1. INTRODUCTION

1.1 Background

Conservation entails management and sustainable use of natural resources for the benefit of humankind. Biodiversity conservation in developing countries has been challenge because of the combination of rising human populations, rapid technological advances, several social hardships, and extreme poverty (Spiteri et al. 2006). Biodiversity can alleviate poverty. It can be used as a tool for ecotourism, advocacy of sericulture and drawing experiences, knowledge and ideas of conservation bodies (Agbogidi 2006). Biodiversity, Conservation, and Community are essentially the three stands running through the concept of "environment". Biodiversity represents genetic variability in a wide variety of plants and animals. Conservation is managing biodiversity and natural resources sustainably. Conservation and maximum sustainable use should be regarded as synonyms (Luna et al. 2007). Conservation should benefit ecosystems, non human organisms, and current and future human beings. Nevertheless, tension among these goals engenders potential ethical conflicts, conservation is true motivations may differ from the justifications they offer for their activities and conservation projects have the potential to disempowered and oppress people (Chan et al. 2007).

Yellowstone National Park was established in 1872 as the first national park of the United States of America (Mackinnon et al. 1986). Its model has been adopted in many countries including Nepal for a variety of conservation objectives, such as protection of flora and fauna, conservation of cultural heritage and soil regeneration and nutrient cycling (HMG 1973). These national parks are diverse in physical setting and cultural patterns of the nations and serves as a special place for spiritual, cultural, and physical renewal. Agricultural lands surround numerous national parks and reserve in developing countries. The people living in and around such national parks and reserve have interacted with them in multifarious ways, sometimes with disastrous side effect (Nepal and Weber 1993). Local people have seen the protected areas as an attempt by the government to curtail their access to their traditional right of resources use. However, the protected areas have become very good resources for villagers to fulfill their needs for resources through venturing into illegal activities

like poaching, logging and hunting (Milton and Binney 1980). Due to such illegal activities, the local people were considered as an obstacle in conservation (UNESCO 1974). Establishment of national parks and reserves in the third world countries has played a crucial role in biodiversity conservation (Soule 1991) but it paid little attention to local people by putting restriction on the local use of resources (Wells and Brandon 1993).

Nepal had a long experience in wildlife conservation. It has been considered a leader among developing countries for conservation through its protected area system. Its conservation policy has evolved from the early emphasis on species preservation and research with strict law enforcement practices to a more conciliatory and participatory approach. Nepal embarked upon a modern era of wildlife conservation. The National Parks and Wildlife Conservation Act 1973 was promulgated for wildlife conservation and protected area management in the country. The protected areas encompass representative examples of various ecosystems in the country, extending from the tropics of the lowland Terai to the Himalayas and Trans-Himalayan region. There are nine national parks, three wildlife reserves, three conservation areas, one hunting reserve including "buffer zones" of nine national parks and reserves. They cover a total area of 28, 998.67 km^2, which is over 19.70% of the total land area of the country.

Nepal created a large number of protected areas successfully but many of them have affected local communities and their livelihood directly and indirectly resulting park-people conflict. When rural livelihoods are affected negatively, the adjacent forest communities often respond in ways involving conflict, illegal exploitation of resources, and apathy. However, increasing number of wildlife within protected areas started to damage the agricultural crops of the surrounding inhabitants. Besides this, the case of human death, injuries, livestock depredation and human harassment by these wild animals had increased the conflict. Park-people conflicts are prevalent in all the protected areas of Nepal although the extent of conflict varies due to several reason including separate legislations (Heinen 1993). After the establishment of national parks, the traditional right of local people's access to the forest for firewood, fodder, and grazing of livestock was forbidden by the government. Moreover, the

crop and livestock depredation by the wild animal of the park created less interest of local people in agriculture and compelled to their agriculture land abandon partially. This problem has been growing in and around the Shivapuri National Park but it has been overlooked in managing the park. Therefore, the assessment was conducted to assess the impacts of wildlife conservation and park management in livelihood of the local people.

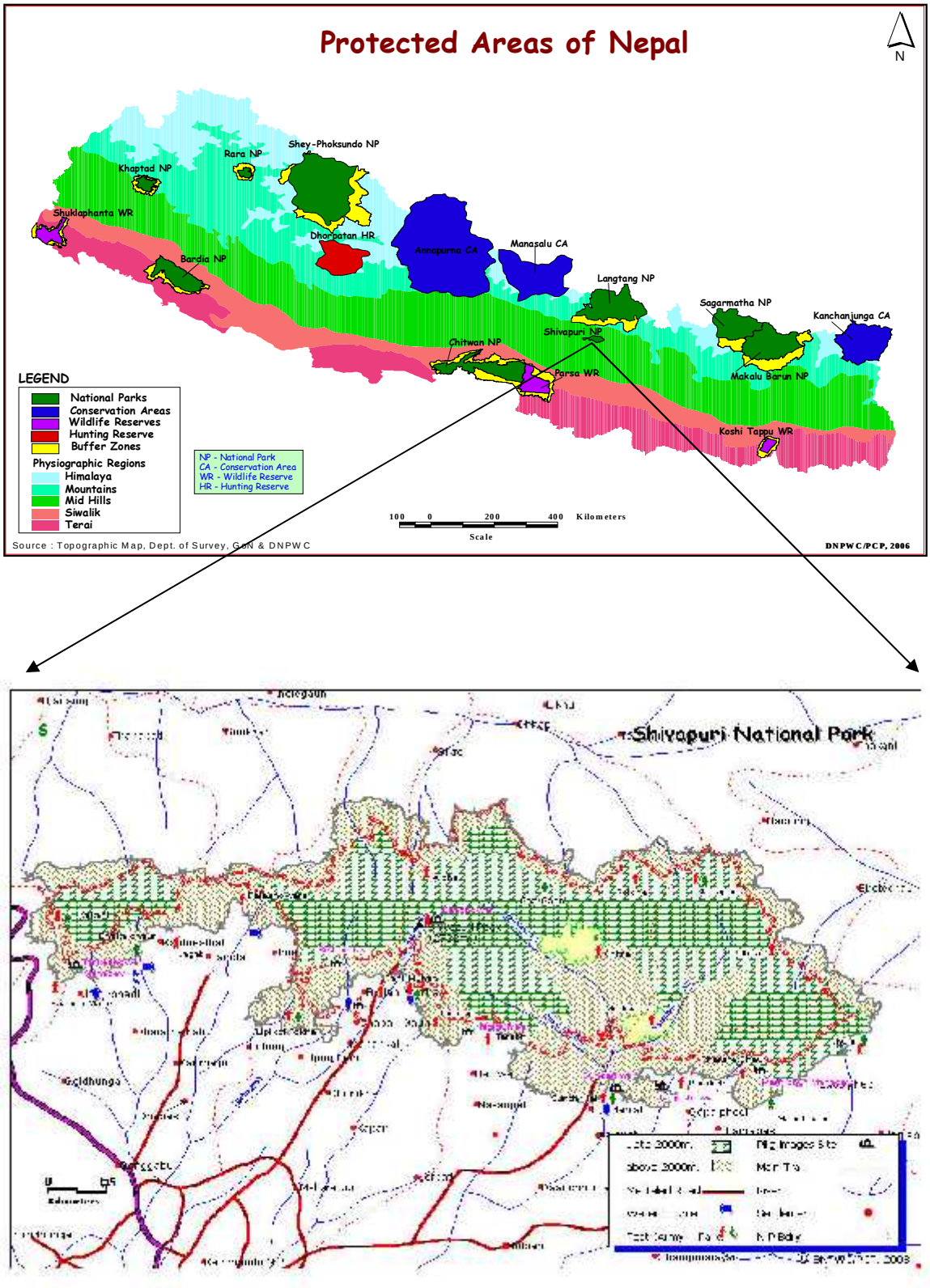
1.2 Objectives

The main objective of this research was to assess wildlife conservation and park management and subsequent effects on the livelihood of local communities in the southern part of the ShNP .The specific objectives were:

a) To explore wildlife and their habitats
b) To investigate livelihood of the local community and their dependency on natural resources
c) To identify major issues generated by the park
d) To estimate the land abandoned due to wildlife problems in the study area

1.3 Justification

Ever increasing human population and their dependency on the ShNP forest resources and pollution have caused subsequent loss in biodiversity at ecosystem, species and genetic levels with human population pressure and continued dependence for subsistence on forest product in protected areas, the conservation measures have been complicated. Furthermore, protected areas face pressure from increasing populations whose well-being has suffered from a cumulative neglect of land and other resources. For biodiversity conservation and management, information on biodiversity such as wildlife distribution, home range, community interaction, and their contribution to ecosystem development is essential. As well as the cultural and socio-economic characteristics of local people on the basis for measures to promote the sustainable use of natural resources raise the quality of human life and create positive support for protected areas. Thus, the study will address the issues of biodiversity conservation for sustainability of park and livelihood.



Map 2.1 Protected Areas of Nepal

2. STUDY AREA

2.1 Shivapuri National Park

2.1.1 Physical Component

Shivapuri National Park (ShNP), initially established as Shivapuri Watershed Reserve in 1976 and Shivapuri Watershed and Wildlife Reserve in 1984, was gazetted as a National Park in 2002. The park is located on the northern edge of Kathmandu valley between 27°45' and 27°52' North latitude and 85°15' and 85°30' East longitude. Covering an area about 144 km^2 of the twelve Village Development Committees (VDCs) at the northern part of Kathmandu District, nine VDCs at the southern part of Nuwakot, and two VDCs at the western part of Sindhupalchowk of Central Development Region, it stretches about eight to ten kilometers from North to South and about 20 to 24 km from East to West. It represents a typical mid hill physiographic zone of Nepal. Two villages Mulkharka and Okhreni are located within the park. The park boundary is well demarcated with a 111 km long wall around the park (KMTNC 2004). It is the main source of the river Bagmati and Vishnumati that flow the southern slopes of the mountain. The highest point is the Shivapuri Peak with 2732m altitude that represents the second highest mountain surrounding the Kathmandu valley. The lowest point of the ShNP is at altitude of about 1360m above the mean sea level.

2.1.2 Biological Components

Vegetation:

There are four types of forest (Amatya 1993).

a) Lower mixed hardwood forests (1000-1500m): dominant tree species are *Schima wallichii* (DC.) Korth., *Castanopsis indica* (Roxb.) Miq., *Alnus nepalensis* D.Don, *Anthosaphalus cadamba, Prunus cerasoides* D.Don.

b) Chirpine forest (1000-1600m): dominant tree species are *Pinus roxburghii* Sargent, *Castanopsis indica, Myrica esculenta* Buch.-Ham.ex D.Don, *Pyrus pashia* Buch.-Ham.ex D.Don.

c) Upper mixed hardwood forest (1500-2700m): dominant tree species are *Acer spp., Aesculus spp., Juglans regia L, Betula spp., Fraxinus spp., Salix spp., Quercus spp., Celtis spp., Alnus nepalensis* D.Don.

