustain our family, if we could prevent our crops."

Adhikari (2000) also reported that wild boar (*Sus scrofa*) once broke the bones of a man while working in his crop field near KTWR but he was not provided anything and any help from the reserve. So he stressed "while the reserve is not responsible for such accidents, wildlife produces conflicts between park and people." There was also not a fixed charge or fine for any particular activity. Besides, penalty rates for illegal activities depended solely on the staff's discretion. He reported it as problem and a reason that unjust penalty is one major conflict in KTWR.

Further more, a notable problem in the study area was the crop compensation scheme. From the key personnel and the local farmers, it was known that a little money as a compensation of the seed-value money of damaged crops had been providing. But, this money/scheme was neither enough to attract the farmers, nor was easily accessible due to its ineffective mechanism. Farmers who are living close to the forest boarder are busy either in crop fields or in rearing their cattle through out the year for their subsistence livelihood. Although they must be the first target group of compensation scheme in fact, they did not like to report the assessment of damage to the concerned authority which would take two days, at least, to many days.

People who were almost not busy in agriculture and were supporting their family from other sources of income like job or business are still benefiting the seed value compensation worth. Thus besides the seed-value money, money value covering some part (say at least 60% at the beginning) of damaged crop has to be increased along with the enhancement of assessment procedure and the dissemination mechanism. Otherwise, some elite groups who do have easy-link/access to and do not have to be busy on farming and rearing cattle through out the year, unlike the poor people living very close to the forest, will be benefiting the scheme.

5.8 .2 PROBLEM CREATED DUE TO LOCAL PEOPLE

5.8.2.1 Utilization of Natural Resources

Prior to the establishment of the park and the innovation of community forestry programmes in BCF people enjoyed forest. They were free to collect timber, fodder, firewood, thatch and grasses. With the strict delineation and expansion of forest land by plantation on the community land that had been using by the local people to graze their cattle and declaration of southern BCF as buffer zone community forests to be ruled under BZ management policy, restriction were imposed to these natural resources. They have been legally restricted from using their traditional rights over the resources. It is one of the reasons that cause conflict between park and people.

5.8.2.2 Livestock Grazing

Livestock rearing is an integral part of the economy. Since most of the pasture lands are now fenced and made the community forest, and few left patches around BCF are overgrazed, there are no alternative pastures that ate readily accessible. The only available grazing areas lie within the forest.

Since livestock grazing within the forest is banned, livestock have been caught by the forest staff on several occasions, and owners are penalized.

Farmers stall feed their livestock on dried food, notably, the by-products from their crops is not sufficient. Though there seems the forest as if it is expanding and being conserved the trees with in the fenced areas, some of the villagers still leave their livestock inside the forest. This does not sustain longer, if alternative support is not provided to the people.

5.8. 2.3 Hunting and Poaching

Hunting and poaching are other illegal activities that create conflicts between the forest and the local people. Conflicts and retaliations with other wild animals are common, regular and usual phenomena for co-existence with between human being and wildlife. Although not severe, most of the killings of wild animals in the area as well as in and around the CNP are mainly for subsistence as the wild animals interfere with the subsistence livelihood of the people. Many people are involved in poaching wild animals. The dramatic decline of rhino population from 612 to 376 from 2000 to 2005 with note able killings of 16 rhinos in one year (2060/2061 fiscal year) in our country clearly illustrates the poaching threats on wildlife. Likewise, the poaching of other endangered animals like royal bengal tiger is also alarming.

On the one hand, no satisfactory mechanism we do have in addressing this issue. In the recent years, the justice system is not found to be effective in punishing the trapped poachers, though there lacks effective controlling mechanism at the national level leaving the matter at the grass root level. This can be well known from that both the state and the national justice system are not capable in punishing (penalty and imprison), rather protecting, the caught poachers (Dristi and Kantipur National News Letters, 2005). It further indicates that there is greater role of high level personnel in promoting the illegal hunting of wild animals. If the top level poachers are protected from the state, it can’t be solved only by the effort of few individuals and the bodies at the grass root level.

On the other hand, naturally and since historical time, local people are having subsistence livelihood with greater dependency forest resources. If they are not considered a major component of ecosystem and conservation; only the approach on forest, trees and wildlife can’t act longer. The direct interference of wild animals in human community is not necessarily to be tolerated by the people, if they are not made liable to be the stakeholder.

Local people are mainly involved in hunting wild animals by two reasons: conflict due to wildlife interference in the adjoining areas (crop damage, harassment and wealth and property loss), and poverty (socioeconomic cause). People in the area kill wild animal, for example wild boar (*Sus scrofa*), as a principle of struggle for existence when it damages their crops. Likewise, deer and wild boar are also killed by the local people of the adjoining areas of BCF for meat and to earn money.

Since there is increasing killings of rhinoceros (*Rhinoceros unicornis*) in recent years and there have been found poachers to be outsiders of the protected areas like in Annapurna Conservation Area (ACA) as reported by Gurung (2005), they might have been having back support from some of the locals (Bhattarai, 2003 reported wild boars reared by the local people) and the merchants in the area. Like wise, people are also involved in timber poaching. Cutting of timber and fodder destroy wildlife habitat greatly during dry season. It has a great effect on wildlife.

5.8.2.4 Fishing

Fishermen are mostly landless, and fishing is often the only source of income for them. Because fishing activities are prohibited inside the park, more pressure is exerted on water bodies and marshes outside the park, where intensive fishing is carried out. For instance, frequent fishing can be observed in Bishazari tal. In addition, some people fish illegally in the main stream of the Rapti, Budhi Rapti and Narayani River. The vegetation in these wetlands, marshes and oxbow lakes are removed by the fishermen to facilitate mash fishing. The removal of vegetation not only eliminates some plant species but also disturb natural succession. Similarly, fishing activities during spawning period (spring season) affect the growth of the fish populations. Prohibition of for fishing is another reason for causing the conflict between park and people.

5.9 PREVENTIVE MEASURES

5.9.1 Preventive Measures To Conserve Forest and Their Effectiveness

5.9.1.1 Boundary Fence

To make the boundaries identifiable and to minimize crop damage by wild animals, local farmers desire fences around the forest. The fencing some where is damaged in part both by animals and the people who would often steal the wooden poles and fencing wire. This acts a nice corridor for wildlife to enter crop land. Concrete poles may be more permanent material. In some cases it does not act for the rhinoceros (*Rhinoceros unicornis*) and the elephant. In such case, electric fencing becomes the most effective one as demanded by the local people during this study. Furthermore, any fencing program would needs to be integrated together with other strategies, such as extension of the forest to include the complete home ranges of the wild ungulates and improve participation by local communities in the management of the forest and buffer zone.

5.9.1.2 Preventive Measures Used by Local People

The problem created due to wildlife has become very serious day by day. Wildlife damages large amount of crops every year. So, some preventive measures have been developed by local people to distract the wild animals feeding on crops and to drive them away from the crop field. Although, they have tried some preventive methods, it did not seem to have more significant as it was most

labour and primitive. Number of respondents and percent of local preventive measures used by the local people are shown in the table 48.

Table 48: Solution of crop damage, people's opinion on effectiveness of methods of remedy.

S. N.	Measures	Frequency	Percent	Cumulative Percentage
1.	Fencing/wiring	25	5.7	5.7
2.	Trenching	44	10	15.7
3.	Fencing and trenching	19	4.3	20
4.	Electric wiring	29	6.6	26.6
5.	Machan	10	7.9	34.5
6.	Tin box	6	2.3	36.8
7.	Shifting near village	22	5	41.8
8.	Killing rhino/wildlife	4	0.9	42.7
9.	Compensation	122	27.6	70.3
10.	Willing alternatives	131	29.7	100
	Total	441	100.0	

Above table shows that only 36.8% local people are still found to have been using six major types of preventive methods to protect their crops. Of the rest population 29.7% people don't have any better idea. 5% people argued on shifting the villages near to forest edge. Though the figure shows 27.6% people willing to have compensation scheme as they were provided the structured questionnaire to choose single answer with no more alternatives, almost all the people prefer the compensation scheme. The measures like fencing/wiring, trenching, fencing and trenching both need much labour and are not durable. Thus the electric wiring and the compensation are the only effective tools of reducing the crop damage and the harmonizing the sound relationship between the people and the forest.

5.9.1.2.1 Machan

A small cottage (platform with roof) locally known as Machan, shedded with thatch grass, is erected prior to the maturity of the crop for guarding purposes. Generally, Machans are made in the center of their field with bamboo pole, so that they can see all crop raiders from there. Machan guarding is one of the most effective methods being adopted by the local people. The time spent in Machan defending their crops against wildlife raids, lack of sleeping and separation from their families at night create tension and inefficiency in local people. Their health condition would become poorer to poorer day by day. Further more, in the dark phase of moon it is very difficult for the people to trace wild animal in the field. Thus, only 8% people, mainly the tharus, were found using the Machan. One more reason of less usage the Machan was lack of raw materials which are strictly prohibited by the respective FUGs.

5.9.1.2.2 Scaring Devices

Various types of scaring devices are needed to chase animals away from the field. Rhinoceros (*Rhinoceros unicornis*), deer and wild boars are mainly frightened by flash of light. So, people use fire on a stick and high voltage torch to scare animal. This method is mainly used by the people who guard their crops by using the Machan. From the study 2.3% respondents were found to use this device.

One of the popular methods for scaring wild animals was making scare-crow (Mukunda) in the crop field. Scare-crow is a figure resembling a person that dressed in old clothes. Since it is easy to make by using few pieces of sticks and old clothes, 42 percent respondents made scare-crow (Mukunda) in their crop fields.

Similarly, a tin plate supported by two wooden poles is hit by a thick and heavy wooden piece. This method was also used by local people. It was found that 2.3 percent respondents used this method by tying a string fro a tin box fitted at their crop field to their houses. This method is almost used by the people who guard their crops from Machan.

Similarly, making loud noise as like 'Ho-Ho, Ho-Ho' is an effective method in chasing wild animals. From the study, 54.7 percent respondents were found using these scaring devices.

The mobility of wild animals is varying with the crop type (season) and the area. Of the wild animals, rhinoceros (*Rhinoceros unicornis*), chital and boar are the most serious crop pests in the area respectively. Though there exist few traditional measures being adopted by the local farmers in the adjoining areas to prevent their crops, Machan, fencing and scaring devices are not satisfactorily successful due to the lack of adequate materials and the maintenance.

People are expecting effective mechanism of economy-relief against the raided crops and benefit-sharing of the resources by sustaining their indigenous practices. Other alternatives like income generating activities and use of wildlife resistant varieties in order to uplift their subsistence livelihood would not only reduce the pressure on the forest resources, but would also harmonize the wildlife-people relationship for the sustainable conservation.

5.9.1.2.3 Traditional Means Applied to Reduce Crop Damage

There were quite a number of traditional methods applied by local villagers to remedy the crop damage problem. Among them, Machan/house guarding, Mukka, Bunkhyacha, trench and fence are the most commonly used methods.

Table 49: Traditional means applied to reduce crop damage.

