

CHAPTER ONE

1. INTRODUCTION

1.1 Background

Wildlife human interaction, such as crop and livestock depredation, human toll by wildlife and resource utilization by local people, in and around the protected area is one of the main issues of protected area management. Numerous national parks in developing countries are surrounded by agricultural lands and the people living in and around such parks have interacted with them in multifarious ways (Nepal and Weber 1993). Chitwan National Park is one of main area of such experiences. The intimate interception of people in protected areas results in conflicts between wildlife and human (Rodgers 1989). Most definition of national parks, including that of the World Conservation Union (IUCN 1982) excluded human habituation and significant human impact. The local people were often considered as an obstacle to, rather than a means towards, conservation objectives (Preston 1969, UNESCO 1974 and Eckholm 1975).

The concept of national park and protected area was developed in U.S.A. (Zebu and Bush 1990) and has been adopted in many countries, including Nepal (GON 1973, GON/IUCN 1988, Kharel 1997). Wildlife conservation after the establishment of National Park and Wildlife Conservation (NPWC) Act 1973 has been quite successful from the viewpoint of habitat conservation of several threatened species (Mishra et al. 1992) and steadily increasing population of wildlife in national parks and protected areas (Upreti 1991). However, the establishment of national parks has had severe adverse impacts on local traditions and beliefs or cultures as such, in some instances resulting in disastrous side effects (Nepal and Weber 1993) and the park is more the source of wildlife nuisance than a source of benefits for the local peoples (Mishra 1984).

There is always cost of leaving with wildlife both direct costs such as the effect of marauding crops and animals, and opportunity cost of limited access to land set aside as wildlife which might otherwise generate income from agriculture, livestock, logging, etc, (Kiss 1990). Crop raiding is the main issue due to which conflict arises between wildlife and human. Similarly, livestock depredation can cause substantial economic losses, and makes the very idea of wildlife conservation unpopular among local residents (Bhatnagar et al. 1999). Wildlife human conflicts are acute when the species involved is highly imperiled while its pressure in an area possesses a serious threat to human welfare (Saberwal et al. 1994). Besides, human encounters with wild animals around the park were common (Jackson 1990), which is also a cause of wildlife human conflict.

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 of the government to curtail access to their traditional rights of resource use. As a result, illegal activities such as hunting and poaching have intensified, and there are many cases of confrontation between park official and local people (Nepal and Weber 1993). Conflicts often arise when conservation regulations are imposed roughly to avoid natural resources usage, such as grazing land, firewood collection, fodder, medicinal plants and land for hunting without alternatives being provided (Mc Neely 1995, Lewis 1997).

A thorough assessment of the conflict is necessary to design an effective conflict management approach as protected areas can not coexist with communities, which are hostile to them (IUCN 1993).

In this research, crop and livestock depredation, human toll by wildlife and human impact on national park were assessed at Buffer zone area of

Dibyapuri VDC of Nawalparasi district on the north-western boundary of Chitwan National Park.

1.2 Buffer Zone Concept

The National Park and Wildlife Conservation Act, 1973 defines Buffer zone as a specified area designated around the National Parks and Wildlife Reserves for the local people in order to provide the facility to utilize the forest products in sustainability (GON op. cit. 7).

According to the Black's Law Dictionary Buffer zone means ' An area separating two different types of zones or classes/areas, which could blend with each other more easily' (Black 1990). It is the area or border adjacent to protected areas on which land use is partially restricted to give an added layer of protection to the protected area itself, which providing valued benefits to the neighboring rural communities.

Buffer zone may serve two functions: Extension buffering and Socio-buffering. First one is related with the need of the protection of Buffer zone and second one is related with the villager's requirements for harvestable products and to cash crops inside the Buffer zone area. A major function of socio-buffers is to ensure that rural people don't need to seek forest and other products inside reserves (Anonymous 2003).

For the first time, the Department of National Park and Wildlife Conservation (DNPWC) has introduced the concept of Buffer zone around the protected areas to address pertinent parks and people issues. In order to translate this concept in to reality pilot projects such as the Park People Program (PPP) has been initiated by DNPWC with the support of United Nations Development Program (UNDP) since 1995. The objective of the project is to minimize the park people conflict. The examples of illegal exploitation of forest products by the people as the evidence to it

are of usual phenomenon occurred elsewhere in the parks and reserves. Those activities constitute direct threats on both the biodiversity and economic value of the protected areas (GON/BZ Development Bulletin 1995).

Buffer zone in Nepal do not necessarily include forest only, they can encompass settlements, agricultural lands, and villages, open spaces and many other lands used forms, which allows park authorities to share park income with local communities, has been introduced as a key component of the national biodiversity conservation strategy (Dewan 2005).

The Buffer zone regulations clearly advocates that 30-50 % revenue generated from each protected area should be ploughed back in to the Buffer zone of respective protected areas for biodiversity conservation and overall community development activities in the Buffer zone purpose (Source: DNPWC).

There are nine declared Buffer zone areas in Nepal. Khaptad National Park (KNP) and Rara National Park (RNP) are proposed recently for buffer zone. Shivapuri National Park (ShNP) and Dhorpatan Hunting Reserve (DHR) are also in planning process (DNPWC/ PCP 2005).

1.3 Chitwan National Park and its Buffer Zone

Chitwan National Park was established in 1973 as the first national park of Nepal to cover remaining wild habitats of endangered wildlife species. The biological richness of the park is outstanding that includes 50 species of mammals, 526 species of birds, 49 species of reptiles and amphibians, 120 species of fishes, over 600 plant species and much rare as well as globally endangered plant and animal species such as One horned rhinoceros, Bengal tiger, Panther, Asian elephant, Gaur, Four horned antelope, Spotted linsang, Gangetic dolphin, Pangolin, Hyena, Sloth bear

and Giant horn bill, Black stork, White stork, Sarus crane, Bengal florican, Lesser florican, Asian rock python, Gharial, Crocodile, and Golden monitor lizard. *Tomoptemamaskeyii*, Tree fern, Cycas, Screw pine and locally extinct species of Swamp deer and Wild water buffalo. Major vegetation types are: Sal forest, Tropical hardwood forest (Khair-Sissoo), Riverine forest and Grasslands. The park is the second largest home to One horned rhinoceros after Kagiranga National Park of India. Recognizing its unique biological resources of global significance, UNESCO designated CNP as a World Heritage Site in November 1984 (Budhathoki 2001).

The Buffer zone on the periphery of CNP was declared in 1996. The BZ area is an excellent mosaic of various ethnic human tribes, both indigenous as well as hill migrants. The cultural religious values and customs associated with them are very impressive and an expression of good blend of nature and management of biodiversity. A study reveals that indigenous “Tharu” communities have been using more than 150 species of plants for various purposes (GON/MFSC and DNPWC 2004).

1.4 Objectives

The overall objective of research was to access the park people interaction in and around the CNP. The specific objectives of research were:

-) To determine the general issues and conflicts that CNP is facing at present.
-) To estimate economic loss due to crops and livestock depredation by wildlife in Dibyapuri VDC.
-) To identify indigenous methods to control crops and livestock depredation and their effectiveness.

1.4.1 Justification of the Study

Wildlife human interaction in terms of crop and livestock depredation has led to wildlife human conflict, which is a severe challenge to the park authority to achieve conservation goals of CNP. Conservation will not be possible until the local people show positive behavior towards the park. The thorough assessment of park people conflict in and around CNP will help to minimize the issues of park management such as crop and livestock depredation by generating actual data. It also explains the importance of building BZs in the protected areas and its interconnection with the local people for the livelihood in the long run and would be beneficial for the student of environment and to the individual who have interested on this project.

1.4.2 Limitations

The present study was mainly based on the questionnaire survey and field observation. It may not have succeeded to capture some ground realities, which is possible only through an extensive household survey and field observation. Similarly, sophisticated equipments, finance, security etc. were some of the lacks felt during the research work.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Crop Depredation

Since the establishment of National Parks and Reserve, conflict has been observed between local people and park. Crop depredation by wildlife is very common in neighboring villages of protected areas in Nepal and other countries. It is one of the main causes of wildlife human conflict both in mountain and tarai parks of Nepal. Studies in tarai parks are such as Chitwan National Park (Jnawali 1989, Mishra and Margaret 1991, Sharma 1991, Nepal and Weber 1993, Shrestha 1994, Uprety 1995, Regmi 1999, Gautam 1999, Shrestha 2002 and Bhattarai and Basnet 2004), Bardia National Park (Khatri 1993, Baral 1999, Adhikari 2000 and Jnawali 2002), Koshi Tappu wildlife Reserve (Adhikari 2000), Suklaphanta Wildlife Reserve (Pande 2000) and mountain parks such as Shivapuri National Park (Kattel 1993, Soti 1995, Poudyal 1997, Gurung 2002, Bashyal 2005, Bajrachaya 2005 and Nepal 2005), Dhorpatan Hunting Reserve (Kharel 1993), Makalu Barun Conservation Area (Jackson 1990, Chalise 1998, Chalise and Johnson 2005), Annapurna conservation Area (Shrestha et. al. 1993), Langtang National Park (Upreti 1985, Kharel 1997, Chalise 2001), Rara National Park (Upreti 1985), Sagarmatha National Park (Upreti 1985, Shrestha 2002, Basnet et al. 2003, Shrestha 2004) and Shey Phoksundo National Park (Basnet 1998).

In Chitwan National Park, wild ungulates such as rhinoceros (*Rhinoceros unicornis*), boar (*Sus scrofa*), and spotted deer (*Axis axis*) are chief crop depredators of rice, maize and mustard (Jnawali 1989, Mishra and Margaret 1991, Sharma 1991, and Regmi 1999). According to Nepal and Weber (1993), crop raiding by wild ungulates continued from May to March in any cropping cycle. Uprety (1995) found rhinoceros as a number one crop raider followed by spotted deer, wild boar and parakeet.

Bhattarai and Basnet (2004) estimated Rhinoceros caused 70 percent damage and the lowest 0.2 percent by Brking deer (*Muntiacus muntjak*). Wild boar (Baral 1999), Elephant (*Elephas maximus*) (Adhikari 2000), Rhinoceros, Blue bull (*Josephus tragocamelus*) (Khatri 1993), Monkey (*Macaca mulatta*) and Spotted deer were crop raiders in Bardia National Park (Jnawali 2002, Khanal 2006). The depredators raid varieties of crops, such as rice, maize, wheat, lentil and vegetables grown in kitchen garden (Jnawali 2002).

In Koshi Tappu Wildlife Reserve, wild buffalo (*Bubalus arnee*) and wild boar raided paddy, wheat, and jute (Adhikari 2000).

Spotted deer, wild boar, elephant, blue bull, monkey, porcupine (*Hystrix indica*) and peacock were identified as pests in Suklaphanta Wildlife Reserve (Pande 2000).

In Shivapuri and Gokarna wild boar, monkey, porcupine, and bird species were identified as crop pests (Kattel 1993, Soti 1995, Poudyal 1997, Gurung 1997, Bajracharya 2005, Basyal 2005, Nepal 2005) that affected crops like maize, millet, rooted crops, rice and wheat.

In high mountain region the identified crop pests were two species of monkey (*Macaca mulatta* and *Simmnopithucus entellus*), barking deer and porcupine at Shankhuwa Valley, Makulu Barun National park (Chalise 1998). In addition to these pests, Kharel (1997) identified wild boar as the major pest in Langtang National Park. Monkeys, bears (*Selenartis thibetanus*), musk deer (*Moschus chrystogaster*), blue sheep (*Pseudois nayaur*) at Langtang National Park (Chalise et al. 2001) as well as Porcupine, and rodents were identified as major crop wildlife pest in Shey Phoksundo National Park (Basnet 1998), and Himalayan tahr (*Hemitragus jemlahicus*) at Sagarmatha National Park (Shrestha 2002 and Shrestha 2004).

2.2 Livestock Depredation

Livestock depredation by wildlife is another issue of the protected area management. Conflict between livestock owners and predators dates back 9,000 years to the time when animals were first domesticated by human it is not recent phenomenon caused by the establishment of protected areas or wildlife protection laws as commonly believed (Jackson 1998). Tiger (*Panthera tigris*), and leopard (*Panthera pardus*) were identified as livestock depredators in Chitwan National Park (Mishra and Margaret 1991, Sharma 1991) and in Bardia National Park (Jnawali 2002). Jackel (*Canis aureus*), Indian fox (*Vulpes vulpes*), common mongoose (*Herpestes spp.*) and jungle cat (*Felis chaus*) have been reported as livestock lifter around the CNP (Uprety 1995). Livestock depredation has led to wildlife human conflict in Dhorpatan (Kaharel 1993), Gokarna (Gurung 1997) and ShNP (Gurung 2002). Leopard, jackel, jungle cat and mongoose were identified as livestock depredating wildlife at Gokarna (Gurung 1997). Snow leopard was identified as livestock depredator in LNP (Kharel 1997, Khatiwada 2004), leopard, jackel, wild dog (*Cuon alpinus*) and grey wolf (*Canis lupas*) in Makalu Barun Conservation Area (Jackson 1990 and Chalise 1998), Annapurna Conservation Area (Shrestha et al. 1993), Tibetan wolf, snow leopard (*Uncia uncia*), common leopard, wild dog, jackel and the fox in SPNP (Basnet 1998).

