# 1. INTRODUCTION

## 1.1 Background

The loss of several species and other global environmental problems has prompted various international agencies and national government to search for a rational approach in the conversation of natural ecosystems. The world conversation strategy proposed a rational model for the establishment of various representatives' coverage of the Earth's wild species and major ecosystems for preservation of genetic diversity and insurance of the sustainable utilization of species and ecosystems (Brekmuller and Manrope 1986). According to this scene, many protected areas were established in the developing countries in the second quarter of the twenties century (Mishra 1971). Nepal has also established extensive network of protected areas to conserve biodiversity since 1960s.

Protected areas are essential for conservation of biological diversity and for meeting a range of community objectives. The commission on National Parks and Protected areas had defined National Park as natural area of land / or sea designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area, and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible (IUCN 1978).

Nepal did not have a long history of the national park system though it has grown substantially in the relatively short period of 35 years. The concept of the national parks and protected areas in the Nepal was primarily initiated for the protection of wildlife, especially endangered species. The establishment of Chitwan National Park in the year of 1973 materialized the nature and species conservation movement. Since then, Nepal has established an extensive network of protected areas, now covering a total area of 28,998.67 $km^2$ occupying 19.70 % of the country area. Currently, this included nine national parks, three wildlife reserves, three conservation areas and one wildlife reserve and hunting reserve (DNPWC 2008).

In developing countries like Nepal, the park related problems were complex since it was a network including local people, tourists and natural resources. Due to boosting of tourism industry, direct physical impacted on a limit resource by local people and tourist which were being open secrets. With more people less resources, managers were facing many difficulties in maintaining parks and reserves. Several different strategies were being developed for providing guideline for nature conservation but most of these had not clearly stated in the specific park management system in Nepal. National Parks and Conservation Acts 1973 was the main legislative, which emphasizes conservation and protection of natural resources rather than management (Thapa 2007). Due to lack of proper management strategies and knowledge among the local people, there occurred high level of conflict between park and people. There was also another conflict between the people and administration due to conservation rules and regulations.

Wildlife conservation had been quite successful to protect several threatened species (Mishra 1982). Active conservation of habitats had increased wildlife population within protected areas, which started causing damage outside the park. The relation between park and people was imbalanced when the park animals damaged outside and disturbed the adjacent settlements. Damage of agricultural crops, human harassment, injuries, death, and livestock depredation were the common causes of this imbalanced relationship (Jnawali 1989, Sharma 1996, Adhikari 2000). With the establishment of national park, people had been denied the right to use the resources inside the park and they had no right to claim the compensation for the damage to their crops by wildlife. Similarly, the responsibility for managing resources had been taken from people whose life in the vicinity and had instead been transferred to a government agency, which was based in the distance capital. The cost goes down access to use of resources falls on the rural people in the vicinity of the reserve (Adhikari 2000). By this, government realized that conservation of wildlife inside the protected areas was not productive in lack of local people's participation and the issues that were repeatedly rose who should benefit from conservation efforts, the local people or the wildlife. Through the fourth amendment in the DNPWC Act 1973, in 1992, the Government has allowed to create buffer zone surrounding national parks and reserves in order to provide the use of forest product to local people. The Act defines buffer zones as "the peripheral area of the national park or reserve under section 3A

for providing facilities to local inhabitants to utilize forest products regularly". Now, a total area of 5079.67 $km^2$ has been declared as buffer zones around eleven protected areas of Nepal to implement a community- based management system aimed at reducing human-protected area interaction.

A thorough assessment is necessary to design an effective conflict management approach and make harmony between local people and protected area for sustainable management of biodiversity. Through this research causes and consequence generated by park were assessed at two sites of Shivapuri National Park (ShNP).

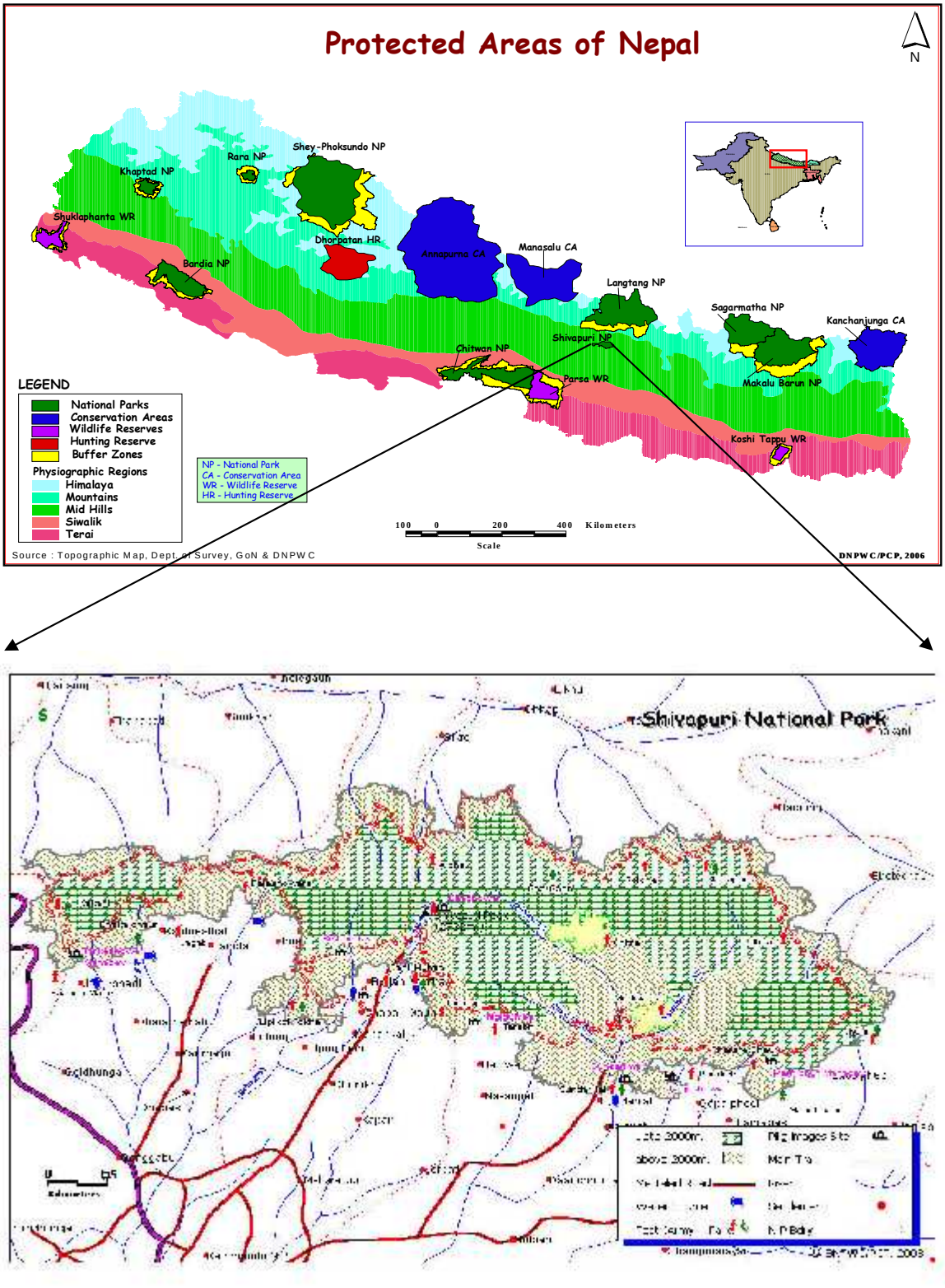
### 1.2 Objectives

The main objective of my study was to determine the causes and consequences generated by the conservation of wildlife in the southern part of the ShNP. Specific objectives were to;

- explore the occurrence of the wild mammals and their habitat in the ShNP forest adjoining to study area,
- investigate the land abandoned due to crops depredation by wildlife,
- assess the quantity of crops loss by wildlife,
- explore the attitude of local people towards wildlife conservation, and
- identify the indigenous methods used to control crops damage by wildlife and their effectiveness.

### 1.3 Justification and Limitation

Crops damage by wildlife was main conflict of human –wildlife relationship and major obstacle of management and conservation of protected areas to meet their objectives. Besides that, developmental activities and perception of local people towards biodiversity conservation and management had adversely affected on sustainability of any protected areas. Thus, studies on assessment of crops damage by wildlife, and recent issues of conflicts, and major gaps in conservation processes were equally important to generate actual data for minimizing the conflicts level. The study was done in two VDCs i.e. Kabresthali and Sangla of Kathmandu district as the representative of the adjoining VDCs to the ShNP.




Map 2.1 Protected Areas of Nepal showing the location of Shivapuri National Park

# 2. STUDY AREA

## 2.1 Location and Physiographic

Shivapuri National Park is an excellent representative site of the middle hills ecosystems of Nepal. It is located on the northern fringes of the Kathmandu Valley between $27^0$45' and $27^0$57'Northern latitude and $85^0$15' and $85^0$30' East longitude. Covering an area of about 144km$^2$ adjoining to southern and western sides with Kathmandu (12), western and northern sides with Nuwakot (9), and eastern sides with Sindhupalchok (2) districts of Central Development Region; consisting 23 Village Development Committees (VDCs) of these districts. The park stretches about 20-24 km from east to west and about 8-10 km from north to south. The Park boundary is well demarcated with 111 kilometer (km) a long wall runs along/between the 23VDCs. Head- quarter of the park Panimuhan is located at about 12 km from the downtown Ratna Park of Kathmandu.

## 2.2 Physical components

The climate of the ShNP has sub-tropical to warm temperate, which is delimited in three climatic periods; a) pre- monsoon season (hot-dry season) extending from mid February to mid- June and is the hottest and dried season. b) Monsoon season occurring from June to September and c) post monsoon season (cold-dry season) occurring from October to mid-January.

Geologically, the park area lies in the inner Himalaya region. The dominant rocks are gneiss and magmatite with mica schist and pegmatic granite. The main soil types are loamy sand on northern sides to sandy loam on the southern sides. The entire area is characterised by its steep topography and more than 50% of the area has greater than 30% slopes. Because of the steep topography and nature of soil, soil erosion and landslides are common all over the ShNP. Elevation of the park ranges from high of 2732meter (m) above mean sea level (msl) at top of Shivapuri Peak to low of less than 1000m above msl at the northern park boarder. The area is comprises with several watersheds, drain by Bagmati, Bishnumati and number of smaller streams, which provides much of water vital to the inhabitants of the Kathmandu valley. Water yields

are heavily influenced by the monsoon rainfall pattern. Hence, much of the streams flow as well as peak discharges occur during rainy period.

### 2.3 Biological components

#### 2.3.1 Vegetation

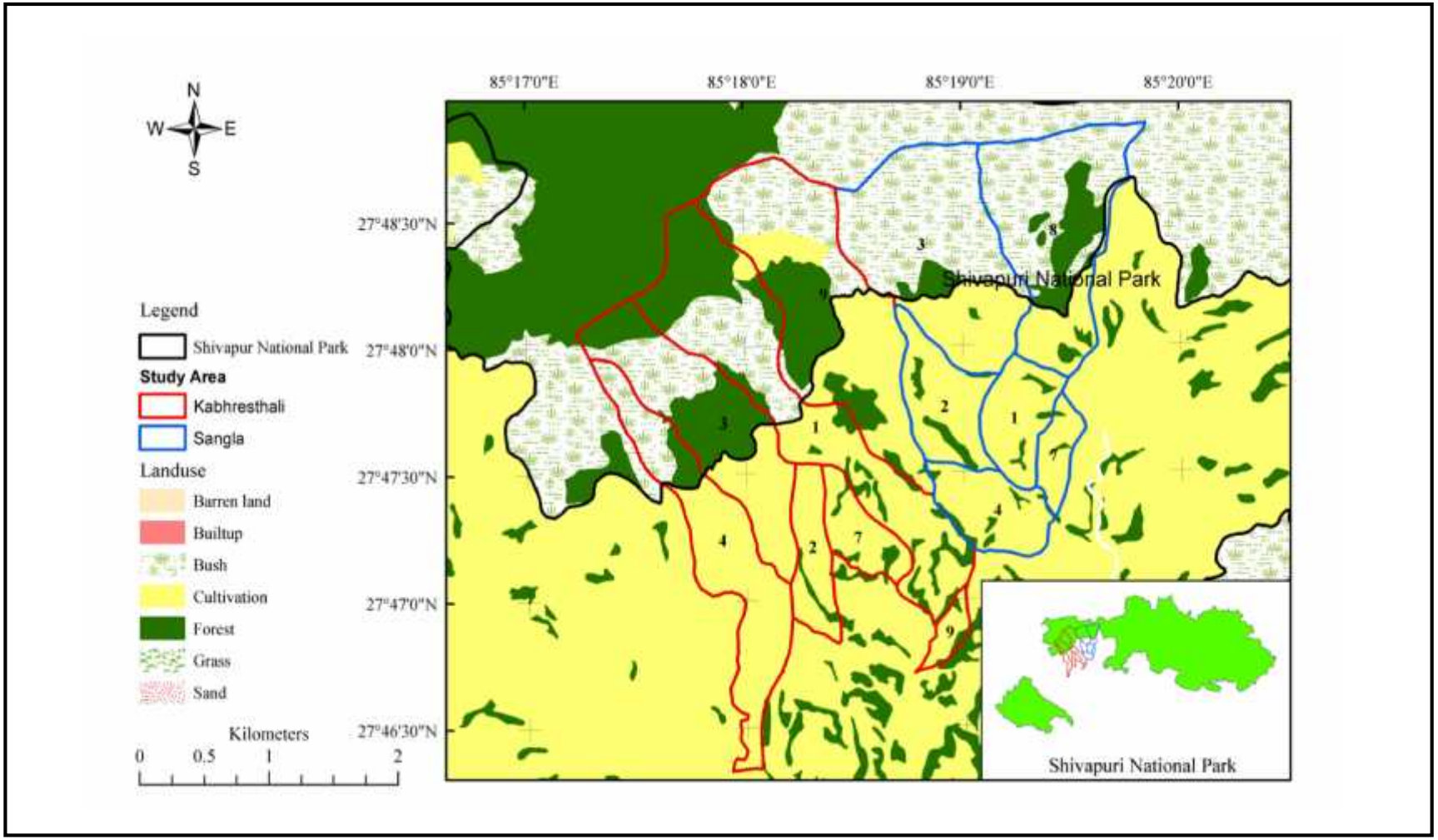
ShNP has floral diversity due to its location, altitudinal and climate variation, *Castanopsis*, Pines, oaks and Rhododendrons are the dominant vegetation in the park. It has four types of forests, which are distributed along the altitudinal gradient (Amatya 1993, Kattel 1993). They are

a) Lower mixed hardwood (*Schima-Castanopsis*) forest at 1000-1500m
b) Chir - Pine forest at 1000-1600m
c) Upper mixed hardwood forest at 1500m-2300m
d) Oak forest at 2300m-2700m