Means	Paddy	Maize	Lentil	Wheat	Mustard	Vegetables and others
Machan/Houseguard	√	√	√	√	√	√
Mukka(ranko)	√	√	-	√	-	√
Tin bell	-	√	√	√	√	√
Baiting sticks	√	√	-	√	-	√
Throwing stones	√	√	√	√	-	√
Lamp (Whole night)	-	-	-	√	√	√
Plastic Flag	-	√	√	√	√	√
Bunkhyacha	-	-	√	√	√	√
Trench	√	√	√	√	√	√
Fence	√	√	√	√	√	√

(√ indicates the methods applied to remedy individual crop damage)

The common crops in the crop fields around BCF are paddy, maize, mustard, lentils and vegetables. During rainy season most of the farming lands were covered with paddy and partly with maize and vegetable crops.

Table 50: People's perception the crop damage measurement mechanism.

S. N.	Opinion	Frequency	Percent	Cumulative Percent
1.	Park warden	35	7.93	7.93
2.	Army officer	4	0.9	8.83
3.	VDC leaders	210	47.62	56.45
4.	Farmer	27	6.12	62.57
5.	Buffer zone	34	7.7	70.27
6.	Government's mechanism	130	29.48	99.75
7.	No response	1	0.22	100
	Total	441	100.0	

5. DISCUSSION

This study was conducted in the human settlement areas adjoining the periphery (forest boarder) within one km distance. Five VDCs; Bachhauli, Gitanagar, Patihani, Jutpani and Padampur (New), and 2 Municipalities; Ratnanagar (Ward Number 5, 6, 7, 8 and 10), Bharatpur (Ward Number 8, 9, 11 and 12) were the study sites for this purpose.

This study shows two types of problems concerning conflicts. They are i) problem created due to forest and Park and ii) problem created due to local people. The first types includes a) crop damage b) human harassment and c) lack of co-ordination, while second type includes a) utilization of natural resources b) livestock grazing c) hunting and poaching and e) fishing.

In past, many investigators identified park and people conflict in National Parks and Wildlife Reserves of Nepal. Milton and Binney (1980), McNeely (1984), Upreti (1985), Jnawali (1989), Sharma (1991) and Shrestha (1994) made very important contribution in the subject. Upreti (1985) found i) crop damage ii) encounter between man and wildlife iii) loss of livestock by predator and iv) tourism as the causes of conflict.

Sharma (1991) identified four causes of conflicts in CNP. They were i) regulation of CNP 2030 (HMG, 1994) ii) crop and livestock depredation iii) loss of human life by wild animals and iv) river erosion. Shrestha (1995) described clearing of forest for agriculture, grazing of livestock, lopping of trees, burning of grasses, collection of thatch-grass, harmful fishing methods, and development projects were major factors of conflict in BNP.

Shrestha (1994) and Upreti (1995) identified park regulation, crop damage, livestock depredation and loss of human life as sources of conflict in CNP, and Sharma (1995) in KTWR. Gautam (1999) reported four major sources of conflict. They were i) fuel wood and fodder ii) crop damage iii) livestock grazing and iv) harassment.

Rhino and wild boar (*Sus scrofa*) were found to be two major wildlife pests in the study area. Spotted deer (*Axis axis*), jackal (*Canis aureus*), birds and porcupine (*Hystrix indica*) were occasional raiders. Sharma (1991) found rhinoceros (*Rhinoceros unicornis*) as number one crop raider followed by wild boar (*Sus scrofa*) and chital (*Axis axis*) in CNP.

Shrestha (1994) and Upreti (1995) also identified rhino (*Rhinoceros unicornis*) as principal crop raider in CNP, while Poudel (1995) found wild boar (*Sus scrofa*) as principal crop raider in then Shivapuri Watershed and Wildlife Reserve (SPWSWR; now Shivapuri National Park since 2002). Gautam (1995) found wild elephant (*Elephas maximus*), wild boar (*Sus scrofa*) and chital (*Axis axis*) as main crop raider in SWR. Limbu (1998) and Sharma (1995) reported wild buffalo (*Bubalus bubalis arnee*) and wild boar (*Sus scrofa*) as maim crop raider in KWTR.

Nepal and Weber (1993) found rhinoceros (*Rhinoceros unicornis*), chital (*Axis axis*) and wild boar (*Sus scrofa*) as principal crop raider in CNP. Kharel (1993) in Langtang National Park, found wild boar (*Sus scrofa*), Himalayan black bear, monkey and deer species as major crop raiders.
Present study showed that total crop damage by wild animals was 127774.9

kg by NAD for the year 2004-2005 and 193509.31 kg by GAD method for the previous year (2003-2004) with their monetary value in NRs. 1774438.46 and 2505135.98 respectively. The average household loss in NRs. was 1658.35 and 2996.57 by those methods for the years respectively. Out of total damage of the principal crops estimated by NAD method, paddy came to be first with NRs. 533622 kg (29.45% of total damage) followed by maize (NRs. 312382.6; 17.60%), lentil (NRs. 199902.9; 11.26%), mustard (NRs. 196101.73; 11.05%) and wheat (NRs. 49304.27; 2.78%). Likewise, vegetables and others grown in kitchen garden were also severely affected with total loss of NRs. 117471.85 (27.84%). Of the total four study zones divided on the basis of location from the Mahendra Highway and the forest patch extended from the northern boundary of CNP to the basin of Mahabharat range, Zone I consisted of 40.41% of total damage followed by Zone IV (35.62%), Zone II (22.29%) and Zone III (1.68%).

Despite the above scenario, GAD (estimation from questionnaire) revealed that the most affected crop was maize 43.37% followed by paddy 30.62%, vegetable and others 13.66%, lentil 6.62%, mustard 4.94% and the wheat 0.78% (the least) damage for the previous year. This result shows the heavy loss for the maize in the previous years was attributed to the weak fencing system/mechanism which was intensified and made effective later.

Comparatively, a heavy economic loss of 717018.4 rupees was estimated by NAD method due to damage of agricultural crops by wild animals in the eastern part (62.7%) of BCF; where as, a total loss of NRs. 29731.81 (37.3%) was in the western part of BCF. Likewise, the total crop loss was in

the buffer zone was 1349131.83 and outside the buffer zone was 425306.61 with percentage value of 76.03 and 23.97 respectively. Among the wild animals, rhino (*Rhinoceros unicornis*) was found to be serious pest species economically (34.56%) followed by wild boar (*Sus scrofa*) which contributed the loss of 26.67% followed by Chital (*Axis axis*) 15.47%, parakeets 10.48%, sambar 2.79%, monkey 2.09%, and other animals caused loss of 4.95%.

Sharma (1991) calculated crop damage by two methods, Interview and NAD. He found real crop damage was five times less by NAD method than interview method. Upreti (1995) also found 2.5 times less crop damage by NAD method than interview method in CNP. But in this, the NAD estimation of crop loss is 1.5 times less than the GAD estimation. In CNP, Sharma (1991) calculated by NAD method that rhino (*Rhinoceros unicornis*), wild boar (*Sus scrofa*) and chital (*Axis axis*) destroyed 43.7 percent, 28.3 percent and 18.3 percent of total crop damage respectively.

Nepal and Weber (1993) calculated rhino (*Rhinoceros unicornis*), wild boar (*Sus scrofa*) and chital (*Axis axis*) destroyed 60 percent, 27 percent and 12.9 percent of the total crop damage respectively.

This was found similar in case of BCF as well from this study. Thus, it can be predicted that the nature of mobility of wild animals and the proportion of damage caused by them in the respective adjoining areas of CNP and BCF is same.

Poudel (1995) in SPWSWR calculated loss of 0.96 metric tons of paddy which was 2.06 percent of total production. Similarly total loss of wheat, maize and millet were 15.37 metric tons or 30.41 percent, 31.5 metric tons or 35.21 percent and 41.93 metric tons or 47.36 of estimated production. He calculated that wild boar (*Sus scrofa*) destroyed maize, wheat and millet by 85 percent, 70 percent and 90% of total loss respectively.

In CNP, Shrestha (1994) found Bodreni as the most affected with annual loss of 38.5 percent in its total production. The loss was 50.88 percent for maize, 25.5 percent for paddy and 6.60 percent for mustard respectively. The second highly affected area was Padampur where 22.56 percent of the total production was estimated as crop loss. The loss was 25 percent for maize, 24.00 percent for paddy and 5.33 percent for mustard. For Sauraha and Baghmara the figure were 11.53 and 13.98 percent respectively.

Sharma (1995) in KTWR calculated that wild boar (*Sus scrofa*) destroyed potato, paddy and wheat

by 67.76 percent, 21.17 percent and 11.07 percent of total loss respectively in P. Kusaha VDC. Similarly in Shirpur VDC potato, wheat and paddy was 49.27 percent, 33.83 percent and 16.89 percent of total damage.

Kasu (1996) in PWR calculated the loss of 23857 kg for paddy which was 77.52 percent of the total paddy damage. Similarly, total loss of wheat and maize were 4896 kg or 15.91 percent and 2022 kg or 6.57 percent respectively. He found that deer, boar and elephant destroyed 52.20 percent, 32.61 percent and 15.19 percent respectively of total crop damage.

In SWR, Gautam (1999) calculated a heavy economic loss estimated at NRs. 947470.19 of which 33.26% occurred in ward number 19 followed by 27.42% in ward no. 13, 15.30% in ward no. 18, 14.28% in ward no. 15 and 9.27% in ward no 14 of Mahendranagar Municipality. Highest economic loss 74.28% was estimated to paddy crop followed by wheat (17.08%) and maize (8.62%). Among the wild animals, highest economic loss 43.29% was estimated by wild elephant followed by wild boar (28.67%), chital (24.09%) and blue bull (3.92%). The reported loss of crop to wild animals ranged form 61.62 kg to 126.33 kg per household.

Baral (1999) in BNP, estimated a heavy economic loss of Rs. 2095346 of which 52.73% occurred in Thakurdwara and 47.27% in Shivapur VDC. Highest economic loss (28.32%) occurred to paddy crop, followed by potato (15.40%), maize (15.21%), wheat (13.80%), musuro (12.42%) and yam (7.57%). The reported loss of crop to wild boar (*Sus scrofa*) ranged from 166.39 kg to 205.51 kg per household.

Limbu (1998) calculated a total crop loss of 117517 kg of which 65240 kg of paddy, 37967 kg of wheat and 14310 kg of potato were damaged on P. Kusaha VDC, area adjacent to KTWR. The study estimated the total economic loss of NRs. 831966. Highest economic loss 54.89% was estimated to paddy followed by wheat (36.51%) and potato (8.60%).

In this study, a household owns 2.51 animals on the average. Among the three study zones, Zone I owned highest animals (2.73) on the average followed by Zone IV (2.63), Zone III (2.3) and Zone II (2.26). Whereas, Bhattarai (2003) reported 3.99 number of livestock per house from the eastern part (Zone I and Zone II) in this study. But it was found to be 2.52 in this study. It is related to the effective fencing of community forests in recent years. Thus, fencing and prohibition of taking the

cattle in to the forest have resulted in reducing herd size of livestock and thus affected the nutrition level and the economy of the people who had been grazing their cattle since historical time. This is related to the findings of Sharma (1991) as he had reported average number of livestock per household was 5.5 in CNP. But, Baral (1999) reported sharp decrease in mean number of livestock per household over the pest two decades (11.1 per household in 1980 to 6.23 per household in 1998) in BNP. Benu (1999) estimated mean number of livestock 5.16 per household in SWR.