According to Bhadauria and Singh (1994) the frequency of domestic livestock being killed by tiger increases during the rainy season. The large livestock depredators such as lion (Srivastav 1997), common leopard (Maan and Chaudhary 2000), snow leopard (*Uncia uncia*), wolf (Misha 1997) resulted a human wildlife conflict and hindered conservation efforts of these predators. Jackson (1991) estimated an average loss of US \$ 25 per household at Qomolangma Nature Reserve due to livestock depredation by wildlife and calves were the most frequent targets of wolf

depredation at Wisconsin, United States (Treves et al. 2002). Frequency of attacks to livestock increased by 22.9 percent in Spain from 1991 to 1999 (Blanco 2003).

2.3 Attacks to Human Life

The encounters with wild animals around the park were common (Nepal and Weber 1993). This included an encounter with rhinoceros in Chitwan National Park (Jnawali 1989 and Shrestha 2000) and human injury and loss of property by elephant in Suklaphanta Wildlife Reserve (Pande 2000). A total of 78 accidents were recorded in a period of 10 years from 1978 to 1988 (Jnawali 1989). Srivastav (1999) recorded 164 man-leopard encounters at Gir, and Mukherjee (2003) recorded tiger - human conflict in Sundarban Tiger Reserve. Human casualties in protected areas, loss of human life in wildlife related incident is one of the most painful experiences faced by park managers and conservationists (GON/ MFSC 2001). Old age, injuries, displacement and lack of prey species sometimes turn tigers and leopards in problem animals and they attack human beings (Mukherjee 2003 and GON/MFSC 2001). Intrusion of people into habitat of wildlife was causes of attack to human life for instance honey collectors and fisherman were victim in Sundarban Tiger Reserve (Mukherjee 2003).

Many studies of wildlife human interaction have been conducted. It should be conducted in every affected area because the interaction issue and its solution differ significantly depending on places. Regular recording of the crop and livestock depredation is necessary for better management of protected areas.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1 Location, Declaration and Extent of Area

Chitwan National Park is located between 27⁰ 34' to 27⁰ 68' North latitude and 83⁰ 87' to 84⁰ 74' East longitude while the Buffer zone extends further at 27⁰ 28' to 27⁰ 70' North latitude and 83⁰ 83' to 84⁰ 77' East longitude (see Map). It lies in the southern part of the mid-central administrative development region of the country and spans across portions of four districts namely Chitwan, Nawalparasi, Parsa and Makawanpur (CNP and BZ Management Plan 2001-2005).

CNP was established under the provisions of National Parks and Wildlife Conservation Act 2029 (1973) and administered under the Chitwan National Park Regulation 2030 (1974). The Act defines a National Park (IUCN Category II of Protected Area) as an area set aside for the conservation and management of the natural environment including fauna, flora and landscapes, it is primarily intended to protect sites, landscapes or formation of scientific or aesthetic importance together with their associated flora and fauna. The second objective, provided it is compatible with the first, is to develop the area for tourism. Initially the park area was 544 sq. km, which was extended to 932 sq. km. in 1977. Current GPS survey, of the park boundary and GIS digitization based on 1992 topographic maps show a total park area of 1182 sq. km. (CNP and BZ Management Plan 2001-2005).

The DNPWC brought forth the Buffer zone policy in 1993 under the fourth amendment of the National parks and Wildlife Conservation Act 1973. Subsequently, Buffer zone of CNP was declared in the same year. After the Buffer zone area was gazetted it's total area was estimated to be

750 sq. km. The current GPS survey of the Buffer zone boundary and the GIS digitization based on 1992 topographic maps show a total area of 767 sq. km (CNP and BZ Management Plan 2001-2005)

The Buffer zone is an area peripheral to the park and is also regarded as a zone of impact. The Buffer zone of CNP is spread over Chitwan, Nawalparasi, Parsa and Makawanpur district covering whole or parts of 35 VDCs and 2 Municipalities having a total human population of 2,23,260 (Table 3.1) (CNP and BZ Management Plan 2001-2005).

Table 3.1 Buffer Zone Description of CNP

Description	Unit	Total
User committee	No.	37
Municipality	No.	2
VDC	No.	35
Wards	No.	233
Settlements (Approx.)	No.	510
Households	No.	36193
Population	No.	223260
Area covered by VDC/Municipality	Ha.	68129.3
Forest area not under VDC	Ha.	8620.7

The CNP is roughly sixty air miles southwest of Kathmandu and 170 Km. road distance from Kathmandu. To considerable extent, access to the park is affected by the season. However, it is possible to visit most part of the park area throughout the year. The Buffer zone is accessible all year round, the average arial distance of the BZ settlements from the park boundary is 3.5 km (CNP and BZ Management Plan 2001-2005).

3.2 Physical Attributes

3.2.1 Boundaries

The park's boundaries extend from Dounne Hill on the west bank of Narayani River to Hasta and Dohoram Khola in the East, bordering the

Parsa Wildlife Reserve. The park is bordered to the north by the Rapti and Narayani river and by the international border with India, Someshwor hills, Reu river and the park road in the south (CNP and BZ Management Plan 2001-2005).

The Buffer zone boundary in the west and north extend either towards the East-west Highway or slightly south of it. It extends towards the south along the international border with India. There is no Buffer zone on the east as the park is contiguous with the Parsa Wildlife Reserve (CNP and BZ Mgmt. Plan, 2001-2005).

3.2.2 Climate

The dominant climatic factor in Chitwan is the southeast monsoon which normally commences around mid-June and continues until late September. But there is a marked increase in pre-monsoon rainfall during May when sporadic thunderstorms are frequent (CNP and BZ Management Plan 2001-2005). The mean annual rainfall recorded over 2100 mm, 90 percent of which fall between May and September (WWF 2002). The average rainfall record of Dumkauli shows that June has recorded higher rain fall in 2004 while August was peak in 2005 and 2006 (Table 3.2a)

Table 3.2a Average Rainfall (mm) at Dumkauli (2004-06)

Months	Year		
	2004	2005	2006
January	42.7	76.5	0.0
February	0.0	0.0	0.0
March	0.0	10.2	19.0
April	204.8	83.4	266.0
May	342.6	81.4	292.2
June	590.7	267.8	270.9
July	490.3	457.7	189.4
August	253.9	796.6	517.4
September	464.9	188.7	474.0
October	219.2	251.5	67.4
November	2.0	0.0	0.0
December	0.0	0.0	20.2

Sources: Hydrological and Meteorological Department, Babarmahal, Kathmandu.

Summer, which endures for 3 months from March to early June, is a very hot season with temperature peaking in May or June (Gurung 1983) The month of May of 1995 was recorded as the hottest month of the decade when average air temperature was 39.1⁰C (CNP and BZ Management Plan 2001-2005).

The cool winter season occurs from October to February. During the winter season dry northly winds from the Himalayas and Tibetan plateau result in greatly reduced temperatures and low relative humidity (CNP and BZ Management Plan 2001- 2005). However in 2004 to 2006 the maximum temperature felt in May and June while most cold month in January (Table 3.2b)

Table 3.2b Average Maximum and Minimum Temperature (⁰C) at Dumkauli (2004-06)

Months	Year					
	2004		2005		2006	
	Tmax(⁰ C)	Tmin(⁰ C)	Tmax(⁰ C)	Tmin(⁰ C)	Tmax(⁰ C)	Tmin(⁰ C)
January	20.7	9.6	22.1	9.9	22.5	9.0
February	25.6	11.2	25.8	12.4	28.1	14.4
March	32.8	17.0	31.8	16.3	31.8	14.5
April	33.0	21.0	35.4	18.7	34.2	19.5
May	34.3	23.0	35.0	22.6	34.7	23.5
June	33.7	24.6	36.1	25.6	33.8	24.7
July	31.9	25.4	33.0	25.9	34.0	26.2
August	33.8	25.7	32.7	25.6	34.5	25.9
September	32.4	24.3	33.9	25.4	32.3	24.2
October	30.2	19.7	30.4	20.5	31.7	20.3
November	26.7	14.0	27.1	14.0	27.1	15.1
December	23.5	11.0	24.6	10.0	23.6	11.6

Sources: Hydrological and Meteorological Department, Babarmahal, Kathmandu.

Chitwan District has tropical monsoon climate with relatively high humidity. In the year 2004, maximum relative humidity, 96 percent and 95.7 percent were recorded in the morning in January and December, whereas, the minimum relative humidity, 48.8 percent was recorded in the evening in March. Similarly, in 2005 and 2006 the relative humidity reached maximum 96.3 percent and 96.6 percent during December whereas minimum 52 percent 39.2 percent during March respectively (Table 3.2c).

Table 3.2c Average Relative Humidity Morning and Evening (%) at Dumkauli (2004-06)

Months	Year					
	2004		2005		2006	
	RH(%) M	RH(%) E	RH(%) M	RH(%) E	RH(%) M	RH(%) E
January	96.0	76.0	95.6	75.3	95.6	79.5
February	92.9	62.7	88.9	65.3	94.2	70.2
March	75.3	48.8	73.6	52.0	64.4	39.2
April	73.4	59.4	71.6	67.5	64.9	50.8
May	74.8	61.3	68.4	52.1	77.4	66.6
June	81.4	72.4	71.9	92.9	82.2	75.8
July	88.4	83.9	84.8	80.2	86.2	79.3
August	87.3	83.5	88.8	83.8	83.5	79.4
September	88.1	86.4	85.0	82.9	87.3	81.8
October	89.0	82.5	89.1	88.6	88.6	81.6
November	94.3	81.8	94.7	84.8	95.8	81.2
December	95.7	83.7	96.3	80.7	96.6	85.3

Sources: Hydrological and Meteorological Department, Babarmahal, Kathmandu.

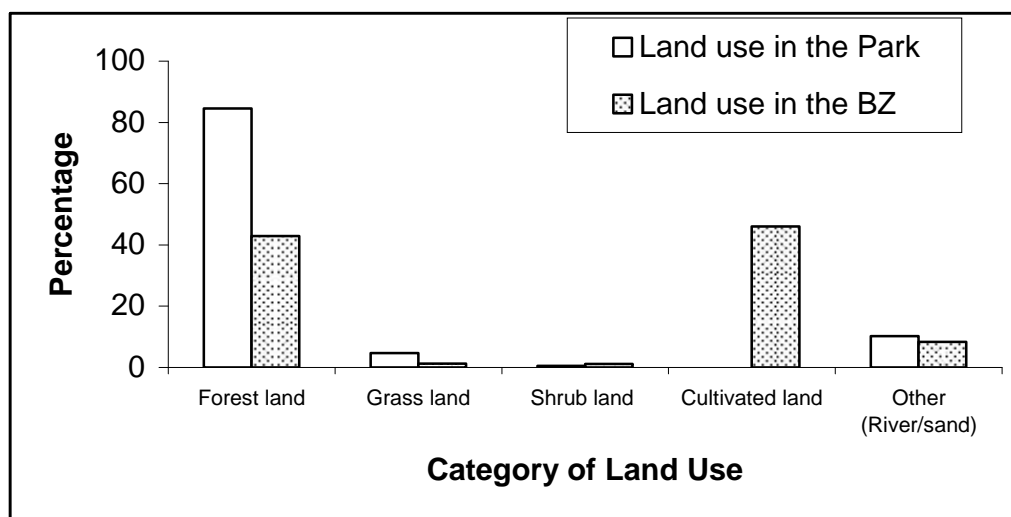
3.2.3 Land Use in the Park and BZ

Forest as the dominant land use is spread over 84.6 percent of the surface area, grasslands occupy 4.7 percent, shrub land 0.5 percent and the other

category including river and sand banks occupy 10.2 percent in the Park (CNP and BZ Management Plan 2001-2005).

The Buffer zone includes settlements, cultivated land, water bodies, grassland and forests. Cultivated agricultural land is the dominant land use and is spread over 46 percent of the area. Likewise, forests occupy 42.3 percent, grasslands occupy 1.1 percent, shrub land occupies 1.3 percent and other category (river/sand) occupies 8.4 percent of the total surface area of the Buffer zone (CNP and BZ Management Plan 2001-2005). (Figure 3.1)

Figure 3.1 Land Use in the Park and BZ



3.2.4 Geology

The Chitwan valley lies within the Siwalik belt and consists of thick alluvial deposits. Both upper and middle Siwalik are found inside the park. Geologically, the area comprises late Tertiary Siwalik formations in the south (Churia and Someswar hills) and Rapti and Chitwan duns (inner valleys) to the north. The core of the siwalik consists mainly of sandstone, conglomerates, quartzities, shales and micaceous sandstone (Soil Survey of Chitwan Division 1968).

Geomorphologically, the area can be divided into Siwalik hills (Churia range), valley, alluvial fans, river terraces and floodplains. The valley lying within the Siwalik belt is filled up with thick alluvial deposits composed of boulders, cobbles, gravel, sand and silt. The fans are located on the end of the slopes where streams also enter the flat terrain. The fans are composed predominantly of sand, gravel, cobbles and boulders with a little of silt and clay. There are river terraces developed mainly by the rivers over the centuries (CNP and BZ Management Plan 2001-2005).

Most of the common soils of Nepal are also found in the Chitwan valley. The following soil types are found in both park and Buffer zone (LRMP Land system Map 1978, NTNC 1996): Brown Shallow soil, Brown Black and Red Soil, Black Soil, Brown soil, Wet Well Drained Soil, Poorly Drained Brown Soil and Well stored Dry shallow Soil (CNP and BZ Management Plan 2001-2005).

3.2.5 Wetland Area in the Park and BZ

The wetlands of the park include three main river systems Narayani, Rapti, Reu and several shallow rivers and streams. Stagnant wetland types include several lakes, floodplains and marshes of various sizes. There are about 40 lakes, ponds and marshes covering about 114 Ha area inside the central sector of the park. The largest water body inside the park is Devi Tal (11 Ha), followed by Tamor Tal (10 Ha), Nandan Tal (9 Ha) and Lami Tal (7 Ha). The rivers and shallow lakes supports diverse wildlife (Bhandari 1998).