There are more than 2122 species flowering plants with 16 endemic plants (Shakya et al. 1997 and Shrestha and Joshi 1996). About 129 species of mushroom including *Lactanrius pleuritides* have been described from the ShNP (BPP 1995).

#### 2.3.2 Fauna

ShNP supports numerous number of wildlife species. There are 21 species of mammals, out of which nine are threatened species (BPP 1995). The major mammals found in the park are Common leopard, Leopard cat, Clouded leopard, Wild boar, Porcupine, Barking deer, Squirrel, Common monkey, Indian hare, Indian crested porcupine, Himalayan goral, Himalayan black bear, Yellow-throated marten etc. It harbors 177 species of birds and 14 of them are threatened such as oriental Hobby (*Falco severus).* Grey sided laughing Thrush (*Garrulax caerulatuus*) and Common tailorbird (*Orthoronus sutorius*) (BPP 1995). Only one species *Oligodon arnensis* of reptilian has been reported from ShNP (BPP 1995). There are more than 102 species of butterfly including a very rare and endangered and susceptible endemic species (Smith 1996), and the rare Himalayan Dragonfly (*Epiophlebia laidla*) are also reported from the park.




Map 2.2 Land use type in the study areas

## 2.4 Intensive Study Area

The study was focused on two VDCs of Kathmandu district namely Kabresthali and Sangla which have been included in the proposed buffer zone area of the ShNP by the ShNP Management Plan 2004 and Government. These two VDCs are lying side by side and located at $27^0$47' to $27^0$48' northern latitude and $85^0$17' to $85^0$19' eastern longitude. The border of these two VDCs connected with Dharmasthali and Phutun on south side, Jhor Mahakal on east side of Sangla, the ShNP on north side of both VDCs, and Jitpurphedi on West side of Kabresthali. Each VDC consists of nine wards but six wards of each VDC are included in the proposed buffer zone area of the ShNP. These 12 wards of two VDCs (1-4, 7, 9 wards of Kabresthali and 1-4, 7, 8 wards of Sangla) were the main focus of my study.

### 2.4.1 Climate

According to climatic data of 2002 -2006 collected from nearest station of these VDCs at Kakani (altitude 2064m) and Budhanikantha (1350m), the mean monthly maximum temperature reaches around $27^0$C and $23^0$C during May to September at Budhanilkantha and Kakani respectively. Similarly, the mean monthly minimum temperature reaches around $18.8^0$C in Budhanilkantha and $15.9^0$C in Kakani during June to September (Figure 2.1a).

The mean monthly relatively humidity (morning) is slightly greater in Budhanilkantha station than Kakani station. The mean monthly relative humidity reaches maximum during July to September in both stations. The mean monthly relative humidity (evening) is greater in Kakani in comparison to Budhanilkantha station. The mean monthly evening relative humidity reaches maximum during month of July-September in both the stations (Figure 2.1b).

Rainfall of this region is more or less similar to Kathmandu valley in southern side of the ShNP. The mean annual precipitation recorded in two stations of Shivapuri National Park was highest during the month of July-August and lowest during November-December (Figure 2.1c).

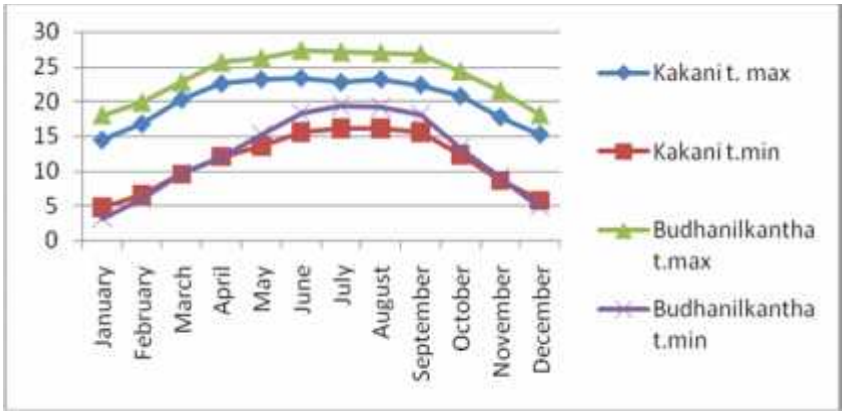



Figure 2.1a Average maximum and minimum temperature ($^0$C) at Kakani and Budhanilkantha (2002-2006)

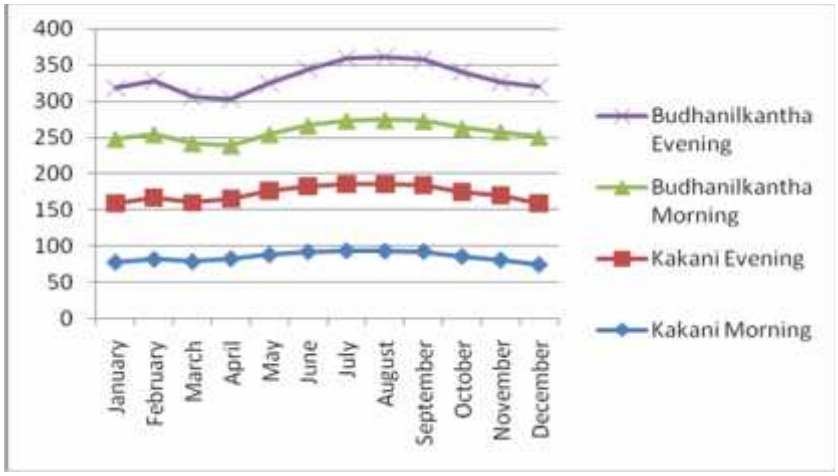



Figure 2.1b Average relative humidity of morning and evening (%) at Kakani and Budhanilkantha (2002-2006)

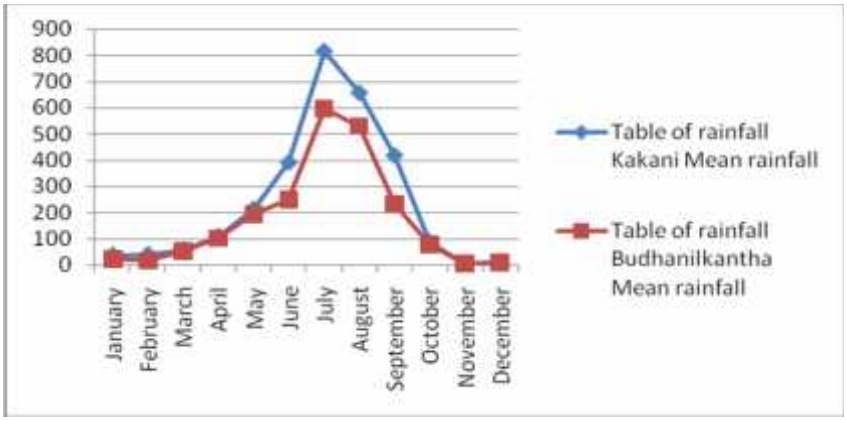



Figure 2.1c Average precipitations (mm) at Kakani and Budhanilkantha (2002-2006)

### 2.4.2 Socio-culture and economy

Social frameworks of two VDCs are more or less similar to each other. The total population living in Kabresthali and Sangla are about 3546 and 3226 with 679 and 617 households respectively. Among the total population 50.4% and 51.6% are male, and 46.6% and 48.4% are female respectively (CBS 2001). Ward numbers 1-4,7,9, of Kabresthali and ward numbers 1-4,7,8, of Sangla comprises about 64.0% and 64.6% of total population (Table 2.1a and 2.1b).

**Table 2.1a Population of Kabresthali**

| Ward No. | Household according to CBS 2001 | Total population | Male population | Female population | Household according to VDC record |
|---|---|---|---|---|---|
| 1 | 80 | 427 | 201 | 226 | 74 |
| 2 | 85 | 421 | 225 | 196 | 73 |
| 3 | 52 | 319 | 154 | 165 | 53 |
| 4 | 66 | 357 | 180 | 177 | 57 |
| 7 | 59 | 300 | 152 | 175 | 66 |
| 9 | 87 | 446 | 208 | 238 | 73 |
| Total | 429 | 2270 | 1120 | 1150 | 396 |

**Table 2.1b Population of Sangla**

| Ward No. | Household according to CBS 2001 | Total population | Male population | Female population | Household according to VDC record |
|---|---|---|---|---|---|
| 1 | 52 | 253 | 130 | 123 | 68 |
| 2 | 127 | 657 | 344 | 313 | 146 |
| 3 | 59 | 373 | 199 | 174 | 78 |
| 4 | 60 | 300 | 151 | 149 | 68 |
| 7 | 37 | 218 | 115 | 103 | 49 |
| 8 | 54 | 284 | 146 | 138 | 62 |
| Total | 389 | 2085 | 1085 | 1000 | 471 |

Major ethnic groups living in the both the study areas (Kabresthali and Sangla) are Brahman, Chhetri, and Tamang. Other ethnic groups are Newar, Sarki, Kami, Magar, Gurung, etc (CBS 2001). Most of these ethnic groups speak Nepali, followed by Tamang, and other languages. Family structure of the communities living in this two study areas (Kabresthali and Sangla) are commonly found nuclear type, besides some large joint families and an average of household size 6.5 and 5.7 persons respectively found.

There are two distinct types of landforms found in study areas i.e. sloppy upland (Bari) and lowland (Khet). These landforms have with or without facilities of irrigation. Paddy, wheat, maize, millet are major crops grown in these land. In addition to that, other crops like potato, common asparagus (ward number 7 of Sangla), hybrid species of pea (ward numbers 2-4 of Kabresthali), tomato (ward number 4), different of mustard ,cucumber, pumpkin etc were cultivated as cash crops in lowland areas. In the lowland areas paddy, wheat and maize, and while in upland areas maize and millet were cultivated. Intercropping of legumes with maize was common. Livestock rearing is another major activity taken as supplementary income source of the households and manure for crop fields.

# 3. LITERATURE REVIEW

## 3.1 Causes and consequences generated by establishment of National Park

Human survival depends on biological diversity. Together with ecosystems, this latter plays formations, climate and diseases regulation and water purification. It provides the genetic resource that are the basis of agricultural development and the source of many of medicines about 75% of which are derived from plants, animals and micro biotic organism (Engels 2008). For the conservation of biodiversity, certain areas are differentiated as protected area. According to the Act of 1973 of Nepal there are four type of protected areas, namely National Parks, Wildlife reserves, hunting reserves, and conservation areas which corresponds to the world conservation union (IUCN) international system of protected areas categories II, IV and VI respectively. Protections of biodiversity in protected area have many benefits for sustainable development of nature.