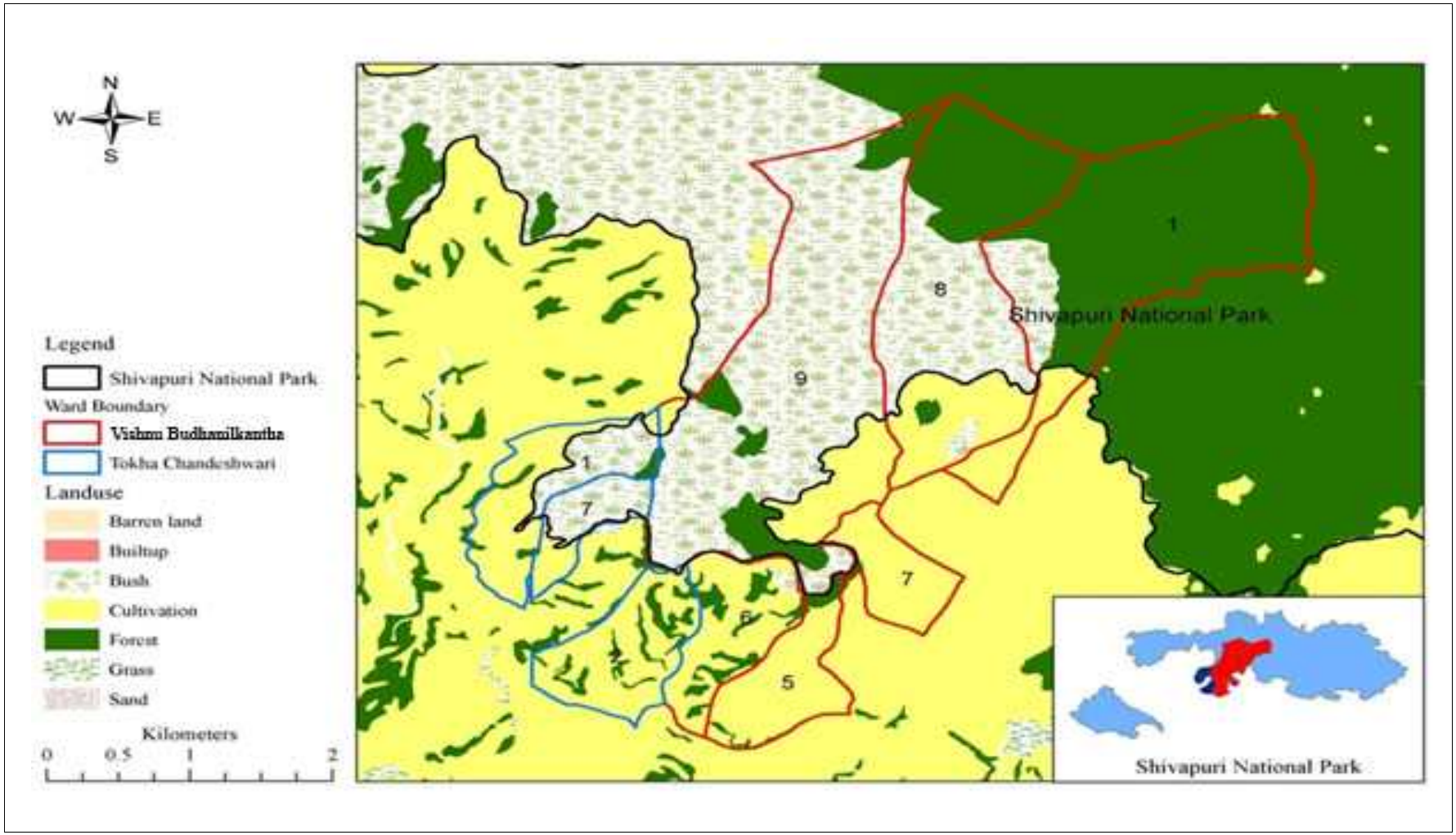
d) Oak forest (2300-2700): dominant tree species are *Quercus semecarpifolia* J.E.Smith, *Eurya acuminate* DC, *Ilex dipyrens* Wall, *Michelia champaca* L, *Rhododendron arboreum* Smith, *Symplocus spp.*

Fauna:

Shrestha (2005) has recorded 20 mammalian species belonging to seven orders and 17 families of which are eight threatened mammal species. Common leopard (*Panthera pardus* Linnaeus), yellow-throated marten (*Martes flavigula* Boddaert), wild boar (*Sus scrofa* Linnaeus), barking deer (*Muntiacus muntjak* Zimmermann) and rhesus monkey (*Macaca mulata* Zimmermann) are some of the common species of the park. The area is popularly known as "bird paradise" as it is well suited for many Himalayan bird species including kalij pheasant (*Lophura leucomelana* Latham) and many subtropical species (Karki 2002).

2.2 Actual Study Sites

The study was conducted in two VDCs of Kathmandu district – Vishnu Budhanilkantha and Tokha Chandeshwari of which were proposed buffer zone area by Shivapuri Integrated Watershed Development Project (SIWDP) and Shivapuri National Park Management Plan Team. They lie at southern side of the ShNP. The dominant rocks are genesis and migmatite with mica schist and pegmatic granite. The soils of the area range from loamy sand on northern side to sandy loam on the southern slope (Baniya 1998). Entire area is characterized by its steep topography. More than 50% of the area has greater than 30% slopes. Erosion hazard is very high in the northern slope. Both natural and man-induced landslides, gullies and stream bank erosion are found all over the area.



Map 2.2 Land Used Type in the Study Area

2.2.1 Vishnu Budhanilkantha

Vishnu Budhanilkantha is located in the northern side of Kathmandu valley. It is one of 57 VDCs of Kathmandu district. It lies between 27°45'─27°50'N latitude and 85°20'─85°22'E longitude. It is linked with Jhor Mahankal in the North, Tokha Chandeshwari in the West, Khadka Bhadrakali and Mahankal in the South and Chapali Bhadrakali in the East. In the Northern side, it is extended from Shivapuri National Park up to Nuwakot District. The area is about 25% hilly regions and remaining part is plain. Both the natural and man-induced landslides, gullies and stream bank erosion are found in Dadagau, Bisnumatigau, Pasikot. About 75% people were Hindus, 20% Buddhist and 5% others. Chhetri Brahman (25%) is major ethnic group followed by 18% Tamang, 11% Newar and 36% other different ethnic group. People are involved in labor, services, driver and farming. The major cropped grown in study sites are maize, millet, paddy and wheat.

2.2.2 Tokha Chandeshwari

It is located on the northern side of Kathmandu valley. It lies between 27°45'─27°47'N latitude and 85°19'─85°20'E longitude. It is linked with Vishnu Budhanilkantha in the East, Jhor Mahankal in the West, Tokha Saraswati in the South and Shivapuri National Park up to Dadagau in the Northern side. Maize, millet, paddy, wheat and potato are the major crops. Newar is the major ethnic group followed by Chhetri and Brahman.

Table 2.1 Distribution of Household and Population in the Study Area

VDCs	Ward no included in proposed BZ	No of ward	House hold '95'	Total household (2001)	Population		Total population
					Male	Female	
Vishnu Budhanilkantha	1,5,6,7,8,9	6	287	1161	2702	2716	5418
Tokha Chandeshwari	1,2,7	3	125	368	1119	1183	2302

2.2.3 Ecotourism

The Shivapuri area only about 12km from Kathmandu is easily accessible. It attracts many visitors and tourists. Popular trekking routes within the study area of the park are Panimuhan to the Shivapuri peak (12km). Panimuhan – Sikre (12km), Nagigumba – Baghdwar (6km), Nagigumba – Baghdwar – Chisapani (12km). Tourists from various countries including Nepal visit the ShNP regularly (Figure 2.1).

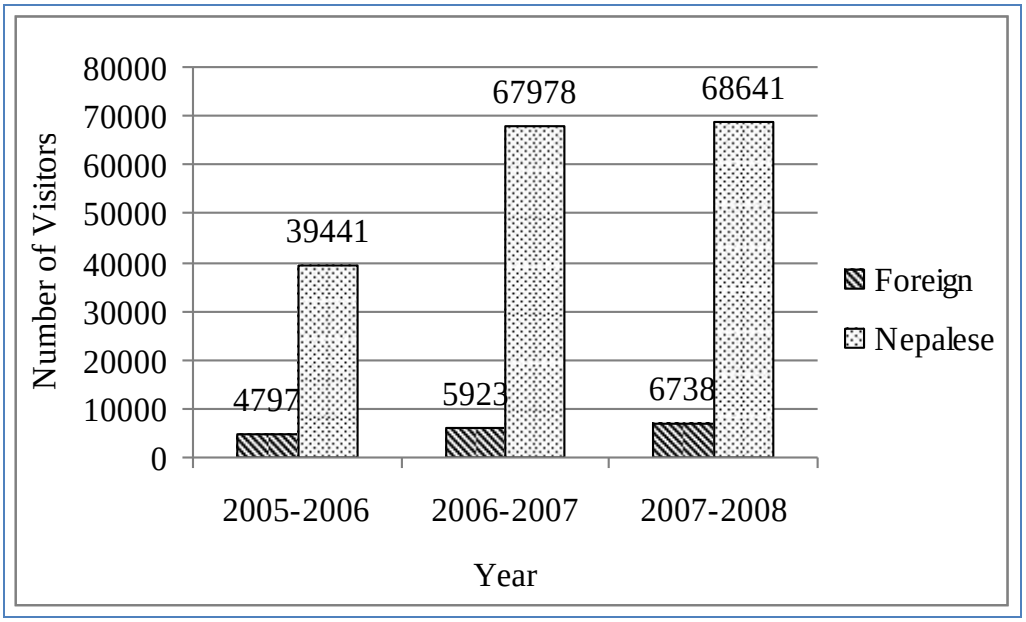


Figure 2.1 Tourists Flow in the ShNP (2005-2008)

2.2.4 Climate

The climate of the ShNP ranges from 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 dries season. b) Monsoon season occurring from June-September and c) post monsoon season (cold-dry season) occurring from October to mid-January. There is a high variation in annual temperature and precipitation. According to climatic data (2002-2006) of Department of Hydrology and Metrology, Babarmahal, the mean monthly minimum temperature at Budhanilkantha was 12.36^{o}c and maximum temperature was 23.76^{o}c (Figure 2.2). The mean relative humidity (morning) was 85.57% and (evening) was 73.79% (Figure 2.3). The mean annual precipitation was 179.39mm (Figure 2.4).

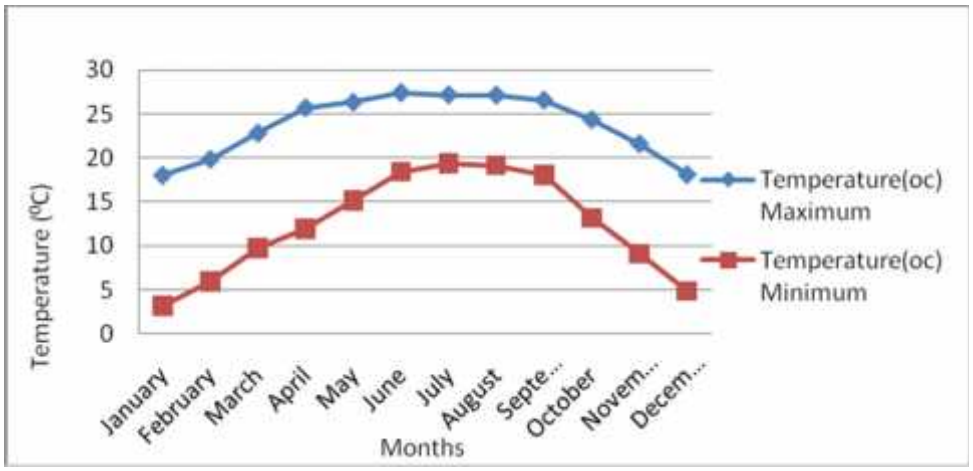


Figure 2.2 Average Maximum and Minimum Temperature (^{0}c) of Budhanilkantha (2002 – 2006)

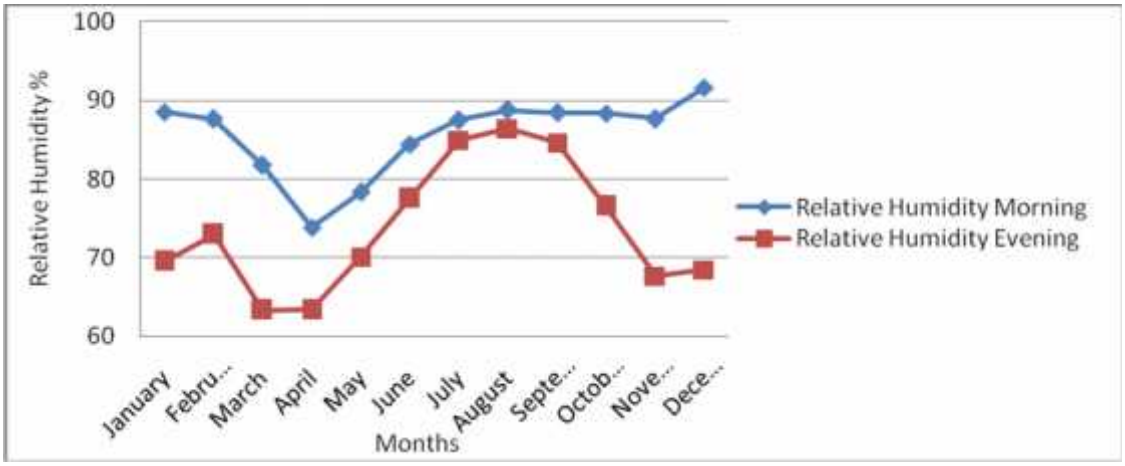


Figure 2.3 Average Relative Humidity Morning and Evening (%) at Budhanilkantha (2002- 2006)