The aquatic habitat of the Buffer zone includes several rivers, lakes, marshes, reservoir and canals. The major rivers of the Buffer zone includes Narayani, Rapti, Reu, Budhi Rapti, Dhungre, Icharni Khola, Lothar, Manahari and Several other small rivers. Other water bodies are

Bishazari Tal (about 100 Ha.), Devi Tal (2.6 Ha.), Pandethan Tal (2.1 ha), Khageri canal, Bagamara Lake, Kumrose ox-bow Lake, Kathar Lake, Gaida Tal etc. They are utilized for various purposes by local communities, e.g. irrigation; fishing, animal grazing, agriculture, and many of them are significant in terms of biodiversity (CNP and BZ Management Plan 2001-2005).

3.3 Biological Attributes

3.3.1 Vegetation

The terrestrial habitats include three different types of vegetation viz, Sal forest, Riverine forest and Grasslands in the park. Total area covered by Sal and Mixed hardwood forest in the park is 70 percent while Riverine forest covers 7 percent and grassland covers 20 percent of the area. (CNP and BZ Management Plan 2001-2005).

The terrestrial habitats in the Buffer zone are not very different from that inside the park. however, there is a high incidence of human pressure in the Buffer zone forests. The vegetation in the Buffer zone can be categorized into six broad types. These include Sal forest, riverine forest (including regeneration forests), short grasslands, tall grasslands, bush land (shrub land) and plantation forest (CNP and BZ Management Plan 2001-2005).

According to Mishra (1982), Tamang (1982) and others, the vegetation of the Chitwan National Park are broadly classified into three major types.

Sal Forest

Sal (*Sorea robusta*) is the principal type of vegetation in the park. About 70 percent of the park vegetation covers predominantly by the Sal forest. It occurs in almost pure stands in association with other tree species

namely, *Terminalia tomentosa*, *Dillenia pentagyana*, *Syziun cumuni*, *Lagerstoemia parviflora* and *Phyllanthus emblica*.

Grasslands

The second type of vegetation includes the grasslands, which account about 20 percent of park vegetation. It could be found in three major areas of parks - the moist places, old agricultural sites and alluvial flood plains.

Species of *Saccharum*, *Narenga* and *Temeda* occur in moist places and form the tall grass communities. *Imperata cylindrica* is a short grass, occurring in old agricultural sites. On the alluvial flood plains, *Saccharum spontaneum* is found profusely in the tall and dense stands. The grassland forms diverse and complex communities with over 50 species are found there (Bruncher 1993). The *Saccharum spp.* often called the elephant grass, can reach up to 8 meters in height. The shorter grasses such, as *Imperata* species is useful for thatch roofs.

The alluvial flood plains support a luxuriant growth of grasses interspersed with patches of riverine forest. According to Mishra (1982), grassland can be divided into 3 types.

- a. The Savanna Dhaddi: It consists of tall elephant grass rowing to 6 to 7m high.
- b. The Old Village Khar-Jhaksi: *Imperata cylindrica* (thatch grass) is the main types of grass in this type of grassland.
- c. The Riverbank Kans: After the monsoon, the elephant grass colonizes into the exposed sand bank.

Most grasses achieve their full growth by the end of the monsoon in September and maximum flowering takes place until November. The grass communities, which have evolved on the plains, are highly

complex. Most of them are not influenced by human interferences, except removing by the annual burning and Khar-khadai practices.

Riverine Forests

The riverine forests comprise 7 percent of the park vegetation and occur along the rivers, ox-bow lakes and on islands. The river forests mainly consist of Khair (*Acacia catechu*), Sissoo (*Dalbergia sissoo*) and Simal (*Bomax ceiba*). The forests are found in two association based on the stages of succession, the association of *Bombax ceiba* and *Trewia nudiflora* in the later stage. Forests in the later succession stage have a larger component of evergreen species (Sharma 1991). The remaining 3 percent of the forests contains Pines with Sal and other species as associates at the Churiya range. The park is annually burnt during the annual grass - cutting period (khar khadai) by the local villagers for the growth of the grasses which will be lushly for their livestock either for grazing or for the installed fed.

3.3.2 Wild Fauna

The park harbors an exceptionally diverse wildlife population. The wild animals of the park includes more than 50 species of mammals, 256 species of birds (Baral and Upadhyaya 1998), 4 species of turtle, 156 species of butterflies (Mishra 1984), 49 species of reptiles and amphibians (Mitchell and Zug 1986) and more than 120 species of fish (Ed. 1989).

The park is especially renowned for the protection of the endangered one-horned rhinoceros (*Rhinoceros unicornis*), tiger (*Panthera tigris*), gharial crocodile (*Gavialis gangeticus*). It also secures the population of endangered species of animals such as gaur (*Bos gaurus*), wild elephant (*Elephas maximus*), four-horned antelope (*Tetraceros quardicornis*), striped hyena, pangolion (*Manis pentadactylus*), monitor lizard (*Varanus*

flavescens), gangetic dolphin (*Platanista gangetica*), python (*Python morulus*) etc. Some of the other animals found in the park are sambar (*Cervus unicolor*), chittal (*Axis axis*), hog deer (*Axis porcinus*), barking deer (*Muntiacus muntjack*), sloth bear (*Melursus ursinus*), palm civet, langur, rhesus monkey and wild boar (*Sus scrofa*). Gaurs are also found in the Siwalik and its foothills. There may be other endangered species such as hispid hare (*Caprolagus hispidus*) and pigmy hog (*Sus sulvinus*) (Sharma 1991). It is estimated that the grassland and riverine forest support higher ungulate biomass than the Sal forest (Tamang 1982).

Nepal is a paradise for ornithologists, which shelters about 863 species, that accounted to about 10 percent of the bird's species of the world. Nepal has declared 9 species of avi-fauna as the endangered bird species. Among the endangered avi-fauna, bengal floricon (*Haubaropsis bengalensis*), giant hornbill (*Buceros bicornis*), black stork (*Ciconia nigra*), sarus crane (*Grus antigone*), lesser florican (*Sypheotides indica*) are reported in the park. The common birds such as peafowl (*Pavo cristatus*), red jungle fowl (*Gallus gallus*) and different species of egrets, herons, kingfishers, fly catchers and woodpeckers are also reported from the park. According to Inskipp (1989), there are 55 breeding bird species in which 36 have been classified as endangered or vulnerable species. The best time of bird watching in Chitwan National Park in March and December.

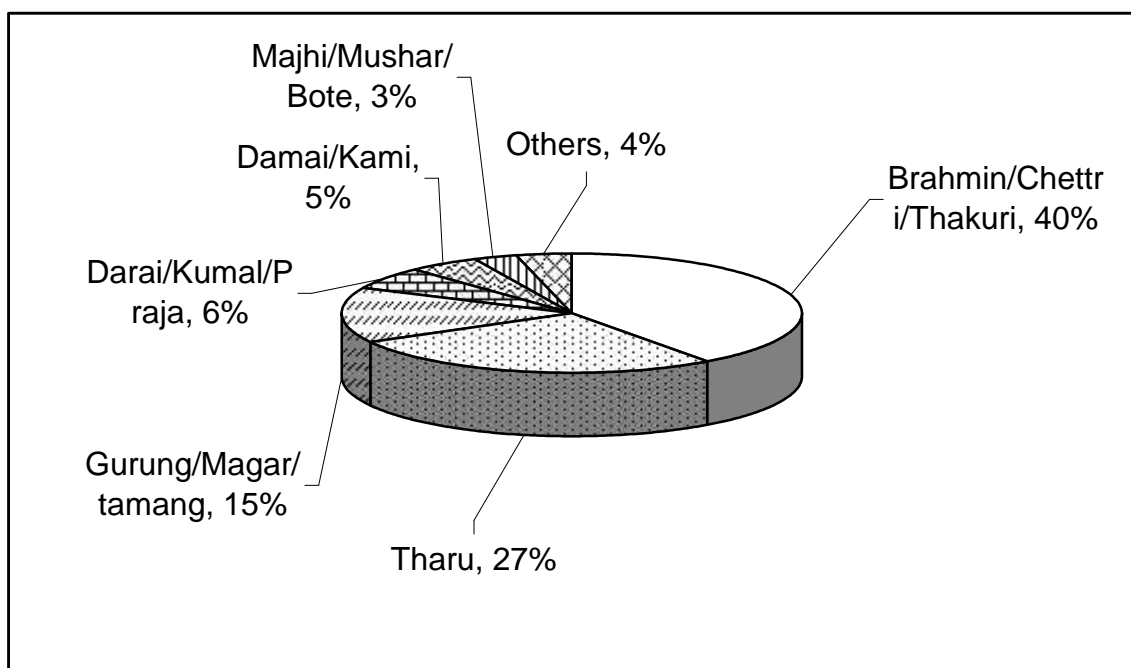
Nepal has declared 27 species of mammals as the protected species in 1973. Among them Chitwan National Park consists of rhinoceros, wild elephant, tiger, gaur, four-horned antelope, gangeticc dolphin, spotted linsang (*Prionodon pardicolor*), python (*Python spp*), gharial (*Gavialis gangeticus*), yellow monitor lizard (*Varanus flavescens*), etc.

There are 49 species of herpeto fauna recorded for the Chitwan National Park area. Some of them are mugger (*Crocodylus palustris*), cobra, green pit viper. There are also record of various species of frogs and tortoises.

3.4 Caste and Ethnic Groups

Tharus, Bote-Majhi and Mushar are pioneer inhabitants of this area. These indigenous groups are displaced by hill migrants following malaria eradication in 1950s. Migration to Chitwan Valley was spurred by government's resettlement programme, fertile agricultural land and the new economic opportunities. Thus the area has become a melting pot of different caste/ethnic groups having different cultural backgrounds. Brahmin, Chhetris, Newars, Gurung, Tamang, Magar, Bote, Majhi, Mushar etc. are the common caste/ethnic groups in the area at present. Brahmin/Chhetris, Thakuri and some other groups claim 40.3 percent household. Tharus, supposed to be the autochthonous, comes in second with 27 percent (CNP and BZ Management Plan 2001-2005).

Figure: 3.2 Major Ethnic Group in Buffer Zone of CNP



3.5 Tourism in the BZ

Tourism in Sauraha of Bacchauli VDC that lies just outside the park started during 1977 with only a couple of lodges. Today, tourism in Sauraha is spread over 5 Km. with about 65 hotels/lodges. In the adjoining areas of the Buffer Zone, tourism development has just started to sprout viz, in Amaltari, Kuzouli, Megghauli, Jagatpur, Kumrose and Bhandara. The pressure of tourism is very high in the central sector of the park in Sauraha, which is causing serious socioeconomic, cultural and economical impact in the locals. Inadequate basic information about the park and lack of physical infrastructure besides Sauraha are the major problems for the sustainable development of tourism in the Buffer Zone (CNP and BZ Management Plan 2001-2005).

The tourists used lodges about 27,000 during 1996 and 38,582 in 1998/99, while tourist arrival in Sauraha was 48,031 and 68,342 during the same period. The average growth rate of tourist arrivals in 1994/95 to 1998/99 was about 12.6 percent. The share of tourist revenue was Rs. 26.02 million in 1991/92 and Rs. 49.57 million in 1998/99, with a growth rate of about 10.8 percent annually (CNP and BZ Management Plan 2001-2005).

3.6 Agricultural Activities

The main cereal crops grown here are paddy, maize, wheat, barley and millet. Oilseed production and fruits are the main cash crop enterprises. Besides soybean and lentils, locals also cultivate some tobacco. The cropping pattern is associated with two different types of landforms, namely, ghol or lowland and tandi or upland cultivation area (Nepal 1993). Rice and wheat are mainly grown on ghol land, whereas maize and oilseed are grown on tandi land. Multiple and inter-cropping are the main features of cropping pattern. Various leguminous crops are

intercropped with maize. Farming method is traditional, and is based on human labor and animal power. However, there is increasing use of tractors for plowing; water irrigation is available only in some parts of the area. Paddy, the dominant crop, is grown twice a year in some places and has the highest land coverage, followed by maize and oilseed (CNP and BZ Management Plan 2001-2005).

3.7 Livestock Population

The fact that livestock rearing is an integral component of the farming system is apparent from the big livestock population in the area. There are about 146,085 heads of livestock that includes cows (28,502), buffalo (33,407), calves (24,031), sheep and goats (60,145). Average livestock owned per households is 4 heads, which is less compared to former estimate of 4.6 (Joshi 1998). Livestock rearing is directly and closely interlinked with forest resources, for their survival. The number of livestock keeping largely dependent on availability of forest resources, as traditional livestock farming is primarily depended upon fodder from the forests (CNP and BZ Management Plan 2001-2005).

Livestock farming in BZ has been facing several problems. Predation by wild animal, shortage of pastureland and fodder are some of the major problems. Of the 510 settlements in BZ, about 34 percent suffer from high predation and 34 percent suffer from moderate damage. Similarly, 80 percent settlement are faced with shortage of pasture land and fodder supply (SES 1999).

3.8 Main Study Sites

Dibyapuri Buffer zone area is located between $27^{\circ} 29.23'$ to $27^{\circ} 40.85'$ North latitude and $84^{\circ} 12.04'$ to $84^{\circ} 13.45'$ East longitude which is 170 km south west of Kathmandu valley and 25 km. from Bharatpur, at an altitude of about 140m-165m above the sea level. It is situated in the

northern fringe of the Chitwan valley (inner tarai) on the southern lap of Mahabharat Range. The boundary of this study area is Rajahar VDC at the east, Pragatinagar VDC at the West, mahendra Highway (BZ boundary) on the north and Narayani River (i.e. CNP) on the south.