In the last few decades, the exponential increase in the human and livestock population and resultant imbalance in the land/people ratio, besides change in land use patterns and developmental activities have placed a tremendous pressure on the natural resources like the forests and the wildlife. The interface of wildlife habitats and human use dominated landscape has become grounds for a wide range of man-wildlife conflicts (Sinha et al. 2004). Wildlife-human conflict is one of the main threats to the continued survival many species in many parts of the world and is also significant threat to many local people wherever there, establishment of protected areas there is conflict with local people living in and around of wildlife habitat. Many of these conflicts are of natural as well as human's origin. They cause severe damage to park resources and jeopardize the accomplishment of set objectives to be made by Park administration and management (Neumann and Machlis 1989). The local people use the park resources to meet their needs from inside the park. There are illegal activities such as hunting, poaching and there are many cases of confrontation between park officials and local people. Moreover, the wild animals of national parks have caused losses by damaging the villager's agriculture crops and predating on livestock, which has a further, aggravated the problems. Thus, without symbiotic correlation between the requirements of conservation and needs of the neighboring

inhabitants can be developed, it is doubtful if any park or reserve will survive well beyond the few decades. Then, it will not be only the endangered species in any particular park or reserve that will be extinct but the whole ecosystem will be damaged (Mishra 1971). Cause of conflicts can be viewed in two aspects: i) Problem created due to park, and ii) Problem created due to local people. Main problem created by establishment of park or reserve in Nepal or all around the world are crop damage, livestock depredation, human harassment, land abandonment, wildlife distribution and abundance in crop field and near areas of residents.

### 3.2 Wild mammal's abundance and distribution

The biodiversity contained in the mid hills ecosystem is of international importance both in terms of the number of globally threatened wildlife and floral elements as well as diversity of ecosystems contained within the area. In the central mid hill and western mid hill of Nepal, 24 mammals and 30 mammals were being recorded. In Shivapuri National Park, about 16 species of mammals out of 24 mammals found in mid hill region and about 13 species of mammals out of 30 mammals found in the western mid hill of Nepal (BPP 1995). Kattle (1995) recorded 14 species of mammals in the ShNP. According to Shrestha, total of 22 mammalian species recorded in the ShNP belonging to seven orders and 17 families was found. Maximum number of mammalian species found at altitudinal range between 1500-2700m. Common leopard (*Panthera pardus* Linnaeus) was distributed from an altitudinal range of 1724-2600m in the ShNP but it was also found in the elevation range of 1790-1960m in Makalu-Barun National Park (Jackson 1990). Himalayan black bear (*Selenarctos thibetanus* G.Cuvier) was found at an altitude of 2157-3660m (Prater 1998, Shrestha 2005). Himalayan goral (*Nemorhaedus goral* Hardwicke) preferred the steep sloppy area with an abundant peak between 2200-3400m in south facing slopes (Gaston et al. 1982). Large civet (*Viverra zibetha* Linnaeus) and barking deer (*Muntiacus muntjak* Zimmermann) were found at elevation 1700-2700m. Barking deer were also reported to distribute in elevation ranging from 1500-3000m in lower temperate broad-leaved forest (Ale and Gurung 1995). Hunuman langur (*Presbytis entellus* Dufresne) is living on rocks and cliff altitude from 1000 up to 3660m and utilizing tall trees of Rhododendron species, Quercus species and Prunus species. Similarly, Rhesus monkeys (*Macaca mulatta* Zimmermann) are present near agricultural land up to

range between 2400-3000m. The habitat preference of Golden jackal (*Canis aureus* Linnaeus) is dense scrubs and thickets close to agricultural fields and village (Sharma 1998). It is distributed at an altitudinal range of 1220-2135m in the hill and up to 3676m in the Himalayas (Prater 1998). It regularly visited the out skirt dumping sites for carcass of livestock, inspect and larvae. Wild boar (*Sus scrofa* Linnaeus) is distributed from 1700-2700m in the ShNP. It is present abundantly in range between 1700-2100, and there was a regular distribution between 2000-2100m and its presence decreases with increasing altitude after 2100m (Gurung 2002 and Shrestha 2005). Himalayan squirrel (*Dremomys lokriah* Hodgson) was distributed at Nepal at 1900-2700m altitude (Shrestha 2005) and at 1525-2745m altitude at India (Prater 1998). Jangle cat *(Felis chaus* Guildenstaedt) found at 1719-2155 altitudinal area (Shrestha 1997). Similarly, leopard cat (*Felis bengalensis* Kerr) at 2000-3000m altitude and porcupine (*Hystrix indica* Kerr) was found below 2000m altitude.

### 3.3 Crop loss by wildlife

Crop loss by wildlife is common thing in the adjoining villages of parks and reserves and it is the main reason of park-people conflict. As the limited grass land areas within park boundaries and highly nutritious supplement food in the crop grown in adjacent agricultural areas and it become probable that the wild animals may be forced to expand their dependence of on agricultural land periphery to the park (Sukumar 1990). Thus, animals feeding such items do not have to expand as the much energy searching instead; they can satisfy their hunger quickly and efficiently. Not all the individual of particular species raid the agricultural fields. Only those animals with home range that encompass croplands can do so (Jackson 1990). From time to time wild animals not only eat but also trample the crops that are not interested in eating during journey through their territory. Crop damage by wild animals has adversely affected the economy of the local people and has increased poverty in the regions (WMI/IUCN Nepal 1994).

ShNP is the only protected area that represent the mid hill ecosystem of Nepal. This national park also suffers from the human-wildlife conflict. In this protected area, major crop raider or depredator wild animals are wild boar, monkey, porcupines, deer, bear and birds. Among them, wild boar is main crop depredator that massively raided on maize, wheat, millet and paddy and also prefer rooted plant sweet potato. In year

1995 about 0.46 tons of paddy, 35.54 tons of maize, 41.92 tons of millet and 15.37 tons of wheat was lost in Sundarijal VDC adjoining to the ShNP causing an average of Rs. 3132 lost in each affected household annually due to crop damage by wildlife (Poudyal 1995). Similarly, in Kakani adjacent VDC of ShNP was found that wild animals respectively lost 999.88, 55.57, 23.65 and 23.06 quintal of maize, millet, wheat, and paddy mainly by wild boar. An increasing of crop raid by wild boar was due to distance from park and local forest that provide shelter for wild boar outside the park (Soti 1995). The studied carried out in Sunkhani VDC of Nuwakot district adjoining to ShNP has found a total of Rs. 554989.31 was a lost due to crop damage by wild animal and most affected crops were maize (33.24%) and followed by paddy (19.59%), wheat (17.35%), millet (10.14%) and potato (16.26%) (Gurung 2002). Bajracharya (2005) conduct study in three adjacent VDCs (Kakani, Sundarijal and Bajrayogini) of the ShNP, estimated the total loss of crops about Rs. 4, 92,988.84 per annum and Rs. 18500 per household. According to her studied, maximum loss was for potato loss, followed by maize, millet, arum, sweet potato, paddy and wheat. In Jitpurphedi, Chapalibhadrakali and Baluwa about 1303.24 quintal of crops loss due to wildlife and highest amount of paddy and wheat were lost at 0-1 km and at 0-500m high amount of maize and millet were lost (Paneru 2004).

For search of the food, wild animals used to travel long distance from the park. Especially wild boar travelled from 1-5 km from park boundary (Kattel 1993, Soti 1995, FAO/HMG 1996, Bajracharya 2005) for the search of food that due to their acute sense of smell and nocturnal feeding habitat. In addition, monkey was used to travel about 500m from the forest boundary (Bajracharya 2005).

In Chitwan National Park, Rhinoceros (*Rhinoceros unicornis* Linnaeus), wild boar and chital are found to be main crop depredators shown by different studied. Among this crop depredator, rhinoceros was found to be most destructive and cause 50-100% crop damage. During, the wheat season, chital caused greater damage, and during maize and potato season, wild boar cause greatest troublesome to the villagers (Milton and Binney 1980).These crop depredator mainly damage crops like paddy, wheat, millet, maize, pulses, mustard and potato (Nepal 1988, Jnawali 1989, Shrestha 1994, Adhikari 2005). In Sauraha, adjoining to the RCNP caused the economic loss of Rs. 17200 within a distance of 500m and highest economic damage occurred on paddy

about 27.6% (Jnawali 1989). Most of the damage within 1750m of edge of the forest occupied by rhinos and beyond 1500m from the forest edge was negligibly damage (Laurie 1978). One study found the highest damage by wild animals in adjoining VDCs of the CNP occurred to maize followed by paddy and mustard (Shrestha 1994). Similarly, study carried by Adhikari (2005) found that most affected crop was paddy (50.45%) followed by maize (17.96%), wheat(13.34%), millet (6.63%) and more than 11% lost was found on potato, pulses and mustard etc. Rhinoceros damage especially on maize and paddy of all stages. Rhinoceros, wild boar and chital are responsible for 60%, 27% and 12.9% of total crop damage respectively (Nepal and Weber 1993). Recently it was found that 70.7% of damage by rhinoceros and 0.2% by bark deer (Bhattarai and Basnet 2004).

In Koshi Tappu Wildlife Reserve, wild buffalo (*Bubalus bubalis* Linnaeus) is the main crop raider and wild boar is second position (Sharma 1996, Limbu 1998, Adhikari 2000). Wild buffalo mainly damage the paddy wheat and potato. About 88.45% of economic loss solely caused by wild buffalo by crop damage and followed by wild boar causing 10.23% lost and other animal caused more than 1% loss (Adhikari 2000). Similarly, in the Bardia National Park wild elephant (*Elephas maximus* Linnaeus), wild boar, chital (*Axis axis* Erxleben), hog deer (*Axis porcinus* Zimmermann), monkey, nilgai (*Boselaphus tragocamelus* Pallas), rhinoceros caused damage on paddy, potato, maize, wheat, musuro, lentils, yam etc. (Khatri 1995, Baral 1999 and Jnawali 2002). In Lumbini area, nilgai caused damage to crop like paddy, wheat, and mustard. In year 2001/2002 about 1.42 quintals of paddy, 2.13 quintals of wheat and 0.42 quintal of mustard were lost (Bagale 2003).

Crop depredation by wildlife has also been reported from many protected areas of world. Major cause of conflict between park and local people is crop damage in developing countries. In India major crop depredator mammals are elephant, gaur (*Bos gaurus* Smith), black buck (*Antilope cervicapra* Linnaeus), chinkova (*Gazella bennetti* Sykes), wild boar, hanuman langur, porcupine, red-breasted parakeet (*Psittacula alexandri* Linnaeus) etc. depredated the crops (Chandra 1997, Das 1998, Changani et al. 2004).

Wild boar, black bear, monkey, pheasant of Quomolanma nature reserve Tibet were involved in crop damage in and around forested area (Jackson 1991). Banana and

maize were the main crop raided at Kibale Forest National Park, Uganda and crop raiding occurred throughout the year with peaks in dry seasons when crop availability was high (Chiyo et al. 2005). Corp damage due to elephants in the Caprivi region of Namibia fluctuated monthly, seasonally and annually depending on elephant movements, rainfall patterns and crop quality and it has main reason of conflict between human and wild animals (O'connell et al. 2000).

Schely (2000) studied on the agricultural crop damage by badger (*Meles meles*) and wild boar found that wild boars and badgers caused damage to maize in autumn, but wild boar also damage maize during spring leading upto 40% loss of productivity.

### 3.4 Conflict with local people

The people who were enjoying free access to areas have forth covered by park and were able to meet their needs from inside reserve, now no longer have legal access and they have no rights to claim the compensation for the damage to their crops by wildlife. However, the park has become a very good source for villagers to fulfill their resource needs through veneering into illegal poaching, logging and hunting, all of which are directly conflicting with the park objectives (Mishra 1971, Milton and Binney 1980).

In Gir National Park area, wild herbivores share the same niche as the cattle in Gir forest and foraging competition is quite heavy in many places, especially near the border area. Due to heavy grazing by cattle, the wild herbivores move into the peripheral region to raid crop and also infestate the weed in this area. In addition to that, over exploitation of ground water, availability of water within forest areas had been lessened that forced the wild herbivores come out from the forest and entering the peripheral agricultural fields in search of water and fodder (Sinha et al. 2004).

Habitat fragmentation, land cover change and biodiversity loss are often associated with village communities in protected areas. About 3-10%, impacts caused this disturbance in protected areas (Karanth et al. 2006). This disturbance factors were trail used by park staffs, tourists, villagers and vehicles, fodder collection, fire, wood collection, village or settlements, livestock, grazing, agricultural land and feral livestock as anthropogenic whereas landslides as natural caused threat to wild

mammals (Shrestha 2005). The man-animal conflict is mainly due to the conservation of forest into large-scale monoculture, plantations, shifting cultivation, over grazing, forest cutting and encroachment in the home ranges, which reduce the availability of natural food to wild animals.

### 3.5 Preventive methods used to control the crop damage

Farmers used many methods to protect their fields from wild animals. These include patrolling the fields, guarding over night, watchdog, fencing, guns, potash bomb, firing, using noise, making tools, shouting, curetting, pit construction, scarecrow, trenches, poison, etc. Prevention method like patrolling the fields, pit construction, guarding over night, using watchdog to chase the wild animals away and making the noise during guarding were common and most frequently used method to prevent crop from wild boar. Similarly, some farmer used destructive method like potash bombs, shot guns, high voltage electric current and poison which usually killed or seriously injured the wild animals. Fencing the farmland by thorny twigs and branches of *Prosopsis juliflora*, *Accacia nilotica* and *Euphorbia* Species and by barbed wire etc. for chasing out the animals from field (Changan et al. 2004, Bajracharya 2005, Paneru 2004, Adhikari 2005). The effectiveness of all these protection measures ranges from partial to effective.