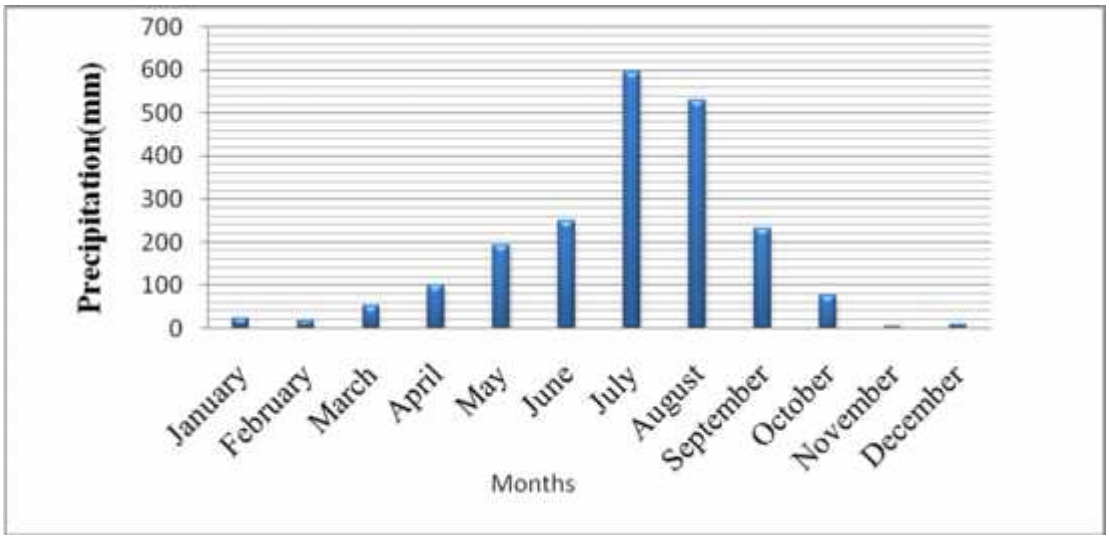


Figure 2.4 Average Precipitations (mm) at Budhanilkantha (2002-2006)

3. Literature Review

3.1 Biodiversity

Biodiversity has a significant role not in sustaining livelihoods of Nepalese people but also in environmental conservation. The forest and trees provide a vast array of goods and services to human beings (Das and Oli 2001). Despite such benefits, many species have been lost and biodiversity is reduced from the deforestation process especially in the natural forest. Indiscriminate and injudicious harvest of natural resources, fragmented population of species and introduction of alien species have all led to both quantitative and qualitative depletion of biodiversity (Bist 1999). The most important direct cause of biodiversity loss is habitat distraction from clearing and burning of forest, fodder, firewood collection, converting natural ecosystem for agriculture and human settlements (Rao 1983). The increase in population pressure together with biodiversity penetration of market and tourism led to many undesirable trends, the loss of plant diversity, habitat degradation, loss of wildlife, and environmental functions of natural ecosystem (Ramakrishna 1992). Wildlife and wildlife habitats in the Himalayan region are mostly affected by human settlements, their activities and livestock grazing. Animal husbandry is an integral part of subsistence agriculture in mountains (Rawat 2000 and Basnet 2006). In mountain pasture, livestock is widely regarded as competing with wild herbivores by depleting forest resources and generates number of impacts on wildlife such as degradation of habitat, poaching of wildlife, competition for forage, and influences the survival of the regions wildlife (Brower 1991).

3.2 Livelihood and Resource Utilization

More than 75.5% of the economically active population of the park and its buffer zone is engaged in agriculture as primary occupation and 45% of the total population working as labor. The younger generation prefers off-farm employment opportunities rather than the traditional occupation of subsistence farming (Khatri-Chhetri 1993). Livestock rearing is an integral part in the hill farming system. It is an important component of the Nepalese farming system providing food for humans, manure for plants, and draft powers for farms and cash income for farm families (SD/FAO 2004).

Generally poor people prefer to collect firewood rather than buying and they have a tendency to exploit the forest near to settlements rather than to think about sustainable use. Firewood is the major source of energy for mountain people (Basnet 1992) because it is easily and freely accessible (Blaikie 1985) and also used by local people where they have no alternative source.

People living in and around the ShNP depend mainly on the park forests for firewood, leaf litter, and timber. Firewood composed of trees, brushwood including green conifer bushes and other example crop residues is the main source of energy for cooking and heating (KMTNC 2004). In the Sagarmatha National Park (SNP), there was heavy demand on forest areas for firewood use, both by local inhabitants and the visitors (Sherpa 1979). The firewood demand from growing population in and around the Chitwan National Park (CNP) was a major cause of park/people conflicts in Old Padmapur (Sharma and Pukkla 1990). In the Bhandara Buffer Zone in Chitwan, only 2.50% of the green fodder and 26.0% of the firewood demand can be fulfilled by the buffer zone community forests and the rest was met from the CNP and neighboring forests (Ghimire 2007).

3.3 Park's Impact on Local People

3.3.1 Crop Depredation

Crop loss by wildlife is very common thing in the adjoining village of parks and reserves. From time to time wild animals eat and trample the crops that are not interested in eating during journey through their territory. In the CNP, wild ungulates such as rhinoceros (*Rhinoceros unicornis* Linnaeus), chital (*Axis axis* Erxleben) and wild boar are principal chief pest of rice, maize and mustard (Sharma 1991, and Nepal and Weber 1993). In the Bardia National Park (BNP), rhinoceros, blue bull (*Boselaphus tragocamelus* Pallas) (Khatri 1993), chital and wild boar were crop raiders (Bhatta 1994).

In the ShNP, major crop raiders as wild boar, monkey, porcupine (*Hystrx indica* Kerr), bear and bird species (Ulak 1992, Kattel 1993, Poudyal 1995, and Soti 1995) along with squirrel (*Dremomys lokriah* Hodgson) (Bajracharya 2005) that affected

crops like maize, millet, rooted crops, paddy, and wheat (Paneru 2004, Nepal 2005, and Kumpakha 2008). Wild boar and langurs was the occasional destroyer of buckwheat and barley (Uprety 1985) in the Rara National Park (RNP) and Shrestha (2002) in the SNP. Shrestha (2004) found Himalayan tahr (*Hemitragus jemlahicus* H. Smith) as crop raiders in the SNP. In the Makalu-Barun National Park (MBNP), monkey, barking deer, and porcupine were crop pests at Shankhuwa valley (Thapa 1996). In Shey Phoksundo National Park (SPNP), monkey, bear, musk deer (*Moschus chrysogaster* Linnaeus), blue sheep (*Pseudois nayaur* Hodgson), porcupine, and rodents were major crop raiders (Basnet 1998).

In the Koshi Tappu Wildlife Reserve (KTWR), wild buffalo (*Bubalus arnee* Kerr) raided paddy, wheat, potato, pulses, sugarcane, maize, oil seeds, and jute (Sharma 1995). Wild elephant, wild boar, and chital were found as major pest animals on paddy followed by wheat and maize in the Parsa Wildlife Reserve (PWR) (Kasu 1996). Paddy and maize (43.29%) damage by wild elephant, wild boar, and chital, blue bull in the Suklaphanta Wildlife Reserve (SWR) (Gautum 1999).

3.3.2 Livestock Depredation

Livestock depredation resulted a human wildlife conflict and hindered conservation efforts of these wildlife. Tiger (*Panthera tigris* Linnaeus*),* leopard were identified as livestock depredators (Sharma 1991), and jackal (*Canis aureus* Linnaeus), indian fox (*Vulpes vulpes* Linnaeus), common mongoose (*Herpestes spp.*), and jungle cat (*Felis chaus* Guildenstaedt) have been reported as livestock lifter around the CNP (Uprety 1995). Tibetan wolf, snow leopard (*Uncia uncia* Schreber), common leopard, wild dog (*Cuon alpines* Pallas), jackal, and the fox in the SPNP (Basnet 1998) were identified as livestock depredators. Wild boar, bear, monkey, deer, porcupine, rat, and birds in the ShNP (Gurung 2002 and Bajracharya 2005). Leopard, jackal, wild dog, and grey wolf (*Canis lupas* Sykes) in the MBNP (Thapa 1996).

3.4 People's Impact on Park

The continuous illegal collection of firewood, fodder, grazing of livestock, and other activities inside the forest causes depletion of resources that cause adverse effect on

biodiversity (Rai and Sharma 1998). Due to increase human population and to meet their needs, large scale habitat changes are occurring globally (Khan et al. 1993) and site which is rich in diversity is also facing threat due to increased tourist movement (Chettri et al. 2001). Due to rapid human population growth, grazing areas have shrunk. Farmers selectively stall feed their animals that include milking cows, buffaloes and grasses for these animals are brought from the forests, plantation areas, and farmland (Jnawali 1994). The growing rates of deforestation in many developing countries have been linked to the growing scarcity of firewood but in most situations the underlying cause of deforestation is the conversion of land to farming (Eckholm et al. 1984).

3.5 Land Abandonment

According to Milton and Binney (1980), a few villagers nearest to the CNP reported that in some years 80 to 90% of all their crops were lost due to grazing by wild animals. As a result, farmers abandoned farming near the park boundary. It has been reported that some people in northern part of the ShNP have abandoned their cultivated land more than 15% of the total land due to crop damage by wildlife (HMG/FAO 1995).

4. MATERIALS AND METHODS

4.1 Review

I reviewed published and unpublished literature such as books, reports, thesis, journals and scientific papers consulting different libraries and websites throughout my research period. Natural resources use, park-people conflict, biodiversity conservation, and park management, and livelihood options were focused in the review.

4.2 Field Survey

4.2.1 Reconnaissance Survey

I conducted reconnaissance survey in the months of October 2007 at accessible areas, which were proposed for buffer zone area such as Vishnu Budhanilkantha and Tokha Chandeshwari (KMTNC 2004). I collected detail information about livelihood, biodiversity, resource utilization and park-people issues by discussion with park authorities, wardens, experts and villagers.

4.2.2 Biodiversity Inventory

Biodiversity inventory was undertaken by a quadrat method. In each study area, one transect line was laid out for sampling 20m x20m quadrats. The transect lines ran in different direction from park boundary into the Park Forest. These lines were not straight compass bearing but followed trails in the rugged and dense forests. A total of 10 quadrats, five each in Vishnu Budhanilkantha and Tokha Chandeshwari forests were established. The quadrats were laid at an approximately 100 m intervals at altitudinal gradient. Sample quadrats of 20 m x 20 m were used for all trees species with diameter at breast height (DBH) over bark of 10 cm and height more about 4 m. Measurement of DBH of the trees was made by the help of a diameter tape. Within that area the cut stumps of tree species and number of lopped branches were also measured and noted in order to identify the human interference in the area (Annex I).

For mammalian diversity, direct observation method, and indirect sign methods were used. The data forms especially for recording signs (footprints, feces, scrapes, scratches, etc) were filled for each quadrat (Annex II). These signs were also surveyed extensively. The feces, footprints, scrapes and scratches were identified by lab technician of central zoo, Jawalakhel, Lalitpur. Individual questionnaire survey were also done for wild mammals (Annex III)

4.3 Questionnaire Survey

Overall 60 households (the chief person) were interviewed using semi structured questionnaires set (Annex IV) to collect information about socio-economic environment, crop loss, and livestock depredation, crop preference by pest species, abandoned land, and frequency of wildlife visiting in and around the ShNP and resources utilization pattern. In absence of the chief person, the representative member of houses was questionnaire. The questionnaires survey was conducted during May, June, July 2008.

The crop loss was estimated in local scale e.g. 'pathi' which was converted into kilogram by weighting 'a pathi' of different crops three times and the concurrent weights were considered as the standard value (Annex V). Rate of different crops were obtained from local people. The information on the resource use and dependency was collected through the source of energy use, daily need or demand of resources and accessibility and availability of the resources they actually depend on. The firewood and fodder collected was estimated in one load (*Bhari*) which was converted into kilogram.