The area of the Nawalpur belt (where Dibyapuri VDC is also situated) with heavy forest's resource was cleared for settlement about 50/55 years ago. The bordering Narayanghat-Butwal highway (i.e. East-west highway) was constructed in 1978/79. Migrations of hilly people was spurred due to the eradication of Malaria in Chitwan valley, government's resettlement programme, fertile agricultural land and the new economic opportunities.

3.8.1 Farming System

Along with paddy, wheat was also the major crops in the study area. However, since, 7/8 years cultivation of wheat had been decreased and ultimately the wheat cultivation has stopped due to depredation of wheat crops completely by wild animals.

Therefore, Paddy and Maize have become the major crops in my study area, in which paddy is grown rain fed low lands while maize is mostly cultivated on the uplands area (i.e. in Tandi). Non cereals crops such as legumes, oil seeds, potatos, pulse and variety of vegetables are also cultivated by most of the households but in low proportion. Kitchen plants like tomato, raddish, cauliflower, cabbage, onion, garlic, chilly etc. are also grown in their vegetable garden. People sell their surplus food grains and vegetables in near by village market.

The cropping pattern in the area consists mostly of either sequential or mixed cropping. Sequential cropping or the cropping cycle depends upon the quality of land, irrigation facilities, ability of the farm holders to invest, credit facilities and extension services. However, in general

practice, the cropping cycle in this area is paddy-oil seeds-fallow, Paddy - fallow-maize, Paddy-pulses-fallow and paddy only in a year.

Paddy is generally planted in late June to mid-August and harvested in October-November and after then pulses or oil seeds are sown in different quality of land as their suitability. In the low lands a local variety of rice called "Sabitri" or "Mota Dhan", which has a short life cycle are usually planted in late May and harvested in late August. Such fields are then used to cultivate either oil seeds or pulses. Maize is generally sown in late February or March and harvested in late June to July (Table 3.3).

Table 3.3 Growing Season for Different Crops in Study Area

Crops	J	F	M	A	M	J	J	A	S	O	N	D
Paddy							←	→				
Maize		←	→									
Mustard	←	→									←	→
Lentil	←	→								←	→	
Rajma	←	→									←	→
Linseed	←	→									←	→
Phaper	←	→								←	→	
Potato	←	→									←	→
Vegetables	←	→										→

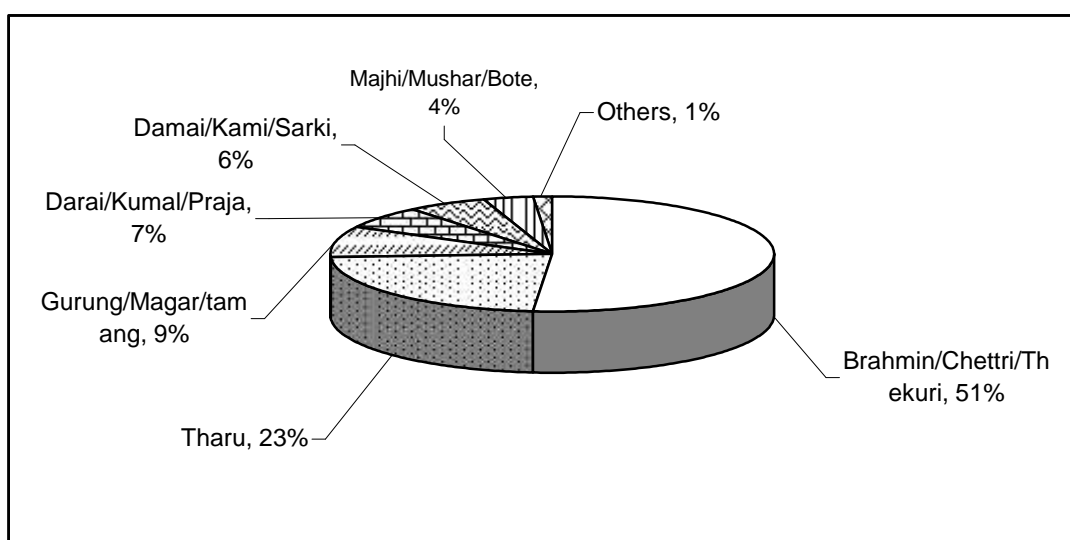
3.8.2 Socio-Economic Aspects

The population growth has leaped fast due to hill migrant and is continuous. Traditionally, local people of Dibyapuri VDC depend upon agriculture and livestock rearing. But some people like Bote and Musahar depend upon forest resources and fishing into the Narayani River for their subsistence economy. People who live near the park used both timber and non-timber forest product such as thatch grasses and seeds, tree fodder, fibers, wild vegetables, driftwood, medicinal herbs and fruits. According

to the caste, Brahman/Chhetri and Tharu are in higher proportion and other caste such as, Bote-Majhi, Gurung/Magar, Kumal, Dalit (Kami, Sarki and Damai) and others are in small numbers (Figure 3.3).

Agriculture is the main source of income in this village and livestock rearing is another important source. Some of the members of this study area are also engaged in corporate job. Fishing is another important source of income for ethnic groups like Majhi, Bote and Musahar. They also collect seasonally the wild vegetables (e.g."Niuro") and get income by selling it at the town.

Figure 3.3 Ethnic Composition of BZ of Dibyapuri VDC (N = 465)



Source: BZ Office of Dibyapuri VDC 2006/07

3.8.3 Land Use System of Dibyapuri BZ

The total land area of Dibyapuri BZ is about 375 ha. Community forest land comprising 125 ha where as settlement (cultivated land) is about 250 ha. The land used system of Dibyapuri BZ shown in table 3.4.

Table 3.4 Land Use in Dibyapuri BZ in ha.

Land type	Area (ha)	Percent
Tall tree forest (old riverine natural forest)	89.0 ha	23.73
Grass Land Area	16.0 ha	4.27
Simsar Area (Ghol+Tal)	8.0 ha	2.13
Plantation area	7.0 ha	1.87
Grazing Land	5.0 ha	1.33
Agriculture/Settlements	250.0 ha	66.67
Total area	375 ha	100.0

Source: (Office: BZ Office of Dibyapuri VDC, 2006/07)

3.8.4 Wet Lands in the BZ

The aquatic habitat of the BZ of Dibyapuri VDC includes Kakarda Khola, Mukunde Khola, Baulaha Khola, Chuwadi of Dumkauli, Devi Tal, Shanishchar Tal, patchy forest of Soraha and Gainda Tal. The main river of the southeastern side of the BZ of Dibyapuri VDC is Narayani River. These wetlands harbour several species of fish, amphibians, reptiles and mammals. The wetlands are utilized for various purposes by local communities e.g. irrigation, fishing, animal grazing and many of them may be significant in terms of biodiversity.

The wetland of the Dibyapuri BZ are somewhat threatened from exploitation of resources, invasion of exotic plant species, chemicals used by fisher men and human disturbances. Major problem for wetlands are invasion of water hyacinth and debris deposition. The total wetland area recorded in Dibyapuri BZ is 8 Ha.

3.8.5 Crop Raiding and Depredation

Although several crops were damaged by wild animals, four major crops, namely, paddy, maize, lentil and oilseed were included in this study. Crop raiding was mainly associated with three principal wild ungulates of the park, those are rhinoceros, wild pig and chital. Crop raiding by wild

ungulates is a common phenomenon in the vicinity of CNP. Feeding in the fields by these wild animals could only be hindered by human interference. During the cropping seasons, the farmers built elevated pole platforms (Machan) on which they sat out at night to guard their crops. If detected, they simply scared the animals off their fields into fallow land, or someone else's crop field and sought the neighboring guards to their attention. Wherever they failed to be on guard, they suffered crop damage. The respondents said that during misty or cloudy nights, and during the dark periods of the lunar cycle, crop raiding was more. Crop raiding by the wild ungulates continued throughout from May to March in any one cropping cycle.

3.9 Selection of Study Area

Four wards of Dibyapuri VDC (1, 2, 3, and 7) which lies inside the BZ were selected for the study because people residing nearby the protected area are increasingly suffer from crop depredation, livestock depredation by the protected wild animals, and local people are also killed or injured by the wildlife attack during the collection of resources from the BZ community forest or trespassing the road in their settlements.

At first, I differentiated all the study area into two strata i.e. villages bordering the National Park boundary (0-1 km from CNP) and villages not bordering the National Park boundary (1-2 km from CNP). The details of these two strata are as follows.

Table 3.5: Research Design for the Study Ares of Dibyapuri BZ

Strata	Total HH	Surveyed HH	Survey %
VBNPB	223	36	16.14
VNNPB	242	36	14.89
Total	465	72	15.48

Note: VBNPB: Villages bordering the NP boundary.

VNNPB : Villages not bordering the NP boundary.

3.10 Data Collection

This study is entirely based on both primary and secondary data. The primary data includes information collected from the study area. The questionnaire for local person concerned land holding, agricultural type, economic condition, resource need, conservation attitude and impact of wildlife.

Secondary data include records and reports from different sources and office on different aspects of the study. Secondary data were collected from BZ office, VDC, central library Kirtipur, park headquarters, DNPWC, INGOs, NGOs etc. Other sources were articles, dissertation works on related fields.

3.11 Questionnaire Survey

The questionnaire addressed different issue related to forest resources, grazing pattern, crop damage, livestock depredation, and other socio-economic data that direct affect the national park. A sample questionnaire is given (Annex I).

A total number of 72 households were selected for household questionnaire survey. There are altogether 465 households in the study area. A questionnaire survey of the households was accomplished as follows:

- * The list of household number collected from office of Sishawar BZ user group committee then households for questionnaire selected randomly.
- * The household heads (who makes most of the major decisions) were then interviewed after being briefed about the objective of the study.

- * Assistants (BZ members, local school teachers, local leader, VDC members) were invited for interview and information sharing.

The household owner survey was conducted during the months of July 2006 to June 2007 and information was collected on frequency and abundance of pest species in and around CNP. I categorized frequency of wildlife visit into three types such as very frequent for wildlife visiting every day or night during crop season, frequent for wildlife visiting once or twice a month; and Rare for wildlife visiting once or twice a year for fewer times.

The loss of crops were estimated in local scale e.g. pathi, muri and quintal which was converted into kilogram/quintal by weighing "a pathi" of different crops for three times and the average weight were considered as a standard value (Annex II). Rate of different crops were obtained from local businessman of Dibyapuri VDC (Annex III). The average value was considered for estimation of the economic loss.

3.12 Field Survey

A structured questionnaire cannot cover all aspects of the reality. Therefore, a field survey was done in the study area in the time of growing and ripening of the crops. Damage area was visited; damaged area, fencing, "Machan" and other important pictures were taken into consideration.

3.13 Data Analysis

Simple data analysis technique was done for this study. After conducting questionnaire survey mean crop loss per household is calculated as:

$$\text{Mean Crop loss per household} = \frac{\text{Total Crop loss (kg)}}{\text{Total no. of household}}$$

By multiplying mean crop loss and total household of the village, the total crop loss of the village was calculated.

Therefore, total crop loss of the village = mean crop loss x total household of the village in (kg)

The price of the crop was multiplied by total crop loss. So the total economic loss of the village was calculated.

Therefore, total economic loss of the village = price of crop x total crop loss of the village.

I used student's t-test to find whether there is a significant difference between crop loss in weight, due to crop depredation by wildlife in villages bordering and non-bordering the park. I took two sides to test a null hypothesis.

Ho : Crop Loss (Value) in villages bordering the NP and villages not - bordering the NP does not differ significantly.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Where,

\bar{X}_1 = Damage in the villages bordering the NP

\bar{X}_2 = Damage in the villages not bordering the NP.

S = Combined standard deviation

$$S = \sqrt{\frac{\phi(\bar{X}_1 - \bar{X}_1)^2 \Gamma \phi(\bar{X}_2 - \bar{X}_2)^2}{n_1 \Gamma n_2 Z^2}}$$

I used χ^2 - test to test the association between the crop loss and study sites setting null hypothesis.

Ho = There is no relation between crop loss and different studied sites.

$$\chi^2 - \text{test} = \frac{(O - E)^2}{E}$$

Where,

O = Observed Value

E = Expected value.

Expected value of contingency table (two way table) can be calculated by;

$$\text{Expected frequency} = \frac{RT \times CT}{N}$$

Where,

RT = Row total

CT = Column total

N = Total

CHAPTER FOUR

4. RESULT

4.1 Occurrence and Abundance of Major Pest Species

I identified ten major pest species in my study area around the park. They included Rhinoceros (*Rhinoceros unicornis*), Tiger (*Panthera tigris*), Common leopard (*Panthera pardus*), Wild boar (*Sus scrofa*), Spotted deer (*Axis axis*), Jackel (*Canis aureus*), wild cat (*Felis chaus*), Python (*Python morulus*), Rabbit (*Lepus nigricollis*) and Sloth bear (*Melursus ursinus*).

Rhinoceros was very frequently visiting pest species in all the study sites where as Wild boar and Spotted deer were very frequently visiting pest species in the season of maize and mustard crops respectively. Jackal and wild cat were also frequently visiting pest species all the year around. Tiger, Leopard, Rabbit, Bear, Python were frequent inside BZ community forest but they were rarely behaving as pest species. Wild boar, Spotted deer, Rabbit and Rhinoceros visit in groups where as Bear, Leopard, Tiger, Jungle cat, Python and Jackal generally visit singly (Table 4.1).