# 4. MATERIALS AND METHODS

## 4.1 Literature review

Literature review was done throughout research period to collect the secondary data. For this purpose, both published and unpublished literatures were reviewed such as books, reports, thesis, scientific papers, journals etc from different libraries, websites and offices with focusing on the literature related to conflicts generated by conservation of biodiversity, relationship between human and natural resource, sustainable conservation of biodiversity in mountainous regions. The information about human impacts on wildlife and vice versa, as well as recent management activities and gap and weakness both local people and national park office obtained from DNPWC annual report and headquarter of the ShNP office. The ward-wise distribution of households and population of two VDCs were obtained from CBS office and VDCs offices. Metrological data were obtained from Meteorological Department.

## 4.2 Reconnaissance survey

Preliminary survey was done in the month of December 2007 and selected two VDCs i.e. Kabresthali and Sangla adjoining to the ShNP where wildlife greatly affected and caused high level of conflict between local people and wildlife due to annual seasonal crop loss and other conservation generated problems. The actual fieldwork was initiated from the month of January to August.

Each VDC (Kabresthali and Sangla) consists of nine wards among them six wards of each VDC included in propose buffer zone area, which were core area of my study. These ward numbers were 1- 4, 7, and 9 of Kabresthali and ward numbers 1 - 4, 7, and 8 of Sangla. The study of crop depredation was mostly base on household questionnaire survey that supported by field survey. The sample size for study was based on total number of households in the study area that was determined from VDC office and CBS record and assumed that there has been no significant changed in the distribution of number of households and population in the study area. Quadrat method was used for study of Wild mammals and Vegetation characteristic in each study area forest of the ShNP.

### 4.3 Quadrat method

Quadrat method was used for floral and faunal sampling. In this process, one transect line in each study area forest of the ShNP was laid which was started from the Park boundary to Park Forest ran in different direction followed the trails in the rugged and dense forest for sampling of 20mx20m quadrat. At the origin point of transect line first quadrat was laid and transect line was considered as mid line of quadrat. By using the GPS meter approximately every 100m rise in altitudinal gradient another quadrat was laid and each transect line consist of five quadrats. Besides the survey of fixed quadrats random search was carried out to record the occurrence of mammals. For the study of vegetation characteristic of forest, plant species having diameter at breast height (1.4m) over bark was greater than 10cm and height higher than 4m were measured and counted within the 20mX20m quadrats (Annex I).

For surveying the occurrence of mammals, direct observation and indirect methods were applied. Indirect methods included collection of signs as data forms and these data contained signs types (pellet, dropping, scratch, pugmark etc.), habitat types, aspect, GPS reading, etc. For identification and confirmation, collected feces sign types (feces) were tallied with feces of mammals of the Central Zoo and through literature reviews. People were interviewed to know the species distribution in their area as well as near forest (Annexes II and III).

### 4.4. Questionnaire survey

For the study, I prepared two sets of questionnaire one set (Annex IV) for park officials (park staffs) of different posts and other set (Annex V) for individual household owners. Questionnaires survey was conducted during the month of June, July and August 2008. The households were selected randomly that represent all population of VDCs. Before taking interview, people were briefed about the study and tried to interview the head of household. In the absence of head of household, the person next to head was interviewed and to reduce any bias door to door visit of respondent was done.

Altogether 85 households were selected from total number of households i.e. 44 households in Kabresthali and 41 in Sangla VDCs. The questionnaires that were

designed to receive information from wildlife affected households and contained most abundance pest species in the study area, amount of crop damaged, most preferred crops by pest species, land abandonment due wildlife, etc. and distance range from 0-3 km, assuming park boundary was an origin point of distance to crop field. Crop loss was estimated in the local scale (e.g. muri, pathi) which was converted into kilogram (kg) by weighting 'a pathi' of different crops for three times and concurrent weight were considered as the standard value (Annex VI). Price of different crops were obtained from local people, local market of Kabresthali and Sangla (Annex VI). The average value was considered for estimation of the economic loss and land measured in ropani (1 ropani = 508.74 $m^2$).

Questionnaire method collected information about local people attitude towards the wildlife conservation, park authorities and their rules and regulation, and indigenous methods that used in study areas to reduce the crop loss by wild animals and their effectiveness and recommendation to minimize the conflict level especially crop loss. Present study was mainly focused in four main crops like paddy (*Oryza sativa*), wheat (*Triticum aestivum*), maize (*Zea mays*), and millet (*Eleusine coracana*) rather than other crops like; potato, pea, and cash crops that grown there.

### 4.5 Data analysis Technique

#### 4.5.1 Vegetation analysis

The different characteristic of vegetation like; the numerical strength of a species in relation to a definite unit space and the proportion of density of a species to that of stand as a whole; for that density and relative density was calculated. Similarly, to find the distribution pattern of individual species in terms of percentage occurrence, frequency of species in area was calculated and dispersion of species in relation to that of all the species, relative frequency was calculated. To know the coverage and ecological importance of a species in community, relative dominance and important value index of the species were calculated. To explore the species diversity of forest and level of disturbance, Shannon's Index was calculated.

$$\text{Density of sp per hectare (D/h)} = \frac{\text{Total no. of a sp in all samples plot}}{\text{Total no. of sample plots studies} \times \text{area of sample plot}} \times 1000$$

$$\text{Relative density (R.D)} = \frac{\text{Total no. of individual of a species}}{\text{Total no. of individuals of all species}} \times 100$$

$$\text{Frequency (F)} = \frac{\text{Total no. of quadrats in which the species occur}}{\text{Total no. of quadrats studied}}$$

$$\text{Relative frequency (R.F)} = \frac{\text{Frequency of one species}}{\text{Sum of frequency of all species}} \times 100$$

$$\text{Relative dominance (R.Dom)} = \frac{\text{Total basal area of a species}}{\text{Total basal area of all the species}} \times 100$$

Basal area is the cross section area of a tree measure at breast height (1.4m) above the ground.

Importance value index (IVI) =Relative density+ Relative frequency +Relative dominance

### 4.5.2 Distribution map preparations

The Global positioning System (GPS) point of every sampling place of vegetation and scats were recorded with "etrex GARMIN GPS" device. The points were in Degree minute second (DMS) units in World Geodetic system (WGS) 84 projection systems. These points were converted to degree decimal (DD). The GPS points were plotted in Arcview GIS 9.2 software to prepare the sample distribution maps.

### 4.5.3 Crop loss

After conducting questionnaire survey, data were quantitatively analyzed by using various statistical tools. For calculated total crop loss (paddy, wheat, maize and millet), following formula has been used i.e.

Total crop loss (kg) = Expected yield before crop loss –Actual yield after crop loss

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

Total economic loss (Rs) = Price of crop (Rs) ×Total crop loss (kg)

Correlation analysis was used to explore the relationship between the distance traveled (km) by pest species from the boundary wall to crop field and crop loss in weight (kg). For the analysis, null hypothesis: there was no significant relationship

between distance and crop loss was tested. Correlation analysis was also used to find the effect of crop loss on conservation attitude of people and for that null hypothesis: there was no effect of crop loss on conservation attitude of local people, was test. Correlation analysis was done by using SSPS 15 version program. Similarly, Z- test was carried out to compare the crop loss weight in two study areas. For that purpose, null hypothesis: there was no significant difference between crops loss in two VDCs, was tested.

a. View of Kabresthali VDC

b. View of Sangla VDC

c. Questionnaire survey

d. Vegetation sampling

e. Dropping of Barking deer

f. Scat of Jungle cat

g. Rhesus Monkey

h. Condition of the ShNP boundary wall

Plate 4.1 View of study areas and methods used for collection of data

# 5. RESULTS

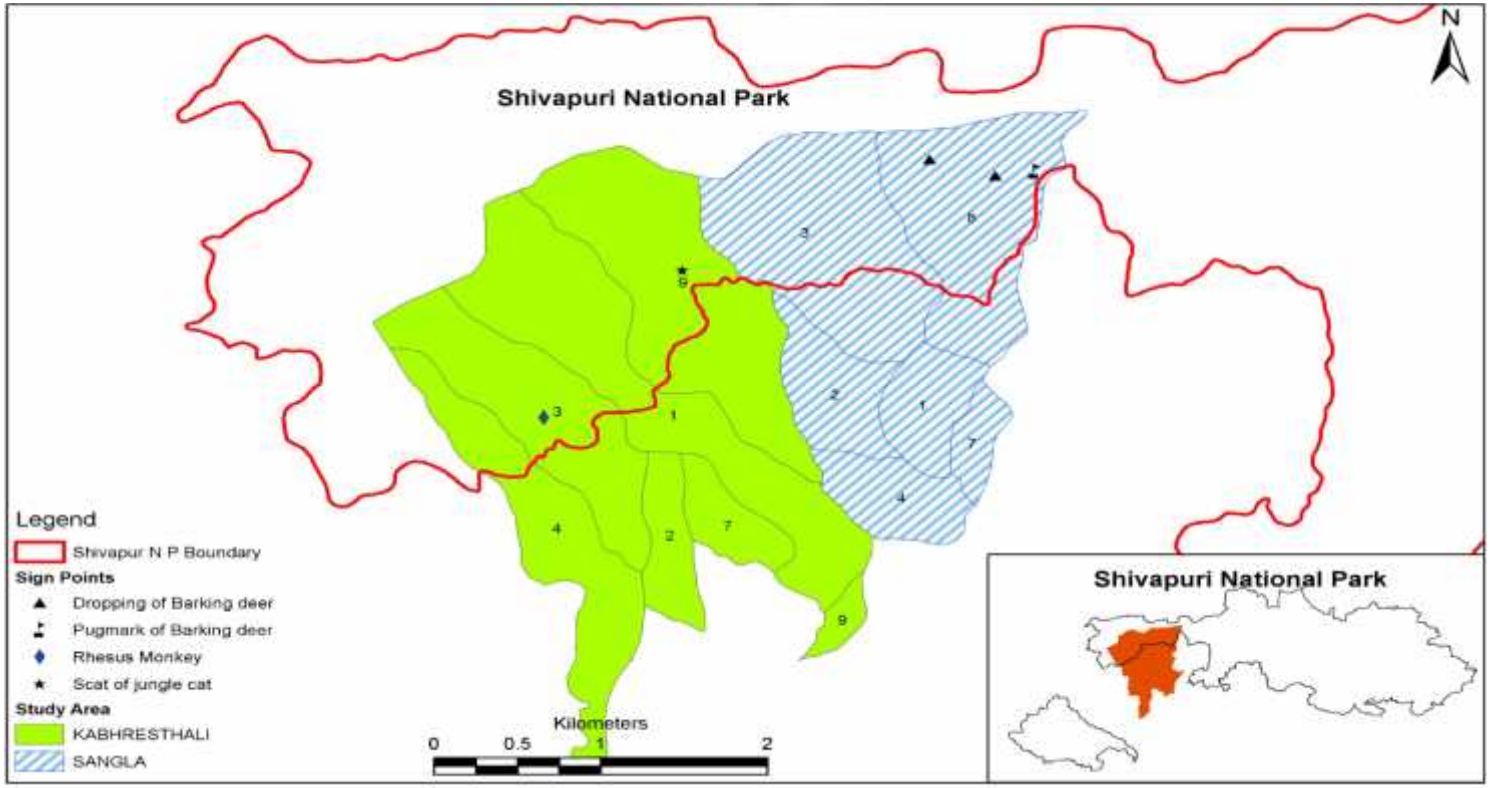
## 5.1 Wildlife occurrence and their habitat

Six signs of three mammalian species were recorded during the study period. Among them two mammalian species signs were found (Barking deer and Monkeys) within the quadrats and one mammalian species (Jungle cat) during the random searching in the ShNP. Barking deer signs (three dropings and one pug mark) were found in *Lyonia*, *Myrica* and *Castanosis* species of trees dominated forest in south western aspect at altitude range of 1700-1910m. Similarly, Jungle cat scat (1924m) and monkey sign (visual observation at 1612m) were found in *Pinus* and *Schima* dominated forest in south eastern and south northern aspect respectively (Map5.1). These all sign found in human disturbance area for firewood and fodder collection, trail uses.

141 numbers of the trees of 17 species belonging to 13 families were recorded during the quadrat sampling at altitudinal ranges between 1600m to nearly 2000m at south-western and south-eastern sides of the ShNP. At that aspect of the park, *Schima, Myrica, Pinus* species of trees were frequency found and covered high density and the species diversity of study was found 1.023 by using Shannon's index (Table 5.1).

