

# 1. INTRODUCTION

## 1.1 Concept of National Park

The Yellowstone National Park in the United States created in 1872 was the first national park ever established in the modern world (Mackinnon et al., 1986). This was a milestone in the evolution of the concept of national parks as we know today. Since its establishment, most countries have recognized the value of protected areas to their people. This resulted in the establishment of more than 2600 protected areas by 124 countries covering nearly four million sq.km of the world to the date, the Third National Park Congress held in Bali Indonesia in 1982 (Mackinnon et al., 1986). National parks in the developing countries, particularly in Asia, were established beginning in the second quarter of this century (Mishra, 1991).

The concept of national parks and protected areas was developed for the preservation of living resources. In the United States, national parks were established for the protection of nature and natural resources. Today all countries have designated protected areas for a variety of conservation objectives such as maintenance of the integrity and diversity of ecosystems, protection of flora and fauna, conservation of cultural heritage and soil regeneration and nutrient cycling. Protected areas are also home to communities of people with traditional cultures and irreplaceable knowledge of nature.

As of 1997, there were 13,321 different parks or equivalent reserves internationally recognized by the World Conservation Monitoring Centre (WCMC), which covered a land area of about 6,145,310 square kilometers (IUCN, 1997). National park is a protected area managed mainly for ecosystem protection and recreation. The objectives of the establishment and management of national park as given by IUCN (1978) are:

- i) To protect natural and scenic areas of National and International significance for spiritual, scientific, educational or tourism purposes.

- ii) To perpetuate in as possible, representative examples of physiographic regions, biotic communities, genetic resources and species, to provide ecological stability and diversity.
- iii) To manage visitor use for inspirational, educational, cultural and recreational purposes of designation.
- iv) To eliminate and thereafter prevent exploitation or occupation inimical to the purposes of designation.
- v) To maintain respect for the ecological, geomorphologic, sacred or aesthetic attributes which warranted designated and
- vi) To take into account the needs of indigenous people, including subsistence resource use in so far as these will not adversely affect the other objectives of management.

## **1.2 Protected Areas of Nepal**

In Nepal, Protected Areas were initially established for the protection of wildlife especially endangered wildlife. However, the objectives have since been broadened to include the preservation of natural, historic, scenic and cultural values (HMG, 2002). The conservation movement in Nepal has effectively initiated in 1970 when His majesty the King Mahendra approved the principle of the establishment of Royal Chitwan national Park and Langtang national Park (Gurung, 2002). In 1973, a National Park and Wildlife protected areas. The Act, subsequently amended four times in 1974, 1982, 1986, and 1994, recognizes the six categories of protected areas in Nepal namely National Park, Strict Nature Reserve, Wildlife Reserve, Hunting Reserve, Conservation Area and Buffer Zone (HMG, 2002) (Fig. 1.). According to NPWC Act 1973, a national park is an area set aside for the conservation and management of the natural environment including the ecological, biological and geomorphologic associations of aesthetic importance to develop with sustainable conservation (HMG, 2002). According to the latest estimates, 28585.67 km<sup>2</sup> i.e. 19.42% of the total area of Nepal is now declared protected (A fact file DNPWC, 1980-2005) (Annex-3).

The Commission on National Park and Protected Area (CNPPA) has defined national park as “Natural area of land or sea, designated

- i) to protect the ecological integrity of one or more ecosystems for present and future generation
- ii) to exclude exploitation or occupation inimical to purposes of designation of the area
- iii) to provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible (IUCN,1978).

World Heritage Committee of UNESCO included Royal Chitwan National Park and Sagarmatha National Park in the World Heritage Natural sites list for the criteria of important habitat for endangered species of universal value and outstanding example of geological formation respectively.

In 1975, HMG of Nepal tried to check the problems of deterioration of Shivapuri ecosystems and established the Shivapuri Development Board. In 1976, the area become under the Shivapuri Watershed Development Project of the guidance and supervision of Shivapuri Development Board. Again the area was gazatted as Shivapuri Watershed and Wildlife Reserve (SWWR) in 1983. In Feb. 2002, the reserve was declared National Park (Nepal Rajpatra, 2002).

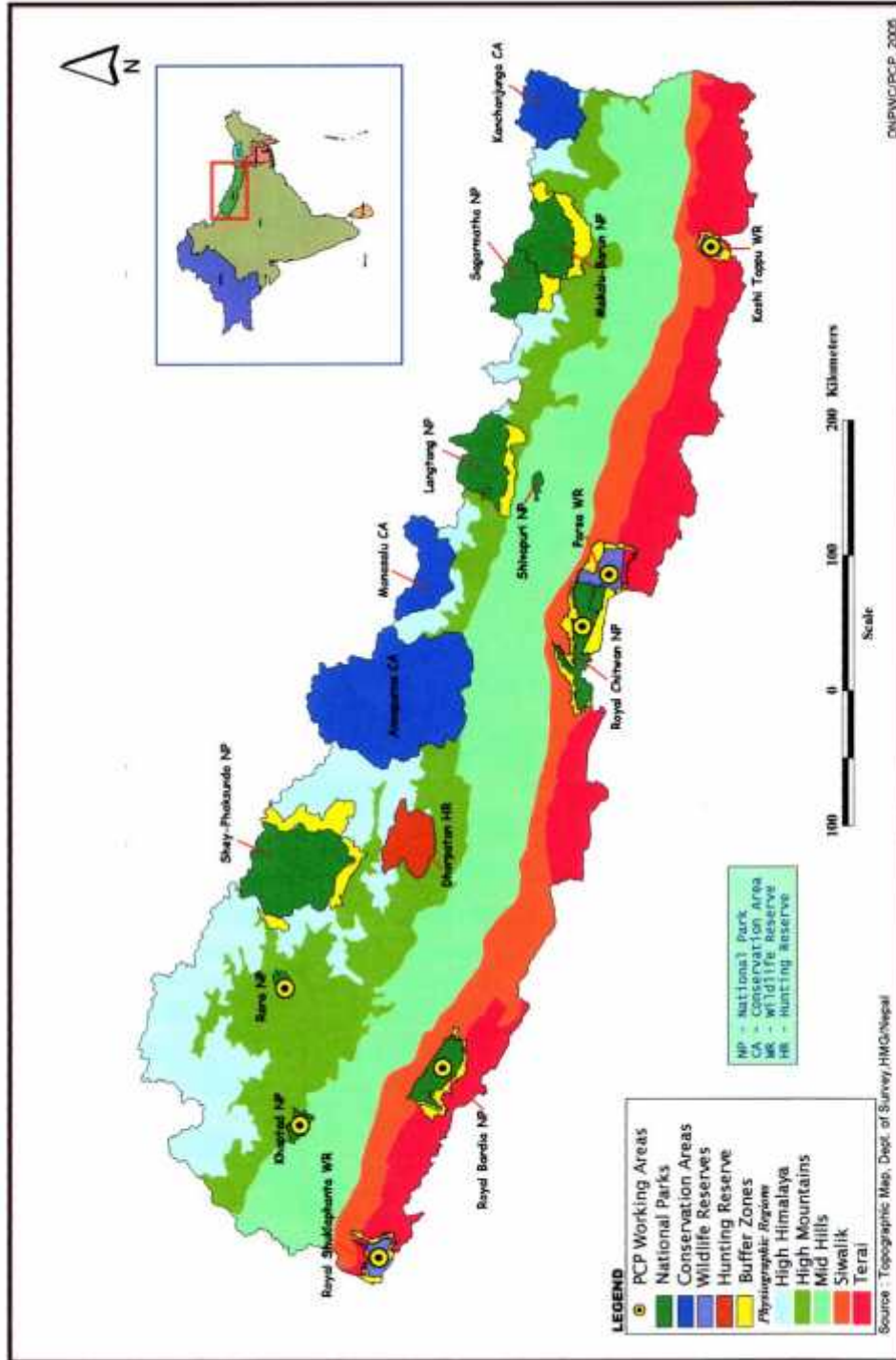


Fig 1: Protected Areas of Nepal

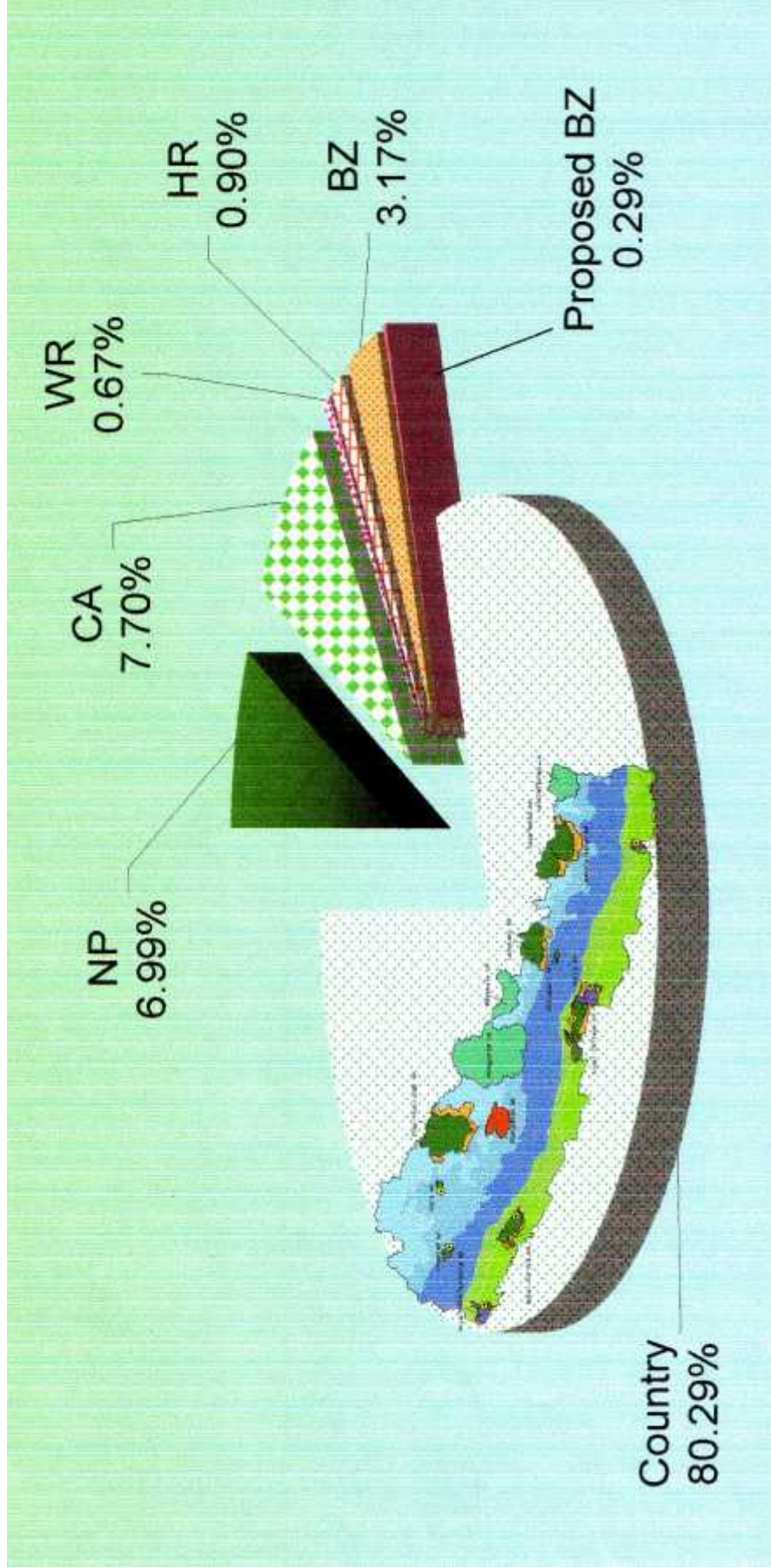


Fig 2: Protected Areas Coverage Within Country

### **1.3 Wild Boar** (*Sus scrofa*)

**Order:** Artiodactyla, **Family:** Suidae, **Genus:** Sus, **Species:** scrofa

Wild boar is well known animal. It has a distinctive sparse coat full crest or mane of black bristles reaching from the nape down the back. Their sense of smell is acute, eye sight and hearing are moderate (Prater, 1980; cited in Barai, 1999). The colour of the animal is black mixed with grey, rusty, brown and white hairs. The young are brown with light or black stripes. The tusks are well developed in the males. Both the upper and lower tusks outwards and are projected from the mouth. A full-grown male stand 36 inches (90 cm.) high at the shoulder, and its weight may well exceed 490 lbs. (230 kg.) (Shrestha, 1997;cited in Gurung, 2002).

#### **Range**

The wild boars are widely distributed in the world. It ranges over the whole of India, Nepal, Burma and Sri Lanka (Mochi and Carter, 1971; cited in Barai, 1999). It is found both in Terai forest and in the higher semi-deciduous and temperate forests of the Himalayas of Nepal.

#### **Habitat**

Versatile with respect to habitat, avoiding only very arid areas. Woody grassland, forest and dense bush are preferred habitats and they build shelter of grass, reeds or bush often raid cultivation.

#### **Ecology and Behaviour**

Wild boars are widespread with a surprisingly wide altitude range. They are most abundant in oak and fir forests. They are omnivorous, living on crops, roots, tubers, insects, snakes, offal and carrion. They feed in the early morning and late in the evening and where much distributed, chiefly at night. No animal is more destructive to crops than wild boar in cultivated areas. It is difficult to make a plea for its protection. Dhorpatan area and Mailung villages support good population of wild boar in high altitude. (Shrestha, 1997; cited in Gurung 2002)

Wild boar display great intelligence and few animals show greater courage and determination. Wild boars are prolific breeders. They apparently breed at all seasons. Two males fight each other occasionally for the possession of a harem. They use their powerful tusks for fighting. During fight the boars stand muzzle to muzzle and by sudden jerks of their head upwards dart forward to cut deep into one another face, throat and shoulders. The quick butts are repeated six to seven times in a minute. Most important factor in the hunting is the fact that boars are allured by the scent of kerosene oil. Both young and old boars and sows are attracted by kerosene oil. (Shrestha, 1997;cited in Gurung, 2002).