4.4 Data Analysis

4.4.1 Vegetation Data

Vegetation characteristics of the forest were explored by using the standard methods. Both absolute and relative values of density, frequency and basal area were determined and relative values were used to calculate importance value index which were estimated by using following formula.

$$\text{Density of a Species} = \frac{\text{Total number of a species in all quadrats}}{\text{Total number of quadrats} \times \text{Area in one plot}} \times 1000$$

$$\text{Relative Density (RD)} = \frac{\text{Number of individuals of a species}}{\text{Total number of all species}} \times 100$$

$$\text{Frequency (F\%)} = \frac{\text{Number of sampling units at which a species occured}}{\text{Total number of sampling units}} \times 100$$

$$\text{Relative Frequency (RF)} = \frac{\text{Frequency of a species}}{\text{Sum of frequencies of all species}} \times 100$$

$$\text{Relative Basal Area (RBA)} = \frac{\text{Basal area of all trees of a species}}{\text{Total basal area of all species}} \times 100$$

$$\text{Basal area of a measured tree (BA)} = \frac{\pi d^2}{4}$$

Where, d=diameter of a tree at breast height

$$\text{Importance Value Index (IVI)} = RD + RF + RBA$$

4.4.2 Ordination

The plant and animal sampling plots were analyzed in computer software "Canoco for Windows 4.5" (ter Braak 1991) with all default. Detrended Correspondence Analysis (DCA) was performed to find out the gradient length. The gradient length helped in determining proper ordination technique. If the gradient length was ≥ 3, the Canonical Correspondence Analysis (CA) was used and the Principle Component Analysis (PCA) when the gradient length was short (< 3). The PCA was performed to find out the associations between the species. It generated plots with clustering of different species. Similar types of species/plots were cluster according to occurrence in the samples.

4.4.3 Distribution Map Preparations

The Global Positioning System (GPS) point of every sampling place of vegetation and scat was recorded with the "etrex GARMIN GPS" device. The points were in Degree

Minute Seconds (DMS) units in World Geodetic System (WGS) 84 projection systems. These points were converted to degree decimal (DD). The GPS points were plotted in ArcGIS 9.2 software to prepare the sample distribution maps.

4.4.4 Socio Economic Data

I used correlation analysis to find relationship between crop loss due to crop depredation by wildlife and distance from the park boundary. I used student's t to test whether there is a significant difference in crop loss due to crop depredation by wildlife in between Vishnu Budhanilkantha and Tokha Chandeshwari VDCs.

5. RESULTS

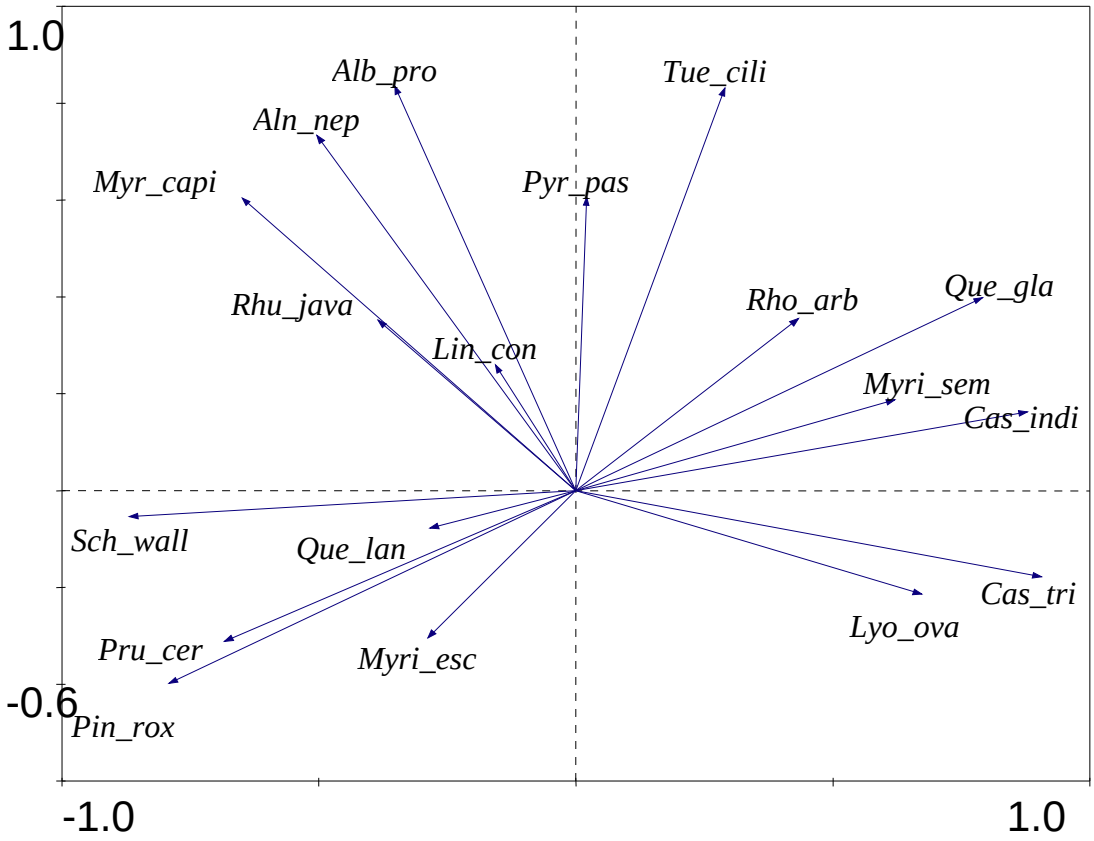
5.1 Biodiversity

5.1.1 Vegetation Composition and Wildlife Habitat

A total number 18 tree species belonging to 12 families in 10 quadrats of (20 ×20) m^2 each were recorded. The forest type of study area is upper mixed hardwood forest. The dominant species were *Pinus roxburghii*, *Alnus nepalensis*, and *Schima wallichii* with a density of 19.5, 3.75, and 3.25 individuals per hectare respectively. The Shannon Diversity Index was 1.029 (Table 5.1**).**

Table 5.1 Vegetation Composition at the Study Sites

Scientific Name	Code	No.	F%	RF%	Density	RD%	BA(m^2)	RBA	IVI
Alnus nepalensis	Aln_nep	15	40	5.79	3.75	8.47	0.41	7.87	22.13
Albizza procera	Alb_pro	6	30	4.34	1.5	3.38	0.27	5.14	12.86
Castanopsis indica	Cas_indi	12	40	5.79	3	6.77	0.21	4.13	16.69
Castanopsis tribuloides	Cas_tri	5	30	4.34	1.25	2.82	0.10	2.01	9.17
Ligustum confusum	Lin_con	2	20	2.89	0.5	1.12	0.02	0.30	4.31
Lyonia ovalifolia	Lyo_ova	4	40	5.79	1	2.25	0.20	3.94	11.98
Myrica esculenta	Myri_esc	4	50	7.24	1	2.25	0.07	1.37	10.86
Myrsine capitellata	Myr_capi	7	50	7.24	1.75	3.95	0.08	1.48	12.67
Myrsine semiserrata	Myri_sem	1	10	1.44	0.25	0.56	0.01	0.23	2.23
Pinus roxburghii	Pin_rox	78	70	10.14	19.5	44.06	2.86	55.31	109.51
Prunus cerasoides	Pru_cer	3	40	5.79	0.75	1.69	0.03	0.63	8.11
Pyrus pashia	Pyr_pas	2	30	4.34	0.5	1.12	0.02	0.38	5.84
Quercus glauca	Que_gla	7	30	4.34	1.75	3.95	0.14	2.74	11.03
Quercus lanata	Que_lan	1	10	1.44	0.25	0.56	0.02	0.34	2.34
Schima wallichii	Sch_wall	13	80	11.59	3.25	7.34	0.28	5.45	24.38
Toona ciliata	Tue_cili	7	30	4.34	1.75	3.95	0.21	4.13	12.42
Rhododendron arboreum	Rho_arb	12	70	10.14	3	6.77	0.18	3.53	20.44
Rhus javanica	Rhu_java	4	20	2.89	1	2.25	0.05	0.90	6.04



Plot 5.1 Ordination of Vegetation

Table 5.2 Principle Components Analysis Summary of Vegetation

Axes	1	2	3	4	Total variance
Eigenvalues	0.363	0.219	0.144	0.112	1
Cumulative percentage variance of species data	36.3	58.2	72.6	83.8	
Sum of all eigenvalues					1

The PCA showed that the first and second axes explained 58.2% of total variance of the data (Table 5.2). The above ordination plot suggested that the plant species *Albizza procera*, *Alnus nepalensis*, and *Myrsine capitellata* came together. Similarly, *Rhododendron arboreum*, *Quercus glauca*, *Myrsine semiserrata*, and *Castanopsis indica* formed another group but these two groups usually came together.

5.1.2 Wildlife

Fifteen mammalian species belonging to five orders and 13 families (Table 5.3) were recorded. I observed and collected altogether 35 signs (dropping: 28, and pugmark: seven) of five mammal (barking deer, jackal, jungle cat, rhesus monkey, and wild boar) in two fixed transect with ten quadrats and 20 signs (dropping: 15, and pugmark: five) of three mammals during random searching in the study area. Among 15 species of mammals recorded, seven species (47%) belonged to order Carnivore, three species (20%) belonged to Artiodactyla, two species (13%) belonged to Primate, two species (13%) belonged to Rodentia, and one species (7%) belonged to Lagomorpha (Figure 5.1). Compared to the high diversity of carnivore (7 species), the herbivore diversity (4 species) was low in the study area.