**Table 5.1 Vegetation analysis**

| Name of species | No. | F % | RF % | D/h | RD % | Basal area | R. Dom | IVI |
|---|---|---|---|---|---|---|---|---|
| *Pinus roxburghii* | 25 | 40 | 9.5 | 6.3 | 17.7 | 2.118 | 38.8 | 66.0 |
| *Schima wallichii* | 32 | 80 | 19.1 | 8 | 22.7 | 0.689 | 12.6 | 54.4 |
| *Alnus nepalensis* | 12 | 20 | 4.8 | 3 | 8.5 | 1.18 | 21.6 | 34.9 |
| *Myrica esculenta* | 30 | 70 | 16.7 | 7.5 | 21.3 | 0.4 | 7.3 | 45.3 |
| *Castanopsis tribuloides* | 11 | 40 | 9.5 | 2.8 | 7.8 | 0.259 | 1.2 | 18.5 |
| *Castanopsis indica* | 3 | 20 | 4.8 | 0.8 | 2.1 | 0.106 | 4.7 | 11.6 |
| *Lyonia ovalifolia* | 3 | 20 | 4.8 | 0.8 | 2.1 | 0.05 | 1.9 | 8.8 |
| *Prunus cerasoides* | 2 | 10 | 2.4 | 0.5 | 1.4 | 0.063 | 4.9 | 8.7 |
| *Pyrus pashia* | 2 | 10 | 2.4 | 0.5 | 1.4 | 0.031 | 0.7 | 4.5 |
| *Madhuca longifolia* | 2 | 10 | 2.4 | 0.5 | 1.4 | 0.27 | 0.6 | 4.4 |
| *Myrisine capitellata* | 2 | 20 | 4.8 | 0.5 | 1.4 | 0.041 | 0.8 | 6.9 |
| *Homalium napaulense* | 2 | 20 | 4.8 | 0.5 | 1.4 | 0.029 | 0.5 | 6.7 |
| *Symplocos paniculata* | 3 | 10 | 2.4 | 0.8 | 2.1 | 0.04 | 1.9 | 6.5 |
| *Quercus lanata* | 3 | 20 | 4.8 | 0.8 | 2.1 | 0.049 | 0.9 | 7.8 |
| *Rhododendon axboreum* | 7 | 10 | 2.4 | 1.8 | 5 | 0.106 | 0.9 | 8.2 |
| *Gaultheria fragrantissima* | 1 | 10 | 2.4 | 0.3 | 0.7 | 0.019 | 0.4 | 3.4 |
| *Semecarpus anacardium* | 1 | 10 | 2.4 | 0.3 | 0.7 | 0.012 | 0.2 | 3.3 |




Map 5.1 Distribution of mammals in intensive study area in the Shivapuri National Park

## 5.2 Land abandonment

Among the total land in Kabresthali about 20% and in Sangla 6.3% of land were abandoned due to various conservation generated reasons. Almost 15% and 5% of a total lands were abandoned because of crops depredation by wildlife, and around 2% of a total land was abandoned as artificial meadow and due to the natural hazard (landslide, erosion, and siltation) respectively in both the VDCs. In addition to that lack of work force's caused around 3% of land abandonment among the total land in Kabresthali VDC (Table 5.2).

**Table 5.2 Land abandoned (ropani) in Kabresthali and Sangla VDCs**

| Reasons for land abandoned | Land abandoned (ropani) in Kabresthali VDC, ward no. | | | | | | Total | Land abandoned (ropani) in Sangla VDC, ward no. | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 7 | 9 | | 1 | 2 | 3 | 4 | 7 | 8 | |
| Wildlife | 8 | 10 | 15 | 7.5 | 9 | 17 | 66.5 | - | 10 | 2 | - | - | 1 | 13 |
| Artificial meadow | 1 | - | - | - | - | - | 1 | - | - | 2 | - | - | | 2 |
| Lack of work force's | 3 | - | - | 10 | - | - | 13 | - | - | - | - | - | | - |
| Other reasons like: landslide, erosion, siltation | 2 | - | - | - | - | 6.5 | 8.5 | - | - | 2 | - | - | | 2 |
| Total | 14 | 10 | 15 | 17.5 | 9 | 23.5 | 89 | - | 10 | 6 | - | - | 1 | 17 |

## 5.3 Major mammalian pest species and stages of crop damage

Wild boar damaged 10 (24.4%) and 17 (50%) respondents crops field alone. Similarly, wild boar and rhesus monkeys, and wild boar, monkeys and porcupine depredated the 20 (49%) and 11 (26.8%) respondents crops field respectively in Kabresthali VDC. While in Sangla VDC, wild boar, porcupines, monkeys and barking deer gave trouble to 11 (32.3%) respondents and 6 (17.7%) respondents had wild boar and porcupines problems in their field.

Maize field of almost 44% respondents were depredated by wild boar, monkeys, porcupines and barking deer and followed by 31.4% respondents' maize and millet field by wild boar, monkeys and porcupines, and 25% respondents' maize, millet,

paddy and wheat field by wild boar (Table5.3.1). Maximum amount of damaged caused by these animals during maturing stage of all crops (Table5.3.2)

**Table 5.3 Wild pest in different crops**

| Species of wildlife | Preferred crops | Time of raiding | Frequency of visit in village | |
|---|---|---|---|---|
| | | | Kabresthali | Sangla |
| Wild boar | Maize, millet, wheat, paddy and potato | Night | Very frequent | Very frequent |
| Monkey | Maize, millet, pear, plum etc | Day | Frequent | Frequent |
| Porcupine | Maize, millet, hyacinth bean | Night | Frequent | Very frequent |
| Barking deer | Maize, hyacinth bean and pumpkin plants | Day and night | - | Frequent |

(Note: Very frequent=everyday and night during crop season, Frequent= Twice a week or once/twice a month)

**Table5.4 Stages of crops damage and season of attack**

| S.N. | Name of wild pest | Name of Crop | Stage of damaging | Season of attack |
|---|---|---|---|---|
| 1. | Wild boar | Paddy | During sprout head of paddy to mature stage | August to September |
| | Porcupine | | - | - |
| | Monkeys | | - | -. |
| 2. | Wild boar | Wheat | During maturing stage | April to May |
| | Porcupine | - | - | - |
| | Monkeys | | During maturing stage | April to May |
| 3. | Wild boar | Maize | Premature to ripening stage | July to September |
| | Porcupine | | Premature to mature stage | July to August |
| | Monkeys | | Mature to ripening stage | August to September |
| 4. | Wild boar | Millet | Mature stage | October to December |
| | Porcupine | | Mature stage | October to December |
| | Monkeys | | Mature to ripening stage | December |

### 5.4 Crops loss

Paddy was planted in 209 ropanis (N=42) and 112.5 ropanis (N=34) of the land. Most of loss was concentrated in ward number 9 of Kabresthali and ward number 2 of Sangla VDCs (Table 5.5). Wheat was cultivated in 117 ropanis (N=30) and 72.5 ropanis (N=29) of land in Kabresthali and Sangla VDCs respectively. There wasnot cultivation of the wheat in ward number 7 of Sangla (Table 5.6).

**Table 5.5 Loss of paddy (Kg) in Kabresthali and Sangla VDCs**

| Kabresthali | | | | | Sangla | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ward no. | Land cover by paddy (ropani) | Expected yield (Kg) | Actual yield (Kg) | Loss (Kg) | Ward no. | Land cover by paddy (ropani) | Expected yield (Kg) | Actual yield (Kg) | Loss (Kg) |
| 1 | 21 | - | - | - | 1 | 12.5 | - | - | - |
| 2 | 64 | 15600 | 15360 | 240 | 2 | 50.5 | 5805 | 5250 | 555 |
| 3 | 34 | 8760 | 8610 | 150 | 3 | 9.5 | 840 | 660 | 180 |
| 4 | 32 | - | - | - | 4 | 22.5 | - | - | - |
| 7 | 21 | - | - | - | 7 | 7 | - | - | - |
| 9 | 37 | 5640 | 3990 | 1650 | 8 | 10.5 | 810 | 630 | 180 |
| Total | 209 | 30000 | 27960 | 2040 | | 112.5 | 7455 | 6540 | 915 |

**Table 5.6 Loss of wheat (Kg) in Kabresthali and Sangla VDCs**

| Kabresthali | | | | | Sangla | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ward no. | Land cover by wheat (ropani) | Expected yield (Kg) | Actual yield (Kg) | Loss (Kg) | Ward no. | Land cover by wheat (ropani) | Expected yield (Kg) | Actual yield (Kg) | Loss (Kg) |
| 1 | 19 | 1330 | 840 | 490 | 1 | 9.5 | - | - | - |
| 2 | 40 | 2800 | 2320.5 | 479.5 | 2 | 22.5 | 1540 | 1284.5 | 255.5 |
| 3 | 18 | 1260 | 857.5 | 402.5 | 3 | 9.5 | 595 | 525 | 70 |
| 4 | 4 | 147 | 80.5 | 66.5 | 4 | 21 | 1260 | 875 | 385 |
| 7 | 7 | 490 | 420 | 70 | 7 | - | - | - | - |
| 9 | 29 | 1225 | 672 | 553 | 8 | 10 | 665 | 577.5 | 87.5 |
| Total | 117 | 7252 | 5190.5 | 2061.5 | | 72.5 | 4060 | 3262 | 798 |

In Kabresthali and Sangla VDCs, maize was sowed in 150.5 ropanis (N=41) and 140 ropanis (N=41) of land. The highest amount of maize loss was found in ward number 4, 9 of Kabresthali and ward number 2, 3 of Sangla (Table 5.7). Millet was harvested from the 76 ropanis (N=25) and 95 ropanis (N=31) of land respectively. Millet loss was high in ward number 9 of Kabresthali and ward number 2 of Sangla (Table 5.8).

**Table 5.7 Loss of maize (Kg) in Kabresthali and Sangla VDCs**

| Kabresthali | | | | | Sangla | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ward no. | Land cover by maize (ropani) | Expected yield (Kg) | Actual yield (Kg) | Loss (Kg) | Ward no. | Land cover by maize (ropani) | Expected yield (Kg) | Actual yield (Kg) | Loss (Kg) |
| 1 | 14 | 980 | 672 | 308 | 1 | 11.5 | 682.5 | 595 | 87.5 |
| 2 | 18.5 | 1120 | 770 | 350 | 2 | 61.5 | 4410 | 2292.5 | 2117.5 |
| 3 | 19 | 1330 | 857.5 | 472.5 | 3 | 21.5 | 1505 | 640.5 | 864.5 |
| 4 | 36 | 2520 | 1102.5 | 1417.5 | 4 | 17 | 1207.5 | 1137.5 | 70 |
| 7 | 27 | 1890 | 1085 | 805 | 7 | 17 | 1260 | 910 | 350 |
| 9 | 36 | 2520 | 875 | 1645 | 8 | 11.5 | 735 | 294 | 441 |
| Total | 150.5 | 10360 | 5362 | 4998 | | 140 | 9800 | 5869.5 | 3930.5 |

**Table5.8 Loss of millet (Kg) in Kabresthali and Sangla VDCs**

| Kabresthali | | | | | Sangla | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ward no. | Land cover by millet (ropani) | Expected yield (Kg) | Actual yield (Kg) | Loss (Kg) | Ward no. | Land cover by millet (ropani) | Expected yield (Kg) | Actual yield (Kg) | Loss (Kg) |
| 1 | 9 | 270 | 192 | 78 | 1 | 1.5 | - | - | - |
| 2 | 12 | 360 | 255 | 105 | 2 | 49.5 | 1500 | 1110 | 390 |
| 3 | 14 | 420 | 225 | 165 | 3 | 21.5 | 660 | 465 | 195 |
| 4 | 5 | 150 | 105 | 45 | 4 | 2 | - | - | - |
| 7 | 12 | 360 | 315 | 45 | 7 | 10 | - | - | - |
| 9 | 24 | 720 | 327 | 393 | 8 | 10.5 | 330 | 255 | 75 |
| Total | 76 | 2280 | 1449 | 831 | | 95 | 2490 | 1830 | 660 |

### 5.4.5 Economic loss and its distribution

The gross crops loss per household (H/H) and total economic loss was much higher in Kabresthali than in Sangla VDCs (Table 5.9).

**Table 5.9 Economic loss and its distribution in Kabresthali and Sangla VDCs**

| S.N | Name of crops | Kabresthali | | | Sangla | | |
|---|---|---|---|---|---|---|---|
| | | Loss per H/H (Kg) | Loss per H/H (Rs) | Total loss (Rs) | Loss per H/H (Kg) | Loss per H/H (Rs) | Total loss (Rs) |
| 1 | Paddy | 48.6 | 1215 | 51000 | 26.9 | 672.5 | 22875 |
| 2 | Wheat | 67.2 | 1209.6 | 37107 | 27.5 | 495 | 14364 |
| 3 | Maize | 121.9 | 2194.2 | 89964 | 95.9 | 1726.2 | 70749 |
| 4 | Millet | 26.8 | 469 | 14542.5 | 27.5 | 481.3 | 11550 |
| 5 | Total | 264.5 | 5087.8 | 192613.5 | 177.8 | 3375 | 119538 |

There was negative correlation between distance and crops loss for crops like paddy, maize and millet in both VDCs. However, Sangla there was positive correlation (r = 0.363) between distance and crop loss (Table 5.10)

**Table 5.10 Correlation between distance and loss of crop**

| Name of crops | Kabresthali | | Sangla | |
|---|---|---|---|---|
| | Correlation coefficient (r) | Remark | Correlation coefficient (r) | Remark |
| Paddy | -0.662 | Medium | -0.437 | Low degree |
| Wheat | -0.153 | Low degree | 0.363 | Low degree |
| Maize | -0.540 | Medium degree | -0.526 | Medium degree |
| Millet | -0.133 | Low degree | -0.372 | Low degree |

Z-test showed that paddy, maize and millet were equally damaged in both VDCs except in case of wheat loss which had significant difference between two VDCs (Table 5.11).