Wild boars live in herds of up to 170 individuals. After breeding, the big boars live alone or in company with another of equal size or with one to two sows. When a juvenile boar becomes mature, it leaves the herd and leads a solitary life. In most cases, an adolescent boar is driven out of the herd. Wild boars breed at all seasons, but the majority of young are born at two periods, shortly before and after the monsoon. The gestation period is said to be four months: four to six young are born at a time. (Shrestha, 1997;cited in Gurung, 2002).

### **Distribution**

In Nepal, wild boars are found both in terai forests and in the higher semi-deciduous and temperate forests of the Himalayas. It is reported from Annapurna Conservation Area, Shey-Phoksundo National Park, Makalu-Barun National Park and Conservation Area, Langtang National Park, Rara National Park, Khaptad National Park and Shivapuri National Park in mountain region. Royal Bardia National Park, Royal Chitwan National Park, Royal Sukla-Phanta Wildlife Reserve, Parsa Wildlife Reserve and Koshi Tappu Wildlife Reserve are among terai-protected area where wild boars are found (Baral, 1998; cited in Gurung, 2002).

Beside these protected areas, in other semi-deciduous and temperate forests of Nepal have also presence of wild boar (Acharya, 1999). The boars are found in reduced numbers in most forested areas outside of reserves and parks. They root for tubers as they turn the soil over in large areas (Heinen and Yonzon, 1994).

## 1.4 Park-People Conflict

The concept of national park and protected areas developed with a philosophy of preservation of living resources. In United States, national parks were developed to protect the natural and cultural features by acknowledging that national parks reflect the common heritage of all people were not permitted to harvest in any form from park resources or to live within the park (From *et al.* 1990, cited in Kharel 1993).

This conservation philosophy of the United States was followed by the national park and protected areas system of different countries but many protected area management authorities failed to adopt appropriate principles and guidelines to protect their areas against the threats of inevitable human pressure for traditional exploitation of natural resources (Sharma 1991, cited in Kharel 1993) resulting conflict.

The national park and protected areas system strictly prohibits all kinds of destruction, exploitation and removal of flora and fauna and damage to habitat. This active conservation of habitat has increased the population of wildlife within the protected areas which cause damage outside the park or the people living within the area.

It is very difficult to the villagers to understand why wildlife may damage their crops, while they must not kill any animals in return. They are not convinced of protecting forests and wildlife, which they have been utilizing for thousands of years.

The restriction imposed on the resources use by the local people to meet their basic needs lead to the deterioration of the park-people relation. Crop damage, human harassment, injuries and death, inappropriate compensation measures, illegal activities such as hunting, poaching are the issues raising conflict between the park and people (Sharma 1991, Jnawali 1989, Kasu 1996, Shrestha 1994).



## 1.5 Justification

Habitat destruction, population pressure and food shortage are exerting tremendous pressure on the ecosystem and natural resources throughout the world and Nepal is no exception. Establishment of the protected areas is only a first step in the protection, conservation maintenance of biodiversity. Protection and conservation of the natural resources by restricting the local people to use the natural resources, which was their traditional rights and the damage caused by the wild animals have created negative attitude towards the park. Also this conservation attitude has increased the population of wildlife within the protected areas which cause damage within the people living areas.

Few research works have been made in ShNP by researchers in the past. Very few attempts have been made to explore the wildlife by scholars although it is rich in flora and fauna. Ulak (1992) studied the economic loss of crops (potato, sweet potato, maize, millet etc) caused by the wild boar in Shivapuri National Park. Kattel (1993) reported about increasing number of wild boar and it is number one crop raiding animal in Shivapuri National Park. SIWDP (1996) has given the report of wild boar in ShNP. Poudyal (1995) studied about the crop damage in Sundarijal VDC, adjacent to the park and Soti (1995) studied about the crop damage in Kakani VDC, adjacent to the park.

Human activities showed a great impact in ShNP. There is a great conflict between the park authorities and the local people due to crop damage, livestock depredation, human harassment, livestock grazing, poaching and fodder, timber and firewood cutting etc.

The study of crop depredation and human harassment by wild animals was done in Sangla Village Development Committee (VDC), in the vicinity of the park. The crop damage is acute in this VDC. Present study is carried out to estimate the loss of the crop depredation by the wild animals. The study is necessary in order to enforce the better governance and park management by the park authority so that the crop depredation by the wild animals is reduced and it also contributes for the sustainable biodiversity conservation.

## **1.6 Limitation of the Study**

Constraints of time and finance are the major limitations of the study. Due to these constraints, I could study the crop damaged by the wildlife in Sangla VDC only, though the problem is prevalent in many surrounding VDCs of the park.

## **1.7 Statement of Problem**

Population pressure in the ShNP leads to the increased requirement of natural resources. Local people's access to the forest for firewood, fodder and NTFPs was their traditional right, but was denied later on after the establishment of National Park. This has been creating negative attitude towards National Park. Moreover, the wild animals of the park cause loss by damaging the local people's agriculture and attacking on the local people which further aggravate to the problem. The money collected as revenue in the National Park is not being utilized for the improvement of the livelihood of local people, which further creates the conflict between the park and people.

## **1.8 Objectives**

The main objective of the study is to assess the loss of crop depredation and human harassment due to the wild animals of the park. The specific objectives are;

- To identify the most destructive wild animal.
- To estimate the actual amount and annual monetary value of crops lost through depredation by wildlife.
- To document problems, needs and views of local people in connection with natural resources management, including wildlife and to recommend possible measures to alleviate problems.

## **2. STUDY AREA**

### **2.1 SHIVAPURI NATIONAL PARK (ShNP)**

#### **2.1.1 Location and Area**

Shivapuri National Park (ShNP), initially established as Shivapuri Watershed Reserve in 1976 and Shivapuri Watershed and Wildlife Reserve in 1984, was gazetted in 2002. Shivapuri National Park is located on the northern fringes of Kathmandu valley. It is about 12 km from the main city and is surrounded by 23 villages' development committees of three districts, Kathmandu, Nuwakot, and Sindupalchowk (DNPWC, 2002). It lies between 27° 45' - 27° 52' North latitude and 85° 15' - 85° 30' East longitude. (SWWR, 1999). The size of the National Park is about 144 km<sup>2</sup> stretching 8-10 km from North to South, and 20 km from east to west (DNPWC, 2002) (Fig. 3). The park boundary is well demarcated with a 111 km long wall around the park. The boundary wall runs along number of villages that include Talakhu, Chhap, Likhu, Samundradevi, Sikre, Sunkhani and Thanapati of Nuwakot district in the North, Bajrayogini, Baluwa, Chapali Bhadrakali, Gagalphedi, Jhor Mahankal, Jitpurphedi, Kavresthali, Lapsiphedi, Nayapati, Sundarijal and Vishnu Budanilkantha of Kathmandu district in the South, Bhotechaur, Haibung and Naglebare of Sindhupalchok district in the East and Okharpauwa and Kakani of Nuwakot district in the West (Fig. 4).

#### **2.1.2 Access to the Area**

ShNP is linked by four major road networks from the Kathmandu Valley (Kathmandu to Budhanilkhantha, Sundarijal, Kakani and Tokha). The distance of the park is 25 to 45 minutes drive from Kathmandu, depending upon the entry point. The park headquarter, Panimuhan, is just 7 km from the city-ring road and 12 km from the city center. One can enter the park from a number of other points namely Jhule, Chisapani, Kakani, and Tokha. There are 95 km graveled road and 83 km foot trails (12 trails) inside the park for trekking and village walk.

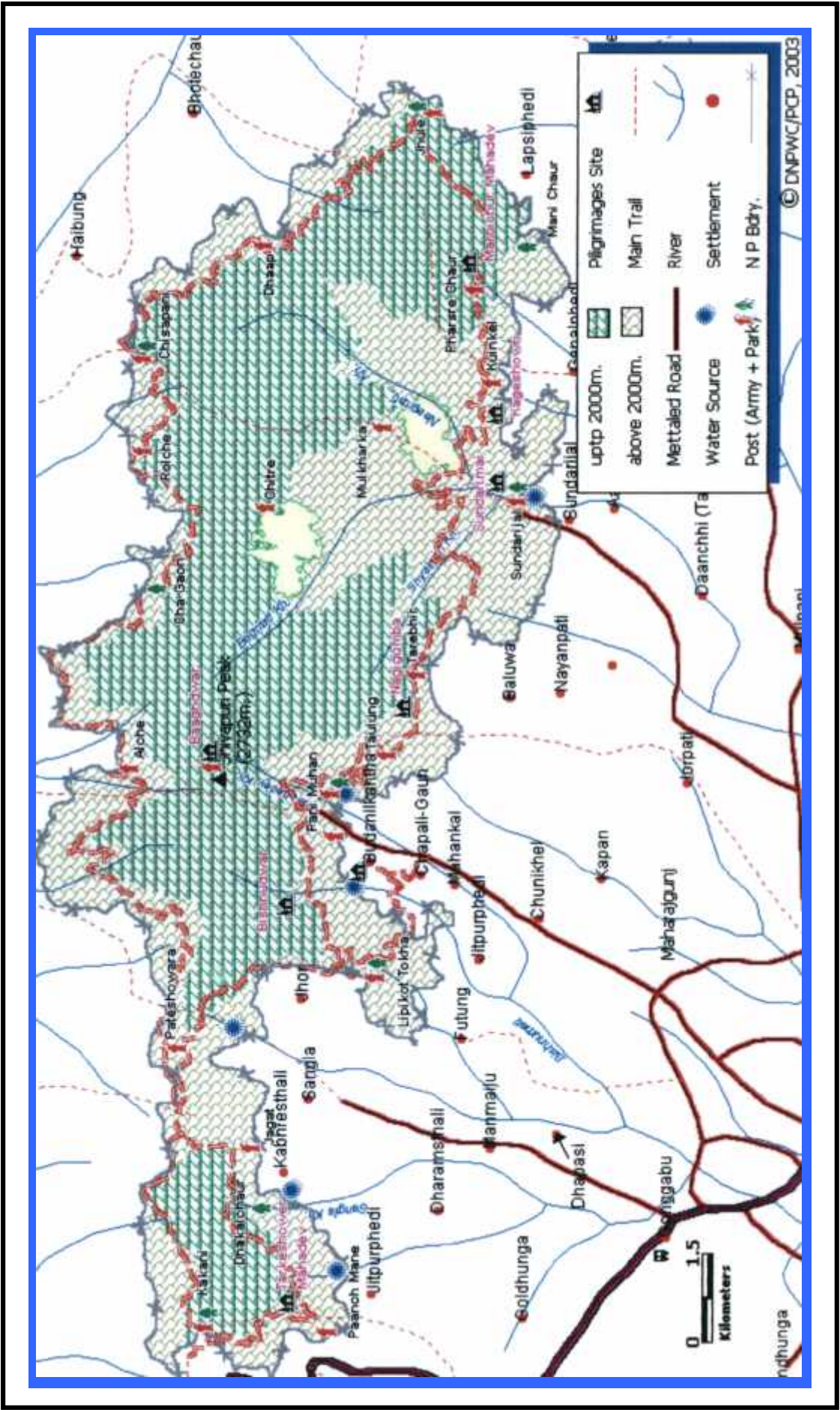


Fig. 3 : Shivapuri National Park

### **2.1.3 Geology, Topography and Elevation**

It is the only protected area that falls entirely within the middle mountain range of Nepal. The highest point is the Shivapuri Peak, 2,732 m above sea level, sloping down to less than 1,000 m. above sea level at the Likhu river in the northern valley, and to about 1,400 m. at the southern (Kathmandu) valley. Geologically, Shivapuri area occupies the Inner Himalayan region. It is the only protected area that falls entirely within the middle mountain range of Nepal. The name of the park is derived from the ancient name “Shiphucho” representing the holly peak of woods. The dominant rocks are gneiss and magnetite with mica schist and pegmatic granite, the soils of the area range from loamy sand on the northern side to sandy loam on the southern slope. Entire area is characterized by its steep topography. More than 50% of the area has greater than 30% slopes. In several spots soil erosion is a serious problem. Erosion hazard is very high in the northern slope. Landslides, gullies and stream bank erosion, both natural and man-induced are found all over the area. (SWWR, 1999).

### **2.1.4 Climate of the Study Area**

The climate of the ShNP lies in a transition zone between subtropical and warm temperate types. It has relatively high humidity all throughout the year. There is a high variation in the annual temperature and precipitation. For the period of 1995-2005, the highest maximum average temperature is 27.45<sup>0</sup>C and the minimum average temperature is 3.35<sup>0</sup>C (Fig. 4). The highest mean monthly rainfall of 590.85 mm occurs in July and the lowest monthly rainfall of 9.24 mm occurs on December (Fig.5). More than 80% of annual precipitation occurs during the rainy season i.e. between mid Junes through late September (Annex 5).