Table 4.1 Frequency of Wildlife Visiting in Village and Number of Individuals in a Visit

S.N.	Species	Abundance	Number
1	Rhinoceros	Very Frequent	1-5
2	Tiger	Rare	Single
3	Leopard	Rare	Single
4	Wild Boar	Very Frequent	1-10
5	Spotted Deer	Very Frequent	5-20
6	Wild cat	Frequent	Single
7	Jackal	Frequent	Single
8	Rabbit	Rare	Group
9	Bear	Rare	Single
10	Python	Rare	Single

The problems created by the wildlife are crop damage, livestock depredation and local harassment. The wild animals from the park frequently visit the nearby village and damage the crops and kill the livestock. The most preferred crops include paddy, wheat, maize, oilseed, pulses, potato, kitchen vegetables and also occasionally goats, sheep, calves and chickens become preys (Table 4.2).

Table 4.2 Wild Pests of Different Crops and Livestock and Their Raiding Time

Species of Wildlife	Raid Crops/ Livestock	Preferred Crops/ Livestock	Time of Raiding	Unpreferred Crops
Rhinoceros	Wheat, Paddy, Maize, Lentil, Potato, Barly, Phaper, Garden Vegetables	Wheat, Paddy, Lentil, Potato	Night	Mentha,, Linseed, Rajma, Tora, Jhuse Til
Wild Boar	Maize, Wheat, Arum, Potato, Yam	Maize, Arum, Potato, Paddy	Night	Chilli, Ginger
Spotted Deer	Mustard, Lentil	Mustard	Early Night	Potato
Bear	Honey, Termite	Honey	Night	Paddy
Rabbit	Paddy, Wheat, Mustard, Barley	Paddy, Wheat	Night	Tall plant
Tiger	Goat, Sheep, calf	Goat, sheep	Night	Crops
Leopard	Goat, Sheep, Calf	Goat, sheep	Night	Crops
Wild cat	Chickens	Chickens	Day/ Night	Crops
Jackel	Chickens, Ducks, Maize	Chickens	Day/ Night	Oilseed
Python	Chickens	Chickens	Day/ Night	Crops

4.2 Land Composition

To determine land composition, questions were asked to 72 households of study area of Dibyapuri VDC. According to their response, there was 1.39 percent landless household, 27.78 percent have below 0.5 Bigha land, 36.11 percent have 0.5-1.0 Bigha land, 22.22 percent have 1-2 Bigha and 12.50 percent have above 2 Bigha land (Table 4.3).

**Table 4.3 Showing the Status of Land Composition in BZ of
Dibyapuri VDC**

S.N.	Area of Field	No. of Household	Percentage
1	Land less	1	1.39
2	Blow 0.5 Bigha	20	27.78
3	(0.5-1.0) Bigha	26	36.11
4	(1.0-2.0) Bigha	16	22.22
5	Above 2.0 Bigha	9	12.50
	Total	72	100.00

Source: Field Survey 2006/07.

4.3 Total Cultivated Land and Land Holding/Household

Total cultivated land owned by the surveyed household in BZ of Dibyapuri VDC was 68.56 Bigha. Table 4.4 shows that cultivated land and land holding per family is higher in villages bordering the NP boundary (0-1 km from NP) i.e. 35.90 Bigha and 0.99 Bigha respectively and lower in villages not bordering the NP boundary (1-2 km) of which total cultivated land and land holding per family is 32.66 Bigha and 0.91 Bigha respectively.

**Table 4.4 Total Land Quantity and Land Holding /HH in
Surveyed HH (in Bigha)**

S.N.	Area	Total No. of HH	No. of Surveyed HH	Surveyed HH%	Total Calculated land in Surveyed HH	Land Holding per HH
1	VBNPB (0-1km)	223	36	16.14%	35.90	0.99 Bigha
2	VNNPB (1-2 km)	242	36	14.89%	32.66	0.91 Bigha
Total		465	72	15.48%	68.56	0.95 Bigha

Source: Field Survey 2006/07

4.4 Land Coverage by Major Crops

In this study area there are various types of soil structure noted. The main crops are paddy and maize. Almost all farmers grow these crops. Besides these crops mustard, lentils, vegetables and potato, linseed and fruits are also cultivated in small quantity. Total land area and coverage by major crops in the surveyed household in two strata of VDC are given in the Table 4.5.

**Table 4.5: Land Coverage by Major Crops in Dibyapuri BZ
(Comparative Studies of Two Strata)**

[Land covered	Paddy		Maize		Mustard		Lentil		Veg.+Pot		Linseed	
		Land	%	Land	%	Land	%	Land	%	Land	%	Land	%
VBNPB	35.90	27.32	76.10	11.09	30.89	2.13	5.93	2.52	7.02	1.98	5.52	0.73	2.03
VNNPB	32.66	23.20	71.03	10.62	32.52	2.20	6.74	2.11	6.46	2.25	6.89	0.52	1.59
Total Area	68.56	50.52	73.69	21.71	31.66	4.33	6.32	4.63	6.75	4.23	6.17	1.25	1.82

Source: Field Survey 2006/07.

Out of 35.90 Bigha, in villages bordering the national park boundary, paddy grown land was 27.32 Bigha, which was 76.10 percent of total cultivated land. Similarly maize grown land was 11.09 Bigha (30.89%), mustard grown land was 2.13 Bigha (5.93%), Lentil grown land was 2.52 Bigha (7.02%), vegetables and potato grown land was 1.98 Bigha (5.52%) and linseed grown land was 0.73 Bigha (2.03%).

In case of villages not bordering in the national park boundary, total cultivated land was 32.66 Bigha. Paddy grown land of this site was 23.20 Bigha (71.03%), Maize grown land was 10.62 Bigha (32.52%), Mustard grown land was 2.20 Bigha (6.74%), Lentil grown land was 2.11 Bigha (6.46%), Potato plus vegetables grown land was 2.25 Bigha (6.89%) and Linseed grown land was 0.52 Bigha (1.59%).

4.5 Economic Loss

Crop depredation is very common in BZ of CNP. Most of the respondents reported crop depredation in their field. On the basis of their total yield if not loss due to wildlife, their actual loss percentage of each crop was paddy (18.09%), wheat (50.19%), maize (21.16%), mustard (19.04%), lentil (40.19%), potato and vegetables (30.58%) and Linseed (11.52%) in my study area of CNP (Table 6.6).

$$\text{Mean crop loss/HH (in kg)} = \frac{\text{Total crop loss in surveyed HH (in kg)}}{\text{No. of surveyed HH}}$$

$$= \frac{36734.03 \text{ kg}}{72} \times 510.19 \text{ kg crops / HH}$$

$$\text{Mean crop loss/HH (in Rs.)} = \frac{\text{Total crop loss in surveyed HH (in Rs.)}}{\text{No. of surveyed HH}}$$

$$= \frac{\text{Rs. } 660557.16}{72} \times \text{Rs. } 9174.41$$

$$\begin{aligned} \text{Total Eco. loss of the village} &= \text{Mean Crop loss/HH} \times \text{Total} \\ &\text{No. of household in study area} \\ &= \text{Rs. } 9174.41 \times 465 \\ &= \text{Rs. } 42,66,100.65 \end{aligned}$$

Table 4.6 Total Yield if not Loss by WL, Average Yield and Crop Loss by WL in Surveyed Households

Crops	Yield if not loss due to WL		Average yield		Crop depredation		Loss% in each crops
	In Kg	In NRs	In Kg	In NRs	In Kg	In NRs	
Paddy	135736.84	2171789.44	133281.21	2132499.36	24552.63	392842.08	18.09
Wheat	982.14	16696.38	482.14	8196.38	500.00	8500.00	50.91
Maize	19551.72	234620.64	15415.51	184986.12	4136.21	49634.52	21.16
Mustard	5300.00	201400.00	4290.92	163054.96	1009.08	38345.04	19.04
Lentils	5350.00	203300.00	3200.00	121600.00	2150.00	81700.00	40.19
Pot+veg	13850.00	277000.00	9615.00	192300.00	4235.00	84700.00	30.58
Linseed	1311.06	41953.92	1159.95	37118.40	151.11	4835.52	11.52
Total	182081.79	3146760.38	167444.73	2839755.22	36734.03	660557.16	20.99

Source: Field Survey 2006/07.

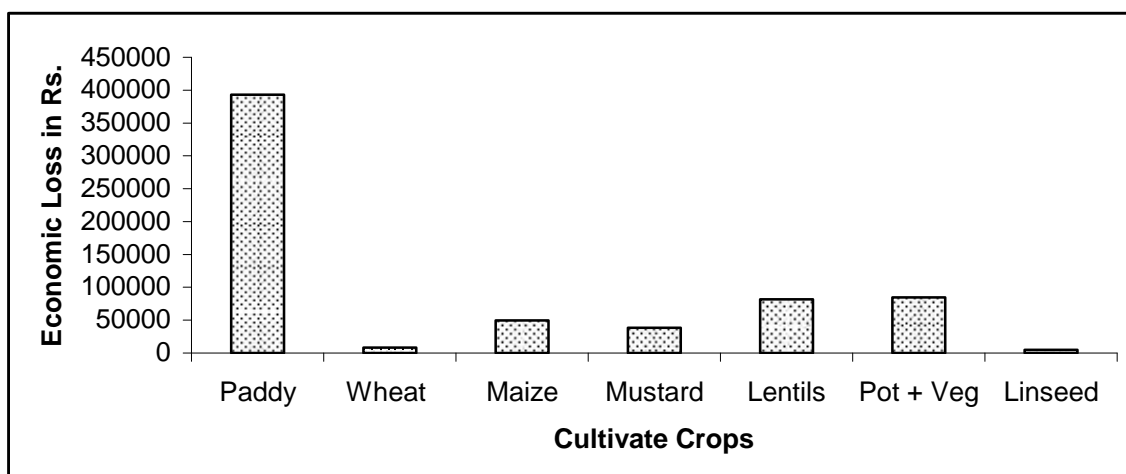
Economically, Paddy (59.47%), wheat (1.29%), maize (7.51%), Mustard (5.81%), Lentils (12.37%), potato and vegetables (12.82%) and Linseed (0.73%) were the most raided crops which are mostly affected during their mature stage. The depredation was not only by eating the crops but also by roaming and wallowing on the crop fields by rhinoceros and other wild animals. I estimated the total economic loss of Rs. 660557.16 per annum and Rs. 9174.41 per household based on 72 households survey (Table 4.6). The maximum economic loss was for paddy followed by Potato and vegetables, Lentil, maize, mustard, wheat and Linseed in Dibyapuri BZ of CNP (Table 4.7 and Figure 4.1).

Table 4.7 Loss of Agricultural Crops Due to Depredation by Wildlife

S.N.	Name of Crops	Distance from the Park (0-1)		Distance from the park (1-2) km		Total loss of wt. in kg. (each crop)	Total Eco loss of each crop (NRs.)	Loss %
		Loss of wt in kg.	Economic loss (Rs)	Loss of wt. in kg.	Eco Loss Rs.			
1	Paddy	161844.21	258947.36	8368.42	133894.72	24552.63	392842.08	59.47
2	Wheat	500.00	8500.00	-	-	500.00	8500.00	1.29
3	Maize	2708.62	32503.44	1427.59	17131.08	4136.21	49634.52	7.51
4	Mustard	557.56	21187.28	451.52	17157.76	1009.08	38345.04	5.81
5	Lentils	1338.46	5086.48	811.54	30838.52	2150.00	81700.00	12.37
6	Pot + Veg	2575.00	51500.00	1660.00	33200.00	4235.00	84700.00	12.82
7	Linseed	117.78	3768.96	33.33	1066.56	151.11	4835.52	0.73
Total		23981.63	427268.52	12752.40	233288.64	36734.03	660557.16	100.0

Source: Field Survey 2006/07).

Figure 4.1: Economic Loss of Different Crop Due to Wildlife



The χ^2 analysis to test the association between the crop loss per household and study sites rejected the null hypothesis ($\chi^2 = 182.44$; df. = 6 and $p = 0.05$), therefore, there is association between crop loss per household and study sites (Table 4.8).

Table 4.8 Result of χ^2 Analysis to Show Relation Between Crop Loss and Study Area

Relation	Observed Value (O)	Expected value E = $\frac{RT \times CT}{N}$	$\frac{(O - E)^2}{E}$
Paddy x (0-1 km)	462.41	572.43	21.14
Paddy x (1-2 km)	440.44	330.42	36.63
Wheat x (0-1 km)	500.00	317.01	105.62
Maize x (0-1 km)	112.86	141.18	5.68
Maize x (1-2 km)	109.81	81.49	9.84
Mustard x (0-1 km)	32.80	46.82	4.20
Mustard x (1-2 km)	41.05	27.03	7.29
Lentils (0-1 km)	60.84	75.33	2.79
Mauro (1-2 km)	57.97	43.48	4.83
Pot + veg. x (0-1 km)	91.96	106.14	1.89
Pot + veg. x (1-2 km)	75.45	61.27	3.28
Linseed x (0-1 km)	23.56	25.51	0.15
Linseed x (1-2 km)	16.67	14.72	0.23
Total χ^2 value =			182.44

I tested the null hypothesis, crop loss (Value) in village bordering the NP boundary (0-1 km distance from the park) and villages not bordering the NP boundary (1-2 km distance from the park) do not differ significantly, by student t-test at 95 percent confidence level. Here, the null hypothesis was accepted i.e. it concluded that there is no significance difference between the mean crop loss in VBNPB (0-1 km distance from the park) and VNNPB (1-2 km distance from the park) (Table 4.9).