**Table 5.11 Z-Test for comparison of crops loss in Kabresthali and Sangla VDCs**

| Name of crops | Z-value | Tabulated Z-value | Remark |
|---|---|---|---|
| Paddy | 1.564 | <1.96 | Insignificant |
| Wheat | 1.961 | =1.96 | Significant |
| Maize | 0.798 | <1.96 | Insignificant |
| Millet | 0.112 | <1.96 | Insignificant |

## 5.5 Conflict with local people

### 5.5.1 Livelihood options

Local people depended partially upon agriculture for their livelihood but 27% respondents of Kabresthali and 26% respondents of Sangla were depended totally on agriculture. Others were engaged in different professions such as services, business, went to foreign countries, liquor production, and others (plumber, electrician, poultry farming, carpenters, farm labor, construction labor, driver, etc) for extra income generation (Figure 5.1a, b).

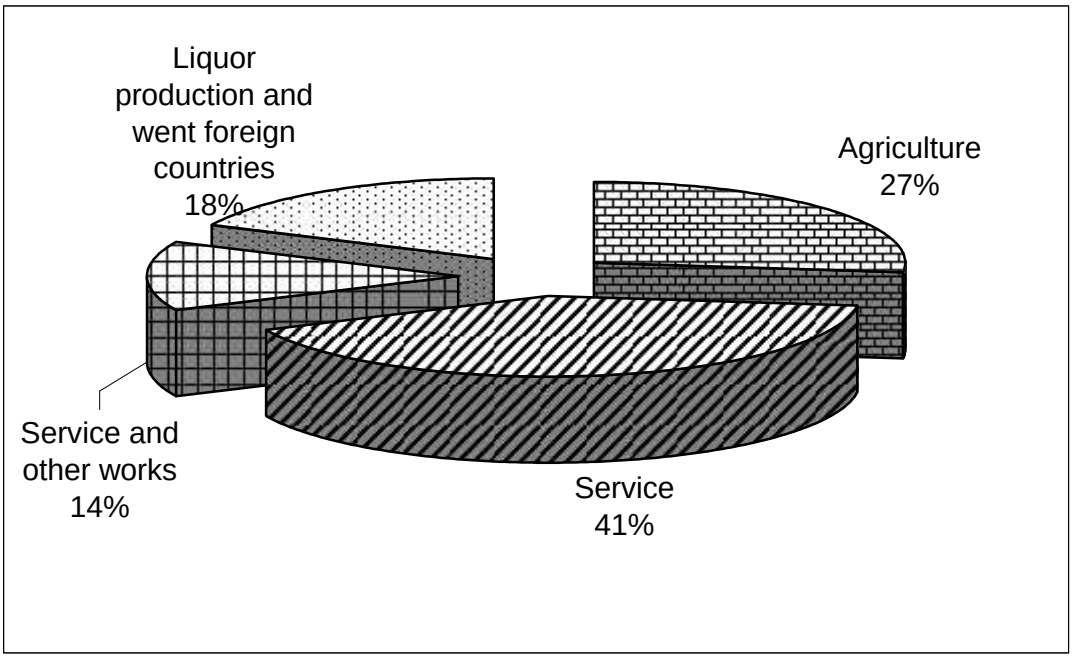



Figure 5.1a Percentage of respondents involved in different occupations in Kabresthali VDC

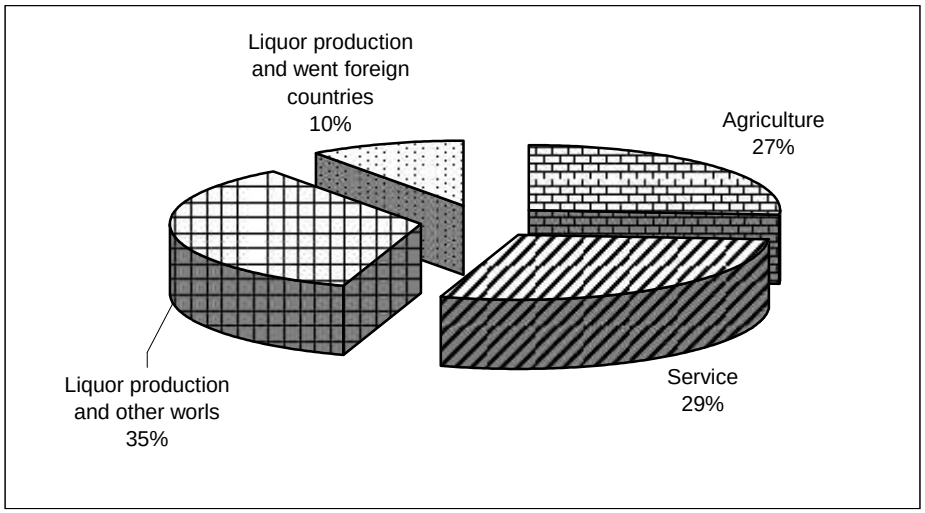



Figure 5.1b Percentage of respondents involved in different occupations in Sangla VDC

### 5.5.2 Dependency upon the ShNP

Hunting and poaching of wildlife for any purpose (private or commercial purposes) was not recorded in the study area either from field observation or questionnaire survey. About 88.6% (N=39) respondents of Kabresthali and 78% (N=32) respondents of Sangla were directly depended on the ShNP either for firewood or fodder collection, grazed the livestock. However, higher percentage of respondents collected freshly cut trees for firewood, fodder and fallen leaves for bedding from the Park Forest (Figure 5.2).

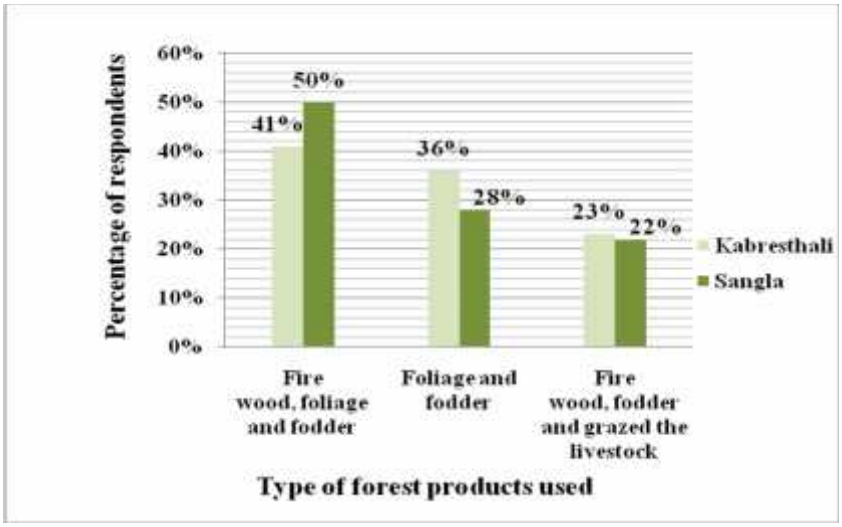



Figure 5.2 Percentage of respondents dependent on the ShNP

### 5.6 Attitude of people towards wildlife conservation

More than 50% of respondents of Kabresthali area had positive attitude towards the wildlife conservation while in Sangla area, nearly equal percentage of respondents had positive as well as negative attitude and almost all respondents of study area had negative perception towards the ShNP management.

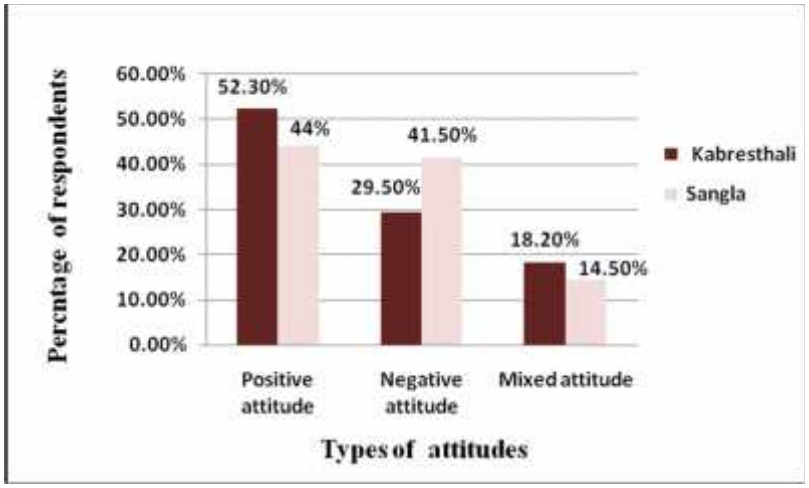



Figure 5.3 Attitude of local people towards wildlife conservation

Correlation analysis between crops loss and attitude of local people in Kabresthali had positive relation while in case of Sangla, there was negative relation between them (Table 5.12).

**Table 5.12 Correlation between crops loss and attitude of people**

| Name of VDC | Correlation coefficient (r) | Remark |
|---|---|---|
| Kabresthali | 0.251 | Low degree |
| Sangla | -0.408 | Low degree |

### 5.7 Preventive methods and their effectiveness

Local people of study area usually practicing different types of indigenous methods such as overnight guarding, drumming, shouting including blowing of molluscan shell, lighting and pit construction methods for the purposed of crops prevention from the depredator animals. They mostly used two or more than two methods correspondingly to get good result (Table 5.13). For guarding purposed, some

respondents made huts (chhapro or tadi) in mounted area of the field which enable the guarding person to notify the wildlife invade in the field while most of others operated this method directly from their resident site. When they noticed wildlife invade in their field or near by area, they shouted or made loud noise by drumming device and showing the light to scare and chase away the invaders. For drumming purpose, people used any materials that made loud sound by hitting like empty tins, brass or steel plate. Preventive methods were frequently used especially during maize maturing season to stop the wild boar intrude and used mostly by upland living people (Tamang ethnic group). They did not get total effectiveness of methods due to nocturnal behavior of wild boar and attack crops field during midnight or second quarter of night.

**Table 5.13 Preventive methods used by local people**

| Preventive methods used in two VDCs | Nos. of H/H using the methods in Kabresthali | Nos. of H/H using the methods in Sangla | Name of crops | Target animals | Effectiveness of the methods | |
|---|---|---|---|---|---|---|
| | | | | | Effective | Partial |
| Shouting and drumming | 5 | 3 | Maize, millet, wheat and paddy | Monkey, wild boar, birds | 3 | 5 |
| Guarding and drumming | 13 | 12 | Maize | Wild boar | 3 | 22 |
| Drumming, lighting and guarding | 2 | 1 | Maize | Wild boar | - | 3 |
| Lighting and pit construction | 1 | - | Paddy | Wild boar | - | 1 |
| Pit construction and drumming | - | 1 | Maize | Wild boar | 1 | |
| Total | 21 | 17 | | | 7 | 31 |

a. Abandoned land in Sangla VDC

b. Maize damaged by wild boar

c. Maize damaged by porcupine

d. Stock of firewood collected

e. Women cutting foliage from park

f. Deforestation for road making in Sangla

g. Alcohol making

h. Hut for guarding of maize field

Plate 5.1: Land abandonment, crop damage, human disturbance and preventive methods used

# 6. DISCUSSION

## 6.1 Wildlife occurrence and their habitat

Barking deer was most frequently distributed wild mammals in the study area (Map 5.1). Local people usually encountered wild boar and porcupines at altitudinal ranges of 1530-1940m and Golden jackals were infrequently visited the settlement area laid at altitude of 1400-1900m but Himalayan black beer was not seen in the area for more than 10 years (Annex III). According to Shrestha (2005), maximum numbers of mammalian species were found in 1700-2400m altitude in the Lower mixed hard wood forest and upper mixed hard wood forest habitat. But, I recorded only three species which may be due to short period of study, covering small altitudinal variation and samples were collected in medium to high human disturbance areas. In study area, wildlife habitat had medium species diversity and dominated by those species of trees which were frequently used as fodder for livestock such as *Schima wallichii, Myrica esculenta, Alnus nepalensis Castanopsis tribuloides* etc and firewood.

## 6.2 Land abandonment

Land abandonment due to crops damage by wildlife was one of the consequences generated after establishment of the ShNP. A total of 106 ropanis of maize and millet cultivating private land in upland area lied at 0-10 m distance from boundary wall of the ShNP were abandoned (Table 5.2). The initial caused of land abandonment was due to high amount of crops damaged by wild boar which was even boosted by lack of legal provision to compensate loss crops, poor condition of boundary wall of the ShNP that made easier for wildlife to escape from the park and raid crops. This reason caused 11% of land abandonment among the total land. In spite of that, continuous loss of money and labour investment due to crop depredation, and closeness of cultivated land towards the barren lands and at the same time lack of manpower, natural hazard forced farmers to leave as fallow land or left totally abandoned. Some respondents which abandoned lands were lies near to resident site were used as meadow. Comparatively, Kabresthali had more abandonment problem than Sangla. That may be due to switching off their total dependency on agriculture as well as effect of urbanization. However, all these reasons caused greater amount of abandonment which directly or indirectly affect livelihood of local people and act as

indicator for development of negative attitude towards wildlife conservation and Park management. According to Nepal Government 1996 report and different studies in the ShNP mention that land abandonment was severe problem in this area which caused huge amount of cultivatable private lands abandoned partially or fully.