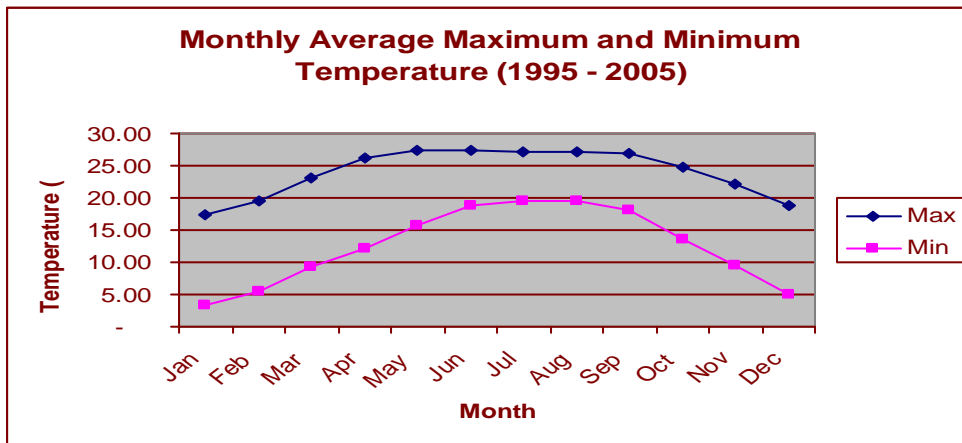


Fig.4 Monthly variations in mean maximum and mean minimum temperature for the year 1995-2005 recorded at Budhanilkantha Station.

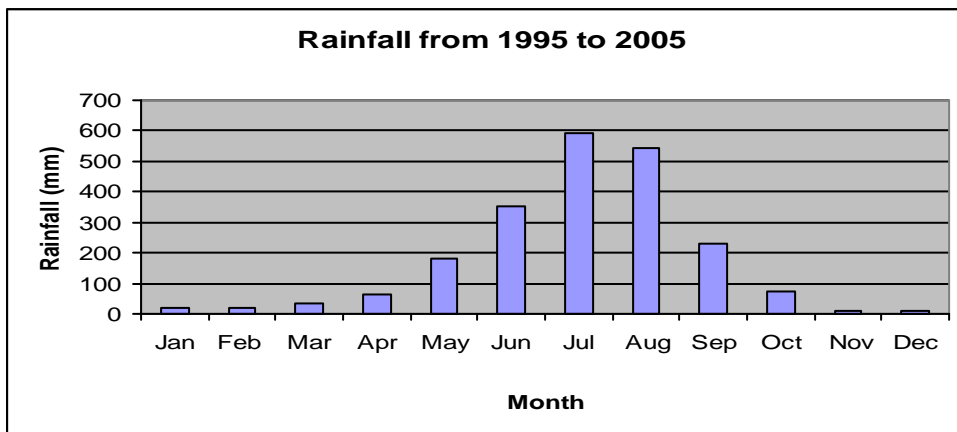


Fig.5 Monthly variations in average monthly rainfall (mm) for the year 1995-2005 recorded at Budhanilkantha Station.

(Source: Department of Hydrology and Meteorology)

### 2.1.5 Biodiversity (Flora and Fauna)

Shivapuri National Park is located in a transition zone between subtropical and temperate climates, Due to its location, altitudinal and climate variations, it has high floral diversity. In general, forests in the ShNP can be categorized by four types, which are distributed along the altitudinal gradient (Amatya 1993, Kattel 1993 cited in Shivapuri National Park A Draft Management Plan, 2004).

They include;

- i) Lower mixed hardwood (Schima-Castanopsis forest at 1000-5000m)
- ii) Chir pine forest at 1000-1600m

- iii) Upper mixed hardwood forest at 1500-2300m and
- iv) Oak forest at 2300-2700m

There are more than 2122 species of d flora and 16 of them are endemic flowering plants. About 129 species of mushroom has been identified in ShNP (BPP 1995 cited in Shivapuri National Park A Draft Management Plan).

The establishment of the protected area has led to an important increase in forest cover and standing stock. This, and the greatly reduced levels of disturbance have resulted in a considerable improvement in wildlife habitats and an increase forest dependent species. Recorded species in the Shivapuri area include: 21 species of mammals out of which 9 are threatened species (BPP 1995). They include Pangolin (*Prionailurus bengalensis*) and clouded leopard (*pardofelis nebulosa*), common leopard (*Panthera pardus*), langur (*Semnopithecus entellus*), rhesus monkey (*Macaca mulatta*), jungle cat (*Felis Chaus*), ghoral (*Naemorhedus goral*) and Himalayan bear (*Ursus thibetanus*), 177 species of birds, including at least 9 threatened species, oriental hobby (*Falco severus*), grey-sided laughing thrush (*Grarrulax caerulatus*) and cinerous vulture (*Aegpius Monachus*), only one species of reptilian i.e. *Oligoden arnensis* (BPP 1995), 102 species of butterflies, including a number of rare and endangered species, such as the Kaiser-I-Hind (*Teinopalpus imperalis*). Shivapuri is the only habitat for rare relict Himalayan dragonfly (*Epiophlebia liadlaw*) in Nepal.

**Table:1 Faunal Diversity in ShNP**

Groups	Number of species	Status	Source
Mammals	21	Protected, Threatened(9)	BPP 1995
Birds	177	Threatened(9) Endemic(1)	BPP 1995
Herpatofauna	1	Under Explored	BPP 1995
Butterflies	102	Endemic, Susceptible species	Smith 1996

Source: Shivapuri Management Plan cited in Shivapuri National Park, A Draft Management Plan, 2004 (Annex 4).

**Table: 2 Forest habitats and altitudinal distribution of Flora and Fauna**

Forest type or Habitat	Altitude (meters)	Flora	Fauna
Lowre mixed hardwood	1000-1500	<i>Schima wallichii</i> <i>Castanopsis indica</i> <i>Alnus nepalensis</i> <i>Anthosaphalus cadamba</i> <i>Prunus cerasoides</i>	Wild boar ( <i>Sus scrofa</i> ) <i>Muntiacus muntjak</i> <i>Macaca mulata</i> Langur ( <i>Semnopithecus entellus</i> ) Indian hare ( <i>Lepusnigricollis</i> )
Chir pine forest	1000-1600	<i>Prunus roxburghi</i> <i>Castanopsis indica</i> <i>Myrica esculenta</i> <i>Prunus pashia</i>	Same as above
Upper mixed hardwood forest	1500-2700	<i>Acer-Aesculus</i> <i>Juglans regia</i> <i>Betula, Fraxinus sp.</i> <i>Alnus nepalensis</i> <i>Salix sp.</i> <i>Quercus sp.</i> <i>Celtis sp.</i>	Himalayan goral ( <i>Nemohaedus goral</i> ) Himalayan black bear ( <i>Ursus tibetanus</i> ) Yellow-throated marten ( <i>Martes flavigula</i> ) Wild boar ( <i>Sus scrofa</i> )
Oak forest	2300-2700	<i>Quercus semecarpifolia</i> <i>Eurya acuminate</i> <i>Ilex dipyrens</i> <i>Michelia champaca</i> <i>Rhododendron arboretum</i> <i>Symplocos sp.</i>	Wild boar ( <i>Sus scrofa</i> ) Barking deer ( <i>Muntiacus muntjak</i> ) Porcupine ( <i>Hystrix indica</i> )

Source: Shivapuri Management Plan, Amatya, 1993, Kattel, 1993 cited in Shivapuri National Park A Draft Management Plan, 2004.

### 2.1.6 Land Use Pattern

ShNP is predominated by forest, followed closely by agriculture, shrubs and grassland with shrubs, landslides, settlements, riverine features and abandoned lands.



**Table 3: Land Use Pattern of ShNP**

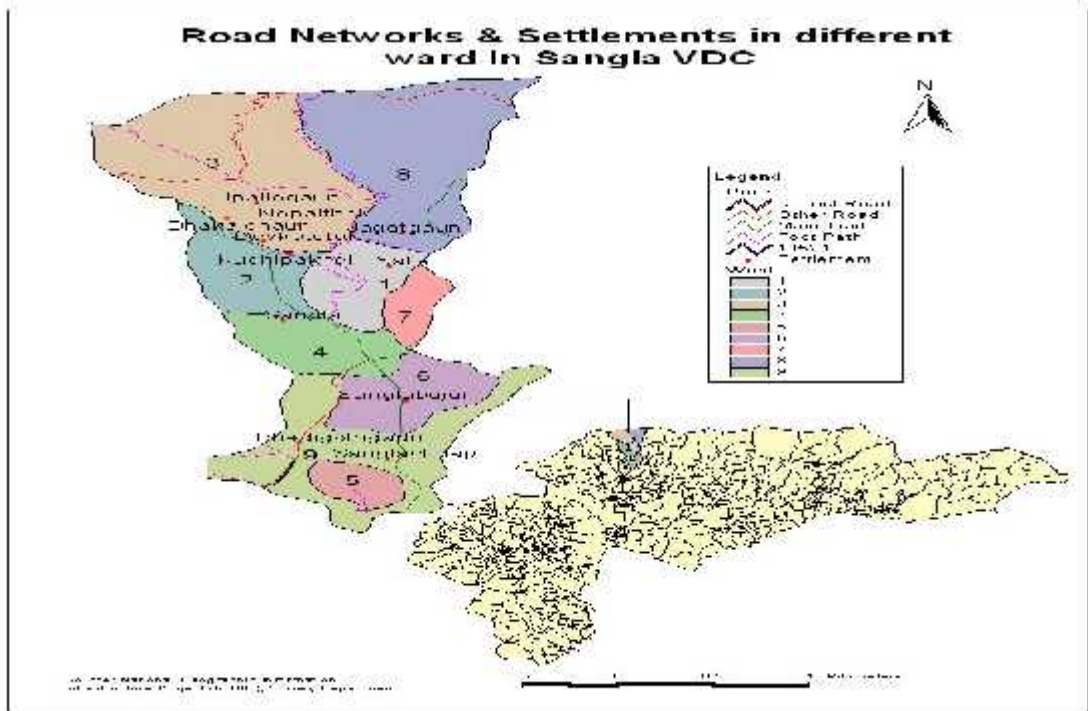
Forest	Agriculture	Shrubs	Grassland	Grassland with shrub	Landslides	Settlements	Riverine features	Abandoned land
40.7%	35.3%	14.8 %	2.9%	2.6%	0.5%	0.9%	0.2%	2.0%

(Cited in Shivapuri National Park A Draft Management Plan, 2004)

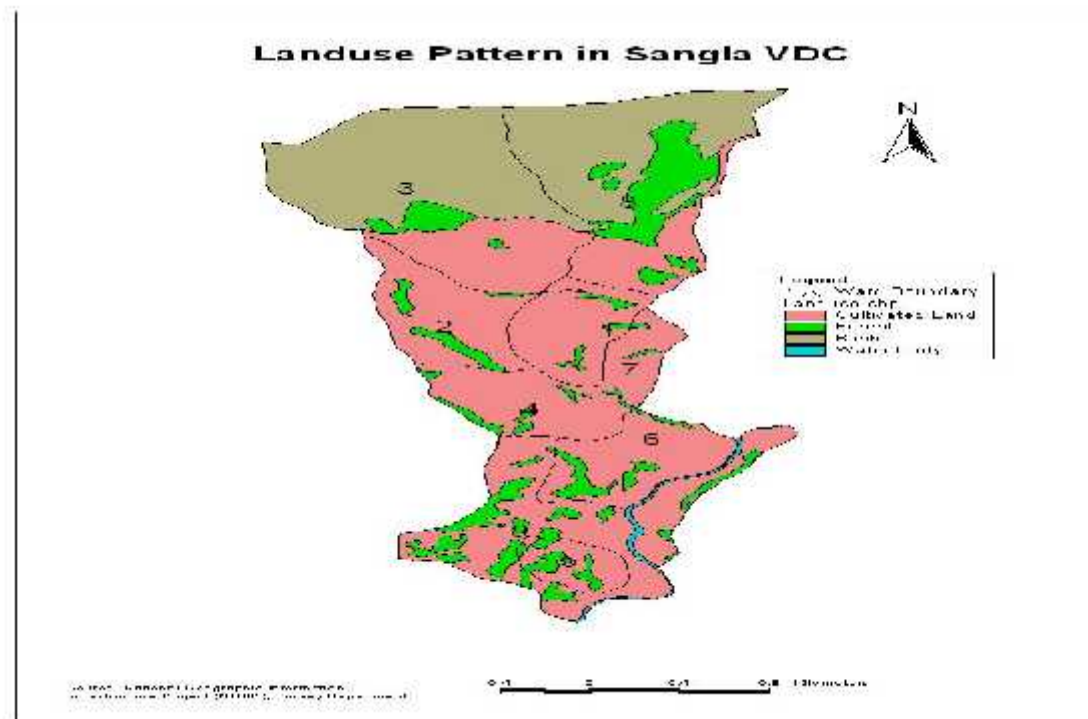
## 2.2 Research Site

ShNP, lying within Shivapuri zone, consists of three districts; Kathmandu, Nuwakot & Sindhupalchok. All the three districts consist of 23 VDCs. Among the 23 VDC areas in the vicinity of ShNP, the studied area, Sangla VDC lies nearby the park. The study was especially carried out in Katheri, Salle and Kungipwakal areas of Sangla VDC. It covers 6 wards i.e. 1, 2, 3, 4, 7, 8 ward numbers. Sangla VDC constitutes the people of different castes. Adhikari, Tamang, Newar, Nepal and Bhurtel. Most of the people of the area are Tamang who are economically deprived, illiterate and less access to better livelihood facilities. The people in the area are engaged in the agricultural activities. Besides agriculture, there is no other income generating activities. Usual cropping sequence in the upland is maize, millet (intercropping) followed by wheat and paddy. In the rain fed lowland (less than 20%) also, only two crops are planted in a year i.e. paddy followed by wheat. The cropping time is given below:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec.
Wheat		J	-----		M							
Maize				M	-----					S		
Millet								A	-----			D
Paddy							J	-----				D



**Fig.6: Road Networks & Settlements in different wards in Sangla VDC**



**Fig.7: Land use Pattern in Sangla VDC**

### 3. LITERATURE REVIEW

National Parks, Wildlife Reserves and other types of protected areas are at the forefront of efforts to conserve biological diversity in developing countries like Nepal along with rest of the world. But many protected areas in Nepal are in crisis due to the expanding human activities and sometimes, wild animals interference in the crop fields. The management of the protected areas requires people's participation for its sustainability.