Adhikari (2000) in KTWR, according to distance, found that highest crop damage occurred in area to 1 km (40.38%) followed by area within 1 km to 2.5 km (32.28%) and area farther than 2.5 km (27.34%). A large number of people from area near to 1 km and area within 1 km to 2.5 km either wish to resettle of compensate their loss.

Sharma (1991) in CNP found that most of the crop damage occurred within 1 km of the park boundary, only a weak correlation with the distance would be established ($r = -0.557$, $p = .031$). Soti (1995) in SNP reported that high percentage of loss (millet 72.22%, maize 58.17% wheat 36.69% and paddy 17.34%) occurred in area 0-1 km followed by area 1 to 2 km, area 3 to 4 km & 2 to 3 km.

In this study, rhino (*Rhinoceros unicornis*) became the first major pest in Zone I with 79.54% of rating, followed by wild boar (*Sus scrofa*) with 48.27% and 76.13% rating in Zone II and Zone IV respectively. Comparatively, highest rating of rhino (81.81%) was in Zone IV followed by 79.77% in Bachhauli including Bodreni and Baghmara villages, and 79.24% in Tikauli. Likewise, wild boar (*Sus scrofa*) became major pest in New Padampur (47.42%) and Zone IV (76.12%).

Benu (1999) in SWR reported that chital (*Axis axis*) was the first major pest with percentage of rating 65.86 followed by wild elephants (*Elephas maximus*) with 63.26 percent and wild boar (*Sus scrofa*) with 60.86 percent. Baral (1999) in BNP reported that elephant (*Elephas maximus*) was the first major pest with 72.73% and 73.24% followed by wild boar (*Sus scrofa*) with 65.91% and 74.29%, chital (*Axis axis*) with 53.18% and 64.44% and others with 40.91% and 45.07% in Thakurdwara and Shivapur VDC.

Every year, people are killed or injured by the wild animals. During the collection of thatch grass, many people are injured due to attack of rhinoceros, tiger and sloth bear. Sometimes, rhinoceros (*Rhinoceros unicornis*) and wild boar (*Sus scrofa*) may stay in the field overnight and it may kill

during the encounter to man. Therefore, risk for people is in night duty. Two dozens persons were killed by wild animals in and around CNP. Of these two persons were killed while working in their private field and 6 persons were killed while collecting firewood/grass from community forest.

Adhikari (2000) reported that more than a half dozen (8) persons were injured or killed by wild animals in previous years in KTWR. Among them 5 persons are seriously injured and 3 persons are killed by wild animals. Sharma (1991) and Nepal and Weber (1993) also reported attack and death of humans by wild animals in CNP.

Benu (1999) reported that there was not any attack and death of human in SWR in previous years but during his study period two persons were killed by rouge bull elephant (*Elephas maximus*) inside the park. Limbu (1998) reported that many villagers were assaulted by wild animals in previous years and one man was killed and many people were seriously injured.

Thus, the human harassment is common in other protected areas of Nepal. Likewise, wealth and property loss due to livestock depredation and destruction of houses by predator species and the elephant are also increasing in the areas.

Local people have adopted different kinds of preventive measures, for instance, spending night on Chhapadi (Machan), use of torch and flash of light, use of loud noise making tools etc. to reduce crop damage. Spending night in Chhapadi and use of noise making tools are more popular method. Kasu (1996) in PWR; Limbu (1998), Sharma (1995 and 1996) and Adhikari (2000) in KTWR; Jnawali (1989), Sharma (1990 and 1991), Shrestha (1994), Upreti (1995) and Subedi (1998) in CNP also reported that Machan guarding was the most popular method. The main reason of crop damage was due to lack of any effective physical barrier between private land and BCF/Park, flood in Khageri Khola, Dhungre and Budhirapti, and taste of agricultural crops are other important reasons for causing damage by wild animals in the adjoining crop fields.

6. CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

The main objectives of study was to quantify the amount of crop damage, source of conflict between reserve and local people, and preventive measures used by reserve and local people and its effectiveness. The simple household questionnaire survey was done in the adjoining human settlement areas of BCF within one km distance from its forest edge. Five VDCs; Bachhauli, Gitanagar, Patihani, Jutpani and New Padampur, and 2 Municipalities; Ratnanagar (Ward Number 5, 6, 7, 8 and 10), Bharatpur (Ward Number 8, 9, 11 and 12) were the study sites for this purpose.

A total of 441 households were selected randomly were interviewed to assess the crop damage. To know the source of conflict, except household leader, Forest User Group's members along with key personnel were interviewed, and a field study was done in the study area. Park officer and junior staffs were also interviewed to know the preventive measures used and causes of park-people conflict. So the pressure of crop damage made it very difficult to live a substantial life. This condition creates conflicts between local people and wildlife. The main source of conflict is crop damage and human harassment due to wild animals.

Most of the people of the study area are poor in economic condition. Very few people in this area engaged in cottage industries. Agriculture based industries can also be more advantageous in this endeavor. The promotion of forestry, especially replanted forests of sissoo (*Dalbergia sissoo*) can also open up a few employment opportunities, since people can be engaged in carpentry and wood carving.

Fences are important physical barriers to check crop damage from wild animals. Fences where established are broken in many places which are the main way for wild animals to come out from the forest on the one hand, and the open boundary between the CNP and the crop fields in the southern BCF adjoining areas (Bachhauli, Gitanagar and Patihani VDCs) are prone to damage by the wild animals of both forests.

Local people want to graze livestock inside the forest and share the forest resources while CFUG's and Park's rules do not permit to do so. The other source of conflict includes fuel wood, fodder, fishing and illegal hunting. Many people have been killed or injured by wild animals, but they do not get any compensation for their treatment.

Besides the several socio-economic consequences, there exist few traditional measures being adopted by the local farmers as a part of their subsistence livelihood in the adjoining areas to prevent their crops; Machan, fencing and scaring devices are not satisfactorily successful due to the lack of adequate materials and their maintenance.

6.2 RECOMMENDATIONS

- Frequently visited area by wildlife should be continuously monitored. The fences where broken are to be re-fenced with barbed wire with due emphasis on the area between CNP and BCF.
- Plantation of thorny plant near the barbed wire, and growing unpalatable crop varieties with in one km distance from forest boarder may be very effective to control the wild animals from going to the crop fields.
- For the protection of fence, people's participation and inspection should be necessary. So, they should be encouraged for their own work.
- Unauthorized harvesting, encroachment (picnic in Bishhazari tal area and open way from New Padampur to Bharatpur) and burning of the vegetation inside the BCF should be checked. Illegal hunting, poaching, logging should be completely controlled.
- Effective mechanism in consumption of forest resources like fire wood, grass, fodder and thatch collection should be established to control local people's activities in the forest.
- The problem of conflict should be solved compensating farmers directly in cash for their loss. Local farmers injured by attack of wild animals should be helped during medical treatment.
- Possible biological solution in controlling the wild animals should be effective to control crop depredation. The food habit of the wildlife should be thoroughly studied and local villagers should be encouraged to grow less preferable crops and other varieties of unpalatable crops. By changing crop varieties, the problem of crop damage can be reduced to some extent.
- So far the livestock farming is a crucial component of agricultural system and is also related to both the nutritional value and the economy of local people, which is revealed by decreasing average number of livestock per family after the extension of community forestry as a part of restoration of wildlife habitat and promotion of corridor function of forest in recent years, livestock grazing zones should be demarcated for the local people who should be encouraged to keep few numbers of improved varieties of livestock.

- Most of the people living around the BCF are illiterate. They have negative attitude towards the

BCF. If education on the importance of BCF, conservation of natural resources were given to them time to time, they can realize the importance of such remained forest patch as a biological corridor for present and future generation and can enjoy the nature, feel the importance of the wild life, feel it as their own and for their benefits. So the programmes concerning people's awareness, participation and sense of responsibilities should be launched.

- To improve the economic condition of the people, income generating activities and better livelihood option programmes like tourist guiding training, hotel management training, and bird watching and guiding training should be given.
- To uplift socio-economic status of local people through forestry based IGAs, the existing small scale rural industries (such as manufacturing of ropes, mats, baskets and stools) should be promoted.
- BCF has great potential for tourism. For the development of tourism, there should be either a visitor centre if applicable; if not initially it can be started by setting up a separate section under a Biological Corridor Function of BCF at Tourist Information Centre in Sauraha, Park Head Office in Kasara and in Department of National Park and Wildlife Conservation at the national level in order to facilitate research and information dissemination.
- More scientific researches are awaited to be carried out. And a management plan from national perspective must be urgently prepared and duly implemented to halt the succession of Bishhazari tal from being changed to grassland, and to promote the tourism and wetland.
- Raw materials like bamboo shoots and partial financial support to construct Machan and fences should be provided to the farmers.
- To understand the depth of crop damage, there need to conduct a long term, comprehensive study with specific focus on the level of abundance of crop pest species in different areas / parts, the economic impacts of wild animals on the agricultural / horticultural crops based on perceived losses, and most importantly, on the community participation programme for wildlife pest management and habitat conservation programmes in the areas with high crop damage.

7. REFERENCES

Adhikary, K. 2000. Assessment of Crpo Damage around Koshi Tappu Wildlife Reserve. M. Sc. Thesis in Zoology, Tribhuvan University, Nepal.

Baral, N. 1998. Wild Boar-Man Conflict: Assessment of Crop Damage by wild Boar (*Sus scrofa*) in the South-Western Section of Royal Bardiya National Park, Nepal. M. Sc. Thesis Submitted to Central department of Zoology, Tribhuvan University, Nepal.

Barnes, R. F. W. 1996. "The Conflict between Humans and Elephants in the Central African Forests." Mammal Review 26(2/3): 67 - 80.

Bell, R. H. V. 1984. The Man-Animal Interface: An Assessment of Crop-Damage and Wildlife Control. Conservation and Wildlife Management in Africa: The Proceeding of a Workshop Organised by the US Peace Corps at Kasungu National Park, Malawi. E. Mc Shane-Caluzi, US Peace Corps: 387 - 416.

Berkmuller, K. and Mukherjee, S. 1989. Buffer Zones in the Service of Eco-Development; Tiger Paper. Regional Quarterly Bulletin on Wildlife and National Parks Management. Published by FAO Regional Office for Asia and the Pacific, Kaliwan Mansion, Phra Atit Road, Bankok, 10200, Thailand.

Berkmuller, K., Mukherjee, S. and Mishra, B. 1990. Grazing and Cutting Pressures on Ranthambhore National Park, Rajasthan, India. Environmental Conservation: 17 - 37.

Bhatta, S.R. 2005. Human Animal Conflict: Conservation of World Heritage and Sacrifice of local People. Biodiversity Conservation Efforts in Nepal. Special issue published on the occasion of 10th Wildlife Week 2061. Published by HMG/DNPWC, Nepal.