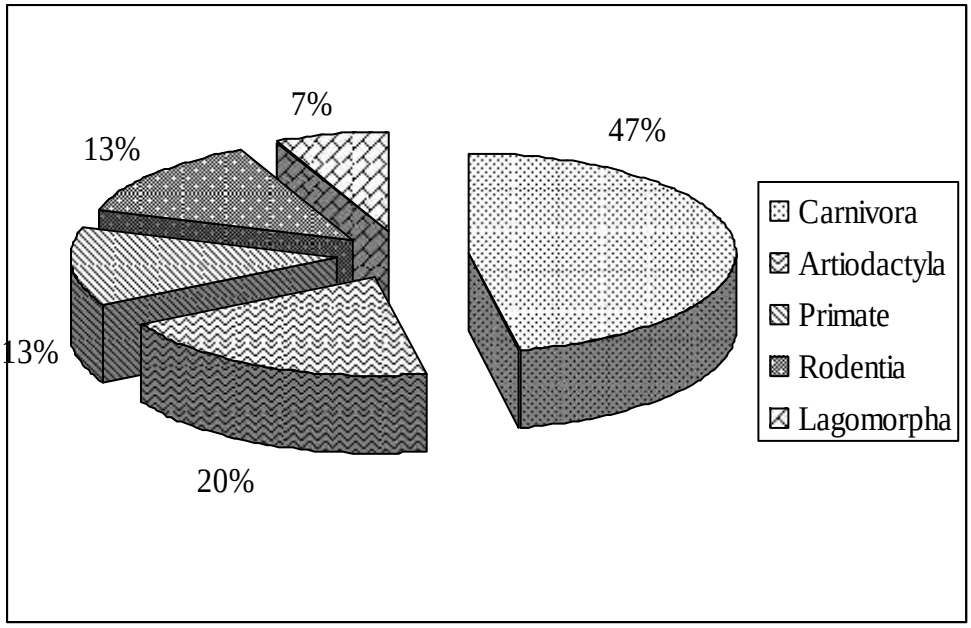
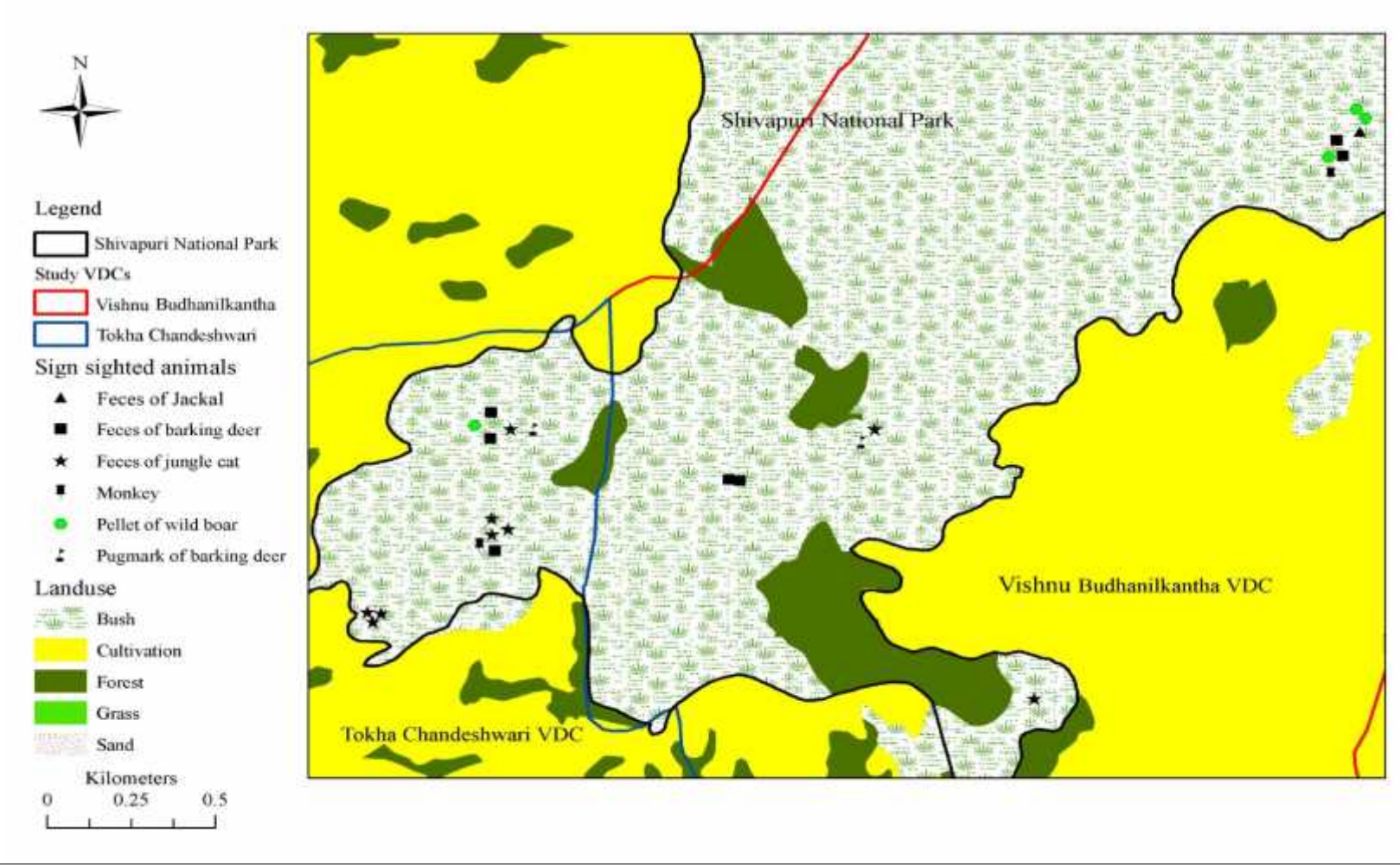


Figure 5.1 Percentage Distribution Mammalian Orders in the Study Area



Map 5.1 Distribution of Mammal in the Study Area

Table 5.3 Diversity of Mammals at the Study Sites

S.N.	Common/Scientific name	Order	Family	Altitudinal Range (meter)	Remarks/ References
1	Wild boar *(Sus scrofa)*	Artiodactyla	Suidae	1700-2700	This study, Shrestha 2005, questionnaire
2	Barking deer *(Muntiacus muntjak)*	Artiodactyla	Cervidae	1700-2700	This study, Shrestha 2005, questionnaire
3	Himalayan goral *(Nemorhaedus goral)*	Artiodactyla	Bovidae	2500-2700	Shrestha2 005
4	Common leopard *(Panthera pardus)*	Carnivore	Felidae	1740-2600	Shrestha 2005, questionnaire
5	Jungle cat (*Felis chaus)*	Carnivore	Felidae	1719-2155	This study, Shrestha 2005, questionnaire
6	Large civet *(Viverra zibetha)*	Carnivore	Viverridae	1740-2350	Shrestha 2005
7	Jackal *(Canis aureus)*	Carnivore	Canidae	1900-2300	This study, Shrestha 2005, questionnaire
8	Small mongoose *(Herpestes auropunctaus)*	Carnivore	Herpestidae	1800-2100	Shrestha 2005, questionnaire
9	Himalayan black bear *(Selenarctos thibetanus)*	Carnivore	Ursidae	At 2517	Shrestha 2005
10	Yellow-throated marten *(Martes flavigula)*	Carnivore	Mustelidae	1850-2400	Shrestha 2005, questionnaire
11	Royel's pika or Himalayan mouse hare *(Ochotona royeli)*	Lagomorpha	Ochotonidae	At 2700	Shrestha 2005
12	Rhesus monkey *(Macaca mulata)*	Primate	Cercopithecida	1670-2100	This study, Shrestha 2005, questionnaire
13	Hanuman langur *(Presbytis entellus)*	Primate	Cercopithecida	2400-2600	Shrestha 2005, questionnaire
14	Himalayan squirrel *(Dremomys lokriah)*	Rodentia	Sciuridae	1900-2700	Shrestha 2005
15	Porcupine *(Hystrix indica)*	Rodentia	Hystricidae	1850-2200 Less than 2000	This study, Shrestha 2005, questionnaire

a. Pellet of Wild boar

b. Pellet of Barking deer

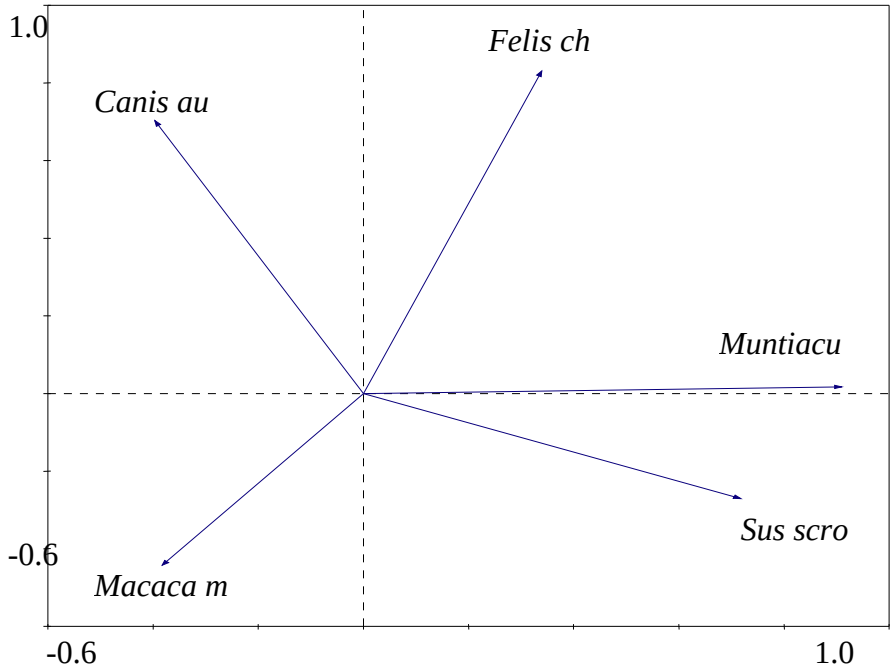
c. Pugmark of Barking deer

d. Scat of Jungle cat

e. Scat of Jackal

f. Rhesus Monkey

Plate 1. Direct and Indirect Evidence of Wildlife



Plot 5.2 Ordinations of Mammal Data

Table 5.4 Principle Component Analysis Summary of Mammals

Axes	1	2	3	4	Total variance
Eigenvalues	0.38	0.319	0.147	0.092	1
Cumulative percentage variance of species data	38	69.8	84.5	93.7	
Sum of all eigenvalues					1

The PCA showed that the first and second axes explained 69.8% of total variance of the data (Table 5.4). The low gradient length suggested that there were only few species and they were distributed all around the study areas.

5.2 Livelihood of Local People

5.2.1 Population and Occupation

The respondents belonged to different age group ranging from 20 years to 84 years. Almost 59% respondents were illiterate, and 41% were literate (Figure 5.2).

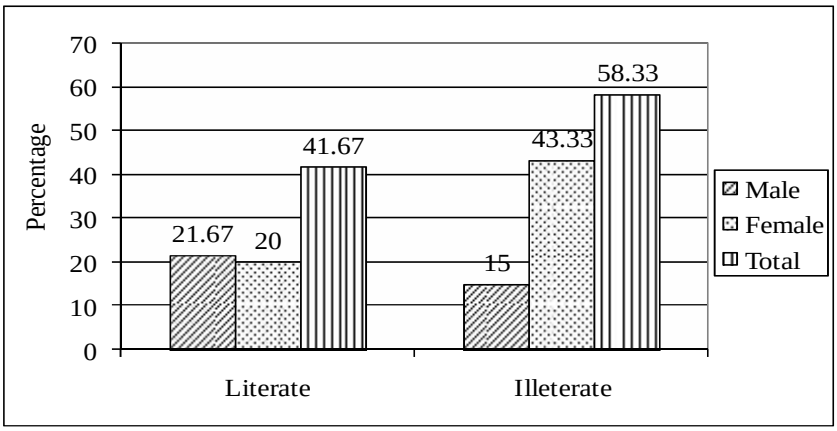


Figure 5.2 Literacy Category of the Study Area

Most of the households practiced subsistence farming. Among them almost 63% respondents was involved in agriculture only (Figure 5.3). Respondents had different sources of alternative income generation including unskilled wage labor, local liquor (raksi) production, business, and services (e.g., technician, masonry etc). More than 18% of the local people were wage earners and almost 17% as alcohol producers (Table 5.5).

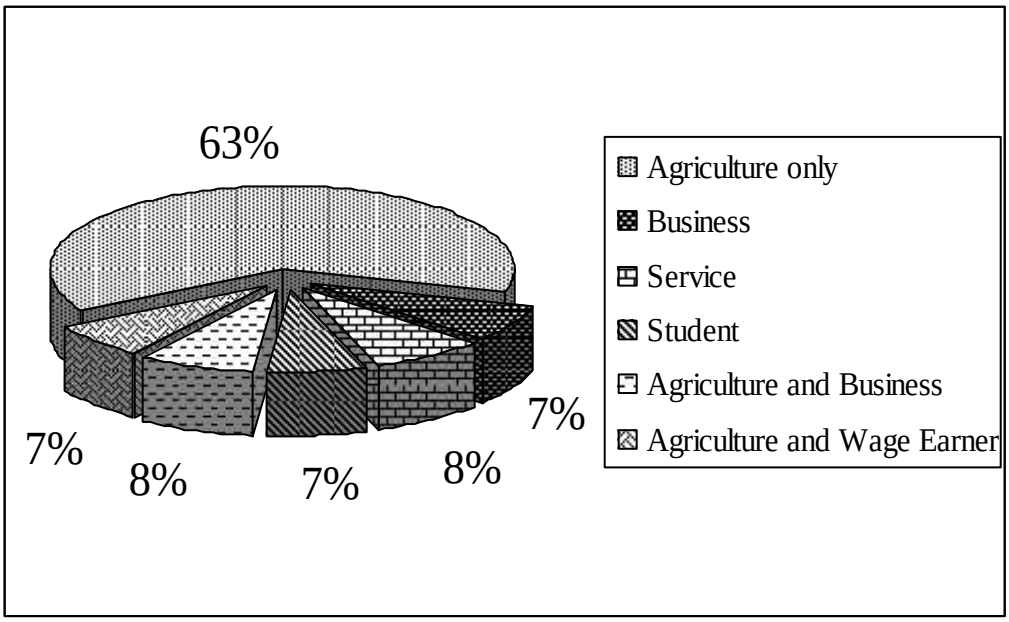


Figure 5.3 Occupation Type in the Study Area

Table 5.5 Sources of Alternative Income Generation

S. N.	Alternative income source	No. of households	% of households
1	Alcohol producer	10	16.67
2	Business	6	10
3	Business, and Service	4	6.67
4	Livestock keeping	5	8.33
5	Service	21	35
6	Wage earner	11	18.33
7	Weaving	3	5

Livestock rearing is another major activity which is taken as a supplementary income source of many households. Major animals raised in the area included goat, buffalo, and cow, chicken and duck (Table 5.6) that provided food, cash income, farm manure, and farm power. People of both VDCs were practicing both stall feeding and grazing. They collected fodder from their own land, and also from the park, and community forest (Table 5.7).