Milton and Binney (1980) carried out a survey on resolving resources conflicts between wildlife conservation and agricultural land use in Padampur VDC Chitwan district. They discovered that crop loss inflicted by wildlife is the main problem of the inhabitants of the areas adjoining the parks. The study in Chitwan identifies three zones of crop damage by wild life. The zone of highest damage suffers from 50% to 100% loss. A larger number of people from such zones either wish to resettle or are deeply concerned that His Majesty's Government takes other defective actions such as fencing or loss compensation.

Prasai (1989) found that crop damage, cattle killed and people toll by wildlife were the consequent effects with the establishment of National Park, resulting conflict between park and the local people. He surveyed in four panchayat i.e. Bachhauli, Padampur, Kumroj and Ratnanagar and found that 80% expressed advantages due to the RCNP. Animals like rhinoceros, tiger, leopard, bear, jackal and fox were the crop depreeding animals. It was also found that tiger constituted 50% attack on human beings, followed by rhino 30%, leopard, bear, and jackal 20% attack respectively. Padampur panchayat comprised 37.25% losses which were the highest and Ratnanagar panchayat comprised 11.50% losses which was the lowest. The Bachhauli and Kumroj comprised 26.66% and 24.58% respectively. The monetary loss of domestic animal by wildlife was Rs.429350.

Jnawali (1989) reported on human harassment and crop damage by greater one horned rhinoceros (*Rhinoceros unicornis*) in Sauraha adjacent to RCNP. The loss was found Rs. 172000 of which 68.6% occurred within a distance of 500 m. The highest economic loss 27.6% occurred to rice.

Sharma (1991) found that the main cause of conflict is due to crop and livestock depredation in RCNP. In 1991, he calculated crop damage by two methods, Interview and Net Area Damage (NDA). He also reported that paddy is highly damaged followed by wheat, corn, oil seeds, and lentils vegetables and miscellaneous.

Ulak (1992) reported that in Shivapuri National Park, the economic loss of crops (potato, sweet potato, maize, millet etc) caused by the wild boar (*Sus scrofa*) is felt by the local people residing in the park areas since 1987 and attack in the crops is going a head in an increasing order.

Khatri (1993) found that crop damage by Nilgai (*Boselaphus tragocamelus*) averaged 8.3% of the total crop loss caused by wild animals in RBNP.

Kattel (1993) reported that 87% peoples were perceived about increasing number of wild boar (*Sus scrofa*) and it is number one crop raiding animal in the neighbouring villages of Shivapuri. He found that wild boar was present from 1000-2700 m in altitude of Shivapuri National Park.

Nepal and Weber (1993) reported that rhinoceros (*Rhinoceros unicornis*), chital (*Axis axis*) and wild boar (*Sus scrofa*) as principal crop pest in RCNP. They also found rhino (*Rhioceros unicornis*) as principal crop pest in Royal Chitwan National Park.

Shrestha (1994) found that there was a biodynamic competition between the park and people. Crop damage, livestock tolls, and local harassment by rhino, deer, boars, parakeets, tiger and leopard were the main problems. The economic loss in crop damage amounted Rs. 26396 in the 2048-2049. Bodreni was found to be the most affected area i.e. 28.8% loss in its total production. The most affected crops were rice (32%0 and maize (60%).

Heinen and Yonzon (1994) have reported that the boar not only presence in all Nepal's park and reserves but also found in reduced numbers in most forested areas outside of reserves and parks. They root for tubers, as they turn the soil over in large areas.

Soti (1995) found that the extent of damage done by wild boar ranged up to a distance of 5 km from reserve boundary. The degree of damage was the highest in the farmland located within a distance of 1 km. Maize was the most affected crop, a huge quantity of loss (1051.92 quintal) in total land (972.72 ropani). Paddy and wheat was low in loss quantity (23.09 and 23.66 quintal respectively). The monetary value of crop lost was Rs.1159999.45 and the livestock lost inside 2 km area from the reserve's boundary wall cost Rs. 30450 in monetary value.

Sharma (1995) found that wild buffalo (*Bubalus bubalis*) and wild boar (*Sus scrofa*) are important crop raiders in Koshi Tappu Wildlife Reserve.

Poudyal (1995) found that on an average each affected household lost around Rs. 3132 annually due to crop loss by wild animals in Shivapuri National Park. Soti (1995) found Wild boar (*Sus scrofa*) as the main crop raider in Shivapuri National Park.

SIWDP (1996) has given the report of the wild boar in Shivapuri National Park. The report showed that in three months (April, May and June 1995), 352 wild boars were seen in 17 survey spots of Shivapuri National Park.

Kasu (1996) found two types of problems that create conflict in Parsa Wildlife Reserve that are: (a) problems created due to reserve and (b) problems created due to local people. He found that wild elephant, wild boar and chital are the major pest animals. He reported paddy damage was 77.52% followed by wheat and maize. The average economic loss of each household due to crop damage by wild animals was Rs. 3,191.48.

Limbu (1998) conducted the survey in Paschim Kusaha VDC, an adjoining village on eastern side of KTWR to study crop loss and human harassment. He found that the most notorious animals damaging the crops were wild boar and wild buffalo. The study also showed that the total loss of crops was 117,517 kg. The mostly damaged crop was paddy followed by wheat, and potato.

Gautam (1999) gave a report on crop damage by wild animals in proposed buffer zone of RSWR. He found highest economic loss 74.28% to paddy crops followed by wheat (17.08%) and maize (8.62%). He found that among the wild animals, highest economic loss 43.29% by wild elephant, followed by wild boar (28.32%), chital (2.09%) and blue bull (3.92%). He reported that loss of crop to wild animals ranged from 61.62 kg to 126.33 kg per household.

Barai (1999) surveyed on wild boar-man interaction in RBNP. He found an economic loss of Rs. 20, 95,346 of which 52.73% occurred in Thakurdwara and 47.27% in Shivapur. He found that the highest economic loss (28.32%) occurred to paddy crop, followed by potato (15.40%), maize (15.21%), wheat (13.80%), mussuro (12.42%) and yam (7.57%).

Acharya (1999) has found that besides protected areas, wild boar also presents in other semi-deciduous and temperate forests of Nepal.

Gurung (2002) reported about the conflict between park and people in Shivapuri National Park due to wild boar (*Sus scrofa*). He found that the distribution of wild boar was in a region ranging from 1400-2700m. The density of wild boar was maximum from 1400-2100m. The wild boar was found throughout the year within 2000-2100m and the economic loss of crop was Rs. 554989.31 and average economic loss was Rs. 4586.68 per household.

Bagale (2002) studied the population status of Nilgai and Nilgai- livestock- local people interaction in Lumbini. A total of 37 Nilgai were estimated. It was reported that the crop damage by the animal was 6.6%, 17.97% and 15.84% to paddy, wheat and mustard respectively and the loss per hectare being 1.42 quintals, 2.13 quintals and 0.42 quintal respectively for paddy, wheat and mustard in the year 2001-2002.

Paneru (2004) studied on crop depredation due to wild animals in Jitpurphedi, Chapalibhadrakali and Baluwa VDCs of Shivapuri National Park and found that wild boar was the major crop raider and monkey and porcupines were the minor crop raider. The animals were responsible for 1303.24 quintals loss of crops and loss were high at 0-1 km distances for paddy and wheat and 0-500 m for maize and millet.

## **4. RESEARCH METHODOLOGY**

This chapter deals with the methodology applied for conducting the research. Research methods are being described in three different steps: sampling method, data collection and data analysis. This study was entirely based on field surveys. The field survey was conducted for one year from October 2005 to October 2006.

### **4.1 Criteria of Selection of study area**

The following criteria were taken under consideration to select the study area for research:

- ) Well known National Park near from Kathmandu Valley.
- ) Less research have been done in the village development committee (VDC)
- ) Rich in Biodiversity
- ) Assessable from the valley

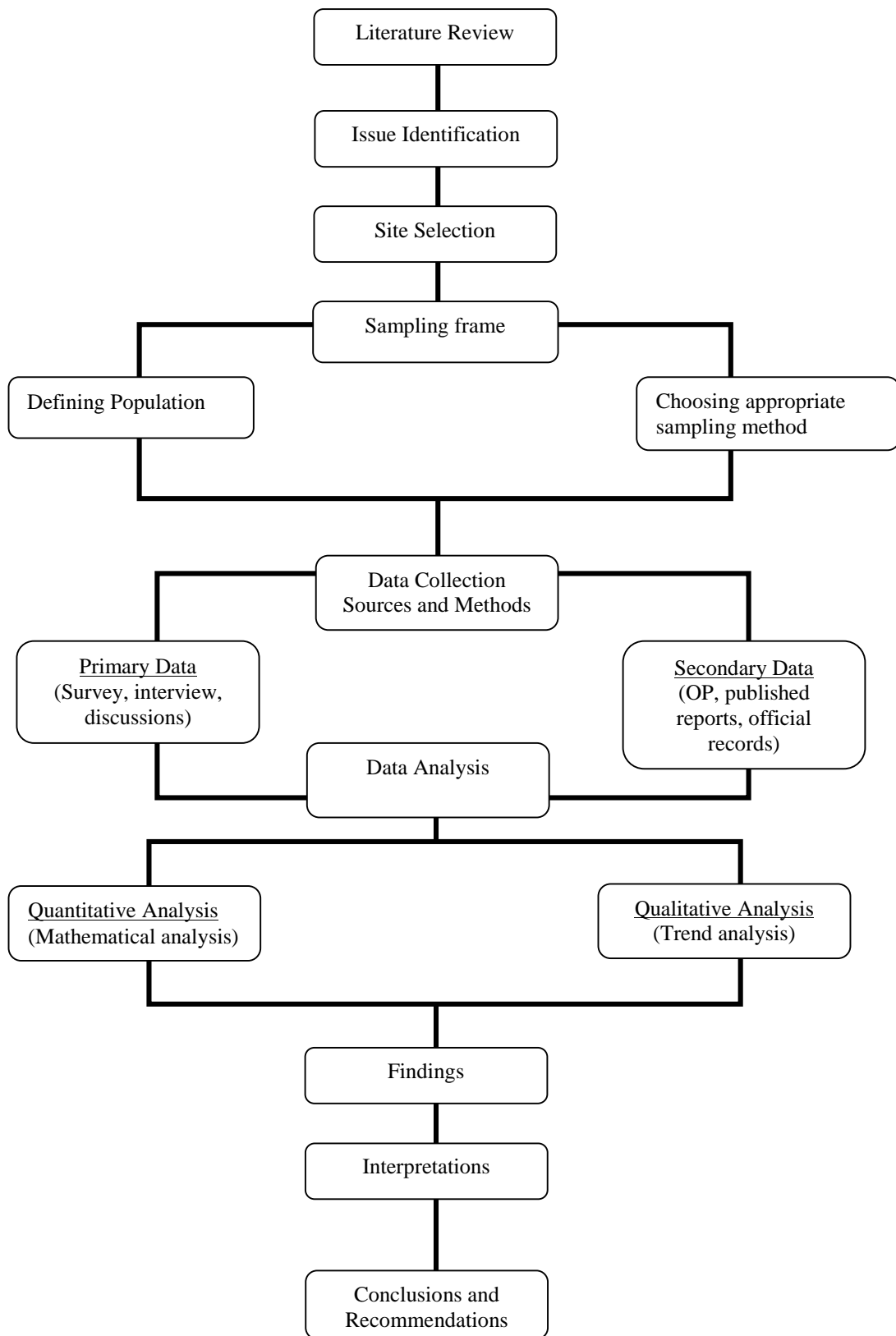
Based on the above selection criteria, Sangla VDC was chosen for the study. It is located nearby the National Park.

### **4.2 Selection of the Study Area**

Main objective of this study is to assess the loss of crops and human harassment by the wild animals of the Shivapuri National Park. Regarding objectives and available time, study should be focused on the VDC. Furthermore, accessibility, availability of required data, and familiarity with the area to complete field survey within available time also had to be taken into account while selecting the study area.

### **4.3 Research Framework**

In order to manage the research work in proper way within limited time and available resources, this work was divided in three different phases: preparation, field survey and post field work. Literature review and field preparation were main activities in the preparation phase. Required ground truth data were collected in the field work. Collected data were rearranged, tested and analysed to answer the research questions at post fieldwork phase.



**Fig.8: Research Framework Showing Different Steps and Activities**



## 4.4 Sampling Method

### 4.4.1 Sampling Design

To assess the crop and livestock depredation by wild animals, Ward No. 1, 2, 3, 4, 7 and 8 of Sangla VDC were selected since these areas are entirely located nearby walled boundary of the Shivapuri National Park and there is a regular comment on the loss of crops by the wild animals. The study of crop depredation was mostly based on household questionnaire survey that is supported by field observation. Simple Random Sampling Method was conducted to determine households to be surveyed since the households are homogeneous in distribution. All are suffering from same kind of problems and the farming system is almost same.

### 4.4.2 Sample Size

The sample size was determined before going to the study area on the basis of total households. The existing number of households in each ward was taken and the total affected households in each wards represented the percentage of the total households. About 30% of the total households are taken as the sample for the research.

The number of households sampled and the number of households surveyed are shown in table below.

**Table 4: Number of Sampled and Surveyed Households in Sangla VDC**

Ward No.	Total Household	Sampled Households	Surveyed Households	Surveyed Percentage (%)
1	52	16	16	30.77
2	127	38	38	29.92
3	59	18	18	30.51
4	60	18	18	30
7	37	11	11	29.73
8	54	16	16	29.63
<b>Total</b>	<b>389</b>	<b>117</b>	<b>117</b>	

## **4.5 Data Collection Method**

Required data to answer the research questions were collected during fieldwork. Different types of data were needed to answer the different research questions. The study on crop depredation by the wildlife, done in Sangla VDC, was based on various data collection methods.