Bird Conservation Nepal. 2003. Birds of Nepal. Official unpublished database of Bird Conservation Nepal, Lajimpat, Kathmandu, Nepal.

CBS 1992b. Population Data of Villages. Central Bureau of Statistics, National Planning Commission Secretariat, HMG, Nepal.

Chalise, M., J.B. Karki and M.K. Ghimire 2005. Status in Nepal: Non-human Primate. Biodiversity Conservation Efforts in Nepal. Published by HMGN/DNPWC, UNDP, IUCN. April, 2005.

Desai, V. 1984. Issues in Agriculture and Forestry. Himalayan Publishing House, Bombay. India.

DNPWC 1998. National Park and Wildlife of Nepal. A Brochure Published by Department of National Parks and Wildlife Conservation, Kathmandu, Nepal.

Eley, D. and J. G. Else 1984. "Primate Pest Problems in Kenya Hotels and Lodges." International Journal of Primatology 5(4): 334.

Else, J. G. and P. C. Lee 1986. Primate-Human Conflict. Primate Ecology and Conservation: Vol. 2 of Selected Proceedings of the Tenth Congress of the International Primatological Society. P. C.

Lee. New York, Cambridge University Press. 2: 213 - 214.

Eudey, A. A. 1986. Hill Tribe Peoples and Primate Conservation in Thailand: A Preliminary Assessment of the Problem of Reconciling Shifting Cultivation Objectives. Primate Ecology and Conservation: Vol. 2 of Selected Proceedings of the Tenth Congress of the International Primatological Society. New York, Cambridge University Press. 2: 237 - 248.

Eudey, A. A. 1994. "Temple and Pet Primates in Thailand." Revue D'Ecologie (Terre & Vie) 49(3): 273 - 280.

Gautam, B. 1999. Park-People Conflict. An Assessment of Crop Damage by Wild Animals in Proposed Buffer Zone Area of Royal Suklaphanta Wildlife Reserve, Nepal. M.Sc. Thesis in Zoology, Tribhuvan University, Nepal.

Hill, C. M. 1998. "Conflicting Attitudes towards Elephants around the Budungo Forest Reserve, Uganda." Environmental Conservation 25(3): 244 - 250.

Hill, C. M. 1999. "Conflict and Interest Between People and Baboons: Crop Raiding in Uganda." International Journal of Primatology 21(2): 299 - 315.

HMG Nepal 1994. Nepalese Acts Collection (*Nepal Yen Sangraha*, in Nepali version). His Majesty's Government of Nepal, Ministry of Justice, Kathmandu, Nepal. 128pp.

HMG Nepal 1997. Statistical Information on Nepalese Agriculture 1997/98. Agricultural Statistics Division, Kathmandu, Nepal.

HMG/UNDP 1996. Parks and People Project (Nep/94/001): Status Report, Jan. 1995-June, 1996. Department of National Parks and Wildlife Conservation, HMG/UNDP, Kathmandu, Nepal.

HMG, GEF/UNDP 2000. Nepal Biodiversity Action Plan. Published by Department of National Parks and Wildlife Conservation, Ministry of Forest and Soil Conservation, His Majesty's Government of Nepal. Kathmandu, Nepal.

Hoare, R. 2000. "African Elephants and Humans in Conflict: the Outlook for Co-existence." Oryx 34(1): 34 - 38.

Infield, M. 1988. "Attitudes of a Rural Community towards Conservation and a local Conservation Area in Natal, South Africa." Biological Conservation 45: 21 - 46.

IUCN 1978. Categories, Objectives and Criteria for Protected Areas. IUCN, Gland, Switzerland.

IUCN 1997. United Nations Lists of Protected Areas. World Conservation Centre, IUCN, Gland, Switzerland.

IUCN 1988. Red List of Threatened Animals. The IUCN Conservation Monitoring Center, Cambridge, UK.

Jnawali, S. R. 1989. Park–People Conflict: Assessment of Crop Damage and Human Harassment by Rhinoceros (*Rhinoceros unicornis*) in Sauraha Area Adjacent to the Royal Chitwan National

Park, Nepal. M. Sc. Thesis Submitted to Agricultural University of Norway.

Khanal, S. 2005. Nepal Became the Centre of Wildlife Poaching (*Banyajantu Taskariko Kendra Banyo Nepal*, in Nepali). *Dristi* National Weekly Magazine. Vol. 43, Year 22, pp. 4.

Khatri, T. B. 1996. Status and Food Habits of Nilgai (*Boselaphus tragocamelus*) in Bardia National Park, Nepal. M. Sc. Thesis, Agricultural University of Norway.

Kherwar, P. K. 1996. Endangered Environment of Wild Buffalo of Koshi Tappu With Reference to Anthropological Impacts. M. Sc. Thesis Submitted to Central Department to Zoology, Tribhuvan University, Kirtipur, Kathmandu, Nepal.

KMTNC 2002. Tiger/Rhino Conservation Project. A leaflet published by Biodiversity Conservation Centre, King Mahendra Trust for Nature Conservation, Lalitpur, Nepal.

KMTNC 2004. Ecological Assessment of Barandabhar Corridor Forest. Final draft by Biodiversity Conservation Centre, King Mahendra Trust for Nature Conservation, Lalitpur, Nepal.

Lee, P. C. and N. E. C. Priston (submitted) 1999. Perceptions of Pests: Human Attitudes to Primates, Conflict and Consequences for Conservation. Commensalism and Conflict: The Primate-Human Interface. J. D. Paterson. Winnipeg, Manitoba, Hignell Printing.

Limbu, K. P. 1998. An Assessment of Crop Depredation and Human Harassment due to Wild Animals in Koshi Tappu Wildlife Reserve. M. Sc. Thesis Submitted to Central Department to Zoology, Tribhuvan University, Kirtipur, Kathmandu, Nepal.

Majupuria, T.C. 1998. Wildlife, National Parks and Reserves. Published by S. Devi, Bajoria Road, Saharanpur (U.P), India.

Malic, I. and R. L. Johnson 1994. "Commensal Rhesus in India: The Need and Cost of Translocation." Revue D'Ecologie (Terre & Vie) 49(3): 233 - 244.

McNeely, J. A. 1984. National Park, Conservation and Development. The Role of Protected Areas in Sustaining Society. Smithsonian Institute Press, Washington D. C., USA.

Milton, J. P. and Binney, G. A. 1980. Ecological Planning in the Nepalese Terai. A Report on Resolving Resource between Wildlife Conservation and Agricultural Land Use in Padampur Panchayat. Threshold, International Centre for Environmental Renewal, Washington D. C., USA.

Mishra, H. R. 1984. A Delicate Balance: Tigers, Rhinoceros, Tourists and Park Management vs the Needs of the Local People in Royal Chitwan National Park, Nepal. National Parks, Conservation and Development: The Role of Protected Areas in Sustaining Society: Proceedings of the World Congress on National Parks, Bali, Indonesia 11-22 October 1982. K. R. Miller. Washington D.C., Smithsonian Institution Press: 197 - 205.

Mishra, H. R. 1991. Regional Review: South and South-East Asia. A Review Developed from a Regional Meeting on National Parks and Protected Areas Held in Bangkok from 1-4 Dec. 1991. IUCN, AIT and World Bank.

Mishra, H. R. et al. 1992. Bio-Politics of Saving Asian Mammals in the Wild: Balancing Conservation in Developing Countries- A New Approach. P. Wegge (Ed.), NORAGRIC Occasional Paper. Series, C. No. 11.

Naughton, T. L. 1998. "Temporal Patterns of Crop-raiding by Primates: Linking Food Availability in Croplands and Adjacent Forest." Journal of Applied Ecology 35: 596 - 606.

Nepal, S. K. and Weber, K. E. 1993. Struggle for Existence: Park-People Conflict in Royal Chitwan National Park, Nepal. Asian Institute of Technology, Bankok, Thailand.

Newmark, W. D. et al. 1994. "The Conflict between Wildlife and Local People Living adjacent to Protected Areas in Tanzania: Human Density as a Predictor." Conservation Biology 8(1): 249 - 255.

Oldfield, S. 1988. Buffer Zone Management in Tropical Forest. IUCN, Tropical Forest Paper 5.

Poudyal, P. R. 1995. An Assessment of Crop Depredation due to Wildlife in Shivapuri Watershed and Wildlife reserve. M. Sc. Thesis in Zoology, Tribhuvan University, Kathmandu, Nepal.

Pradhan, M. L., T. Bahadur K. C. and D. B. Tamang 1967. Soil Survey of Saptari District. Report No. 12. Soil Science Section, Department of Agricultural Education and Research, Ministry of Food and Agriculture, HMG, Nepal.

Prasai, S. 1989. Investigation on the Depredation and Losses of Domestic animals in the adjoining Settlements of Chitwan National Park Area. M. Sc. Thesis Submitted to Central Department of Zoology, Tribhuvan University, Kirtipur, Kathmandu, Nepal.

Priston, N. E. C. 2001. Assessment of Crop Damage by *Macaca ochreata brunnescens* in Southeast Sulawesi: Farmer's Perspective. Department of Biological Anthropology. Cambridge, England, University of Cambridge: 109.

Priston, N. 2004. An Assessment of Crop-raiding by *Macaca ochreata brunnescens* in Buton, Southeast Sulawesi: Farmers' Perceptions, Reality and the Impact on Primate Behaviour and Conservation. University of Cambridge.

Ranjitsinh, M. K. 1984. Keynote Address: The Indomalayan Realm, National Parks, Conservation and Development: The Role of Protected Areas in Sustaining Society: Proceedings of the World Congress on National Parks, Bali, Indonesia 11-22 October 1982. Washington, D.C., Smithsonian Institution Press: 148 - 153.

Richard, A. F. et al. 1989. "Weed Macaques: The Evolutionary Implications of Macaque Feeding Ecology." International Journal of Primatology 10(6): 569 - 594.

Resources Himalaya. 2001. Official Executive Summary. Legal Framework for the Conservation of the Western Terai - Churiya Region, Nepal. URL: www. resourceshimalaya.org/ reports_resourceshimalaya.htm. April, 2005.

Sanjaya, M. et al. 2003. Status of south Asian Primates: Conservation Assessment and Management Plan (CAMP) Workshop Report. Zoo Outreach Organization/CBSG-south Asia,

Coimbatore, India.

Sayer, I. 1991. Buffer Zone Management in Rain Forest Protected Areas. Tiger Paper XVIII (4). A Regional Querterly Bulletin on Wildlife and national Parks Management. Published by FAO Regional Office for Asia and the Pacific, Kaliwan Mansion, Phra Atit Road, Bankok, 10200, Thailand.

Scott, D. A. (Ed.) 1989. A Directory of Asian Wetlands, IUCN- the World Conservation Union, Gland, Switzerland.

Sharma, B. K. 1995. An Assessment of Crop Damage by Wild Animals and Depredation of the Wildlife due to Activities of Local People in Koshi Tappu Wildlife Reserve. M. Sc. Thesis Submitted to Central Department to Zoology, Tribhuvan University, Kirtipur, Kathmandu, Nepal.

Sharma, U. R. 1990. An Overview of Park-People Interactions in CNP, Nepal. Landscape and Urban Planning,. Vol. 19, pp. 133-144.