5.2.2 Landholding and Crop Yield

Ownership of land was a powerful cultural and economic significance governing food sufficiency in the area. On an average, the landholding in both VDCs was about five ropanies per household. The cultivated lands ranged from 0.5 to 30 ropanies. Most of the people had their own land. Landless farmers were involved in sharecropping and contract farming (Figure 5.4).

Table 5.6 Livestock in Two VDCs

Livestock species	Vishnu Budhanilkantha				Tokha Chandeshwari			
	Total no. of hh. having livestock	Total no. of livestock	livestock composition %	Livestock per hh.	Total no. of hh. having livestock	Total no. of livestock	livestock composition %	Livestock per hh
Goat	25	138	58.98	5.52	16	45	25.57	2.81
Buffalo	7	12	5.13	1.71	14	21	11.93	1.5
Cow	10	17	7.26	1.7	10	19	10.80	1.9
Chicken	15	65	27.78	4.33	15	76	43.18	5.06
Duck	1	2	0.85	2	3	15	8.52	5

Table 5.7 Livestock Raising Type

Village Development Committee	Raising type (%)			Grazing source (%)			Source of fodder (%)			
	Stall feeding(SF)	SF, Open grazing with attendant	SF, Open grazing without attendant	NP	PL	NP,PL	NP	PL	NP,PL	PL, CF
Vishnu Budhanilkantha	74.19	25.81	_	50	37.5	12.5	38.71	22.58	33.26	6.45
Tokha Chandeshwari	45	5	50	36.36	36.36	27.28	20	45	35	_

Note: NP = National Park, PL = Private Land, CF = Community Forest, hh. = Household

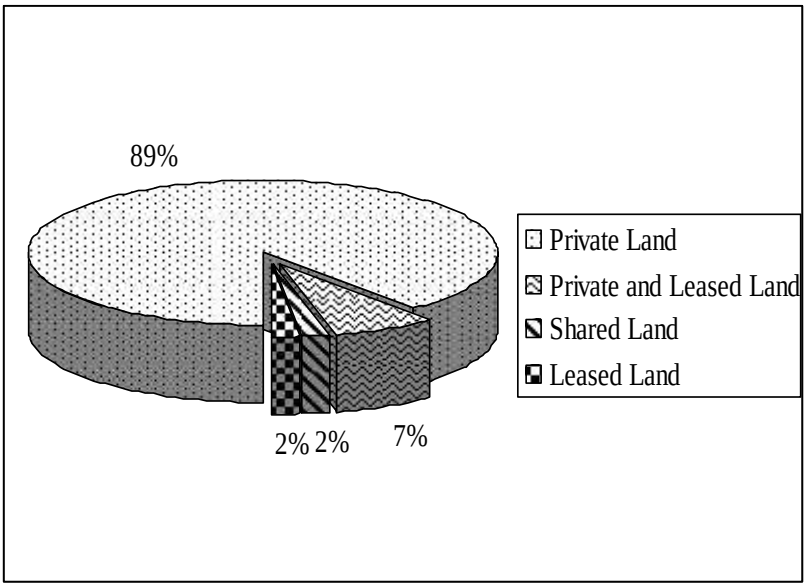


Figure 5.4 Landholding Type in the Study Area

Maize were the major crops grown in the area. Vegetable, Potatoes, Pindalu etc were cropped in small amount (Figure 5.5). Farmers' harvested paddy, wheat, and potato in irrigated *Khet* land, while only maize, millet in *Bari* land with different combinations. The productivity of the land was declined due to the use of local crop varieties, declining soil fertility, poor economic condition of the farmers to afford farm inputs, and increasing incident of diseases and pests.

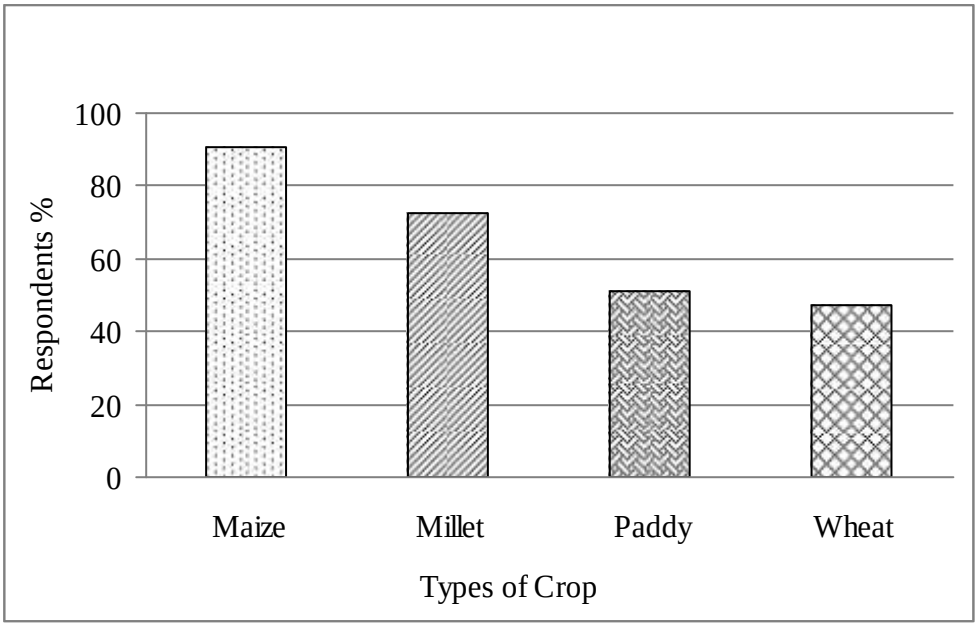


Figure 5.5 Types of Crop Production in the Study Area

a. Water Resource

b. Mushroom in the Park

c. People in the Park

d. Lopped Trees for Firewood Collection

e. Piles of Firewood

f. Interviewing House Owner

Plate 2. Natural Resources of Shivapuri National Park

5.3 Resource Utilization

People were getting benefits from the park such as income from tourism and resource utilization including water, firewood, fodder, and leaf litter fall. Firewood and fodder collection is illegal. Trees such as *Alnus nepalensis, Castanopsis spp., Lyonia ovalifolia, Myrica esculenta, Myrsine capitellata, Myrsine semiserrata, Pyrus pashia, Schima wallichii,* and *Quercus spp*. were mostly used as fodder. Firewood is main source of energy and mostly used in alcohol production (Figure 5.6). These firewood were collected from the National park as well as private land (Figure 5.7).

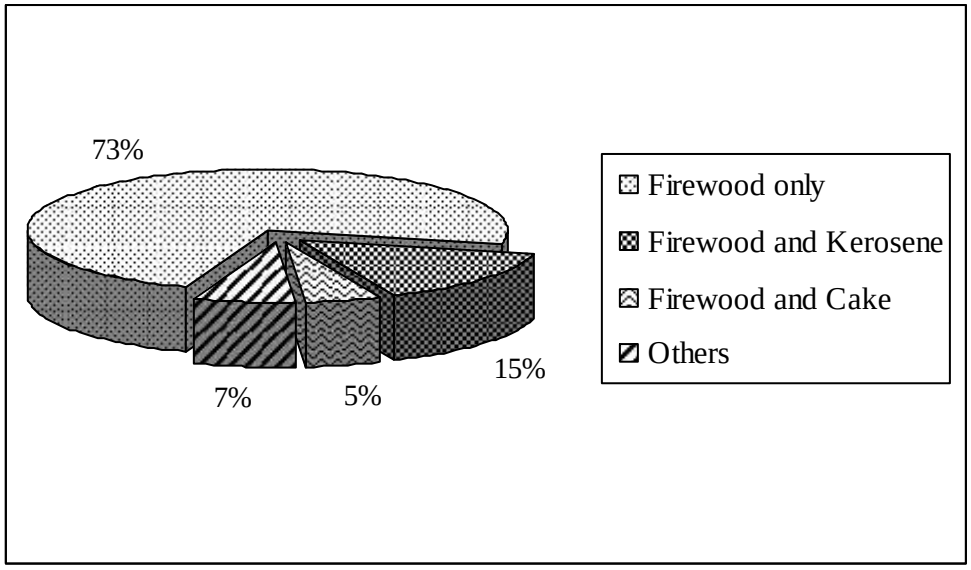


Figure 5.6 Types of Domestic Fuel Use in the Study Area

The average amount of firewood consumption was about nine kilogram (kg) per day for each household. The firewood consumption pattern was different in the household making alcohol and household not making alcohol and was about 26 kg and seven kg per day respectively. All kinds of trees species available in the study area were used for the firewood.

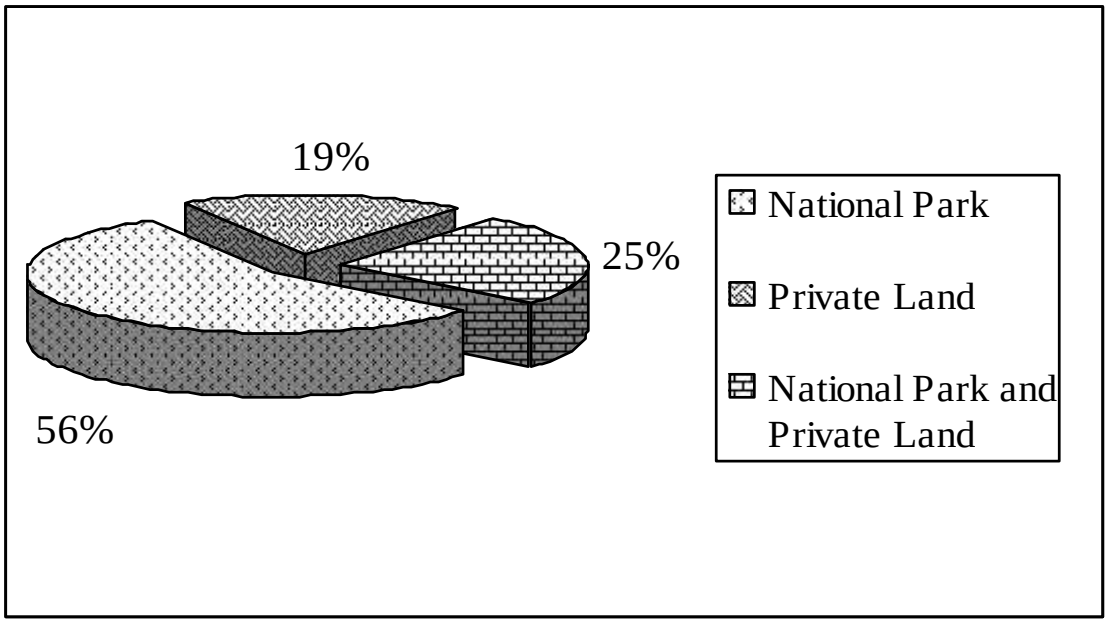


Figure 5.7 Sources of Firewood in the Study Area

5.4 Park's Impact

5.4.1 Crop Depredation

Six pest species were observed in the study area that included barking deer, monkey, porcupine, wild boar, jungle cat, and jackal (Table 5.8). Respondents reported that wild boar (37%), monkey (30%), porcupine (22%), and barking deer (7%) damaged their crops. Among them, wild boar was the major destructive crop raider and frequently visiting pest species in the study area. And also, Jungle cat (7%), and jackal (4%) were the main predators, which preferred goats and chicken as their preys. Wild boar and monkey visited in group and jungle cat, and jackal visited singly. Crop depredation was common in the ShNP. More than 44% of the respondents reported crop depredation by wildlife. Maize (24%), millet (16%), paddy (5%), and wheat (2%) were the most raided crops, which were the most affected during mature stages.