### **4.5.1 Primary Data Collection**

The primary data includes information collected from the study area through the field survey with direct observation, informal interview with the villagers and household questionnaire survey. One set of questionnaire was designed to receive information about crop damage and other local conflicts due to the wild animals (Annex 1). Another set of questionnaire was developed to ask National Park Officer and respected individuals to know the measures applied for the resolution of the problem (Annex 2).

### **4.5.2 Secondary Data Collection**

The secondary data like the Ward wise distribution of the households and the population for the VDC as a whole was obtained from CBS office and VDC office (2004). The secondary data used in the study were also received form various books, articles and brochures and concerning departments and offices and also from published and unpublished journals.

Ward wise Distribution of Household and Population in Sangla VDC is shown in the table below.

**Table 5: Ward wise Distribution of Household and Population in Sangla VDC**

<b>Ward No.</b>	<b>Village</b>	<b>Total Household</b>	<b>Total Population</b>
1.	Salle	52	253
2.	Kunjipwakal	127	657
3.	Dhakalchaur	59	373
4.	Chuni	60	300
7	Patapu	37	218
8	Katheri	54	284
<b>Total</b>		<b>389</b>	<b>2085</b>

Source: National Population Census 2001, Nepal (Page: 829 of 1999)

#### **4.6 Data Analysis**

Data analysis is the process of bringing order to the data, organizing what is there into patterns, categorizes and basic descriptive units (Patton, 1988). The collected data was quantitatively analyzed. The crop damage i.e. the loss per unit area is calculated. The objectives behind this are to calculate the total loss of different crops i.e. maize, millet, wheat and paddy. It defines the magnitude of the damage on different crops. It is defined as

$$i) \ x \ X \frac{xE \ Z \ xA}{xLC}$$

where, x = loss per unit land

xE = expected yield before crop loss

xA = actual yield after crop depredation

xLC = total cropping land of that field

$$\text{ii) } xL = xE - xA$$

where,

$xL$  = total loss

$$\text{iii) } \text{Loss percent (\%)} = \frac{xL}{xE} \times 100$$

iv) Statistical Analysis

Chi- square Test was used to determine whether there is significant difference between **observed productivity** and **expected productivity** of the crops. **Expected productivity** of the crops of the VDC is the productivity if the crops have not been depreded by the wild animals. Whereas, **observed productivity** of the crops refer to the recently obtained productivity by the farmers of the VDC.

**Ho : There is no significant difference between observed productivity and expected productivity. (O = E)**

**H1 : There is significant difference between observed productivity and expected productivity. (O ≠ E)**

Mathematically;

$$\text{Chi-square ( } t^2 \text{ )} = \sum \frac{(O-E)^2}{E}$$

2

## 5. RESULTS

### 5.1 Total Cultivated Land and Land Holding per Households

Total cultivated land owned by the surveyed households in six wards of the Sangla VDC was 19.01 hectares. It was found that the cultivated land was 6.78 hectares in Ward No. 2 which was the highest and the cultivated land in Ward No. 7 was 1.41 hectares which was the lowest (Fig. 9). The land holding per household was more in Ward No. 2 i.e. 0.18 hectare/ household and lowest in Ward No. 7 i.e. 0.13 hectare/ household. The average land holding per household in the surveyed household was 0.95 hectare/ household (Table 6.1).

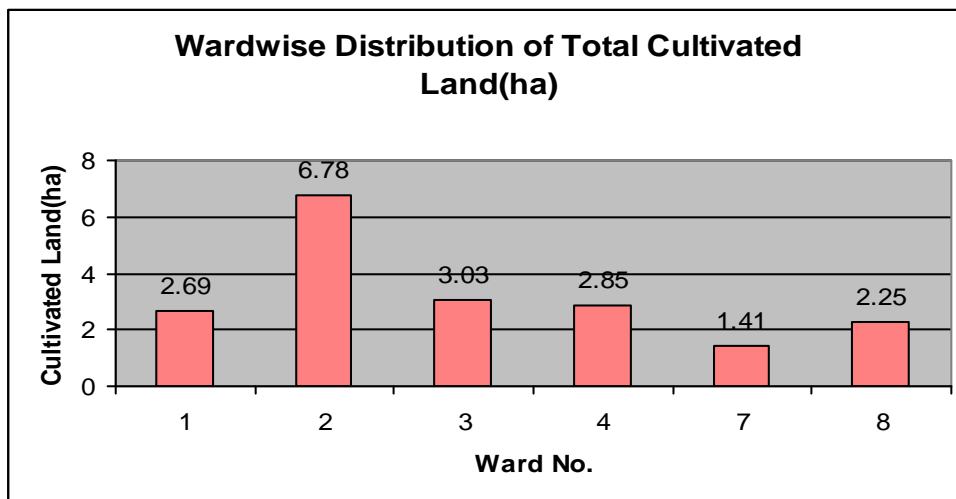


Fig.9: Ward wise Distribution of Total Cultivated Land

### 5.2 Crops Grown

The major crops grown in the study area were maize, millet, wheat and paddy. Other crops such as potato, buckwheat, mustard, vegetables etc were also grown in the area. The cropping sequence in the upland was maize- millet intercropping followed by wheat and paddy. The lowland was also cultivated by maize, millet, paddy followed by wheat. From the study, it was found that every household grows paddy and wheat i.e. 100% households grow paddy, and wheat. 86.32% of the households grow maize and millet 71.79% of the households grows other crops (Table 6.2, 6.3, 6.4, 6.5, 6.6).

**Paddy** In the surveyed households, all households of every wards grow paddy i.e. paddy was the dominant crops grown in the study area (Fig. 10, Table 6.2).

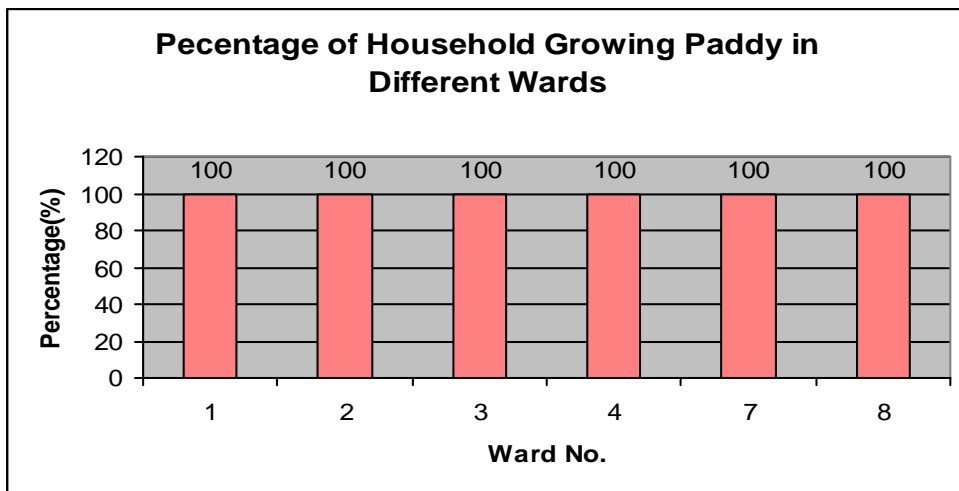


Fig. 10: Percentage of Household Growing Paddy in Different Wards

**Wheat** Out of 117 surveyed households, all households of every wards grow wheat i.e. 100% of households grow wheat (Fig. 11, Table 6.3).

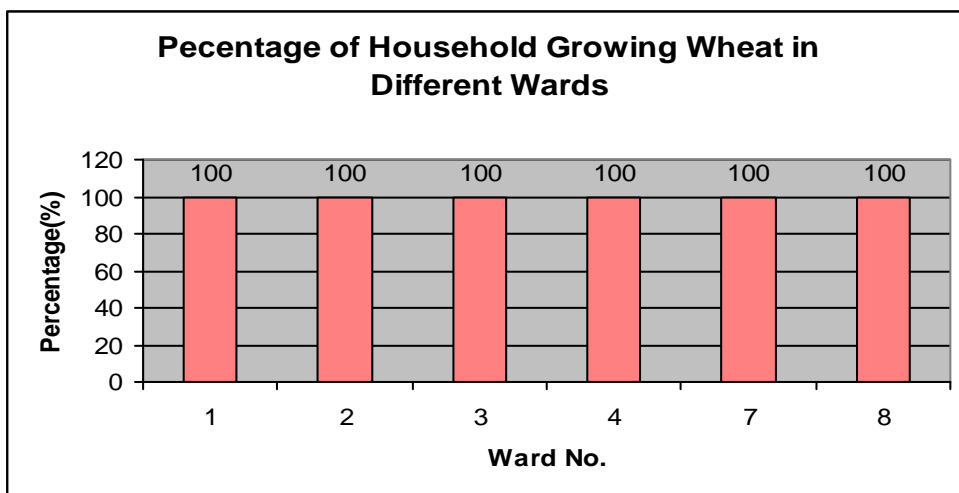


Fig. 11: Percentage of Household Growing Wheat in Different Wards

**Maize** Out of 117 surveyed households, only 101 households grow maize i.e. 86.32% of the households grow the maize. In Ward No.4, 50% of the households grow maize and in Ward No. 7, only 36.36% of the households grow maize. Except in these two Wards, maize was grown by 100%households in other four Wards. (Fig. 12, Table 6.4).

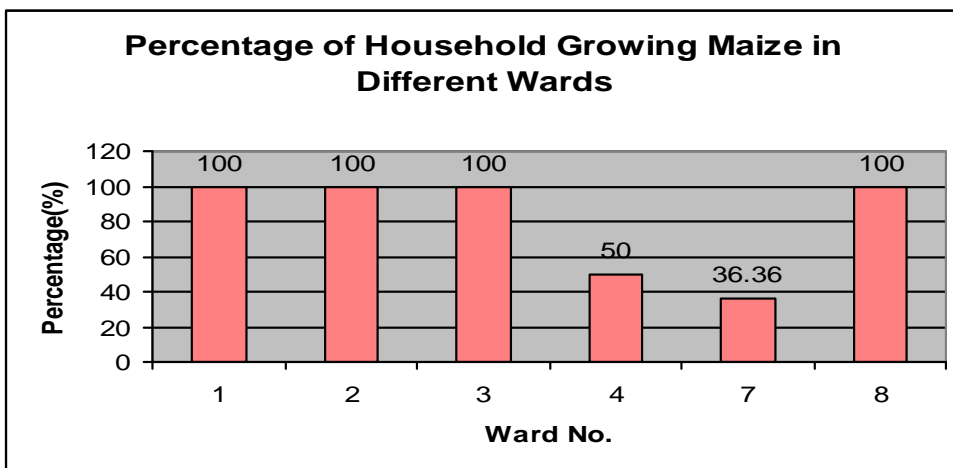


Fig.12: Percentage of Household Growing Maize in Different Wards

**Millet** From the study, it was found that 101 households grow millet out of 117 surveyed households i.e. 86.32% of households grow millet. It was found that in Ward No.1, 2, 3 and 8, there 100% cultivation of the millet and Ward No. 7 was the area where millet was grown in fewer amounts (Fig. 13, Table 6.5).

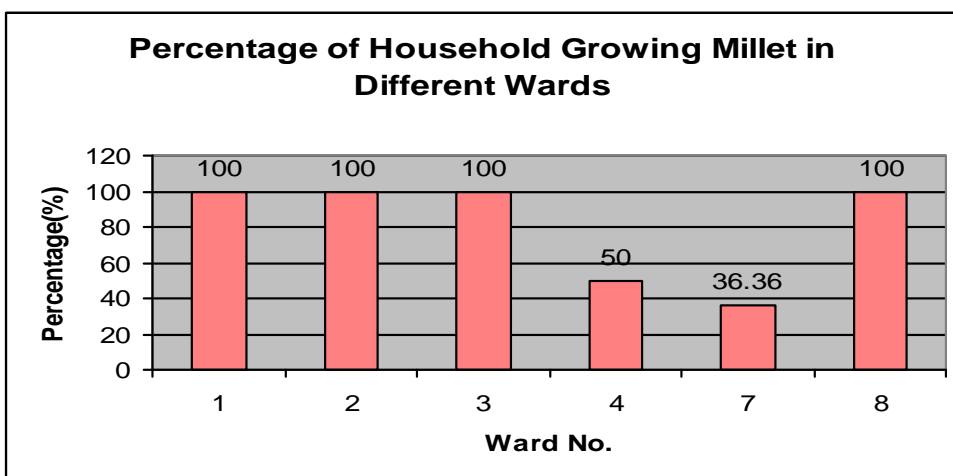


Fig. 13: Percentage of Household Growing Millet in Different Wards

**Other Crops** Although 71.79% of the households grown buckwheat, mustard, vegetables, potato etc, the area covered by these crops was very small (Fig.14, Table 6.6)

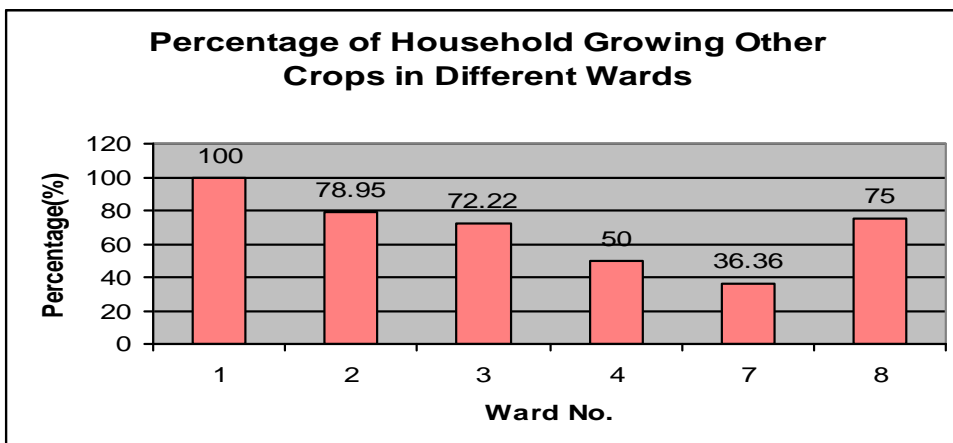


Fig. 14: Percentage of Household Growing Other Crops in Different Wards

### 5.3 Land Coverage by Major Crops

Paddy and wheat were the dominant crops grown in the study area followed by maize and millet. Besides these crops, potato, buckwheat, mustard, fruits etc. were also cultivated in small amount. The total land coverage by major crops in the surveyed households is shown in figures 14, 15, 16 and 17 (Table 6.7, 6.8, 6.9 and 6.10).