Sharma, U. R. 1991. Park People Interaction in Royal Chitwan National Park, Nepal. Ph. D. Thesis. The University of Arizona, USA.

Shrestha, B. 1994. Studies on Park-People Conflicts, Investigation on Resolving Resources Conflict between Park Conservation and Adjoining Settlements in the Northeastern Boundary of CNP. M. Sc. Thesis Submitted to Central Department to Zoology, Tribhuvan University, Kirtipur, Kathmandu, Nepal.

Shrestha, T. K. 1997. Mammals of Nepal. R.K. Printers, Kathmandu, Nepal.

Shrestha, T. K. 2001. Mammals of Nepal with reference to those of India, Bangladesh, Bhutan and Pakistan. Published by Bimala Shrestha. Kathmandu, Nepal.

Smith, H. G. 1971. Conservation of Natural Resources. New York, Willey.

Southwick, C. H. et al. 1961a. "A Population Survey of Rhesus Monkeys in Northern India: Transportation Routes and Forest Areas." Ecology 42(4): 698 - 710.

Southwick, C. H. et al. 1961b. "A Population Survey of Rhesus Monkeys in Villages, Towns and Temples of Northern India." Ecology 42(3): 538 - 547.

Strum, S. C. 1986. A Role for Long-term Primate Field Research in Source Countries. Primate Ecology and Conservation: Vol. 2 of Selected Proceedings of the Tenth Congress of the International Primatological Society. P. C. Lee. New York, Cambridge University Press. 2: 215 - 220.

Strum, S. C. 1987a. Almost Human: A Journey into the World of Baboons. New York, Random House.

Strum, S. C. 1987b. The Pumphouse Gang Moves to a Strange New Land. National Geographic. 172: 552 - 601.

Strum, S. C. 1994. "Prospects for Management of Primate Pests." Revue D'Ecologie (Terre & Vie) 49(3): 295 - 306.

Strum, S. C. and C. H. Southwick 1986. Translocation of Primates. Primates: The Road to Self-sustaining Populations. K. Benirschke. New York, Springer-verlag New York Incorporated: 949 - 957.

Studsord, J. E. and Wegge, P. 1995. Park People Relationships: A Case Study of Damaged Caused by Park Animals around the Royal Bardia National Park, Nepal. Environment Conservation 22 (2).

Sunday Post (2003). The Weekly Magazine of The Kathmandu Post, Kathmandu. 08th Sharwan, 2057. www.nepalnews.com.np/sumdaypost.htm

Tchamba, M. N. 1996. "History and Present Status of the Human/Elephant Conflict in the Waza-Logone Region, Cameroon, West Africa." Biological Conservation 75: 35 - 41.

Upreti, B. N. 1985. The Park-People Interface in Nepal: Problems and New Direction. Jeffrey, A., Mc. Neely James, W. Thorell and Suresh Chalise (Eds.). People and Protected Area in the Hindu Kush Himalaya, Proceeding of International Workshop on the Management of National Parks and Protected Areas in the Hindu Kush-Himalaya, 6-11 May 1985, Kathmandu: KMTNC and ICIMOD.

Upreti, H. K. 1995. An Assessment of Agriculture and Livestock Depredation Through Wild Animals at Pathihani and Jagatpur Area Near Royal Chitwan National Park. M. Sc. Thesis Submitted to Central Department to Zoology, Tribhuvan University, Kirtipur, Kathmandu, Nepal.

Wegge, P. 1976. Terai Shikar Reserves Document No. 4. Department of National Parks and Wildlife Conservation, Nepal, FAO / UNDP, Rome.

WMI/IUCN-Nepal 1994. Biodiversity of Koshi Tappu Wildlife Reserve and its Adjacent Area. Applied Databases for Integrated Biodiversity Conservation in Nepal. Woodlands Mountain Institute / IUCN-Nepal.

Yadav, B. R. 2005. Asian Wild Elephant-human conflict and measures to reduce the damage due to elephants in eastern Nepal. Biodiversity Conservation Efforts in Nepal. Special issue published on the occasion of 10th Wildlife Week 2061. Published by HMG/DNPWC, Nepal.

Yonzon, P. 2000. Habitat Himalaya. Fact File 3 (1) Page 2-3. Published by Resources Himalaya. Lalitpur, Nepal.

8. APPENDICES

Appendix: 1. Questionnaire

Problem Associated with Crop damage:

A. Household Questionnaire

Name:……. VDC: …….. Date: ……Ethnicity:……..
Ward No: …….. Education …… Village: ……
Sex: …… Age: ……. Occupation:……..

1) How much land do you own? Biga: …… Kattha: ……. Dhur: …….
2) How far is your field from the Jungle edges? ……..km …….meter
3) What sorts of Crops did you grow last year?

Crops	Land	Yield
a) Paddy	…….	……
b) Maize	…….	……
c) Wheat	…….	…….
d) Mustard	…….	…….
e) Potato	…….	…….
f) Rajma	…….	…….
g) Others	…….	…….

4) Do you practice mix cropping system? a) Yes b) No
5) If yes, which crops do you plant combinely? 1……2…….3……
6) Do the wild animals make trouble? a) Yes b) No if yes, what are the highest and lowest trouble maker? a) …… b) …… c) …… d) ……
7) What kind of problems do you have?
1. Crop damage…….. 2. Harassment…… 3. Others……
8) How often do wildlife enter the field?

1. Every Night	Rhino	Wild boar	Sambar	Spotted deer	Barking deer	Parrot	Others
2. 1-2 times/ week							
3. 1-2 times/ month							
4. Occasionally							
5. Never							

9) Do rhinos enter the field during the day time? a) Yes b) No
10) How do you identify the damage done by a particular wildlife?
1. Observing…….. 2. From noise…….
3. From foot prints…….. 4. Grazing pattern……
5. Others …….
11) Do you think baby rhino damages more or less than the mother? a) More b) Less
If yes can you explain why? ……
12) Which crop do they prefer most? (List in the order of preference)

Crops	Rhino	Sambar	Wild boar	Spotted	Barking	Parrot	Others
1.							
2.							
3.							

13) Do rhinos damage equally in all growing periods? a) Yes b) No

14) If yes, whey do they damage most?

1. Maize a. Juvenile stage b. When they are of waist height
   c. Tasseling stage d. Mature stage
2. Wheat a. Juvenile stage b. medium stage c. Mature stage
3. Mustard a. Juvenile stage b. Flowering stage c. Mature stage
4. Lentil a. Juvenile stage b. Flowering c. Mature stage
5. Rice a. Green stage b. Flowering c. Mature stage
6. Others a. …….1…….2……..3……..
   b. …….1…….2……..3……..
   c. …….1…….2……..3……..

15) Did you have damage problem this year? a) Yes b) No

16) If yes how much land was damaged from wildlife?

	Completely	Partially
a. Rhino	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..
b. Sambar	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..
c. Wild boar	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..
d. Spotted deer	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..
e. Barking deer	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..
f. Parrots	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..
g. Others	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..	i) Rice…. ii) Maize…. iii) Wheat…. iii) Mustard…….. iv) Lentil …..

17) How much crop was lost from wildlife in this year? (Please Mention in % as 0-1 %,1-10 %,10-25%,25-50 %,75-100%).

Crops	Rhino	Sambar	Wild Boar	Spotted	Barking	Parrot	Others
1. Rice							
2. Maize							
3.Mustard							
4.Lentil							
5. Wheat							
5.Others							

18) What kind of technique do you apply to chase the wildlife?

Techniques	Name of wildlife
1 Shouting and following	
2. Following with fire	
3. Following with fire and shouting	
4. Following + Throwing stones + Shouting	
5. Scaring by hitting tin boxes	
6. Machan guarding	

19) Does only your family chase rhino from field? a. Yes b. No
20) If yes, who else?
a. Your neighbours …… b. All farmers in your village…….
c. farmers from neighbouring villages……..
21) Do you grow all kinds of crop which are common in surrounding areas? a) Yes b) No
22) If no, which crop not grown?
a)Paddy … .b)Maize. . . c)Wheat. . . .. d)Mustard. . . . .e)Potato. . .. . .f) Rajma
g) Others i) …….. ii) ……. iii) …….
23) If any from above, why do you not grow?
1. Difficult to grow 2. Crop damage problem 3. Low yield 4. Less market demand
24) Do you leave some land area follow during some period in the year due to rhino problem? a) Yes b) No
25) If yes, how much land do you leave follow?…… in local unit.
26) Are you able to support your family from agriculture? a) Yes b) No
27) If no, because part of your crops are destroyed by wildlife? a) Yes b) No
28) Do you think the damage problem is growing every year? a) Yes b) No
29) Has any compensation or other work been done? a) Yes b) No
30) In your opinion, what we have to do for not coming out them?
31) Did the wild animals attack or kill anyone in your family? a) Yes b) No
32) Have you entered the BCF/community-forest? a) Yes b) No
If yes, for what purpose?
33) Did the wild animals attack or kill anyone in the park/BCF? a) Yes b) No
34) Have you got benefit or harm from the park/? a) Benefit b) Harm
35) What do you think, these wild animals are to be protected or killed? Why?
a) To be killed b) To be protected
36) Have you ever complaint to the park officials about loss of crops by the wild animals? a) Yes b) No
37) Are you satisfied with the park/BCF management systems? a) Yes b) No
38) What devices are applied by the park/BCF authorities for the protection of crop damage? What are their affection?
39) Have you ever received any information on the importance of wildlife conservation and National Park from the government side? a) Yes b) No
40) Do you have cattle? a) Yes b) No, If yes, how many? (in numbers)
a) Cow … … b) Buffalo …… c) Goat…… d) Sheep…… e) Pig……
41) Where do you graze your livestock?
a) Private land b) Community land c) Inside park/BCF
If inside park/BCF, do you have compulsion? a) Yes b) No

B. Means to remedy the crop damage problem:

1. Name:. .. . . 2. Age:. . . . . 3. Sex:-1. Male 2. Female
4. Occupation:-1. Local farmer. . . . . 2. Park warden .. . .
3. Local administrative officer. . . . . 4.Army officer. . . ..
5. Hotel owner. . .. . 6. Naturalist. .. . .
5. Experience in the study area:. . . .. . . .years.
6. Could you please suggest some better means to remedy these problems or which of the following means do you think better in this particular situation:-
1. Barbed wire fence. . . . .. 2. Trench . . . .
3. Barbed wire fence and trench. . . . .. 4. Electric fence. . . . . .

5. Move people from the area. . . . . 6. Translocation of all rhinos from the adjacent BCF/Park area. . . . . 7. Kill rhinos which enter the fields. . 8. Economic compensation for damage. . . . .

7. If 6.8 How should damage be measured?
   1. By park warden. . . . . 2. By army officer. . . .. .
   3. By VDC leaders . . . . 4. By farmer. . . ..

8. Descriptive answers and other reasoning:

C. Field data form:

Measurement of area and yield of damaged and control plots.