Table 5.8 Wild Pests of Different Crops and Livestock and Raiding Time

Wildlife species	Raid crops/livestock	Preferred crops/livestock	Stage of crops	Time of raiding	Not preferred crops
Wild boar	Maize, Millet, Paddy, Wheat, Potato, Sweet potato, Pindalu	Maize, Millet, Pindalu, Potato, Sweet potato	Matured stages	Night	Raddish, Chilly, Ginger, Garlic
Monkey	Maize, Millet, Paddy, Wheat, Potato, Sweet potato, Pindalu, Fruits	Maize, Millet, Fruits	All stages	Day	Garlic
Porcupine	Maize , Bean	Maize, Bean	All stages	Night	Not known
Barking deer	Maize, Millet, Wheat, Paddy	Maize, Millet, Wheat, Paddy	All stages	Day/ Night	Not known
Jungle cat	Chickens	Chickens	_	Day/ Night	_
Jackal	Goat/Chickens	Goat/Chickens	_	Day/ Night	_

The crop loss was only Vishnu Budhanilkantha VDC not in Tokha Chandeshwari. I estimated total crop loss of 4062.5 kg in weight and total economic loss of Rs.74182.5 per annum and Rs.1236.37 per household. The maximum loss was for maize and followed by millet, paddy, and wheat. The statistical correlation coefficient analysis between distance and loss showed that there was negatively correlated at Vishnu Budhanilkantha that means increased in crop loss nearer to the park boundary wall and decreased in crop loss away from the park boundary wall and not correlated in Tokha Chandeswari that means crop loss was not affected by distance (Table 5.9).

Table 5.9 Agricultural Crop Loss due to Depredation by Wildlife of the Park

Name of crops	Vishnu Budhanilkantha			Tokha Chandeshwari		
	Loss in weight (kg)	Loss in rupees	r-calculated value	Loss in weight (kg)	Loss in rupees	r-calculated value
Maize	2996	53928	-0.207	0	0	0
Millet	825	14437.5	-0.152	0	0	0
Paddy	210	5250	-0.117	0	0	0
Wheat	31.5	567	-0.58	0	0	0

The Student's t-test at 95% confidence level, the null hypothesis accepted for millet, paddy, and wheat that mean there was no significant difference between Vishnu Budhanilkantha and Tokha Chandeshwari in crop loss for millet, paddy, and wheat. But in case of maize, the null hypothesis rejected that mean loss was significant difference ($t = 3.44$, $P \geq 0.05$, and $df = 48$) (Table 5.10).

Table 5.10 Comparison of Results of Student's t-test of Crops between Vishnu Budhanilkantha and Tokha Chandeshwari

Names of crops	Calculated value of t	Remarks
Maize	3.44, $P \geq 0.05$, $df = 48$	Significant difference
Millet	1.45, $P \leq 0.05$, $df = 38$	No significant difference
Paddy	0.26, $P \leq 0.05$, $df = 26$	No significant difference
Wheat	1.72, $P \leq 0.05$, $df = 24$	No significant difference

5.4.2 Livestock Depredation

Jungle cat and jackal were the predators of chicken and goats. Predators were found as livestock lifter and killed domestic prey in the shed, pen, and grazing land. No incident of wildlife attack on human was recorded. Little over 8% of the total respondents complained about some harassment from monkeys.

a. Manure of Leaf litter fall

b. Livestock Grazing inside the Park

c. Preparation of Alcohol Traditionally

d. Livestock kept by Stall Feeding

e. Crop Damaged by Porcupine

f. Abandoned Land due to Wildlife Depredation

Plate 3. Livelihood of Local People and Park Impacts in the Study Area

Table 5.11 Livestock Loss due to Wild Predators of the ShNP and Possible Prey Predator

Predator	Vishnu Budhanilkantha			Tokha Chandeshwari		
	Livestock (prey)	Loss in no.	Possible prey	Livestock (prey)	Loss in no.	Possible prey
Jackal	Goat	2	Chicken, Duck	Goat	5	Chicken, Duck
Jungle cat	_	_	Chicken, Duck	Chicken	12	Duck
Common leopard	_	_		_	_	Buffalo, Chicken, Duck Goat, Men
Large civet	_	_	Chicken, Duck	_	_	_
Small mongoose	_	_	Chicken, Duck	_	_	Chicken, Duck
Yellow throated marten	_	_	Chicken, Duck	_	_	Chicken, Duck

5.5 Human Impact on the Park

None of the hunting and poaching wildlife activities were recorded in the area. People collected firewood, fodder, and leaf litter fall, and grazed livestock inside the park. Many trees about 62% were found cut and lopped. Total density of cut stumps was two individuals per hectare. Similarly, lopping intensity was recorded 137 individuals per hectare. Other impacts such as unmanaged garbage and trails inside the park directly or indirectly influenced the biodiversity. Motor road at Tokha entry point to Alche where two buses entry and two buses leaved everyday and pilgrims like Bagdwar and Bishnudwar also generated significant disturbance to wildlife and their habitats. Trails to the other village (Panimuhan to Sikre) were also major cause of habitat disturbance.

5.6 Land Abandonment

Land abandonment due to crop depredation by wildlife was not very extensive. Only one ropani (0.36%) of the total land area was abandoned. Abandoned land was non-irrigated up land *Bari* type adjacent to the park in Vishnu Budhanilkantha ward number nine where they used to grow bean and maize. The park boundary wall was also broken down there. Land cover map of 1992 showed that there was no barren land in the study area. The length of the park boundary wall was joined with Vishnu Budhanilkantha and Tokha Chandeshwari VDCs about 6.7 km and 4.1 km respectively.

6. DISCUSSION

6.1 Biodiversity

The study area was rich in biodiversity with 18 tree species of 12 families. The dominant species were *Pinus roxburghii* followed by *Alnus nepalensis, Rhododendron arboreum,* and *Castanopsis spp.* in study area. Malla (2005) reported that *Rhododendron spp.* as dominating species in the Vishnu Budhailkantha area and *Castanopsis tribuloid*es and *Quercus semicarpifolia* were dominating plant species in Shivapuri peak of the ShNP. The range of density of individual species (0.25-19.5 trees/ha) in the present study was in the lower range of the individual species (44.4-555.6 tree/ha) reported by Adhikari (2006). The first and second axes of PCA ordination plots of trees explained 58.2% of total variance and suggested that the tree species *Albizza procera, Alnus nepalensis,* and *Myrsine capitellata* were came together. Similarly, *Rhododendron arboreum, Quercus glauca, Myrsine semiserrata,* and *Castanopsis indica* were came together as another group (Plot 5.1).

Fifteen mammalian species were in that habitat between 1350m to 2220m (Table 5.3). Signs of barking deer, jackal, and jungle cat were frequently observed. The occurrence of porcupine and common leopard conformed through the questionnaire survey. Shrestha (2005) found barking deer (1700-2700m), golden jackal (1900-2300m), jungle cat (1719-2155m), rhesus monkey (1670-2100m), and wild boar (1700-2700m) in the ShNP. Among them, jungle cat and wild boar were common in the middle sector of the park area. The first and second axes of PCA ordination plots of mammal's data explained 69% of total variance of the data. The low gradient length suggested that there were only few species, which were barking deer, jackal, jungle cat, monkey, and wild boar. They were distributed all over the study area (Plot 5.2).

6.2 Livelihood of Local People

Majority of the respondents belonged to indigenous groups such as Tamang in Vishnu Budhanilkantha and Newar in Tokha Chandeshwari. Family structures of the community were nuclear type. Many people have migrated to city areas and abroad for better employment, and education but the area has also attracted some people here.

The literacy rate of sampled household was 41% which was less than the average national literacy rate of 46% (CBS 2004). Agriculture was the main occupation of the local people. There was a gradual shift from traditional agriculture to non agriculture sectors such as business, services in the city area, and abroad. Only Women and elder groups were involved in agriculture but other of some people of Vishnu Budhanilkantha (ward number seven and nine) in alcohol production which was the chief source of income. People of Dadagaun of Vishnu Budhanilkantha VDC were keeping improved breeder goat as alternative income generation.

Most of the respondents (92%) had their own land and the rest engaged in others profession. Some respondents (5%) had sold the land and deposited the money in the bank and lived on its of the interests. The average landholding per household was 4.87 ropani (0.254 hectares), which was less than the average landholding (0.85 ha) in the Shivapuri area (HMG/FAO 1996), 0.51 hectares in Sundarijal VDC of the ShNP (Poudyal 1995). This may be due to the increasing population, nuclear family lifestyle, and land fragmentation.

6.3 Resource Utilization

More than 70% of the total populations of Nepal depend on firewood as the main source of energy (HMG 2000). The main source of energy of Vishnu Budhanilkantha and Tokha Chandeshwari VDCs was also firewood, which was fulfilled from the park's forest. Agricultural residues e.g., straw fulfilled a little of the total firewood and fodder requirements. According to the park authority, the local people were cutting and lopping off green branches of trees, bushes, and grasses for firewood and fodder, which is illegal. But respondents claimed that they collected dry and fallen branches, as it was their traditional right. The load size ranged from 35 kg to 65 kg depending upon the age, sex, and health of the people. The firewood consumption was different according to their profession. The firewood consumption of household in the study area was less than in Okhreni and Mulkharka 13198 kg/year by each alcohol making household and 8015.4 kg/year by each household not making alcohol (Kumpakha 2008). The firewood consumption in Vishnu Budhanilkantha and Tokha Chandeshwari was less because other sources of energy such as agricultural residues, liquefied petroleum gas, kerosene, and electricity were also common.

6.4 Park's Impacts

People living around the park were facing crop damage and livestock depredation by wildlife. Wild boar and monkey were major pests among the six pests' species at study area (Table 5.8). Besides this, birds especially Kalij Pheasant *(Lophura leucomelanos)* was also major pests. The most frequently raided crop by wildlife was maize in maturity period. Kattel (1993), Soti (1995), and HMG/FAO (1996) identified wild boar as the main the frequent pest species in the ShNP. Jungle cat was frequent predator species as chicken lifter. Paneru (2004) reported maize (24.41%) depredated by wildlife in Chapali Bhadrakali VDC which was similar up to now. The millet loss was higher than other crops like maize, wheat, and paddy in the ShNP (Poudyal 1995, and Soti 1995). According to the local people, production of crop is decreasing every year due to some crop diseases like wilting, dryness, and other unusual cases, which were most probably due to the climate change, urbanization, deforestation, introduction of chemicals fertilizer, and pesticides.

Difference in the crude loss values in two VDCs was probably due to topography, park vegetation, wildlife distribution in that area and cropping type. In Tokha Chandeshwori, *Pinus* trees species were dominant in Park Forest and the area was also highly disturbed. Jungle cat were only found. Landform was lowland (*khet*) type where mainly paddy and wheat was major crop grown which is not preferable for wildlife. Moreover, in Vishnu Budhanilkantha area, the Park Forest consists of trees species such as *Castanopsis spp., Rhododendron spp., Alnus nepalensis* where barking deer, jackal, jungle cat, monkey, porcupine, and wild boar were found. Landform was upland (*Bari*) type, where maize, millet, and some rooted crop were grown which is most preferred by wildlife. Abandonment of the most preferred crop like rooted crop must have pushed the wild boar to switch the other crops (Bajracharya 2005). The wildlife depredation was increasing due to collection of firewood, fodder, grasses, leaf litter collection, livestock grazing, food scarcity inside the park, and broken of wall boundary. Different animals preferred different stages of crop. For example wild boar preferred the crop mostly at milky stage rather than other stages while monkey and porcupine preferred maize at milky stage of the grain. Most of farmers detected the loss of crops by seeing damaged pattern directly, other methods like feces, and footprint provided supplementary evidence.

6.5 Human Impacts

The main threat to biodiversity was influenced by human activities. Firewood, fodder, leaf litter fall and grasses were extracted (Figure 5.8) throughout the year mainly during winter because firewood was used for cooking, food heating, and for cowshed (feeder boiling and heating) as different energy sources and fodder and leaf litter for manure making, insulator, and bed for livestock which created wildlife habitat disturb, scarcity of food, nutrient cycle unbalanced as well as some species of wildlife may become extinct. Total density of cut stumps was two individuals per hectare and lopping intensity was 137 individuals per hectare where as Kumpakha (2008) found 426.67 individuals per hectare and 1134.67 individuals per hectare respectively. The grazing at the edge of the park (Table 5.7) resulted habitat shrinkage and showed there would be chances of change in vegetation composition, diseases transmission, and soil erosion and siltation problem later on. Urban tourists, trekkers, villagers, peoples, visitors used certain trails, trekking routes, motor roads for different interests and pilgrims like Bag Dwar and Bishnu Dwar inside the park directly or indirectly disturbing the wildlife habitat creating water pollution, land (garbage) pollution, air pollution, and noise pollution in the park.