**Paddy** The study showed that paddy was grown in 42.71 hectares of the total cultivated land i.e. 19.01 hectare. Approximately 87% of the total cultivated land was occupied by paddy in Ward No. 7 which was the largest area among the six wards and about 53.33 % of the total cultivated land was covered by paddy in Ward No.8 which was the smallest (Fig.15). About 62% of the land was cultivated by paddy (Table 6.7). It means that local people in the study area heavily depend on paddy

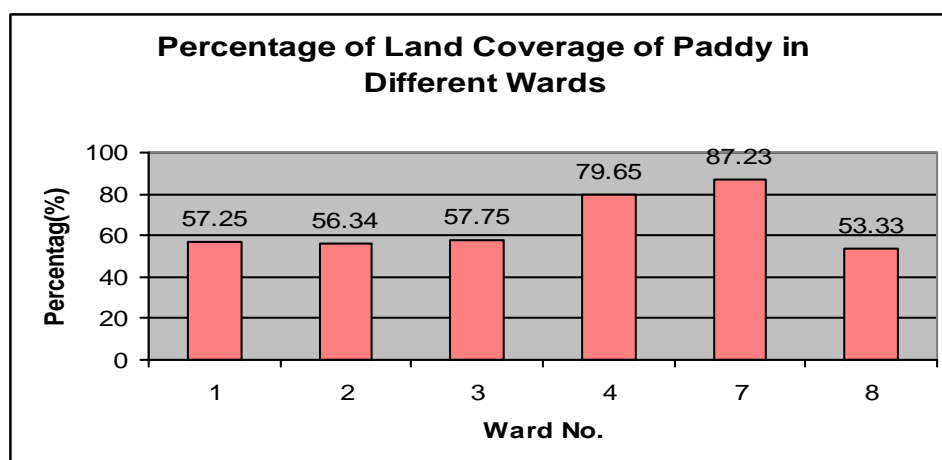


Fig. 15: Percentage of Land Coverage of Paddy in Different Wards



**Wheat** From this study, it was found that wheat was grown in 11.18 hectare of the total cultivated land i.e. 62.12% of the land was cultivated by millet. In Ward No. 7, there was also high percentage of land covered by wheat i.e. approximately 87% of the total cultivated land was covered by wheat. In Ward No. 8, only 53.33% of the total cultivated land was cultivated with wheat (Fig.16, Table 6.8).

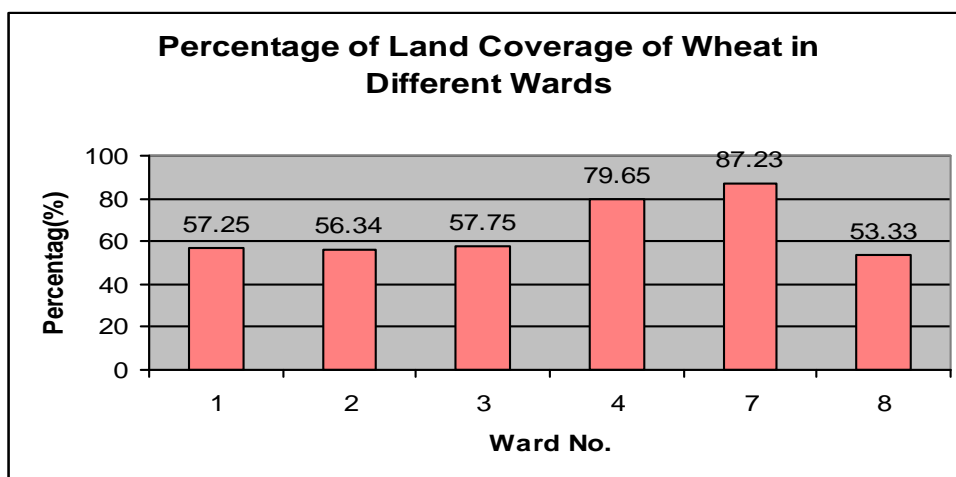


Fig. 16: Percentage of Land Coverage of Wheat in Different Wards

**Maize** It was also found that only 6.83 hectare of land was cultivated with maize out of 19.01 hectares of total cultivated land. It means that 35.93% of the total cultivated land was covered by maize. In Ward No.8, there was high percentage of land cultivated with maize and in Ward No. 7, there is the lowest percentage of land cultivated with maize. (Fig.17, Table 6.9). It means that there is the opposite relation between these two Wards in the cultivation of maize and paddy.

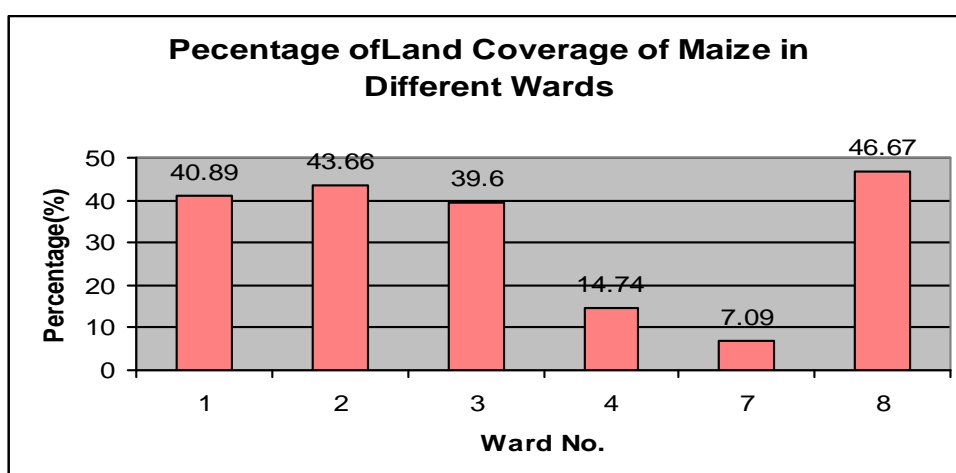


Fig. 17: Percentage of Land Coverage of Maize in Different Wards

**Millet** From this study, it was also found that only 5.78 hectares of land was cultivated with paddy out of the total cultivated land. In Ward No. 8, there was high percentage of land cultivated with millet. The percentage of land cultivated with millet was low in Ward No. 7 (Fig. 18, Table 6.10).

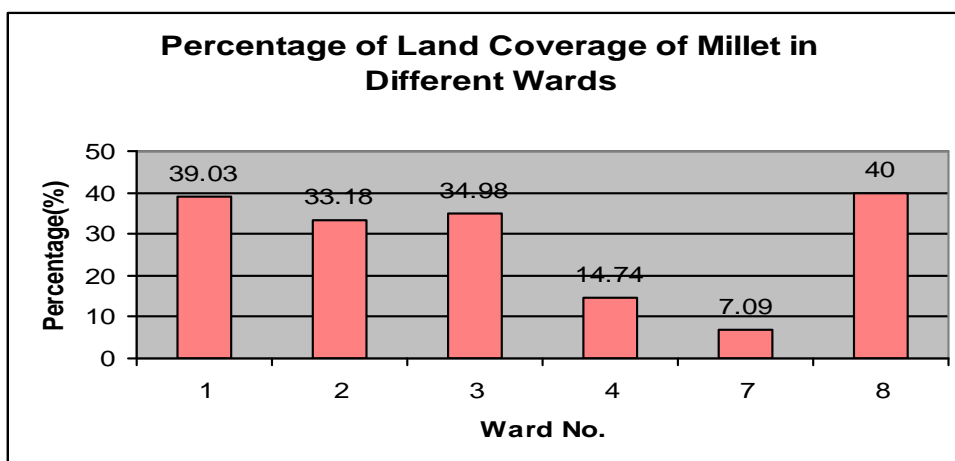


Fig. 18 Percentage of Land Coverage of Millet in Different Wards

## 5.4 Types of Problem

Different types of problems were found in the study area. Crop damage and human harassment were the problems faced by the local people living in that area near the national park. In the surveyed households, 88.99% households reported that crop damage by the wild animals was the main problem. Human harassment was not the serious problem, only 2.58% reported about the human harassment by the wild animals (Fig. 19, Table 6.11).

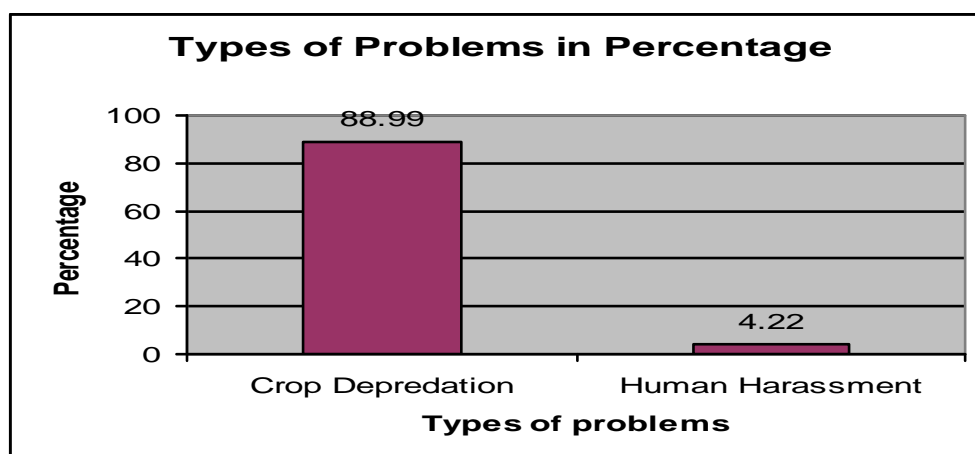


Fig. 19: Types of Problems in Percentage

## 5.5 Loss of Major Crops

**Paddy** was the major crop in Sangla VDC and it covers about 11.81 hectares of the total cultivated land. The expected production of paddy was 52724 kg whereas the amount harvested by farmers was 44780 kg. There is significant difference between expected productivity and observed productivity of paddy ( $t^2_{5, 0.05} = 787.13$ ). It showed that the null hypothesis is accepted and alternative hypothesis is rejected. In all the wards, the observed productivity of paddy is less than the expected productivity. There was loss of 7944 kg of paddy in the surveyed households. Average loss per hectare was found to be 756.27 kg. The study showed that 15.07% of the expected production of paddy was lost. The loss percentage of paddy was highest in Ward No. 3 (Fig. 20, Table 6.13(a)). The loss is mainly due to depredation by wild animals (as observed from questionnaire survey).

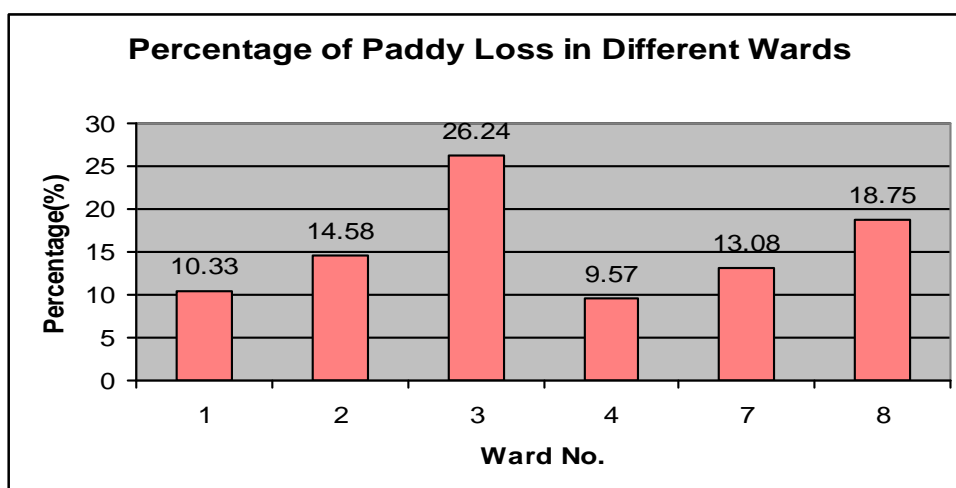


Fig. 20: Percentage of Paddy Loss in Different Wards

**Wheat** was grown in 11.81 hectares of the total cultivated land and the expected production of wheat was 37145.50 kg whereas the actual production was only 32438 kg. There is significant difference between expected productivity and observed productivity of wheat ( $t^2_{5, 0.05} = 317.6$ ). It showed that the null hypothesis is accepted and alternative hypothesis is rejected. In all the wards, the observed productivity of wheat is less as compared to the expected productivity. The loss of wheat was 4707.50 kg. Average loss of wheat per hectare was found to be 431.08 kg. This means that 12.57% of the expected production of wheat was lost due to

depreddation. The loss percentage of wheat was highest in Ward No.8 and lowest in Ward No.1 (Fig. 21, Table 6.14(a)). This loss is due to the wild animals.1