1. Observation No:……..Plot No:……. Date:……..
2. Crop:…… Planted in …….. Harvest in ……..
3. Owner's name: ……. Location: ……..
4. Area measurement of damaged plot ……
   1. Length of transacts
      1……. cm/m …….
      2…….cm/m ……
      3…….cm/m ……
      4…….cm/m ……
      5…….cm/m ……
      6…….cm/m ……
      7…….cm/m ……
      8…….cm/m ……
      9. Sum Total Length …….m.

   2. Distance between transect: ……. cm/m
   3. Total area:- A =L X D
      = ……. Sq. m.
   2. Total area: ……..

8. Control plots
   No. 1. Area: …….. sq.m. 1. Field ……..
   No. 2. Area: …….. sq.m. 2. Field ……..
   No. 3. Area: …….. sq.m. 3. Field ……..
   No. 4. Area: …….. sq.m. 4. Field ……..

D. Questionnaire for Community Leaders

Name:……. Ward/Tol:…….. Date: …… Education ……
Age: …… Occupation:…… Sex : …… Ethnicity: ……

1. What is your perception about the wild animals and the National Park?
2. Would you like to tell your suggestion for the management of reserve and maintaining of its balance?
3. Are there any complains come from public sector? a) Yes b) No. if yes, please mention its type, and how do you try to solve?
4. What are your concerns towards such complaints?
5. Have you ever visited park officer about public complaints for solving the problems?
6. If yes, from which side do you talk? From public sector or park sector or as mediator?

7. What are your suggestions for managing the reserve and using its resources for the local people?
8. Does the park/BCF call you ever for discussing park and people issues and solving them? If yes, what is your role?
9. Have you been involved in making decisions with reserve officials to adversely affect the public? a) Yes b) No
10. In your opinion, have you found any differences between past and current reserve management approach? a) Yes b) No
11. If yes, please mention the differences.

E. Questionnaire to Key Personnel.

Name:……. Office Address:…….. Date: …… Ward No: ……
Education …… Age: …. Occupation:…… Ethnicity:……

1. What is the condition of BCF? What improvement has been done since its establishment?
2. I think you are facing many more problems for the management of BCF but how you are facing such challenges?
3. What are main causes to make conflict between the park/BCF authorities and local people?
4. Are there any domestic animals inside the BCF? a) Yes b) No if yes, how many and how would you avoid them in future?
5. In your opinion, why do animals come out of the reserve and do the damage?
6. Are the people aware of the importance of National Park and its rule and regulations?
7. What kind of illegal activities made by people? And what action do you take?
8. How do you think the problem of firewood, grazing, fodder collecting and poaching can be solved?
9. Does the CNP/BCF make compensations of the loss of crops, in getting injured and inhuman death?
10. Have you considered the suggestions of the community leaders while solving the problems? What types of suggestions made by them?
11. Have you made participant to your junior staffs to solve the problems? What types of suggestions do they submit?
12. Do you call the public for discussing any issues related to the park/BCF management? a) Yes b) No
13. If yes, have you used the conclusions of such discussions in park/BCF management?
14. Have you trying to get suggestion from political leaders and local people? And what do they suggest?
15. Did you face the political pressures? a) Yes b) No. If yes what kind of pressure was that?
16. Have you adopted any measures to control the wild animals to come outside the reserves? a) Yes b) No. if so, please mention the measures
17. What suggestions do you give to avoid damage caused by wild animals?
18. What policies are implemented by the government to resolve the problem of conflict?
19. At last, what is the better and permanent solution to minimize the conflict between CNP/BCF authorities and local people?

Appendix 2. Tables:

Table 8.1: Conversion table of Pathi into Quintal and Kg.

S. N.	Major Crop type	1 Quintal equivalents	1 Pathi equivalents	Remarks
1.	Paddy	40 Pathi	2.50 kg	Adopted from local market and com. with farmers.
2.	Maize	28 Pathi	3.57 kg	
3.	Wheat	25 Pathi	4.00 kg	
4.	Mustard	33 Pathi	3.03 kg	
5.1	Lentil (Musuro)	25 Pathi	4.00 kg	
5.2	Mas	26 Pathi	3.85 kg	
6.	Aalas	35 Pathi	2.86 kg	

Table 8.2 Impact of major flood in Chitwan.

Year	House lost	Human-killed	Crop- land (hec)	Livestock	Habitat	Ungulate killed
1990	1035	46	>340	>1000	>300	>100
1993	650	62	>1700	>25000	>700	>200
2002	950	181	>680	>1000	>500	>240

(Source: Bhattarai, 2003)

Table 8.3: Plant Species List Recorded in Barandabhar Corridor Forest.

S. No.	Botanical Name	Family	Local Name
1	*Elephantopus scaber* L.	Compositae	Bhiringi jhar
2	*Commelina benghalensis* L.	Commelinaceae	Kane jhar
3	*Commelina* spp. 1	Commelinaceae	-
4	*Cynodon dactylon* (L.) pers.	Gramineae	Dubo
5	*Kyllinga nemoralis*	-	-
6	*Rungia parviflora* (Retz.) Nees	Acanthaceae	Ukuche jhar
7	*Evolvulus alsinoides* (L.) L.	Convolvulaceae	Ankuri ful
8	*Flemingia macrophylla* (willd.) Merril.	Leguminosae	Bhatvasi
9	*Urena lobota* L.	Malvaceae	-
10	*Panicum Paludosum*	Gramineae	-
11	*Commelina* spp. 2	Commelinaceae	-
12	*Eclipta prostrata* (L.) L.	Compositae	Bhangeri jhar
13	*Corchorus* spp.	Tiliaceae	-
14	*Setaria palledifusca* (schumach.) (Stapf & C.E. Hubb.)	Gramineae	-
15	*Paspalidium punctatum* L.	-	-
16	*Lindernia* spp.	-	-
17	*Polygonum barbaratum* L.	Polygonaceae	-
18	*Hedyotis corymbosa* (L.) Lam.	Rubiaceae	Piringo
19	*Luduligia adscendens* L.	Onagraceae	-
20	*Borreria alata*	Rubiaceae	-
21	*Clerodendron infortunatum*	Herbinaceae	Bhanti
22	*Hedyotis diffusa* Willd.	Rubiaceae	Mojithe jhar
23	*Cynoglossum lanceolatum*	Boraginaceae	-
24	*Borreria biflora*	Rubiaceae	-
25	*Fimbristylis bisumbellata* L.	Cyperaceae	-

26	*Euphorbia hirta* L.	Euphorbiaceae	Dudhe jhar
27	*Paspalidium flavidum*	-	-
28	*Euphorbia parviflora* L.	-	Masino dudhe
29	*Cymbopogon microtheca* (Hook. f) A. Camus.	Poaceae	Banso
30	*Phyllanthus urinaria* L.	Euphorbiaceae	Bhui amala
31	*Justicia simplex* L.	Acanthaceae	-
32	*Persicaria* spp.	Polygonaceae	-
33	*Apluda mutica* L.	Gramineae	-
34	*Eleusine indica* (L.) Gaertn.	Gramineae	-
35	*Colocasia esculenta* (L.) Schott.	Araceae	Karkalo
36	*Oplismenus compositus*	-	Banso
37	*Saccharum bengalensis* L.	Gramineae	Jheksi
38	*Saccharum spontanium* L.	Gramineae	Kans.
39	*Chloro phytum nepalense*	Liliaceae	-
40	*Fimbristylis Miliaoea* (L.) Vahl.	Cyperaceae	Jwane jhar.
41	*Leersia hexandra* sw.	Urticaceae	Karaunti jhar
42	*Phyllodium* spp.	-	-
43	*Rubia* spp.	Rubiaceae	-
44	*Colebrookea oppositifolia* sm.	Labiatae	Dhurseli
45	*Cymbopogon* spp.	Poaceae	Dhaddi
46.	*Equisetum debile* Roxb. Ex. Vaucher.	Equisetaceae	Kurkure jhar (Ankhle jhar.)
47	*Erianthus ravennae* (L.) P. Beauv.	Poaceae	Khar.
48.	*Fimbristylis miliaceae* (L.) Vahl.	Cyperaceae	Mothe jhar.
49	*Imperata cylindrical* (L.) P. Beauv	Poaceae	Siru
50	*Oplismenus burmanii* (Retz.) P.Beauv.	Poaceae	Banso
51	*Phaulopsis imbricata* (Forssk.) Sweet.	Acanthaceae	Phurke
52	*Phragmites karka* (Retz.) Trin ex steud.	Poaceae	Narkat
53	*Themeda* spp.	Poaceae	Khar.
54	*Thespesia lampus* (cav) Dalz and Gibs.	Malvaceae	Ban Kapas.
55	*Elsholtzia flava* (Benth.) Benth.	Labiatae	Ban Silam
56	*Sambucus hookeri* Render	Caprifoliaceae	Galeni
57	*Oxalis* spp.	Leguminoceae.	-
58	*Selaginella* spp.	Selaginellaceae	-
59	*Bidens pilosa* L.	Compositae	Kuro
60	*Dryopteris cochleata* (D.Don) C. chr.	Aspidiaceae	Niuro
61	*Commelina* spp. 3	Commelinaceae	-
62	*Ceropegia pubescens* Wall.	Asclepiadaceae	Ban simi
63	*Eupatorium adenophorum* Spreng.	Compositae	Ban mara
64	*Ageratum conyzoides*. L.	Compositae	Gandhe
65	*Grewia sclerophylla* Roxb.	Tiliaceae.	Pharsa
66	*Sida cordifolia* L.	Malvaceae	Balu
67	*Dioscorea bulbifera*	Dioscoreaceae	Ban Githo
68	*Centella asiatica* (L.) Urban.	Umbelliferae	Ghod tapre
69	*Paspalidium flavidum* (Retz.) A. camus	Urticaceae	Janai lahara (Ghans)
70	-	Gramineae	Ghode dubo
71	*Cassia tora* L.	Leguminoceae.	Tapre

72	*Leersia hexandra* sw.	Poaceae	Muse kharu
73	*Daphne papyracea* Wall. Ex steud.	Thymelaeaceae	Baruwa.
74	*Cirsium arvense* (L.) soop.	Compositae.	Gaida kanda.
75	*Ageratum houstonianum* Mill.	Compositae	Nilo Gandhe
76	*Hedyotis gracilis* Wall.	Rubiaceae	Mjithe jhar.
77	*Achyranthes aspera* L.	Amaranthaceae	Datiwan
78	*Floscopa scadens* Lour.	Commelinaceae.	Kane
79	*Hibiscus manihot* L.	Malvaceae.	Jangali Lasun
80	-	Asteraceae 1	-
81	-	Poaceae 1	-
82	-	Poaceae 2	-
83	-	Asteraceae 2	-
84	-	Asteraceae 3	-
85	-	Poaceae 3	-
86	*Digitaria* spp.	Gramineae	-
87	-	Labiateae	-
88	-	Cyperaceae 1	-
89	-	Cyperaceae 2	-
90	-	Compositae 1	-
91	-	Compositae 2	-

Table 8.4: Population of Rhinoceros in Nepal.