Table 4.9 Comparison Between Two Strata i.e. (0-1 km) and (1-2 km)Distance from the Park

Crops	(0-1 km) Loss of Wt. in Kg	(1-2 km) Loss of Wt. in Kg	calculated t-test vale	Tab. value at 95%
Paddy	16184.21	8368.42	0.20	$t(0.05,52) = 2.000$
Wheat	500.00	-	-	
Maize	2708.62	1427.59	-0.86	$t(0.05,35) = >2.021$
Mustard	557.56	451.59	-0.73	$t(0.05,26) = >2.056$
Lentil	1338.46	811.54	0.12	$t(0.05,34) = >2.021$
Pot. + veg	2575.00	1060.00	0.65	$t(0.05,48) = >2.000$
Linseed	117.78	33.33	1.24	$t(0.05,5) = 2.571$

Although the statistical analysis showed that there was no significant difference in the crop loss among the two strata i.e. area bordering the park (0-1 km) and area not bordering the park (1-2 km from the park), comparison of the crude crop loss percent showed that loss due to crop depredation by wildlife was higher at the bordering area of the park than the area not bordering the park (Table 4.10).

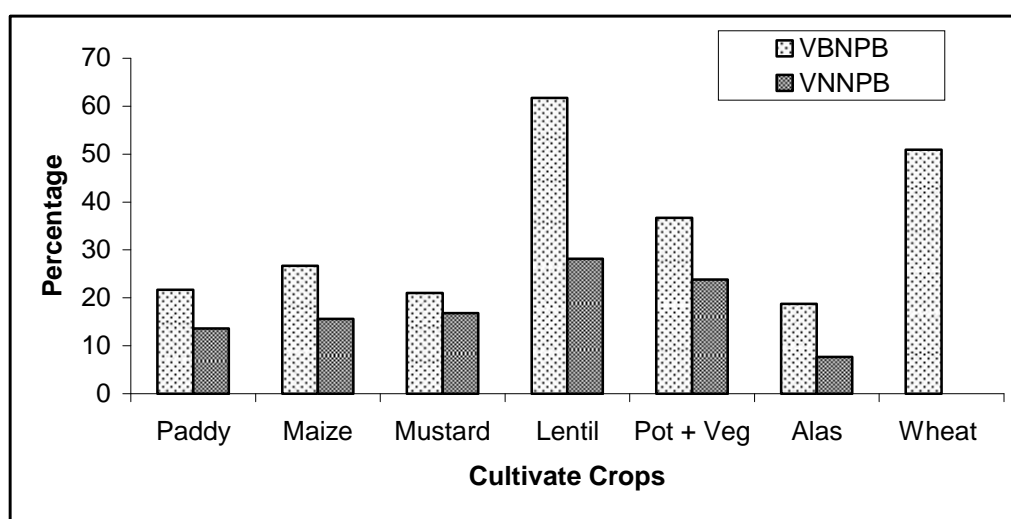
Table 4.10 Comparison of Crop Loss Percent in Two Different Strata

Crops	VBNPB			VNNPB		
	Total Yield if not loss due to wildlife	Loss due to wild life	Loss %	Total yield if not loss due to wild life	Loss due to wild life	loss %
Paddy	1417 muri	307.5 muri	21.40	1160 muri	158 muri	13.62
Maize	150.75 muri	39.8 muri	26.7	132.75 muri	20.75 muri	15.62
Mustard	43.1 muri	9.05 muri	21.0	44.35 muri	7.45 muri	16.80
Lentil	30.3 muri	18.7 muri	61.72	39.25 muri	11.05 muri	28.15
Pot + Veg.	Rs. 137500	Rs. 50500	36.73	Rs. 139500	Rs. 33200	23.80
Linseed	12.00 muri	2.25 muri	18.75	9.80 muri	0.75 muri	7.65
Wheat	13.75 muri	7.0 muri	50.91			

Source: Field Survey 2006/07.

On the VBNPB, the crude data on lentil loss percent showed high (61.72%) damage followed by wheat (50.91%) potato and vegetable (36.73%), maize (26.40%), paddy (21.7%), mustard (21%) and linseed (18.75%) whereas on the VNNPB, the crop loss percent was lentils (28.15%), potato and vegetable (23.80%), mustard (16.80%), maize (15.62%), paddy (13.62%) and linseed (7.65%) (Figure 4.2)

Figure 4.2 Crop Loss in Percentage in Two Strata



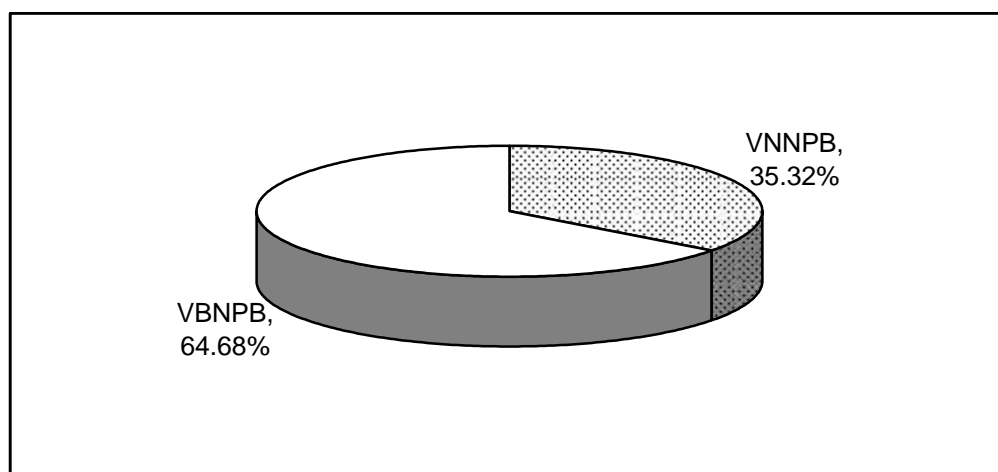
The analysis shows that the crop loss varied in the different areas, depending on the intrusion by wild ungulates responsible for crop

damage. While the rhinoceros was mainly responsible for paddy and wheat losses, wild boar caused heavy loss to maize and chital to oil seed. The crop loss declined as the distance from the park increased.

The volume of crop loss increased as the size of landholding and frequency of crop raid increased. Distance and crop loss had an inverse relationship, i.e. the shorter the distance from the park, the higher was the loss.

Comparison of the crude economic loss in bordering area (0-1km) Rs. 4,27,268.52 and non bordering area (1-2km) Rs.2,33,288.64 showed that loss due to crop depredation was unequal in two strata (Figure 4.3).

Figure 4.3 Economic Loss in Two Strata Due to Crop Depredation



Source: Field Survey 2006/07.

4.6 Preferences of Crop by Rhinoceros and Crop Abandoned by Local People

From the questionnaire survey, it showed that the crop preference by Rhinoceros was wheat (59.72%), potato (12.50%), paddy (8.33%), lentils (8.33%) and so on (Table 4.11). The most of the local people had completely abandoned wheat cropping in their cultivated land because of increasing crop (especially wheat) depredation by Rhinoceros.

Table 4.11 Preference of Crops by Rhinoceros

S.N.	Preferred Crops	No. of Respondents	Respondents %
1	Wheat	43	59.72
2	Paddy	6	8.33
3	Potato	9	12.50
4	Lentils	6	8.33
5	Radish	2	2.78
6	Vegetables	1	1.39
7	Phapar	2	2.78
8	Maize	2	2.78
9	Not known	1	1.39
Total		72	100.0

Source: Field Survey 2006/07

4.7 Estimation of Economic Loss Due to Livestock Depredation

I found that tiger caused maximum economic loss (Rs 46,000) being goats, cows and buffalos as chief domestic prey and total loss was Rs. 51,550 in BZ of Dibyapuri VDC (Table 4.12). Predators were found to kill domestic preys in the shed, meadow, jungle and trap.

Table 4.12 Loss of Livestock Due to Wild Predator

S.N.	Livestock	Killed Site	Place	Loss Rs.	Killed time	Predator
1	Cow	VBNPB	Shed	15000	Night	Tiger
2	Goat	VBNPB	Shed	2000	Night	Tiger
3	Ox	VBNPB	Shed	6000	Night	Tiger
4	Buffalo	VBNPB	Meadow	15000	Day	Tiger
5	OX	VBNPB	Meadow	3000	Day	Tiger
6	Buffalo	VBNPB	Jungle	5000	Day	Tiger
7	Goat	VBNPB	Shed	1500	Night	Leopard
8	Chickens	-	Trap/Cage	4050 (27)	Day/Night	Jackel/Jungle cat/Python
Total				51550		

Source: BZ Office of Dibyapuri VDC 2006/07

4.8 Parks Impact on Local People

Wildfauna in Dibyapuri VDC have killed two people and seven people have injured so far (Table 4.13). The killing of Mitralal Pandey was happened during daytime when he was entering the community forest of his village. Similarly, Jogeswar Mahato, worker of Hattisar was killed by tiger on the day time when he was entering the park for the collection of thatch grass for elephant. During the field study a victim of rhinoceros was found. A man aged forty-five was severely wounded by rhinoceros. He spent more than Rs. 20,000. for his treatment but he had got only Rs. 5,000 as a compensation by BZ council, Sauraha.

Table 4.13 Number of People Injured/Killed by Wildlife in BZ of Dibyapuri VDC.

S.N.	Name of Person	Encounter Place	Date	Treatment	Killed	Predator
1	Devkala Dhakal	Home	2057			Rhino
2	Megh Nath Bastakoti	Way to Howm	2058			Rhino
3	Bishnu Pangeni	BZ Jungle	2059			Rhino
4	Mitralal Pandey	BZ Jungle	2059			Rhino
5	Hiradevi	Farm	2060			Rhino
6	Sailo	BZ Jungle	2061			Rhino
7	Jogeshwar Mahato	Park	2062			Tiger
8	Poudel Dai	Com. Forest	2063			Rhino
9	Damber's Mother	Com. Forest	2064			Rhino

Source: BZ Office of Dibyapuri VDC 2006/07

4.9 Human Impact on the Park/BZ Community Forest

One chital and five rhinoceros were found (recorded) dead in different places of Dibyapuri BZ, which were killed by different causes. The details of the wild life casualties in Dibyapuri BZ were given as in the Table 4.14.

Table 4.14 Wildlife Casualties in BZ of Dibyapuri VDC

Wildlife species	Sex	Date	Place	Cause of death	Remarks
Chital	Juv.	057/12/26	Field	Killed by street dog	Chaudhary Industrial area.
Rhino	UK	058/11/7	Com. forest Dibyapuri	Gunshot	Horn missing
Rhino	F	059/3/2	Com. forest Dibyapuri	Poaching	Horn missing Hooves found
Rhino (Infant)	M	059/6/9	Near Narayani River	Natural death	Horn and Hooves were found
Rhino (3yrs)	M	059/6/22	Com. Forest of Dibyapuri	Killed by rhino Natural death	Horn and Hooves present
Rhino	F	059/6/26	Com. Forest of Dibyapuri	Gunshot poaching	Horn missing Hooves present

M = Male; F = Female, Juv. = Juvenile, UK = Unknown

(Source: Annual Reports DNPWC)

Along with the establishment of BZ concept, the Users' Group Committee of Dibya BZ community Forest has been taken many strong actions against the poacher and illegal dealers of wildlife products in BZ area of Dibyapuri VDC (Annex IV).

4.10 Benefits to Local People from BZ

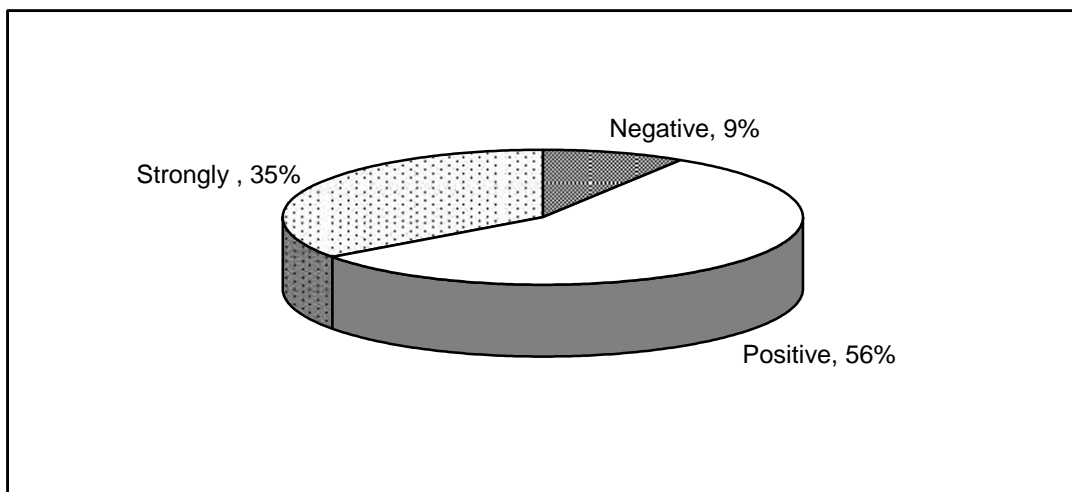
The political conflict during 3/4 years ago, the people were totally restricted from the entry of park, but they were taking resource benefit and developmental support continue from the BZ community forest and fund of BZ. Except these benefits, I found that some people are benefited from skilled training and educational tour funded by BZ budget collect by the revenue of NP.

4.11 Attitude of Local People Towards Park/BZ Community Forest Conservation and its Management

Attitude of people were categorized into three aspects i.e. strongly positive, positive and negative. In my study area I found that about 35

percent of total respondents expressed strongly positive attitude, 56 percent of total respondents expressed positive attitude and about 9 percent respondents were not in favor of park conservation and its management (Figure 4.4). That might be due to loss of their properties by wildlife.