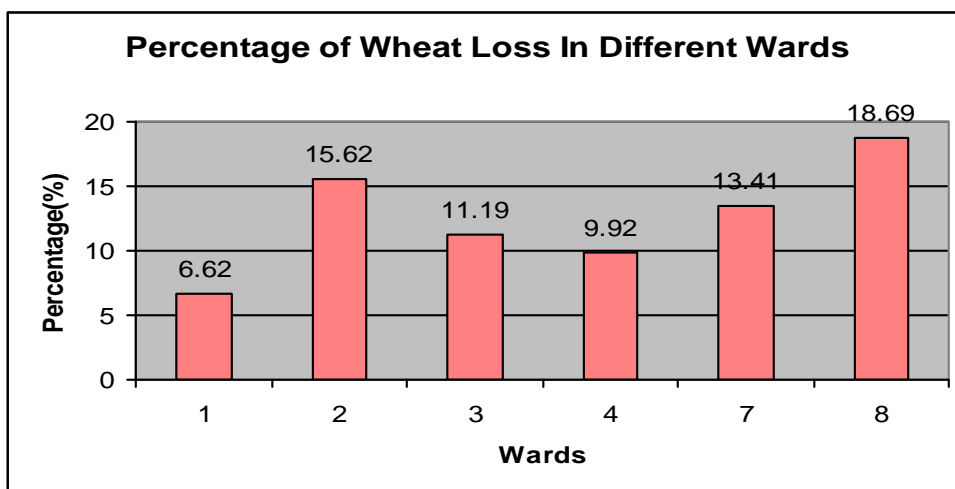


Fig. 21: Percentage of Wheat Loss in Different Wards

**Maize** was grown in 6.83 hectares area of the total cultivated land. The expected production of maize was 23765 kg but only 16821 kg of maize was harvested in the surveyed households, and 6944 kg was lost. There is significant difference between expected productivity and observed productivity of maize ( $t^2_{5,0.05} = 1561.6$ ). It showed that the null hypothesis is accepted and alternative hypothesis is rejected. Here also the observed productivity was less as than the expected productivity. Average loss per hectare was 1225.01 kg. The loss percentage of wheat was highest in Ward No. 3 and in Ward No. 4, there was lowest percentage of loss of maize (Fig. 22, Table 6.15(a)). From the questionnaire survey, the loss was found to be mainly due to the wild animals.1

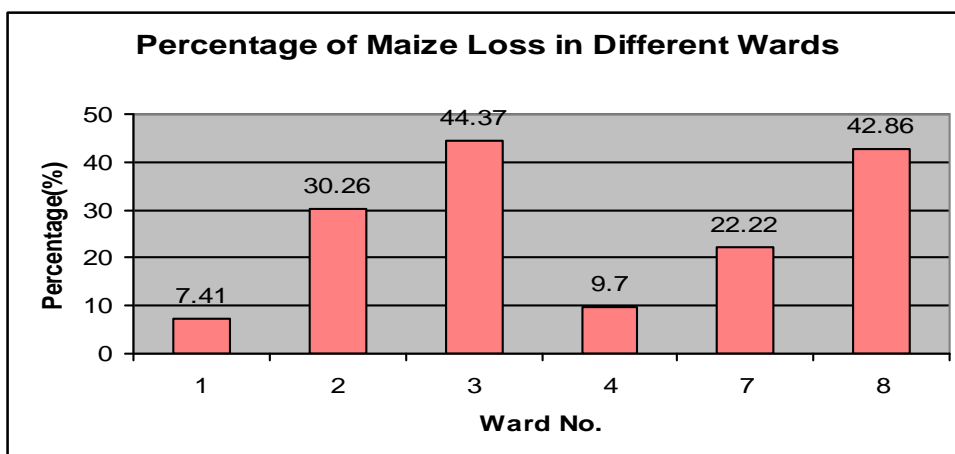


Fig. 22: Percentage of Maize Loss in Different Wards

**Millet** was grown only in 5.78 hectares of the total cultivated land in the surveyed households. The expected production of millet was 14415 kg but only 10775 kg of millet was grown, loss was 3640 kg. There is significant difference between expected productivity and observed productivity of millet ( $t^2_{5, 0.05} = 698.75$ ). It showed that the null hypothesis is accepted and alternative hypothesis is rejected. Here also, the observed value is less than the expected one. Average loss per hectare was 724.53 kg. The loss percentage of millet was highest in Ward No. 8 (Fig. 23, Table 6.16(a))

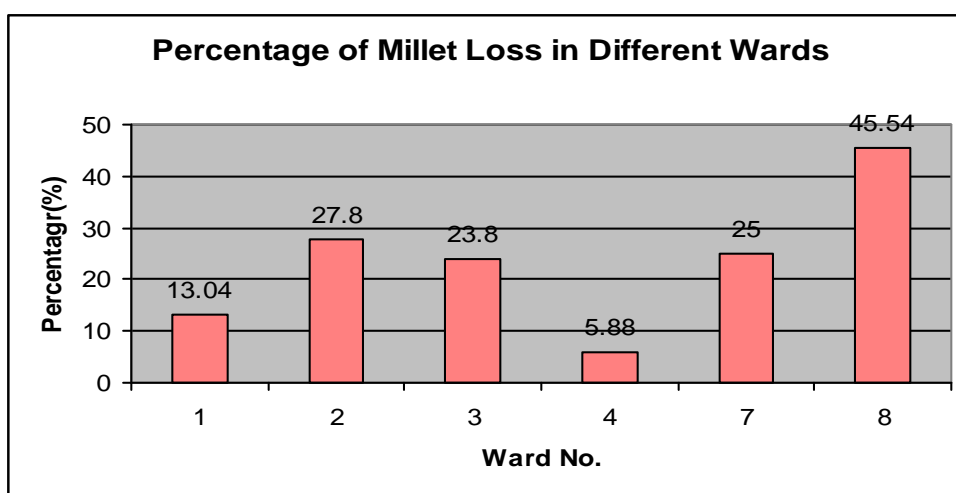


Fig. 23: Percentage of Millet Loss in Different Wards

## 5.6 Loss of Crops by Different Animals

Wild boar and porcupines were found to be the common wild animals that usually raid on crops. The most destructive wild animal damaging the crops was the wild boar. Other wild animals including rat, squirrel etc. also damaged the crops. The study showed that 52.53% of the household reported wild boar as the main crop raider followed by birds (43.80%). 19.79% of the households said that porcupines also damaged the crops (Fig.24, Table 6.17).

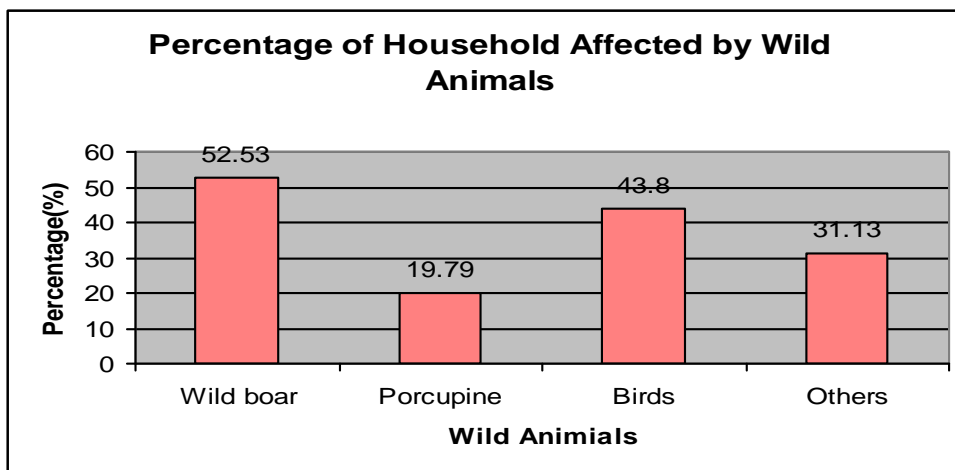


Fig. 24: Percentage of Household Affected by Wild Animals

### 5.7 Market Price and Monetary Value of Damaged Crops

The total loss of the major crops in the study area due to the crop raiding by different wild animals is 23235.50 kg. The loss of maize, millet, paddy and wheat is 6944 kg (26.14%), 3640 kg (23.51%), 79.44 kg (15.07%) and 4707.50 kg (12.57%) respectively. (Table; 6.18, Fig.24). The total lost of the crops in the sampled households is NRs. 628138. On an average each affected household lost approximately NRs. 5368.70 annually due to the crop damage by wildlife.

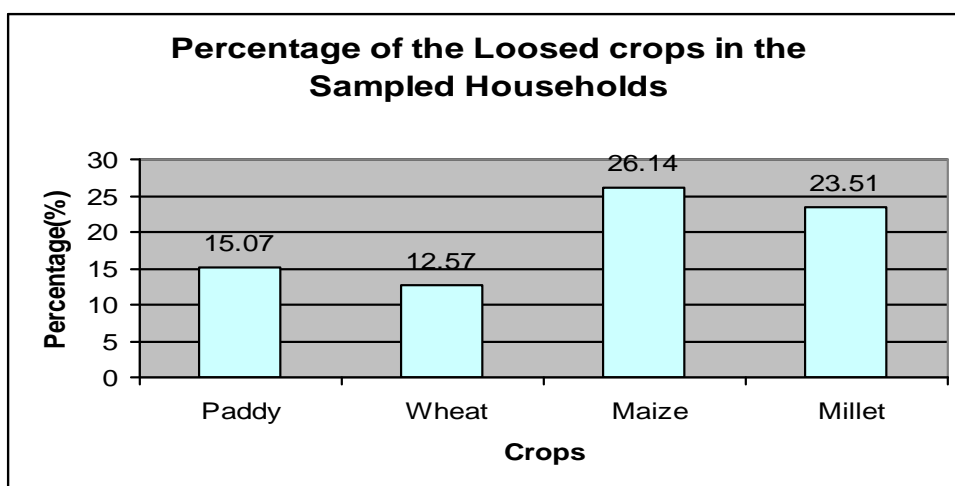


Fig. 25: Percentage of the lost crops in the Sampled Households

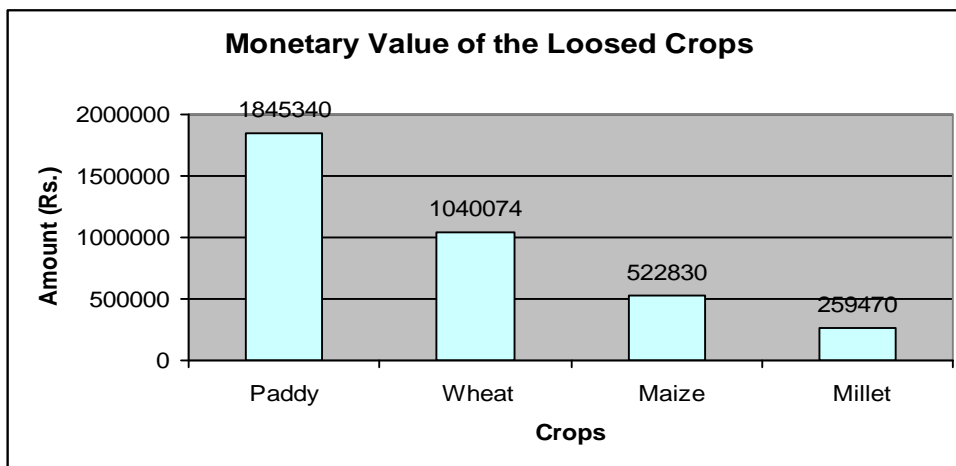


Fig. 26: Monetary value of the Lost Crops

### 5.8 Wild Animals Damaging Crops

**Paddy** In the 117 surveyed households, 57 households reported the bird as a major paddy raider. 24 households told that the wild boar also heavily damages the paddy. It was also found that porcupines and other animals including rat, squirrel also damage the paddy (Fig. 27, Table 6.19).

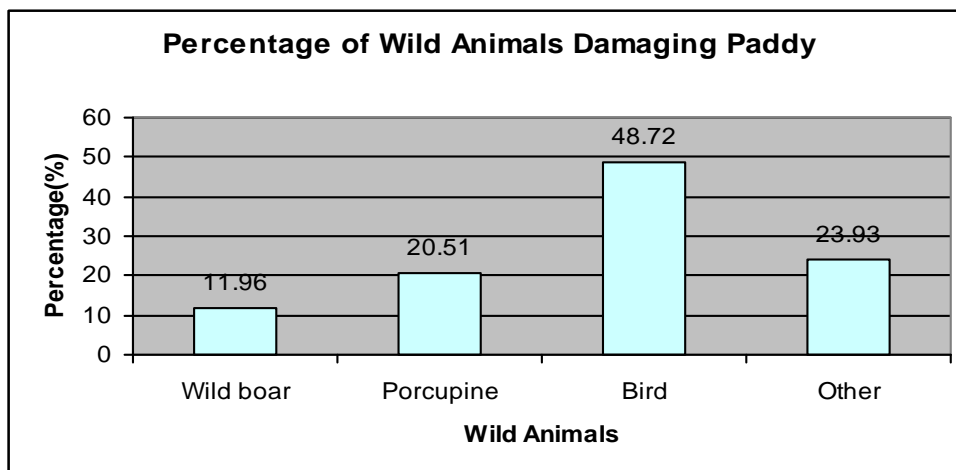


Fig. 27: Percentage of Wild Animals Damaging Paddy

**Wheat** In the 117 surveyed households, 56 households told that birds damage the wheat. 20.51% of households told that the other animals like; rat, squirrel etc are also serious wheat raider. 18.8% of households reported that the porcupines damage wheat. 11.96% of households reported wild boar as a wheat raider (Fig. 28, Table 6.20).