S. No.	Year	Population of Rhino			Total	Sources
		CNP	BNP	SWR		
1.	<1950	1000	-	-	1000	-
2.	1950	800	-	-	800	Willan
3.	1957	400	-	-	400	Stracey
4.	1959	300	-	-	300	Gee
5.	1966	100	-	-	100	Spilleter & Tamang
6.	1968	108	-	-	108	Caughley & Mishra
7.	1972	147	-	-	147	Pellink & Upreti
8.	1978	310	-	-	310	Laurie
9.	1988	358	13	-	371	Dienerstein
10.	1994	466	38	-	504	Rhino count 1994
11.	2000	544	67	1	612	Rhino count 2000
12.	2005	372 (-11*)	-	-	-	Rhino count 2005 (continued)

Source: DNPWC Annual reports, News letters. * Poaching

Table 8.5: Poaching records of rhinoceros from in /around BCF.

S.N.	Place	Date	Age/Sex
1.	Baghmara BZCF	1991-07-07	Female
2.	Baghmara BZCF – Bodreni	1999-09-08	Sub adult, Male
3.	Khorsor	1991-10-10	Male
4.	Khorsor	1991-10-10	Female
5.	Lankaline	1997-07-19	Female
6.	Near Tikauli post	1999-02-02	-
7.	North of Bishhazari Tal	1999-02-07	-
8.	North-east of Pyalu Post	1999-02-02	Calf, Female
9.	Mohana village	1999-07-20	Sub adult, Female

Source: KMTNC, 2003.

Table 8.6: The Mortality of the Rhinoceros in Nepal (1973 - 2002)

S. N.	Year	Natural Death		Poaching		Total
		CNP	BNP	CNP	BNP	
1.	1973	6	-	5	-	11
2.	1974	12	-	4	-	16
3.	1975	8	-	1	-	9
4.	1976	3	-	2	-	5
5.	1977	7	-	-	-	7
6.	1978	8	-	-	-	8
7.	1979	8	-	-	-	8
8.	1980	11	-	-	-	11
9.	1981	11	-	-	-	11
10.	1982	13	-	-	-	13
11.	1983	6	-	-	-	6
12.	1984	10	-	6	-	16
13.	1985	6	-	2	-	8
14.	1986	6	-	3	-	9
15.	1987	11	-	1	-	12
16.	1988	3	-	3	-	6
17.	1989	9	-	1	1	11
18.	1990	10	-	6	-	16
19.	1991	8	-	1	-	9
20.	1992	1	4	18	2	25
21.	1993	11	1	9	4	25
22.	1994	6	2	1	1	10
23.	1995	7	-	1	-	8
24.	1996	8	-	1	-	9
25.	1997	7	-	1	-	8
26	1998	13	-	6	1	20
27.	1999	21	1	9	-	31
28.	2000	27	5	12	1	45
29.	2001	9	3	17	1	30
30.	2002 June	5	1	24	3	33

Source: Pachyderm No. 22, 1996 and No. 20, 1995. DNPWC Annual Reports.

Table 8.7 : Ecological Densities of Major Crop Pests in Different Protected Areas of Asia.

Species	Protected Areas	Ecological density (No./km^2)	Authority
Chital	BCF	6.5 - 9	Bhattarai (2003)
	CNP	17.3	Seidensticker (1976)
	Karnali – Bardia	29.7 - 33.9	Dinerstein (1980)
	Wilpattu National Park, Srilanka	12	Eisenberg & Lockhart (1972)
	BNP	225.3 - 384.5	Naess & Andersen (1993)
	Bharatpur, India	12.3	Spillet (1967)
Samber Deer	BCF	0.14 - 0.4	Bhattarai (2003)
	CNP (Reverine/tall grass)	2	Seidensticker (1976)
	CNP (Sal forest)	2.9	Seidensticker (1976)
Barking Deer	BCF	0.5 - 0.8	Bhattarai (2003)
	CNP	6.7	Seidensticker (1976)
	BNP	1.0 - 2.44	Naess & Andersen (1993)
	Karnali – Bardia	1.7	Dinerstein (1979)
	Wilpattu NP	2.3	Eisenberg & Lockhart (1972)
Hog Deer	BCF	0.14 - 0.4	Bhattarai (2003)
	CNP	35	Seidensticker (1976)
	Karnali – Bardia	2.1 - 4.2	Dinerstein (1979)
	BNP	3.1 - 4.1	Naess & Andersen (1993)
	Jaldapara and Gorumara, India	0.13	Bhowmik and Chakraborty (2001)
Wild Boar	BCF	1.0 - 1.9	Bhattarai (2003)
	CNP	5.8	Seidensticker (1976)
	BNP	3.3 - 6.7	Naess & Andersen (1993)
	Karnali – Bardia	4.2	Dinerstein (1979)
	Wilpattu National Park, Srilanka	0.3	Eisenberg & Lockhart (1972)
Rhino	BCF	0.2 - 0.4	Bhattarai (2003)
	CNP	11.2	Seidensticker (1976)
	CNP	0.6	Rhino count (2000)
	BNP	0.07	Rhino count (2000) Rhino Conservation action plan of west Bengal and Assam, India
	Kaziranga National Park, Assam, India	3.7	
	Orang Wildlife Sanctuary, Assam	1.35	
	Pabitora Wildlife Sanctuary, Assam	4.06	
	Manas National Park, Assam.	0.2	
	Lookhowa/Burachapori Wildlife Sanctuary, Assam	Few	

	Sonai Rupai Wildlife Sanctuary, Assam	Few	
	Jaldapara Wildlife Sanctuary, West Bengal	0.23	
	Gorumara National Park, West Bengal	2	

Table 8.8: Livestock observed from different sites of forest boundary.

Grazing spots	Cattle		Buffalo		Goat		Sheep		Total Livestock
	N	M	N	M	N	M	N	M	
Gundre-mandre	187	1078.2	132	1110.5					319
Bhojhad	152	328.6	102	355.2	66	272.5	46	426.8	366
Naurange	102	296.6	65	522.6	42	215.3	28	466.3	237
Khageri bank	263	588.6	244	585.4	96	492.5	58	373.5	661
Gondrang	75	228.3	62	252.1	52	35.5			189
Khor sor	178	426.2	110	462.2	38	410.2	18	251.3	344
Mainahari	64	3150	46	3250					110
Ujelinagar	10	70.3	36	150.4	132	131.6	28	1204	206
Total	1031		797		426		178		2432

Note N = Number of livestock. M= Mean distance from forest boundary in meter

Table 8.9. Frequencies of ungulates in BCF.

Crop type	Damage based on frequency	Highly frequented animals	Number of cases.
Paddy	33.34	Rhinoceros, Chital	453
Maize	28.5	Rhinoceros, Wild boar, Chital	384
Lentil	16.2	Rhinoceros, Chital	218
Wheat	2.0	Rhinoceros, Chital	27
Mustard	11.65	Rhinoceros, Chital	157
Vegetableand others	8.01	Rhinoceros, Chital, Wild boar, Sambar deer, Barking deer.	108
Total	100		1347

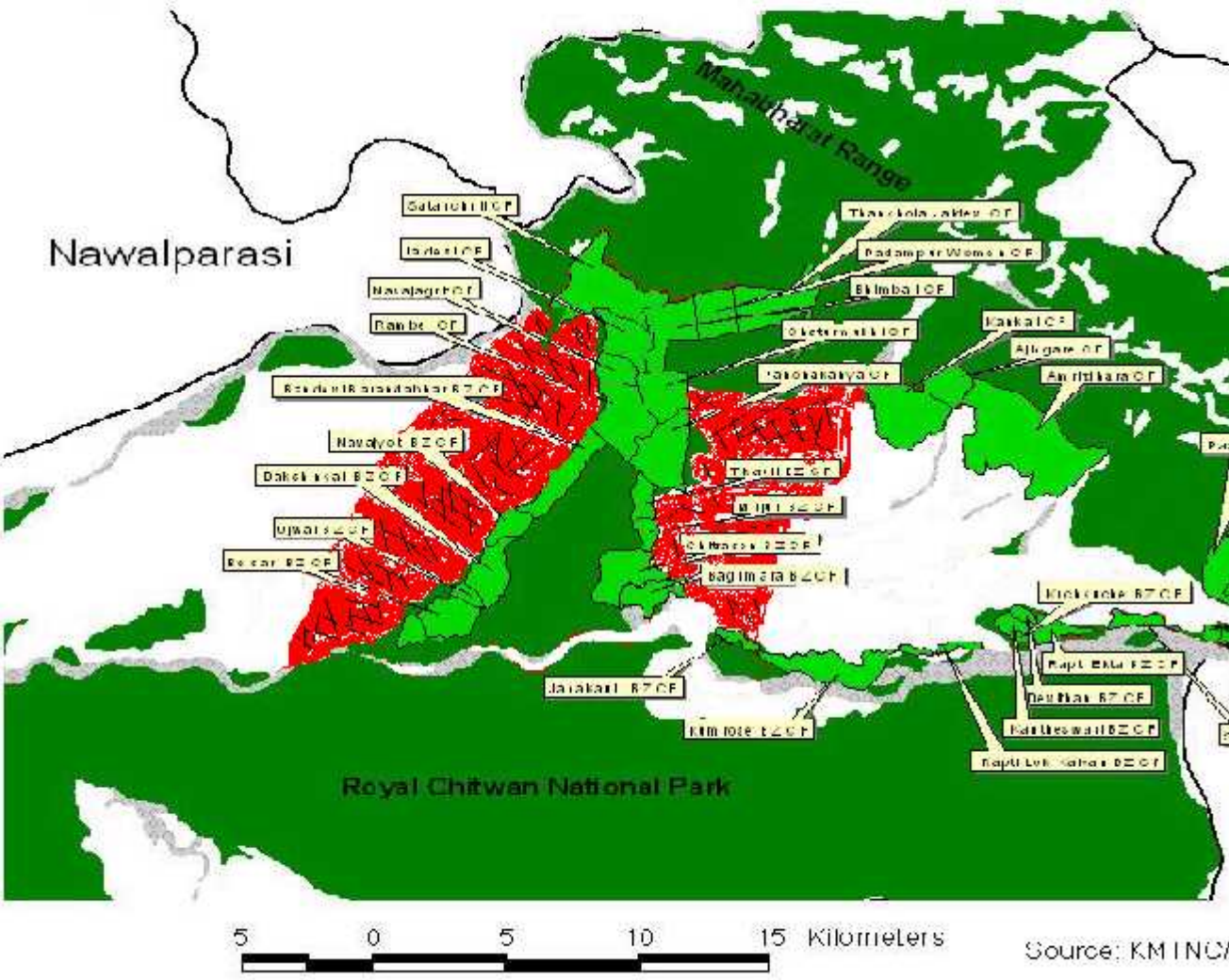
(Source: Bhattarai, 2003)