Figure 4.4 Attitude of People Towards Wildlife and its Management



(Source: Field Survey 2006/07)

4.12 Cause of Park Animals Visiting Settlements

The field study and questionnaire survey revealed that most of the park animals visited the crops field due to the lack of abundance of food at the time of breeding season in the park. Sometimes they enter the settlements to change their taste also. Details of the causes are given below.

4.12.1 Lack of Abundance Food

The area of CNP is limited and due to effective protection the number of animals in the park are increasing. There is high demand of food inside the park. Food inside the park might not sufficient for subsistence, so wild animals mainly rhino have to come out of the park and damage the agricultural crops.

4.12.2 Taste of Agricultural Crops

Crops such as paddy, wheat, maize, pulses etc. cultivated around the park are rich in protein and carbohydrate as well as some minerals than most of the wild plants available in the park. Agricultural crops tender, clumped than wild mature plant species. In spring season, wild animals come more frequently outside the park because they find nutritious food outside the park easily. Wild animals also need to spend much energy in search of qualitative food in the park as the foods are found scattered.

4.12.3 Lack of Effective Physical Barrier

Strong physical barrier is important to prevent the entering of wild animals in the settlement. In the study area, although there is large Narayani river in-between NP and study area but animals like rhino easily cross the river and raid the adjoining agricultural fields.

4.12.4 Succession

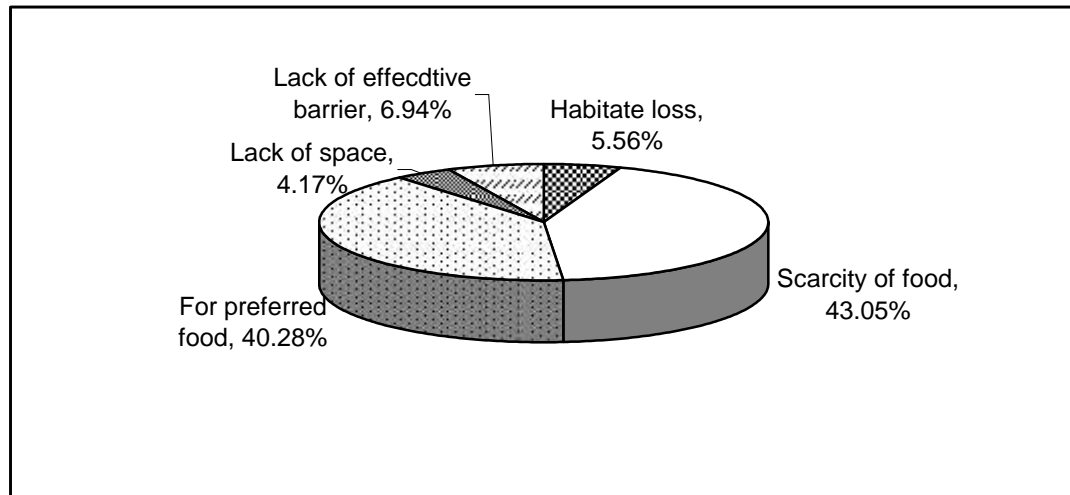
Succession is the gradual change of barren land to forest. Many ecologists suggested that due to succession, grass land of CNP is changing towards forest and the animals that live in grassland migrate out wads in the surrounding field in search of food.

4.12.5 Introduction of Exotic Species

Introduction of exotic species in the park causes the alteration of their habitat by wildlife. Some introduced exotic species of plants such as "Banmara" and "Mile a minute" in their new habitat allowed them to dominate in their new ecosystem and wipe out the natural food habitat of wild animals and it ultimately causes the migration of animals towards the crop fields.

Attitude of people towards the intering to the park and wild animals into people's crop fields seems ecological imbalance in the area (Figure 4.5).

Figure 4.5 Attitude of People Towards the Interring of Park Animals into Their Crop Fields



Source: Field Survey 2006/07.

4.13 Sources of Conflicts

Protection of natural environment through the establishment of parks and reserves are of great importance to mankind. But establishment of NP and reserves become 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 (Adhikari 2000). Like other protected areas, CNP is also facing this problem with local people. The park has affected their life in both direct and indirect way. Thus conflict is due to problem arises between reserve and local people. There are two types of problems.

4.14 Problem Created Due to Park Animals

4.14.1 Crop Damage

Crop damage by wild animals has remained as a perennial problem. Crop is frequently damaged in almost all the settlements of BZ.

They do not only destroy the crop by grazing but also by their heavy trampling through a single line during night. A single rhino is able to destroy about 50 cm crop a row by trampling. The data collected during the field study show that there is heavy economic loss estimated at Rs. 6,60,557.16. The economic loss was Rs. 9,174.41 per household. My field study showed that the crop damage was reported by 63 households (87.5%) out of 72 households.

4.14.2 Human Harassment

Every year, people are killed or injured by the wild animals during the collection of forest products. In my study area two persons were killed and many others were injured by wild animals in and around the park (see table 4.13). So, it becomes very risky to visit local people during night time. During my surveyed period, 65 households (90.28%) reported that they are still suffering from harassment.

4.14.3 Livestock Depredation

Of the 72 questionnaire, about 6.94 percent (5 households) reported that predation was occurred by tiger to their livestock.

4.15 Problem Created Due to Local People

The CNP is surrounded almost all side by the settlements. A kind of mixed culture is found in the study area. One time people around the national park were using accesses of national park freely. After the establishment of park, all these accesses are prohibited and people are restricted to enter the park. Economic status of local people is not so sound by which there is compulsion to use protected area illegally. In my study area, although all the households head know that jungle should be

protected and establishment of national park is preferred but there is no alternative to collect the firewood, thatch grass from park forest.

4.15.1 Livestock Grazing

People are prohibited to take their cattle inside the park but there is no alternate grazing area. The grazing land is very small in the VDC. Farmers stall-feed their livestock on the by-products of their crops, which is not sufficient. But livestock grazing inside the park is very rare due to Narayani River in-between park and village settlements.

4.15.2 Fodder, Timber and Firewood Cutting

People living around the park fulfill their fodder requirement from their land but it is not sufficient to feed their livestock. They can get various species of fodder plants for their livestock from the park. So people enter the park to lop off green branches of the trees, bushes and grasses for fodder. Local people are also involved in timber cutting to build house and furniture. Kerosene is rarely used by villagers and firewood is insufficient in the VDC, so they enter the park for firewood. Due to all these reasons, conflict arises between local people and the park. Cutting of timber and fodder destroy wildlife habitat greatly during dry season. It has a great effect on wildlife.

4.15.3 Poaching

Poaching of wild animals is a reality in CNP. Hunting in Chitwan has been a practice since historical times. Rhinoceros is heavily poached for its highly valued horn. According to "Rhino Count 2005" the total Rhinoceros killed by poachers is 108 in CNP from May 1996 to 2004. So poaching has created huge conflicts between the park and the local people.

4.15.4 Fishing and River Poisoning

Another impact practiced by local people is fishing in Narayani River. Only a few number of people are engaged for fishing daily. Narayani River is the habitat of endangered aquatic mammals such as gangetic dolphin (*Platanista* spp.). Some indigenous casts also doing nuisance of poisoning of small ox – bow lake to catch large amount of fishes impacting the aquatic flora and fauna.

4.16 Local Preventive Measures

Quite a number of different local methods are applied to reduce wildlife damage. Machan guarding, chasing with fires, shouting, drumming, fencing etc. are most commonly used methods in Dibyapuri VDC (Table 4.15).

Table 4.15 Means Applied to Reduce Damage for Different Crops

Means guarding	Rice	Maize	Mustard	Lentil	Pot+Veg.
Machan			-	-	-
Chasing with fires					-
Soughting					
Drumming					-
Fencing	-			-	

(- indicates the methods applied to reduce individual's crops)

Source: Field Survey 2006/07.

Methods used depend upon the type of crop and the type of animal. In the case of rhinos, they use all these methods. Machan which is installed to protect rice and maize from the pests, is the most common and useful technique. Deers and wild boars are kept away by drumming. Fencing is not very useful against huge animals like rhinos, although it does often

keep wild boars and deers away. Chasing with fires is very effective for rhinos along with shouting and drumming. Effectiveness of those local preventive techniques have found different level to chase animals (Table 4.16).

Table 4.16 Effectiveness of Techniques Used to Protect Crops

Techniques	Rhino	Wild Boar	Deer
Machan guarding	III	III	II
Chasing with fire	III	-	-
Shouting	I	III	III
Drumming	I	II	III
Fencing	I	III	III

Note : I - Very little effective, II - Little effective, III - Most effective

Source: Field survey 2006/07.

About 56.94 percent of people gave their view that chasing with fire is effective techniques to protect the crops from wildlife. Similarly machan guarding (29.17%), drumming (6.49%), shouting (4.17%) and fencing (2.78%) were the ways of method by local people for crops protection from wildlife (Table 4.17).

Table 4.17 Method of Crops Protection by Local People

Methods	Respondents	
	Number	Percent
Chasing with fires	41	56.94
Machan guarding	21	29.17
Drumming	5	6.94
Shouting	3	4.17
Fencing	2	2.78
Total	72	100.0

Source: Field Survey 2006/07

CHAPTER FIVE

5. DISCUSSION

This study shows that there are different factors causing conflict between the park and the surrounding settlements. It shows that park conservation has greatly affected the people's social life in the area. Similarly, human inhabitation in the surrounding areas of park also poses a critical problem to the conservation of the national park. These factors have caused enormous damage to the environment and economy.

The impacts on the surrounding settlements due to park conservation can be categorized into two types - direct and indirect. This study focused on the direct impact of park conservation on the social life of the adjoining area.

5.1 Identification of Wildlife Pest

Among ten major pest species in NP (table 4.2) rhinoceros, wild boar and deer were very frequent species (Table 4.1). Mishra (1980), Upreti (1985), Gyawali (1989), Sharma (1991), Nepal and Weber (1993) and Adhikari (2005) identified rhinoceros as main very frequent pest species in CNP and paddy, wheat, maize and lentil are the most raided crops by wildlife. This study remarks that out of total loss Rs. 42,66,100.65, the major loss was occurred by rhinoceros, wild boar and deer suggesting similar result.

5.2 Crop and Livestock Depredation

Mishra (1980) enumerates four basic causes of conflict between the park authorities and local people (loss of life, livestock, and crops to animals from the park, and difficulties and resentments arising from the park regulation), and emphasizes crop loss as the most serious problem.

Upreti (1985) found (i) crop damage (ii) encounter between man and wildlife, (iii) loss of livestock by predators, (iv) Fishing and hunting V antipathy towards parks and reserves and (vi) tourism as causes of conflict.

Sharma (1991), identified four causes of conflict in CNP. They were (i) Regulation of CNP, 2030 (GON, 1994) (ii) Crop of livestock depredation (iii) loss of human life by wild animals and (iv) river erosion.

Nepal and Weber (1993) found rhinoceros, chital and wild boar as principal crop raider in CNP. In Lantang National Park wild boar was important crop raiding animals followed by Himalayan black bear, monkey and deer species (Kharel, 1993).

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 Koshi Tappu wildlife Reserve. Shrestha (1995) described clearing of forest for agriculture, grazing of livestock, lopping of trees, burning of grasses, collection of thatch grasses, harmful fishing methods and development projects are major factors of conflict in BNP. Adhikari (2005) identified rhinoceros, deers and others as a major pest species in his study on the BZ of CNP.

Sharma (1995), identified wild buffalo (*Bubalus bubalis*) and wild boar is important crop raiders in Koshi Tappu wildlife Reserve (KTWR). Kharel (1993), Soti (1995), GON/FAO (1996) and Poudyal (1997) identified wild boar as main very frequent pest species in Shivapuri National Park (ShNP) and maize is the most raided crop by wildlife. Limbu (1998) studied the crop depredation and human harassment due to wild animals in KTWR. He found that, most notorious animal to damage the crop was wild buffalo and wild boar. Shrestha (2004) observed that crop

depredation in Sagarmatha National Park (SNP) by Himalayan Tahr was due to their habituation with human and increasing mobility towards agricultural field.

My study revealed that, rhinoceros, wild boar and chital as principal crop raider in my study area which were also reported by Nepal and Weber (1993) and Adhikari (2005) in their study on the BZ of CNP. Crop damage harassment and livestock depredation are common in my study sites which were also reported by Mishra (1980), Upreti (1985), Sharma (1991), Nepal and Weber (1993) and Upreti (1995).

Total land covered in surveyed household in my study area was 68.56 Bigha and land holding per house hold is 0.95 Bigha (Table 4.4). The 36 surveyed household bordering the national park boundary was holding 35.90 Bigha and 36 household not bordering the national park boundary was holding 32.66 Bigha.

I estimated the total economic loss of Rs. 6,60,557.16 per annum and Rs. 9,174.41 per household based on 72 household surveys (Table 4.6) which is near about the average per capita income of Nepalese. Kasu (1996) estimated the total loss of Rs. 9,57,766.92 per annum and Rs 3,470.70 per household in Parsa Wild life Reserve. His estimated loss per household (Rs. 3,470.70) is lesser than my estimation (Rs. 9,174.41 per household) as I concentrated in the BZ area of Dibyapuri VDC only which is near the national park and another reason might be probably due to the price different of crops at that time.

A study on crop damage by rhinos, done by Jnawali (1989) in Sauraha and other villages shows the estimated economic loss at total of Rs. 1,70,500 for 1988-89 based on 90 household survey in 4 villages of CNP. Besides this deers, boar and parakeets also can be taken as the major

animals causing crop damage. As indicated his study wheat, millet, lentil and green vegetable are mainly preferred by rhinos and deers. Respondents said that those crops are not cultivated due to wildlife disturbance. Out of a total damage of 2,768 kg, deers were responsible only for 18.16 percent, which is not a high figure. Still they compete with rhinos in damaging crops. Similarly, boars and parakeets were responsible for 7.53 percent and 2.95 percent of the total crop loss.