6.6 Land Abandonment

One ropani land (0.36% of the total land) was abandoned in Vishnu Budhanilkantha VDC due to crop depredation by wild boar. Rooted plants, bean, and maize were used to grow before abandoning the land which was the most preferred crop of wild boar. The abandoned land was joined with park boundary and the wall of the park boundary was also broken. The surrounding of the Park Forest was rich in biodiversity (Table 5.1 and Table 5.3). The area of the abandoned land was small due to the lack of alternative income generating sources, socio economic condition of people, culture. And if the land is kept barn for two or more than two years then the government will have right to take off it. So, to prevent from that case and to control the encroachment of land from neighbors the people give the land on leased to the people or plant something by themselves. Aaitabare Community Forests of Vishnu Budhanilkantha VDC adjacent to the park was more degraded by human disturbance, and their illegal activities. Jackal, Jungle cat, and monkey only found there.

7. CONCLUSION AND RECOMMENDATION

My study in Vishnu Budhanilkantha and Tokha Chandeshwori villages adjacent to the ShNP during October 2007-October 2008 showed that the area was rich in biodiversity. A total number 18 tree species belonging to 12 families were recorded. The Shannon diversity index was 1.029. The tree species *Albizza procera*, *Alnus nepalensis*, and *Myrsine capitellata* were came together. Similarly, *Rhododendron arboreum*, *Quercus glauca*, *Myrsine semiserrata*, and *Castanopsis indica* were associated as another group. These two groups usually come together. Fifteen mammalian species were recorded (Table 5.3). Barking deer, golden jackal, jungle cat, rhesus monkey, and wild boar were abundant in the area. The majority of people were Tamang and Newar ethnic groups in Vishnu Budhanilkantha and Tokha Chandeshwori respectively. Traditional subsistence agriculture system was predominant. Livestock keeping and alcohol making were the main alternative sources of income generation. The firewood was the basic need of local people residing around the park, which was fulfilled from the park as well as private land (Figure 5.7). Average amount of firewood consumption was about nine kilogram per day for each household. Another resource used was leaf litter fall, fodder and grasses were also collected from the park.

The main issues of park-people conflicts included 1) scarcity of fodder/ firewood/alternative energy sources, 2) crop damage by wildlife, 3) livestock depredation by wild predators, 4) absence of compensation for crop damage 5) lack of alternative sources of income generation, and 6) lack of awareness. One ropani (0.36%) of total land was abandoned due to wildlife damage. I estimated total economic loss of Rs.74182.5 per annum due to crop depredation by wild mammals. The most destructive pests were wild boar, monkey, and porcupine (Table 5.8). Total density of cut stumps was two individuals per hectare and lopping intensity was 137 individuals per hectare. The wildlife habitat was disturbed by trail used by park staff, tourist, villagers and vehicles, fodder collection, firewood collection, livestock grazing, and unmanaged garbage. Local people were strongly positive about biodiversity conservation and management but negative feelings about wild boar. They were practicing livestock keeping by stall feeding and using kerosene, liquefied petroleum gas as fuel energy to conserve and manage biodiversity.

Based on my research, I have derived following recommendations

1. Maintain the park boundary to protect water bodies, flora, and fauna, and their habitats, and also to minimize conflict
2. Develop patchy, peripheral forest areas as nurseries for herbal plants, species, commercial plants, and local tree varieties, which will help to fulfill the people's economic and firewood needs. This also lessens the wild crop raiders in the field
3. Promote training on improved cooking stove and biogas in order to reduce the existing pressure on forests
4. Encourage stall feeding to reduce grazing pressure
5. Give a provision of harvesting wild boar, and identify and introduce crops disliked by the animal
6. Promote eco-tourism to uplift the economy of local people with minimum negative impacts in natural environment and traditional socio-cultural values
7. Launch awareness program about the national park and wildlife conservation and initiate training on resource management for the local people as a part of the park management.

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ANNEX I

ANALYTICAL SAMPLE SURVEY DATA SHEET

(Sarjina 2007 / 2008, Study)

Serial no.: …….. Date: ……..

Location: ……... Plot code: ……...

Topography: ……. Aspect: ……..

Inclination: ……..... Altitude: ……

Latitude: ……... Longitude: …….

Vegetation type: …… Management type: …….

Disturbance gradient: …… Disturbance factors: …….

Table 1: Tree (DBH >10 cm)

S.N.	Name of species	DBH cm	Height (m)	Stem	Stand	Remarks
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Code:

Stem: B = Branch, U = Unbranch

Stand: L = Living, D = Death, C = Cut

ANNEX II

WILD MAMMAL SIGN TRANSECT SHEET

(Sarjina 2007 / 2008, Study)

Serial no.: …….. Date: ……

Transect no. / Location: ……. Plot code: …….....

Topography: …….. Aspect: …….

Vegetation type: ……..... Management type: ……..... ..

Disturbance gradient: …… Disturbance factors: ……...

GPS reading (beginning):

Altitude: …… Latitude: …… Longitude: …… Elevation: …….

GPS reading (at end):

Altitude: …… Latitude: …… Longitude: …… Elevation: ……..

S.N.	Sign type	Mammal species	Elevation	Aspect	GPS reading	Remark
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						

Sign type code:

Fe = Feces (scat / pellet / dropping), Ft = Foot print (pugmark / track), Sh = Scratches, Br = Burrow, Fu = Fur, Q = Quill and V = Visual Observation.

ANNEX III

INDIVIDUAL QUESTIONNAIRE SURVEY FOR WILD MAMMAL

(Sarjina 2007 / 2008, Study)

Serial no.: …… Date: ……

Name: ……..

Sex: …….. Age: …… VDC: ……

Ward no. : ..... Education: …… Occupation: …….

---

1. What wild mammals have you seen in southern part of Shivapuri National Park?

S.N.	Name of mammal 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 languor						
10	Rhesus monkey						
11	Himalayan ghoral						
12	Brown-toothed shrew						
13	Chinese pangolin						
14	Fawn 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							

Code:

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

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

ANNEX IV

(Sarjina 2007 / 2008 Study)

Individual Questionnaire Survey to get information about resources use, conservation and management issues of park and attitude and perception of people towards wild mammals.

Name: …… VDC: ……...

Ward no.…… … Education: ……..

Occupation (major / minor): …….....

Sex: a. Male b. Female Age: ……. Family member……

Questions:

1. How far is your home from the park?

   .....

2. How much land do you own? How far is your land from the park?

Description	*Private*		*Leased*		*Shared*		*Total*
	Ropani	Distant from park	*Ropani*	Distant from park.	*Ropani*	Distant from park	
Khet							
Bari							

3. Do you have any problem from the park? Yes / No. If yes, which problem

   i. Crop depredation ii. Human harassment

   iii. Livestock depredation iv. Others

4. Which crops you grow in your land? And what is their average yield?

S.N.	*Name of species*	*Season*	*Average Yield*	*Yield if not loss due to wildlife*	*Loss due to wildlife*	*In which stage wild life visit*
1	Wheat					
2	Paddy					
3	Millet					
4	Maize					
5	Potato					
6	Sweet potato					
7	Vegetables					
8	Others					

5. Is that sufficient for whole family for a year? Yes / No.

If No, then for how many months?

.....

What are the alternatives sources to support your family?

…..……

6. Do the wildlife raid crop in your land? Yes / No. If yes

S.N.	*Wildlife*	*Raid crops*	*Most preferred crop*	*Time of raiding*	*Unpreferred crops*	*Frequency of visit*	*Number of time*
1	Wild boar						
2	Monkey						
3	Bear						
4	Deer						
5	Others						

{Frequency: R = Rare, S = Sometime, F = Frequent}

7. Have you seen any wild mammals species graze or visit in the same area where the livestock graze? Yes / No.

If yes, in which month? ……

8. Have you abandoned any land? Yes / No. If yes, what

Type of land	*How much*	*Crop you grow before*	*Average yield*	*Distance from park*
Irrigated				
Partially irrigated				
Non-irrigated				

9. Why you abandoned the land?

i. Low soil fertility ii. Poor irrigation iii. Wildlife damage iv. Drought v. Others

10. Do you raise livestock? Yes / No, If yes

Type of livestock	*Numbers(M/F)*		*How you raise them?*	*Source(NP/CF/PL/others)*
Goat				
Sheep				
Buffalo				
Cow				
Pig				
Chicken				
Duck				

a. Stall feeding (SF) b. Dhuto (DU) c. Open grazing with attendant (OG/A)

d. Open grazing without attendant (OG/NA) e. Dana (D) f. Pitho (P)

Note *:-{ NP: National Park, CF: Community Forest, PL: Private Land}*

11. Is your cattle been killed recently by any predator of the national park? Yes/No,

If yes,

S.N.	*Name of livestock*	*Number*	*Killed month*	*Annual injured*	*Cost of livestock*	*Name of predator*	*Time (morn/aft/nights)*
1							
2							
3							

12. Where did the wildlife kill your livestock?

i. Shed ii. Meadow iii. Road iv. Agricultural land

13. Have the wildlife attacked human? Yes/No. If yes

S.N.	*Where*	*Who*	*Remarks(dead/live)*
1			
2			
3			

14. What are the preventive methods you are using to control the crop damage?

Methods	Effectiveness for crops								
	wheat	maize	millet	paddy	potato	Sweet potato	pindalu	badam	vegetables
Shouting									
Drumming									
Guarding									
Dog									
Fencing									
Others									

15. Did you get compensation from the park? Yes / No. If yes, how much

……

16. What is the main energy source for cooking and other purposes?

i. Firewood ii. Electricity ii. Biogas iv. Kerosene/LP gas v. Cake vi. Mixed

17. What benefit do you have from the Park?

i. Resource utilization ii.Economic benefit from tourisms iii. Training iv. Others

18. Resource use pattern

Sources	*Timber*		*Firewood*		*Fodder*		*Other (NTFPs)*	
	species	*quantity*	*species*	*quantity*	*species*	*quantity*	*species*	*quantity*
Community forest								
National park								
Private land								

19. Do the park management involve you in managing park? Yes / No. If yes,

i. Information about hunting poaching ii. Information about inconvenience

iii. Meeting iv. Awareness program. v. Others

20. Are you satisfied with park? Yes /No. If No, why?

……..

21. What kind of support you want from the national park?

……..

22. Do you think these animals should be protected?

i. Strongly positive ii. Positive iii. Negative iv. Strongly negative

23. Is there any local organization and institutions in the VDC for the conservation and management of park? Yes/No. If yes, which

……..

24. Do you know about the park resource use rules? Yes/No. If yes, what do you know?

……..

25. Is there any encroachment here? Yes/No. If yes, where…….and how much area……For what purpose,

i. Agriculture ii. Settlement iii. Firewood iv. Timber v. Other

26. Do you think protection and conservation of NP is good? Yes/no. If yes, what do you do to help to conserve the NP?

i. Reporting ii. Protection of trees and their seedlings

iii. Protection of NTFPs iv. Protection from fire

v. Protection from poaching hunting and felling of trees vi. Others

27. Would you like to tell your suggestion for the conservation and management of the park?

……

ANNEX V

Unit Conversion

Maize	=1 pathi	= 3.5 kg.
Millet	=1 pathi	= 3.0 kg.
Paddy	=1 pathi	= 3.0 kg.
Wheat	=1 pathi	= 3.5 kg.

1 Ropani = 455m2=0.0523076 hectare

ANNEX VI

Local Rate of Different Crops

Crops (NRs.)	Market Rate per kg.
Maize	15.00
Millet	17.50
Paddy	25.00
Wheat	18.00

Source: Local Respondents

ANNEX VII

Local Name, Common Name, and Scientific Name of the Crops Grown in the Study Area

Local Name	Common Name	Scientific Name
Dhan	Paddy	*Oryza sativa* L.
Makai	Wheat	*Zea Mays* L.
Gahun	Millet	*Triticum aestivum* L.
Kodo	Millet	*Eleusine coracana* (L.) Gaertn