SPSS Data Format

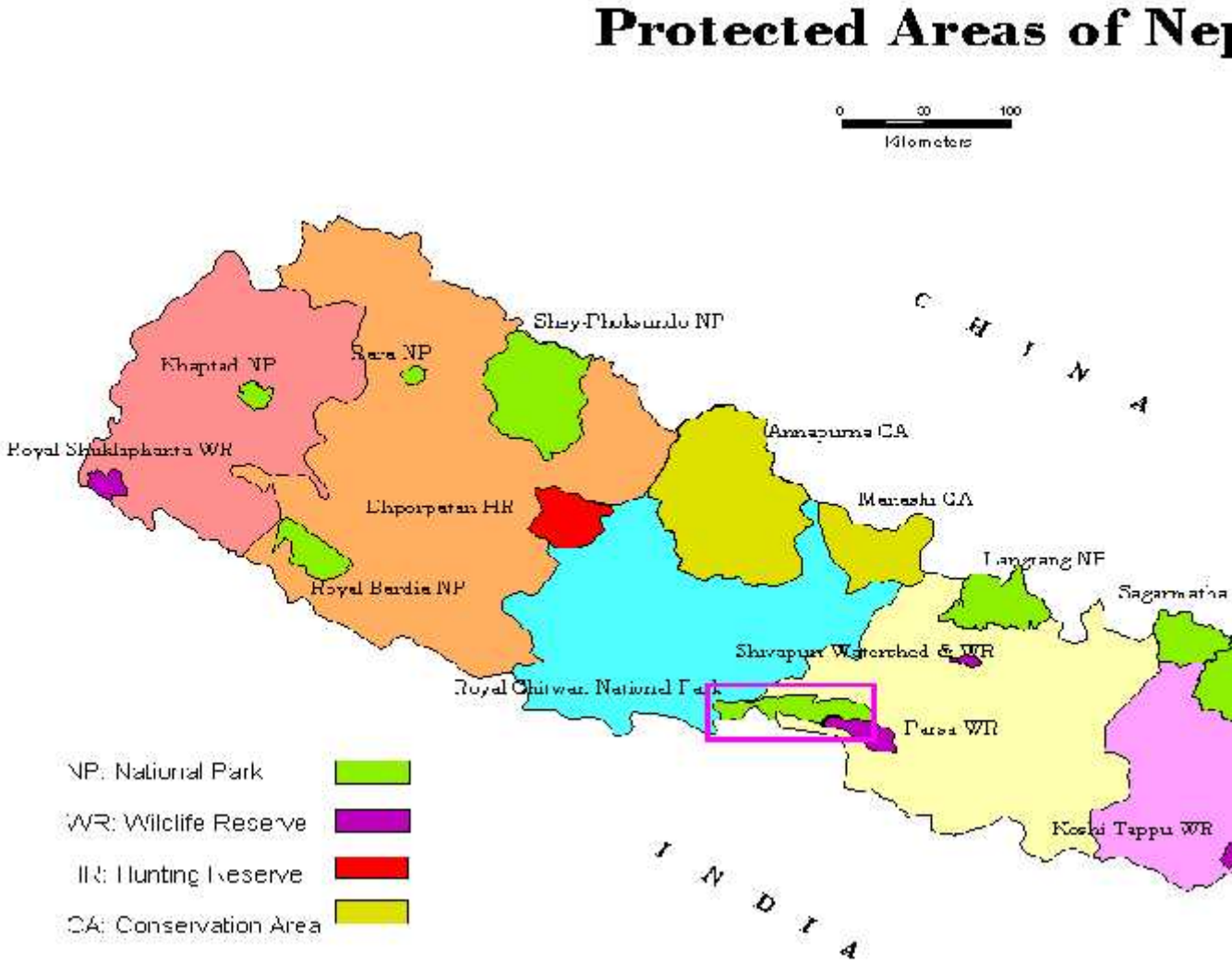
Name	Label
name	Name of respondent
vdc_muni	VDC or Municipality of respondent
ward	Ward number
tol	Name of village or tole
education	Education
pesha	Occupation
age	Age of the respondent
sex	Sex of respondent
agr_exp	Experience in agriculture in years
caste	Caste or ethnicity
location	Location from forest and highway
q1_bigha	How much land do you own?
q2_mtr	How far is your field from the Jungle edges?
ques4	Do you practice mix cropping system?
ques5	If yes, which crops do you plant combinely?
ques6	Do the wild animals make crop damage trouble?
ques7	If yes, What are the highest and lowest trouble maker?
ques8	What kind of problems do you have?
ques10	Does wildlife enter the field during the day time?
ques11	How do you identify the damage done by a particular wildlife?
ques12	Do you think rhinos damage more or less than the mother?
ques13	If yes can you explain why?
ques15	Do rhinos damage equally in all growing periods?
que16.1	Maize
que16.2	Wheat
que16.3	Mustard
ques16.4	Lentil/Musuro/Mas
que16.5	Paddy
ques17	Did you have damage problem last year?
ques20	Does only your family chase rhino from field?
ques21	Who helps you in chasing wildlife?
ques22	Do you grow all kinds of crop which are common in surrounding areas?
que23	If no ques. 22, which crop not grown?
ques24	Why do you not grow above crops?
ques25	Do you leave some land area fallow during some period in the year due to rhino problem?
ques26	How much land do you leave follow?
ques27	Are you able to support your family from agriculture?
ques28	If agriculture can not support, ie because part of your crops are destroyed by wildlife?
ques29	Do you think the damage problem is growing every year?
ques30	Has any compensation or other work been done?
ques31	In your opinion, what we have to do for not coming out them?
ques32	Did the wild animals attack or kill anyone in your family?
ques33	Have you entered the BCF/community-forest?
ques34	If you entered the BCF/community-forest, for what purpose?

ques35	Have you got benefit or harm from the park/?
ques36	Do you think, these wild animals are to be protected or killed?
ques_37	If yes to protect, why?
ques38	Why to kill wildlife?
ques39	Have you ever complaint to the park officials about loss of crops by the wild animals?
ques40	Any effort applied by the park/BCF authorities for the protection of crop damage?
ques42	Any good affection of the effort of GOs/NGOs in prevention of crop damage?
ques43	Any effort from KMTNC or others?
ques44	If any from KMTNC or others, what effectiveness?
ques45	Any suggestion to KMTNC/GOs?
q46.1gai	Number of Cow
q46.2buf	Number of buffalo
q46.3goa	Number of goat
q46.4pig	Number of pig
ques47	Where do you graze your livestock?
ques48	Have you ever received any meeting/training on the importance of wildlife conservation and National Park from the government side?
queb1	What type of effective measures have you been adopting to protect crop from wildlife?
queb2	Could you please suggest some better means to remedy these problems or which of the following means do you think better in this particular situation
queb3	If compensation, how should damage be measured?
queb4	Details.....

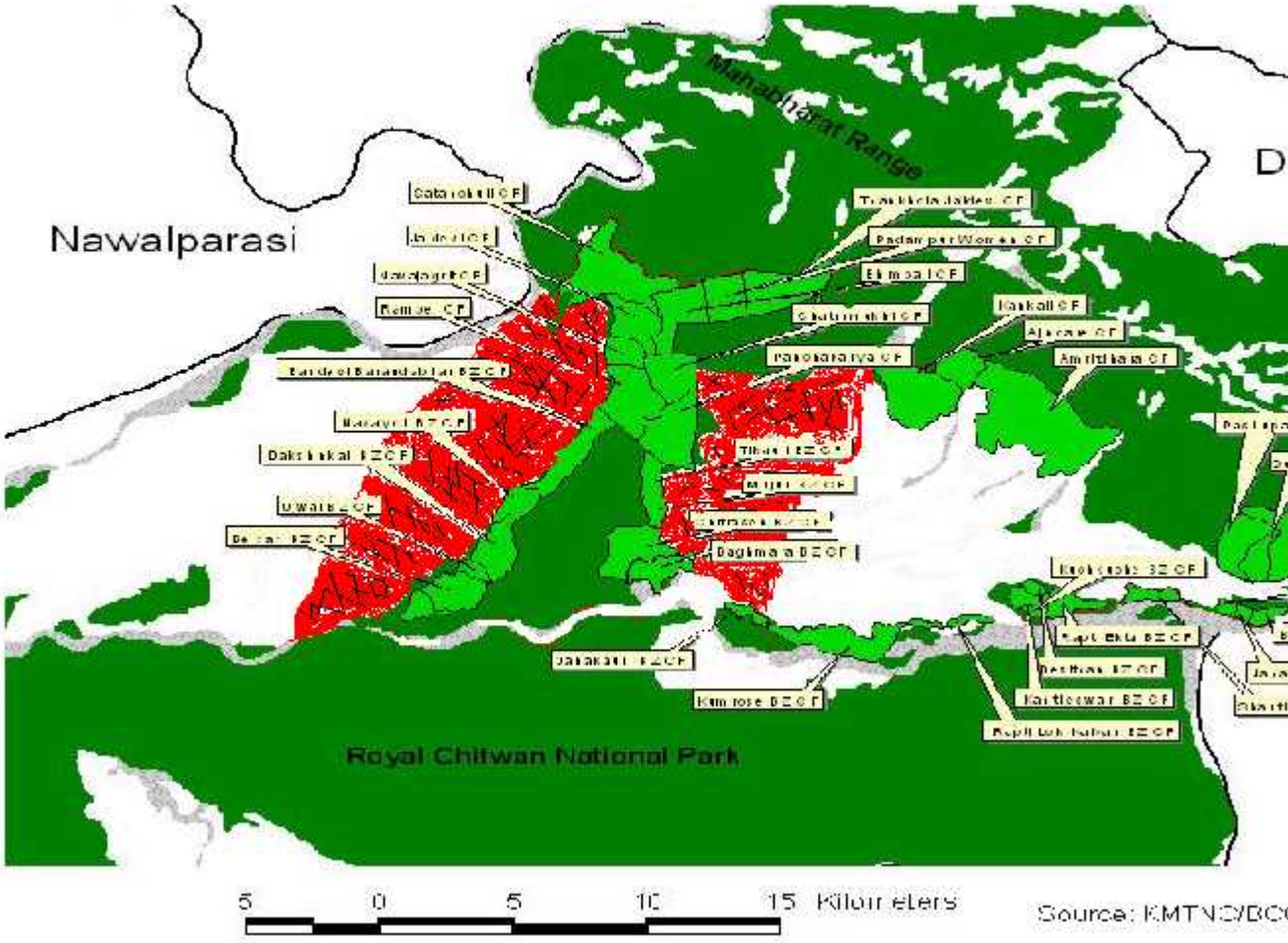
Map showing the location of study area.



Map 1: Protected areas of Nepal.



Map 2: Showing the location of study area.


Nawalparasi
Mahabharat Range
Royal Chitwan National Park
5 0 5 10 15 Kilometers

1. Machan (Researcher standing below)

2. Rhinoceros in grassland

3. Spotted deer in forest

4. Rhinoceros in Bishazari Lake

5. Wild elephant in Khorsor, western boarder of BBZCF

6. Young wild boar captured by local people

7. Wild Boar reared by local people

8. Impact of flood in Rapti, southern boarder of BBZCF

9. Forest fires in adjoining areas

10. Livestock grazing outside the forest

11. Sal forest in Chitrasen BZCF, northern boarder of BBZCF

12. Mustard trampling at flowering stage

13. : Paddy damaged by Rhinoceros at early stage (Foot prints on crop field)

14. Trench made by local people to remedy from crop damage

15. Paddy damaged by rhinoceros

16. Measurement of damaged wheat field

17. Machan guarding with plastic flags

18. Mukundo on the crop field