### 6.3 Crops loss

Wild boar was principal crop raider and followed by monkey, porcupine, barking deer in the study area (Table5.3). They mostly damaged on maize during the premature to mature stage but maximum during mature growing stage (Table 5.4). During study period, a total 16234 kg of crops were lost (Tables 5.5, 5.6, 5.7, 5.8) which market value was about Rs 312151 (Table 5.9). Study carried out by Paneru (2004) and Bajracharya (2005) in different adjoining VDCs of the ShNP found, a total of 1303.24 quintal and 32662.5 kg of crops were lost due to crop depredation which was much higher than mine due to inclusion of extra crops along with four major crops. Crops depredation was found high in those ward numbers of study area which lies closer to forest boundary (Table 5.10) and quantity of crop loss were more or similar in both VDCs (Table 5.11). Area lies 0-1 km distance from park were most vulnerable area for crop shown by different study carried different protected areas.

### 6.4 Conflict created by local people

Urbanization of near by areas generated new scope of works such as alcohol making, livestock rearing for commercial purpose etc which help to uplift the economic condition and life style of people (Figure 5.1a, b). In spite of that, for biomass energy people were directly dependent on the agricultural residue and fire wood. These all activities were totally relied on the forest products which come from the ShNP (Figure 5.2). However, the extent and intensity of such works on protected area and wildlife were not assessed either from authorities of the ShNP or local people themselves. The main caused of wild mammals straying in the human settlement and agriculture field, was the habitat fragmentation, land cover change and biodiversity loss which were often associated with village communities in protected areas and directly impacted 8-10% in it (Karanth et al. 2006). The damage to crop fields was a signal about the scarcity of food sources and heavy interference of human in their wild habitat.

### 6.5 Attitude of local people toward the wildlife conservation

People showed their willingness to conserve the natural resources and known the necessities of conservation of biodiversity (Figure 5.3). That may because of their livelihood dependent on it. Many factors affected conservation attitude of people living in and around the protected areas such as wildlife imposed constraints, socio-demographic factors and participation in the community base project (Jafari et al. 2007). In the Kabresthali study area wildlife imposed constraints especially crops loss did not affected conservation attitude but reverse happened in the case of Sangla (Table 5.12).

### 6.6 Indigenous methods of controlling depredation and its effectiveness

Local people were practicing five indigenous means of controlling methods to stop the wild boar intrusion in maize field during mature growing stage (Table 5.13). Different notorious means of preventive methods such as electric wire fence, poison, traps, guns etc were used in adjacent villages of the ShNP explored by different study. But, I did not record such harmful means in my study area during study period. According to respondents, practicing of such methods during different crop seasons were decreasing day after day due to migration of young and energetic people to foreign countries and near urban area, partial effectiveness as well as labor intensive and time consuming.

## 7. CONCLUSION AND RECOMMENDATIONS

This study was conducted in two VDCs Kabresthali and Sangla that lied in the southern part of the ShNP. Barking deer, rhesus monkey and jungle cat were occurred in the *Schima, Myrica* and *Pinus* species of trees dominated habitat in high level of human disturbance areas (Shannon's Index value=1.023). Habitat of these mammal's consist of 17 species of trees belonging to 13 families and maximum numbers of these were used as firewood, fodder and even the forest floor was used as grazing place for livestock which degraded wilderness of area.

After establishment of the park, a total 106 ropanis of private maize and millet cultivating farm land were abandoned lie at marginal and sub marginal areas of the ShNP forest. Intensive crop damaged by wild animals caused almost 11% of land abandonment among the total land and other reasons such as artificial meadow, natural hazard caused 2% and lack of work force caused 1.8% of land abandonment. Wild boar was the principal crop raider and followed by porcupine, monkey, barking deer etc in study area. They raided crops during premature to mature stage but excessive during mature growing stage and a total of 16234 kg of crops were lost. Maize loss (4998 kg and 3930.5 kg) was high and followed by wheat (2061.5 kg), paddy (2040 kg), millet (831 kg) in Kabresthali and paddy (915 kg), wheat (798 kg), millet (660 kg) in Sangla study area. Due to crop depredation, each household deprived of using 264.5 kg and 177.8 kg of crops per annum in Kabresthali and Sangla respectively. Crops loss were concentrated near to boundary wall rather than farther distance except wheat loss in Sangla which had direct relation with distance ($r=0.36$). Quantity of crops loss in two study areas had no significant different except wheat loss ($Z=1.96$). That may be due to both study areas were lying side by side as well as at same altitudinal gradient and similar topography of places. Despite this, local people also created disturbance in wildlife habitat by relying on for extra income generation (18% in Kabresthali and 45% in Sangla) and domestic used of forest products (89% in Kabresthali and 78% in Sangla). Around 50% of local people had positive attitude towards the wildlife conservation in both study areas and conservation attitude of people were not affected by wildlife imposed constraint like crop loss in Kabresthali ($r=0.25$) but in Sangla, wildlife imposed constraint had affected in certain level ($r=-0.41$). Different controlling means were used to stop the

wildlife invade in field such as shouting, guarding, drumming, lighting and pit construction. These all methods were found to use for stoppage of wild boar intrusion during maize season only and for other crops; preventive methods were not used frequently. These means had partial effectiveness and were consuming many man hours and labour.

Based on my study, I derived the following recommendations

1. Extensive research on population status of crop depredating animals and the carrying capacity of the ShNP in terms of food and space availability should be urgently required.
2. Increasing effectiveness of patrols by developing a more systematic process whereby guards record, monitor and determine high level activity of 'concern area' both by location and seasons. They should also establish extensive patrol routes in all areas of park that would be patrolled regularly.
3. Crops which were disliked or least damaged by depredators should be introduced in damage afflicted areas to minimize the level of conflict created due to crop loss. Before introducing such crops to local farmers, their market demand and profit level should be study which help to uplift the economic condition of people and generation of positive attitude towards wildlife conservation.
4. Unless poverty alleviation, conservation of biodiversity were impossible. So, community development programmes should be lunch such as herbal farming, development of ecotourism, encouraging the development of cottage industries by using local raw materials etc.
5. Local people of adjoining villages of ShNP should be allowed to collect fire fodder, fallen leaves, dry branches etc in yearly basis or once in six month or according to condition of ShNP. .
6. Aware the people by lunching different programmes from government side as well as from NGO or INGO about importance and necessities of conservation of biodiversity and protected areas for their own selves and what effect and trouble would get by destruction of common properties and local people should be taken as helping hands not as opponents.

## 8. REFERENCES


Adhikari, K. 2000. An Assessment on Crop Damage by Wild Animals in the Eastern Part of Koshi Tappu Wildlife Reserve. M.Sc. Thesis. Tribhuvan University, Kirtipur, Nepal.

Adhikari, R. 2005. Interdependence of Wildlife Conservation and People in the Northern Part of Royal Chitwan National Park, Nepal. M.Sc. Thesis. Tribhuvan University, Kirtipur, Nepal.

Ale, S. B. and P. C. Gurung 1995. Wildlife Habitat and Land-use Practice in Lower Manang. A Draft Report Submitted to King Mahendra Trust for Natural Conservation, Annapurna Conservation Area Project.

Amatya, D. 1993. Study on Forest Vegetation Analysis. Field Document No.7. Shivapuri Integrated Watershed Development Project (SWIDP), HMG/FAO, Kathmandu, Nepal.

Bagale, I. 2003. Population Status of Nilgai (*Boselaphus tragocamelus pallas*) and Nilgai-Livestock-People Interaction: A Case Study in Lumbini. M.Sc. Thesis. Tribhuvan University, Kirtipur, Nepal.

Bajracharya, P. 2005. Wildlife Human Interation: A Case Study of Shivapuri National Park, Nepal. M. Sc. Thesis. Tribhuvan University, Kirtipur, Nepal.

Baral, N. 1999. Wild boar- Man Conflict: Assessment of Crop Damage by Wild boar (*Sus scrofa*) in the South-Western Section of Royal Bardia National Park, Nepal. M.Sc. Thesis. Tribhuvan University, Kirtipur, Nepal.

Berkmuller, K. and Martha C. Manroe. 1986. Environment Projects Education, Training and Awareness Series No. 1: IUCN-UNEP International Youth Federation. Gland and Cambridge.

Bhattari, B. P. and K. Basnet. 2004. Assessment of Crop Damage by Wild Ungulates in Eastern Side of Barandabhar Corridor Forest, Chitwan. RONAST Fourth National Conference on Science and Technology, Kathmandu.

Biodiversity Profiles Projects (BPP). 1995. Department of National Parks and Wildlife Conservation, Ministry of Forest and Soil Conservation.HMG/Nepal, Kathmandu.

Chandra, J. 1997. Crop Damage Caused by Blackbucks at Karera Great Indian Bustard Sanctuary and its Possible Remedial Solutions. Tiger Paper 24 (3): 26-32.

Chhangani, A. K. and S. M. Mohnot. 2004. Crop Raiding by Wild boar (*Sus scrofa*) in and around Aravalli and its Management in Rajasthan, India. Tiger Paper 31(2): 1-4.

Chiyo, P. I., E. P. Cochrane, L. Naughton and G. I. Basuta. 2005. Temporal Pattern of Crop Raiding by Elephants: A Response to Changes in Forage Quality or Crop Availability? *African Journal of Ecology* 43(1): 48.

CBS. 2001. Population Census, Central Bureau of Statistics, Kathmandu.

Das, S. 1998. Depredation on Crops by Langurs in Tripura. Tiger Paper 25(4): 29-32.

DNPWC.2008. Department of National Parks and Wildlife Conservation 1980-2005: 25 years of Conservation. DNPWC, Kathmandu, Nepal.

Engels, B. 2008. World Heritage and the 2010 Biodiversity. World Heritage Biodiversity. No. 49.

Gaston, A. J., M. L. Hunter and P. J. Garson 1981. The Wildlife of Himachal Pardesh-Western Himalayas. University of Maine School for Resource Technology. Notes No. 82.

Gurung, D. P. 2002. Wild boar (*Sus scrofa*, Linnaeus 1785). Distribution and Conflict Between Park and People in Shivapuri National Park, Nepal. M.Sc. Thesis. Central Department of Zoology, Tribhuvan University, Kathmandu, Nepal.

HMG/FAO 1996. Shivapuri Management Plan, A Policy Framework for Participatory Management of Natural Resource, Protection and Development of the Shivapuri Area FAO/HMG-GCP/NEP/048/NOR.

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

Jackson, R. 1990. Threatened Wildlife, Crop and Livestock Depredation and Grazing in the Makalu-Barun Conservation Area. The Makalu-Barun Conservation Project. Working Paper Publication Series 12:105.

Jackson, R. 1991. A Wildlife Survey of the Qomolongma Nature Reserve, Tibet Autonomous Region, People's Republic of China. Unpublished Report, Woodlands Mountain Institute. Pages 61.

Jafari, K., R. E. Roskaft and B. P. Kaltenborn 2007. Factors Influencing Conservation Attitudes of Local People in Western Serengeti, Tanzania. Biodiversity and Conservation 16 (7): 2213-2230.

Jnawali, S. R. 1989. Park-People Conflict; Assessment of Crop Damage and Human Harassment by Rhinoceros (*Rhinoceros unicornis*) in Sauraha Area Adjacent to Royal Chitwan National Park, Nepal. M.Sc. Thesis. Agricultural University of Norway.

Jnawali, S. R. 2002. Final Report Habitat Restoration in Royal Bardia National Park (Scaling up Effort to Conserve the Wild Tiger Population in an Around Nepal's Royal Bardia National Park) Project # 2000-0182-017 Submitted to Save the Tiger Fund, U.S. KMTNC.

Karnath, K. K., L. M. Curron and J. D. Reuning-Scherer 2006. Village Size and Forest Disturbance in Bhadra Wildlife Sanctuary, Western Ghat, India. Biological Conservation 128(2): 147-157.

Kattel, B. 1993. An Assessment of Wildlife Diversity and Crop Depredation in Shivapuri Watershed and Wildlife Reserve HMG/FAO, Shivapuri Integrated Watershed Development Project (SIWDP), Kathmandu, Nepal.

Khatri, T. B. 1993. Status and Food Habits of Nilgai (*Boselaphus tragocamelus*) in Royal Bardia National Park, Nepal. M.Sc. Thesis. NORAGRIC. Agricultural University of Norway.

Laurie, A. 1978. Ecology and Behaviour of Greater One Horned Rhinoceros. Doctoral Dissertation, London University of Edinburgh

Limbu, K. P. 1998. An Assessment of Crop Depredation and Human Harassment Due to Wild Animals in Koshi Tappu Wildlife Reseve; A Case Study of Pashim Kusaha VDC. M.Sc. Thesis. Tribhuvan University, Kirtipur Nepal. Pages 69.