Shrestha (1994) found Bodreni as the most affected area with annual loss of 38.5 percent in its total production in CNP. The loss was 50.88 percent for maize, 25.50 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 percent for paddy and 5.33 percent for mustard. For Sauraha and Baghmara the figures were 11.53 percent and 13.98 percent.

Paudel (1995) calculated loss of paddy was 2.06 percent of total production in Sundarijal VDC adjacent to Shivapuri National Park. Similarly, total loss of wheat, maize and millet were 30.41 percent, 35.21 percent and 47.36 percent of the expected production. He calculated that wild boar (*Sus scrofa*) destroyed maize, wheat and millet by 85 percent, 70 percent and 90 percent of total loss respectively.

Soti (1995) in Kakani VDC adjacent to Shivapuri National Park, calculated the loss of maize was 999.88 quintal. Likewise, the total loss of millet, wheat and paddy were 55.57, 23.65 and 23.06 quintal respectively. He found the wild boar as the main crop raider. He found wild boar destroyed maize, wheat, millet and paddy by 80 percent, 45 percent, 90 percent and 40 percent respectively.

Sharma (1995) found 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 Kusaha VDC adjacent to KTWR. Similarly in Shripur VDC, potato, wheat and paddy were 49.27 percent, 33.83 percent and 16.89 percent of the total damage.

Kasu (1996) in PWR, found the loss of 23,857 kg for paddy, which was 77.52 percent of the total paddy damage. Likewise, total loss of wheat and maize were 4,896 kg or 15.91 percent and 2,022 kg or 6.57 percent respectively. He found that deer, boar and elephant destroyed 52.2 percent, 32.61 percent and 15.19 percent respectively of the total crop damage.

Limbu (1998) found a total 1,17,517 kg crop loss consisting 65,240 kg of paddy, 37,967 kg of wheat and 14,310 kg of potato were damaged in Kusaha VDC, area adjacent to KTWR. The study found the economic loss of Rs. 8,31,966. Highest economic loss 54.89 percent was estimated of paddy followed by wheat (36.51 %) and potato (8.60 %)

Baral (1999) found the loss of Rs. 20,95,346 of which 52.73 percent in Thakurdwara and 47.27 percent in Shivapur VDC. Highest loss (28.32 %) occurred to paddy, followed by potato (15.40%) maize (15.21%), wheat (13.80%), lentil (12.42%) and yam (7.57%). The loss of crop to wild boar ranged from 166.39 kg to 205.51 kg per household.

Gautam (1999) found the loss of Rs 9,47,470.19 in ward no 13, 14, 15, 18 and 19 of Mahendranagar Municipality adjacent to Suklaphanta Wildlife Reserve (SWR). Highest economic loss 74.28 percent was estimated to paddy crop followed by wheat (17.08%) and maize (8.62%). Among the wild animals, highest economic loss was estimated by wild elephant followed by wild boar (28.67%), chital (24.09%), (43.29 %) and bluebell

(3.92%). The reported loss of crop to wild animals ranged from 61.62 kg to 126.33 kg per household.

Gurung (2002) found a total 46,872.40 kg crop loss consisting 12,085.83 kg of paddy followed by 11,531.46 kg of maize, 11,281.50 kg of potato, 6,421.85 kg of wheat, 5,119.01 kg of millet and 432.75 kg of mustard in Sunkhani VDC of ShNP. The study found the economic loss of Rs. 5,54,989.31 of which the loss were 33.24 percent of maize, 19.59 percent of paddy, 17.35 percent of wheat, 16.26 percent of potato, 10.14 percent of millet and 3.39% of mustard. The estimated economic loss was Rs. 4,586.68 per household on an average.

Chalise (1998), Chalise et al. (2001) and Chalise and Jonson (2005) reported that crop depredation proportion by monkey is different in different crops. In MBCA they recorded highest loss of maize (32%), followed by potato (24%), rice (14%), fruits (12%), millets (11%), wheat (4%), buckwheat (2%) and pulses (1%). Chalise (2001) stated that out of total loss of cereals 55.41 percent shared by three monkey species while 25.7 percent to deer, 11.26 percent by porcupine, 3.63 percent by small mammals and 3.99 percent by birds species.

Adhikari (2005) calculated the total crop damage by wild animals in his study area (ward no. 7 and 8 of Gunjanagar VDC and ward no. 2, 3, 4 and 5 of Dibyanagar VDC of CNP) was 2,51,565.12 kg, in which paddy covers 1,26,909.91 kg (50.43%), maize 45,206.14 kg (17.96%) and wheat 33,569.96 kg (13.34%). Other were millet 16,690.86 kg (6.63%), potato 11,664.9 kg (4.64%), pulses 10,819.78 kg (4.31%) and mustard 6,705.84 kg (2.62%). Economically, the loss of paddy was Rs. 7,08,771.80 followed by maize Rs. 1,96,060.17, wheat Rs. 1,79,319.78, millet Rs. 1,23,842.91, pulses Rs. 91,886.88, mustard Rs. 76,884.56 and potato Rs. 5,139.97.

Above studies show that there are considerable loss of crops due to wildlife adjacent to the reserves and parks of Nepal. In my study also, crop loss worth 36,734.03 kg was found in 72 households among 465 households,. Out of the total damage of the crops, paddy came to be first with 24,552.63 kg (66.83%) followed by potato and vegetables 4,235 kg (11.53%), maize 4,136.21 kg (11.26%), lentil 2,150 kg (5.85%), mustard 1,009.08 kg (2.75%), wheat 500 kg (1.36%) and linseed 151.11 kg (0.41%) by Weight.

This study shows that the total economic loss of 72 households was Rs. 6,60,557.16 annually. Out of the total loss, the economic loss of the paddy was Rs. 3,92,842.08 (59.47%) followed by potato and vegetables Rs. 84,700.00 (12.82%), lentil Rs. 81,700.00 (12.37%), maize Rs. 49,634.52 (7.51%), mustard Rs. 38,345.04 (5.81%), wheat Rs. 8,500.00 (1.29%) and linseed Rs 4,835.52 (0.73%) The estimated economic loss was Rs 9,174.41 per household on an average.

I had differentiated my study area into two strata. The first strata lie on the bordering side of the NP, which was 0-1 km from the forest. Here the total crop loss was 23,981.63 kg in which paddy covers 16,184.21 kg followed by maize 2,708.62 kg, potato and vegetables 2,575 kg, lentil 1,338.46 kg, mustard 557.56 kg, wheat 500 kg and linseed 117.78 kg.

Second strata was 1-2 km from the park. Here in this site, the total crop loss was 12,752.40 kg in which paddy loss was 8,368.62 kg followed by potato and vegetables 1,660 kg, maize 1,427.59 kg, lentil 811.54 kg, mustard 451.52 kg and linseed 33.33 kg.

Difference in the crude loss value in these two strata was probably due to the difference in distance from the park forest and Mahendra highway as a boundary of BZ.

In almost all the habitats of big cats, cattle lifting are one of the major sources of conflicts between park and people (Oli 1991). Prasai (1989) found that 247 different livestock heads loss by predators in five VDCs in CNP in three different years. Among these 247 heads, 111 were cattle, 38 buffalos, 65 goats and 33 sheeps.

Sharma (1991) found a total of 119 animals lost in 14 wards due to different predators in CNP.

Nepal and Weber (1993) found the proportion of killed animals highest in lose vicinity to the park, followed by location close to the forest and location far from the forest. Out of 275 animals killed, 111 were killed close to the park, 79 in areas close to the forest and 86 in areas far from the forest.

Pradhan (1995) also found positive relation between the distance from the park and the livestock loss in the south-eastern part of Bardia National Park (BNP). He found a total of 301 animals killed in five years time. Among them, 227 (75%) were killed in wards with Buffer zone forests/national parks, 59 (20%) in wards with other forests and 15 (5%) in wards with no forests.

Kasu (1996) recorded 63 animals killed in two years in four villages near PWR.

In my study, I estimated the economic loss by livestock depredation was Rs 51,500. In which most of the depredation was occurred by tiger (see table 4.12). Out of the 7 animals killed, 3 were cattle, 2 were buffalos and 2 were goats. Besides this, about 27 chickens were lifted by different predators such as wild cat, jackal and python, which were also recorded during my study period.

The study done by Jyawali (1989) on the park people conflict in Sauraha area adjacent to CNP show 78 accidents occurred in 1978-1988. Among them 78 percent attacked by wild animals, 23 were killed and 55 were injured. Most of the accidents were occurred outside the park. Sharma (1991) and Nepal and Weber (1993) reported the attack and death of humans by wild animals in CNP.

Shrestha (1994) found in her work in CNP, 10 people were attacked in which 2 victims were killed and 8 victims were seriously injured.

Limbu (1998) found that many villagers were assaulted by wild animals in previous years but during his study period one man was killed and many people were seriously injured in KTWR.

In my study area, I found that there were altogether nine accidents occurred in BZ area of Dibyapuri VDC. Among them two man were killed and other seven were seriously injured (Table 4.13)

5.3 Effect on Human

The beneficial program such as resource utilization, developmental support, educational tour, skilled training was launched by the park in BZ area. If rural communities are to tolerate and coexist with wildlife, they must derive sufficient benefit from it to compensate the costs of living with wildlife, like crop and livestock depredation (Kiss 1990). Government and non-government organizations should launch new income generating programs to change negative attitude of local residents.

5.4 Indigenous Method of Controlling Depredation

Only a single technique is not effective to control the wild animals. Various types of techniques such as machan guarding, catapult, chasing with fire, shouting, drumming, fencing etc in multifarious ways are much effective in the study area to prevent the crop in some extent in more effective area. The local people were practicing five traditional means of controlling crop depredation (Table 4.15) and their effectiveness is different for different crops (Table 4.16). Similar observation was revealed by Chalise (2001) in MBCA. Locals used indigenous techniques for driving off crop raiders included producing sound with the help of waste water and bamboo slicks and smoking the night resting sites of animals specially monkeys by burning the green leaves of *Melastoma melabthricum* and *machilus odoratissima*. Driving wildlife away using dogs and regularly guarding also were common procedure to save crops. Some farmers sprayed crops in marginal farming areas with a chilli solution that caused irritating effects and frightened off crop raider (p.7).

CHAPTER SIX

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The study of park people conflict was conducted during 2006-2007 in BZ of Dibyapuri VDC of Nawalparasi district, located adjacent to the northwestern side of CNP.

My study showed that people living adjacent to the CNP were facing crop damage, harassment and livestock depredation. I identified ten pest species such as rhinoceros (*Rhinoceros unicornis*), Tiger (*Panthera tigris*), common leopard (*Panthera pardus*), wild boar (*Sus scrofa*), spotted deer (*Axis axis*), Jackel (*Canis aureus*), wild cat (*Felis chaus*), Python (*Python morulus*), rabbit (*Lepus nigricollis*) and sloth bear (*Melursus ursinus*). Among them rhinoceros, deer and wild boar were very frequent pest species in and around the park. Jackel and wild cats were frequent in all study sites but the remaining pest species such as tiger, common leopard, bear, rabbit and python were rarely visiting pest species.

Present study indicated that the poor socio-economic condition creates conflicts between local people and park. The main causes of conflict are breaking the rules and regulation of the park; crop and livestock depredation and human harassment due to wildlife; livestock grazing, hunting and poaching and fodder, timber and firewood cutting by local people inside the park.

I estimated total economic loss of Rs. 6,60,557.16 due to crop depredation by wild herbivores. The comparison of the curde economic loss at two strata showed that people near the park boundary were in heavy loss. Wheat, lentil, potato and paddy were preferred crops of

rhinoceros. This forced people to partially abandon the affected crops such as wheat, potato etc in affected areas. The incidents of livestock lifting by wild predator were becoming common at the peripheral villages of CNP. The estimation of total economic loss due to livestock depredation by wild predator was equal to Rs. 51,500.00. There were altogether nine accidents occurred in my study area. Among them two men were killed and other seven were seriously injured.

Local people were getting resource utilization (fodder, grass, firewood, timber, khar khadai, wild vegetables, medicinal plants etc) from community forest and park and developmental support (graveling, electric pole, biogas support, ham pipe, wells, building material for school, irrigation support etc) from the BZ management committee. People of BZ have also gained benefits from education tour and skilled-training co-ordinated by BZ office.

People were aware of the declaration of the national park and hunting/poaching as illegal. Only 9 percent of local people had negative attitude towards wildlife protection but the most of the people had negative feeling towards rhinoceros as the main culprit of crop loss at the study sites.

Local people were practicing direct methods such as shouting, drumming, machan guarding, chasing with fire and fencing to control the depredation and practicing stall-feeding and open grazing with attendant as indirect methods to control livestock depredation by wild predators.

6.2 Recommendations

1. Research on the carrying capacity of CNP in terms of food and space availability for wildlife should be done with high priority of park management.
2. Local people of CNP and its BZ should be involved in the conservation and management of biodiversity in true sense.
3. The problem of conflict should be resolved by compensating farmers directly in cash for their actual loss of crops.
4. Crop depredation by wildlife should be altered growing unpalatable, less preferable crops in former area.
5. Good and effective physical barrier (Strong wall with wire fencing on it) should be constructed in the point of entering wild animals to prevent them to enter inside the crop fields
6. People who are engaged in illegal logging, poaching and hunting should be strictly punished.

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