Milton, J. P. and G. A. Binney 1980. Ecological Planning in the Nepalese Terai; A Report on Resolving Resource Conflicts Between Wildlife Conservation and Agricultural Land Use in Padampur Panchayat. Threshold, International Center for Environment Renewal, Washington DC. USA. Pages 35.

Mishra, H. R. 1982. Balancing Human Needs and Conservation in Nepal's Royal Chitwan National Park. Ambio 11(5): 246-251.

Mishra, J. 1971. An Assessment of Animal Damage to Crops by Wild Elephant in Palamau District of Bihar. Journal of Bombay Natural History Society 68(2): 307-310.

Nepal, S. K. 1988. Wild Animals Interference in the Agricultural Activity of Geetanagar VDC. M.A. Thesis, Tribhuvan University, Kirtipur, Nepal. Page no. 150.

Nepal, S. K. and K. E. Weber. 1993. Struggle and Existence; Park-People Conflict in Royal Chitwan National Park , Nepal. Asian Institute of Technology, Bangkok, Thailand. Pages 193.

Neumann, R. P. and G. E. Machlis. 1989. Land Use and Threat to the Park in the Neo-tropics. Ambio 16(1): 13-18.

O'connell- Rodwell, C. E.T. Rodwell, M. Rice, and L. A. Hart 2000. Living with Modern Conservation Paradigm: Can Agricultural communities Co-exist with Elephants? A Five Year Case Study in East Caprivi, Namibia. Biological Conservation 93: 381-391.

Paneru, P. 2004. Study on Assessment of Crop Depredation Due to Wild Animals in Three Adjoining Village Development Committee of Shivapuri National Park (A Case Study of Jitpurphedi, Baluwa and Chapalibhadrakali VDCs). M.Sc. Thesis, Tribhuvan University, Kirtipur, Nepal.

Poudyal, P. R. 1995. An Assessment of Crop Depredation Due to Wildlife in Shivapuri Watershed and Wildlife Reserve: A Case Study of Sundarijal VDC. M.Sc. Thesis, Tribhuvan University, Kirtipur, Nepal.

Prater, S. H. 1998. The Book of Indian Animals (third edition, eleventh impression). Bombay Natural History Society, India. Pages 324.

Sharma, B.K. 1996. An Assessment of Crop Damage by Wild Animals and Depredation of the Wildlife due to the Activities of Local People in Koshi Tappu Wildlife Reserve. M. Sc. Thesis, Tribhuvan University, Kirtipur, Nepal.

Sharma, I. K. 1998. Habitat Preference, Feeding Behaviour, Adaptation and Conservation of the Asiatic Jackal (*Canis aureus*) in the Indian Thar Desert. Tiger Paper 25(4): 18-22.

Sharma, U. R. 1991. Park People Interactions in Royal Chitwan National Park, Nepal. Ph.D. Dissertation, University of Arizona, Tuscon.

Shcley, L. 2000. The Badger Males and Wild boar Distribution and Damage to Agricultural Crops in Luxembourg.Ph.D. Dissertation, University of Sussex.

Shakya, P. R., M. Adhikari, K. R. Rajbhandari, R. P. Choudhary and K. K. Shrestha 1997.Floral of Nepal-country Paper Presented at the International Seminar Cum Workshop on Flora of Nepal,15-16 April, Kathmandu, Nepal.

Shrestha, B. 1994. Study on Park and People Conflict: Investigation on Resolving Resources Conflicts between Park Conservation and Adjoining Settlements in the North-Eastern Boundary of Royal Chitwan National Park. M.Sc. Thesis, Tribhuvan University, Kirtipur, Nepal.

Shrestha, B. 2005. Distribution and Diversity of Mammals with Reference to Disturbance in Shivapuri National Park. M.Sc. Thesis, Tribhuvan University, Kirtipur, Nepal.

Sherstha, T. B. and R. M. Joshi 1996. Rare, Endemic and Endanger Plant of Nepal, WWF Nepal Program, Kathmandu, Nepal.

Shrestha,T. K. 1997. Mammals of Nepal. Published by B. Shrestha. R.K. Printer, Teku, Kathmandu, Nepal. Pages 371.

Sinha, S. P., B. J. Pathak and P. P. Rawal 2004. Man-Animal Conflicts in and around Protected Areas-A Case Study on Gir National Park/Wildlife Sanctuary, Junagadh, Gujarat, India.Tiger Paper 31(3): 27-32.

Smith, C. 1996. Database of Recordings of Nepal's Butterflies.Unpublished, Annapurna Museum, Prithvi Narayan Campus, Pokhara, Nepal.

Soti, J. M. 1995. An Assessment of Crop Depredation Due to Wildlife in the Neighhood of Shivapuri Watershed and Wildlife Reserve: A Case Study of Kakani VDC. M.Sc. Thesis, Tribhuvan University, Kirtipur, Nepal.

Sukumar, R. 1990. Ecology of the Asian Elephant in Southern India. Feeding Habits and Crop Raiding Patterns. Journal of Tropical Ecology 6: 33-35.

Thapa, B. B. 2007. Role of Interpretation in Management: A Case Study of the Protected Area System in Nepal. Banko Janakari 17 (2): 40-45.

WMI/IUCN Nepal 1994: Biodiversity of Koshi Tappu Wildlife Reserve and its Adjacent Areas.

# 9. ANNEXS

## I. ANALYTICAL SAMPLE SURVEY DATA SHEET

(Bajracharya, S., 2007/2008 study)

Serial no……  Date …….

Location …… Plot code ……. Topography...……..

Aspect…… Inclination…… Canopy coverage (%) ……...

Altitude …… Latitude …….. Longitude ……..

Vegetation type …… Management type ……...

Distribution gradient …… Disturbance factors ……

Table 1: Tree (DBH >10 cm)

| S.N | Name of species | DBH cm | Height | Stem | Stand | Remarks |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |
| 16 | | | | | | |
| 17 | | | | | | |
| 18 | | | | | | |
| 19 | | | | | | |
| 20 | | | | | | |
| 21 | | | | | | |
| 22 | | | | | | |
| 23 | | | | | | |
| 24 | | | | | | |
| 25 | | | | | | |
| 26 | | | | | | |
| 27 | | | | | | |
| 28 | | | | | | |
| 29 | | | | | | |
| 30 | | | | | | |
| 31 | | | | | | |
| 32 | | | | | | |
| 33 | | | | | | |
| 34 | | | | | | |
| 35 | | | | | | |
| 36 | | | | | | |

Code: Stem: B = Branch, U = Unbranch Stand: L = Living, D = Death, C = Cut

## II. WILD MAMMALS SIGN TRANSECT SHEET

(Bajracharya, S., 2007/2008 study)

Serial no. ……  Date …….

Location / Quadrat no. …….  Plot code ……  Topography ……..

Aspect …….  Vegetation type ……..  Management type ……..

Disturbance gradient ……..  Disturbance factors ……

GPS reading

Altitude ……  Latitude …….  Longitude …….

| SN | Sign type | Mammalian species | Elevation | Aspect | GPS reading | Remarks |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Sign type code:

Fe =Feces (scat / pellet / dropping), Ft Foot print (pugmark / track), Sh =Scratches,

V = Visual Observation

## III. INDIVIDUAL QUESTIONNAIRE SURVEY FOR WILD MAMMALS

(Bajracharya, S., 2007/2008 study)

Serial no. …….. Date ……..

Name ……..

Sex …… Age ……. VDC …….. Ward no. …….

Education …… Occupation …….. Family size …….

What wild mammals have you seen in south eastern and south northern part of Shivapuri National Park?

| SN | Name of mammalian species | Abundance | Frequency of encounter | Location | Date of last sighting | Time | Remark |
|---|---|---|---|---|---|---|---|
| 1 | Barking deer | | | | | | |
| 2 | Wild boar | | | | | | |
| 3 | Common leopard | | | | | | |
| 4 | Clouded leopard | | | | | | |
| 5 | Jungle cat | | | | | | |
| 6 | Leopard cat | | | | | | |
| 7 | Large civet | | | | | | |
| 8 | Himalayan black bear | | | | | | |
| 9 | Hanuman languar | | | | | | |
| 10 | Rhesus monkey | | | | | | |
| 11 | Himalayan goral | | | | | | |
| 12 | Brown toothed shrew | | | | | | |
| 13 | Chinese pangolin | | | | | | |
| 14 | Fawen colored mouse | | | | | | |
| 15 | Golden jackal | | | | | | |
| 16 | Himalayan squirrel | | | | | | |
| 17 | House rat | | | | | | |
| 18 | Indian hare | | | | | | |
| 19 | Porcupine | | | | | | |
| 20 | Royal's pica | | | | | | |
| 21 | Small indian mongoose | | | | | | |
| 22 | Yellow throated marten | | | | | | |
| 23 | | | | | | | |
| 24 | | | | | | | |
| 25 | | | | | | | |
| 26 | | | | | | | |

Code

Abundance: L = Low, M = Medium, H = High

Frequency: R = Rare, S = Sometime F = Frequency

# IV. QUESTIONNAIRE FOR SHNP AUTHORITY

(Brajracharya, S., 2007/2008 study)

What is the condition of Shivapuri National Park (ShNP)? What types of improvement have been done since its establishment?

What types of problems faced by ShNP for the process of conservation and management of biodiversity from the local people as well as from government sectors?

What are the main causes to create conflict between the Park authorities and local people?

Have you get any complains of crops damage by wild animals from surrounding villages?

Why do animals come out of the Park and do the damage?

Does the Park make any compensation for the crops loss?

What kind of illegal activities are carried out by people? What and which types of action do you taken?

Are the development activities carried out in surrounding/within the ShNP area caused the problems toward the conservation process?

Have you taken any suggestion from local people and used them in planning and management programs of conservation biodiversity?

For healthy relationship between Park and local people, what types of programs are proceed in present and in near future ?

# V. QUSETIONNAIRE FOR HOUSEHOLDS SURVEY

(Bajracharya, S., 2007/2008 study)

S. No.
Name: VDC: Ward no:
Education: Occupation: Sex: Age:

How many members are there in your family?

What kind of work are the all the members engaged?

How much and what type of lands do you have?

a. Khet……ropani b. Bari……ropani

What kinds of crops do you grow in your field?

a. Rice b. Maize c. Wheat d. Millet

Do you practice mix cropping system?

a. Yes b. No

If yes, which crops do you plant together?

What is the total production of these crops?

| | Muri | Pathi |
|---|---|---|
| a) Paddy | | |
| b) Wheat | | |
| c) Maize | | |
| d) Millet | | |

How much crop do you get from your one ropani land?

a. Muri b. Pathi c. Mana

Do you get full production from your land? Yes/No

If not, why?

a. Manure b .Wild animal c. Irrigation d. other

Are you collected fire wood, foliage and fodder from the park?

How far your land from the park boundary?

| | 0-1km | 1-2km | 2-3km |
|---|---|---|---|
| a) Khet | | | |
| b) Bari | | | |

Do you have any problem from park animals? Yes/No

What kinds of problem do you have from park animals?

a. Crop damage b. Harassments c. Others

If crop damage, which animals damage mostly and in which crops?

| | Rice | Wheat | Millet | Maize |
|---|---|---|---|---|
| a) Wild boar | | | | |
| b) Monkeys | | | | |
| c) Porcupines | | | | |
| d) Other | | | | |

Which animals visit and what stage of the crops is the most affected by these animals?

| | Wild bores | Monkeys | porcupines | Others |
|---|---|---|---|---|

a) Juvenile stage
b) Flowering stage
c) Mature stage
d) Ripening time
e) All stage

How frequently do those animals visit during that crop season?

a. Every day/night b. Once a week c. Twice a week d. Every month

If there was not such damage, what is the total production of these crops?

a) Paddy
b) Wheat
c) Maize
d) Millet

Is there any crop, which you don't cultivate because of these wild animals?

What protection measures do you apply to stop the damage?

a. Shouting b. Drumming c. Guarding overnight d. Pit construction e. Lighting f. Watchdog g. Trap

Are these methods effective?

a. Yes b. No c. Partially

Do you abandon land? Yes/No. If yes, why?

How much land do you abandon?

a. Ropani b. Ana

Does agriculture support your livelihood? Yes /No

Do you think the damage problem is growing every year after the establishment of the park? Yes /No

What you recommend to manage wildlife and crop raiding problem?

Are you satisfied with the park management?

a. Yes b. No

Have you ever received any information on the importance of the wildlife and National Park from government sector? Yes/ No

What do you think about wildlife and conservation of park is it necessary?

## VI. CONVERSION OF UNITS USED IN THE TEXT

1 muri = 20 pathi

Paddy = 1 pathi = 3 kg

Wheat = 1 pathi =3.5 kg

Maize = 1 pathi = 3.5 kg

Millet = 1 pathi =3 kg

LOCAL RATE OF DIFFERENT CROPS

Crops = Market rate Rs/kg

Paddy = Rs 25

Wheat = Rs 18

Maize = Rs 18

Millet = Rs 17.50