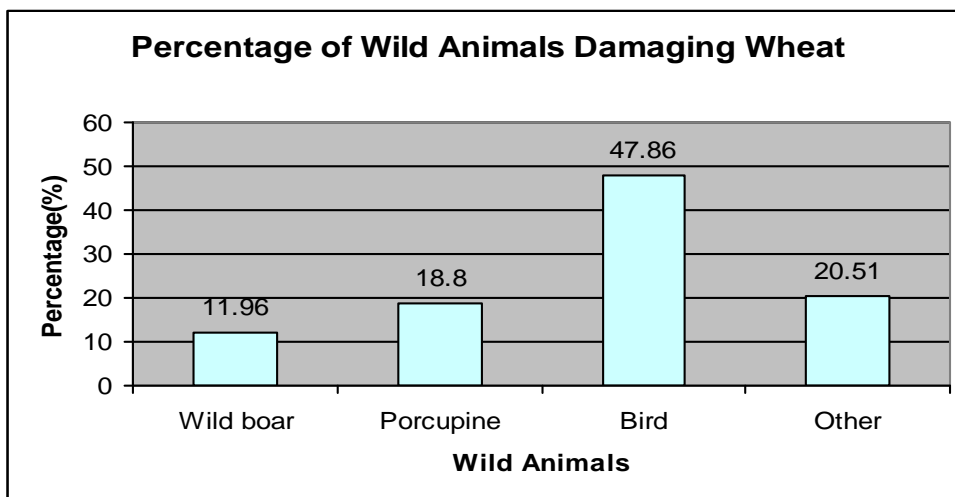


Fig. 28: Percentage of Wild Animals Damaging Wheat

**Maize** Among 117 surveyed households, 86.32% households had grown maize in their field. It was found that 54.70% of households reported wild boar as a serious maize raider. 35.89% of household told that birds also damage the maize. Wild boar damages the maize at the milky stage. 18.80% of households told that porcupines damage the maize and other animals also damage the maize in the study area (Fig. 29, Table 6.21).

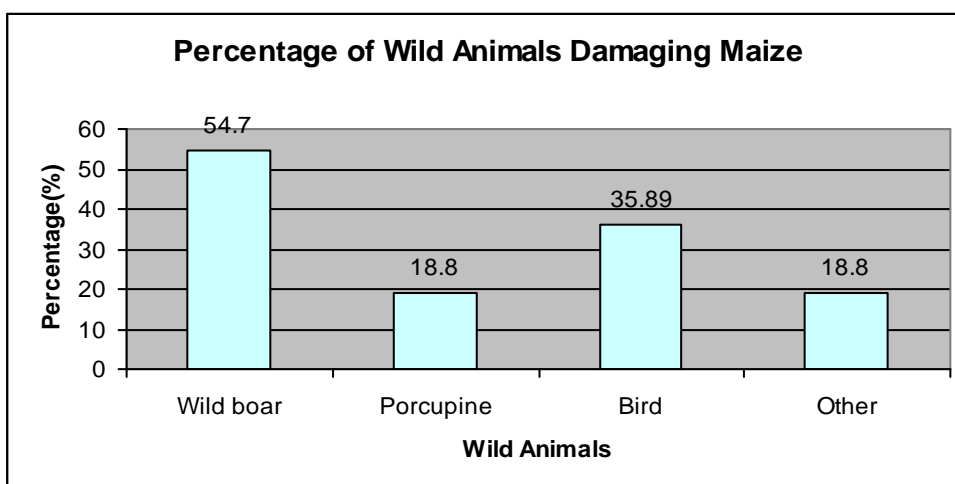


Fig. 29: Percentage of Wild Animals Damaging Maize



**Millet** In 117 households surveyed, it was found that 43.59% of households reported wild boar damages the millet most. 33.33% of households reported that birds damage the millet. 14.53% of households said porcupines damage the millet and 23.93% of household told other animals also damage the millet (Fig. 30, Table 6.22).

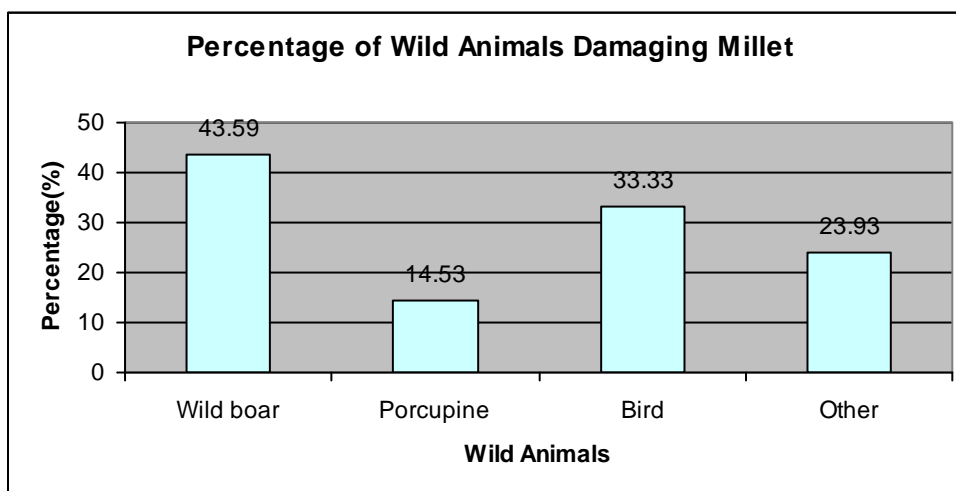


Fig. 30: Percentage of Wild Animals Damaging Millet

## 5.9 Stages of Crop Damage by Wild Animals

Loss of crops due to wild animals varied in different stages of crops. Maize was found to be damaged by wild boar at milky grain stage to adult stage. The milky grain stage was preferred most. Wheat was destroyed in milky stage and adult stage and sometimes milky shoot was preferred by wild boar. Millet was found to be damaged from young to adult stage and paddy was damaged from milky stage to mature stage.

**Table 6: Stages of Crop Damage**

S.N.	Name of Wild animals	Crops	Stage of Crop Raiding
1	Wild boar Porcupines Birds	Paddy	Young to adult stage Young to adult stage Adult stage
2	Wild boar Porcupines Birds	Wheat	Young to adult stage Young to adult stage Seedlings
3	Wild boar Porcupines Birds	Maize	Milky to adult stage Milky to adult stage Seedlings
4	Wild boar Porcupines Birds	Millet	Young to adult stage Young shoot Adult stage

### 5.10 Techniques of Crop Protection

Wild animals damage the crops every year. The problem created by the wild animal has become severe day by day in the upper land area, near the national park. To reduce the crop damage by the wild animals, the local people of the every ward have adopted some preventive measures i.e. above 50% of the households in every ward have adopted the preventive measures (Table 6.23, Fig. 30). In the surveyed households, only some households had not used the techniques. Though the people of the every ward had tried the preventive method, it did not seem to be effective in controlling the loss as it was mostly labour intensive and primitive (Table 6.24). These preventive methods were less effective since the people chase the wild animals when they saw them in their field. Wild boar was the most destructive since it is nocturnal animal and damages the crops at night as the farmers cannot wake up whole night. The preventive methods include shouting and clapping, spending night on machan, following with fire and shouting, making noise by beating empty tin etc. In the study, it was found that 41.02% of the households using shouting and clapping method in day time and only 16.24% of households spending night on machan as most of the villagers cultivated land is far from their houses. Scare crew was also used to chase the wild animals and birds.

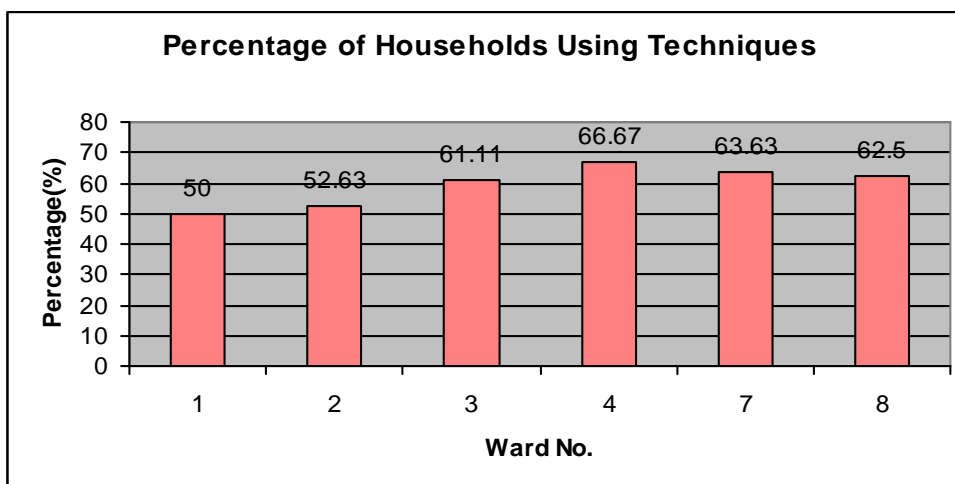


Fig. 31: Percentage of Households Using Techniques

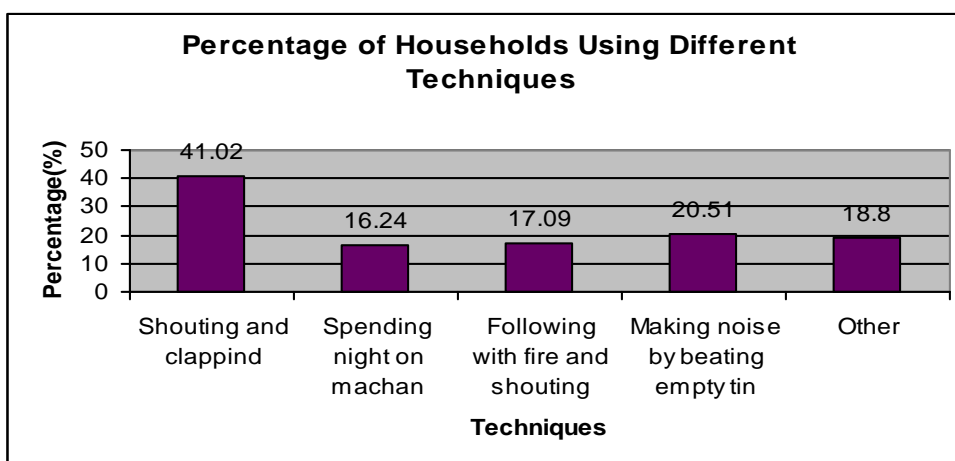


Fig.32: Percentage of Households Using Different Techniques

## 5.11 Livestock Reared

Livestock rearing is another major activity next to crop production and is taken as a supplementary income source of the households. Livestock play a significant in household's food sufficiency and economy, as it provides valuable food and have selling values in the market. It was found that all households have their own livestock. The number of goat was high in the study area. The number of goat was 175 i.e. 47.04% of the total livestock. Buffalo constituted the smallest number only 35 i.e. 9.41% of the total livestock. Similarly cow constituted 19.62% and others constituted 23.92% of the total livestock. Others include pigeon, hen, duck etc. In Ward No. 2, there was the highest number of livestock and in Ward No. 7 there was the lowest number of livestock (Table 6.25).

## 5.12 Wildlife Attack on Human

There was no record of people attacked by wildlife from the four wards out of six wards of the study area. But in Ward No. 2, it was found that 1.52% of the people were attacked by the wild animals during a few years period and from Ward No. 8 it was found that 1.06% of the people were attacked by the wild animals (Table 6.12, Fig. 33)

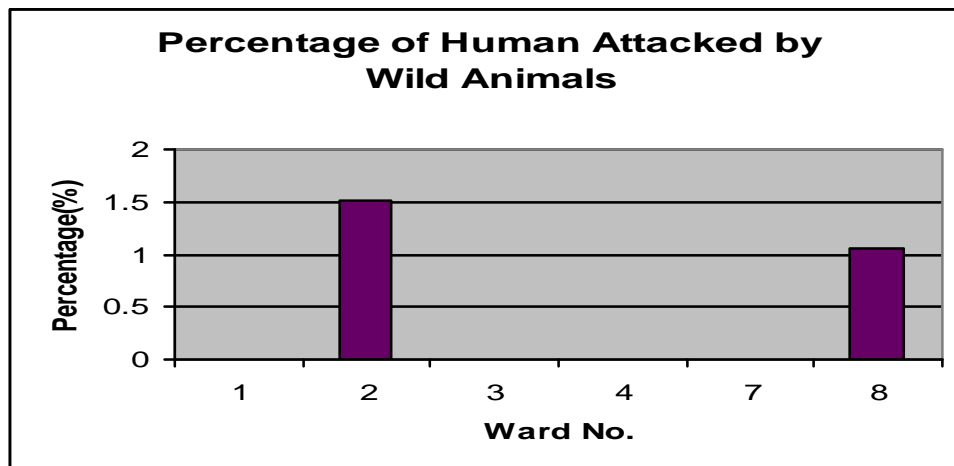


Fig.33: Percentage of human attacked by Wild Animals in different Wards

## 5.13 Fuel Wood and Fodder Collection

The study showed that the local people of the upper land area, near the national park were dependent on national park for firewood and fodder. Agricultural residues fulfill only the little part of total firewood and fodder requirements. Due to the lack of community forest and private forest also, local people were compelled to enter the national park for the collection of firewood and fodder which is illegal according to the rules of Protected Areas. According to the park staff, the local people lop off green branches of the trees, bushes and grass for fodder, the most serious problem causing the conflict. Along with the fodder, firewood was also collected by the people. Not only fodder and firewood collection but also timber poaching was the serious problem. But among the six wards of the study area, local people of Ward no. 4 and ward No. 7 told that they do not enter the national park area even though they are needed. They buy the firewood and wheat flour, corn flour to feed their livestock.

## 5.14 Hunting

According to the park staff, in the earlier days the local people used to hunt wild boar but today the wild boar as well as other wild animals were not hunted. The park has no data of the wild animals hunted by the local people.

## 5.15 People's Perception

Local people reported that there is no difference in the management after it has been converted into national park. The revenue collected has not been used for the betterment of the local people. The park collects money as entry fee, camping fee, vehicle fee, penalties, tender form and filming etc. In the fiscal year 060/061, NRs. 23,37,615 revenue was collected by the ShNP (Annual Report, 2005) and the money collected was not used for the betterment of the local people. The local people reported either they should be compensated or they should be allowed to enter the forest for fodder, firewood, timber and NTFPs collection (Fig.34, Table 6.27).

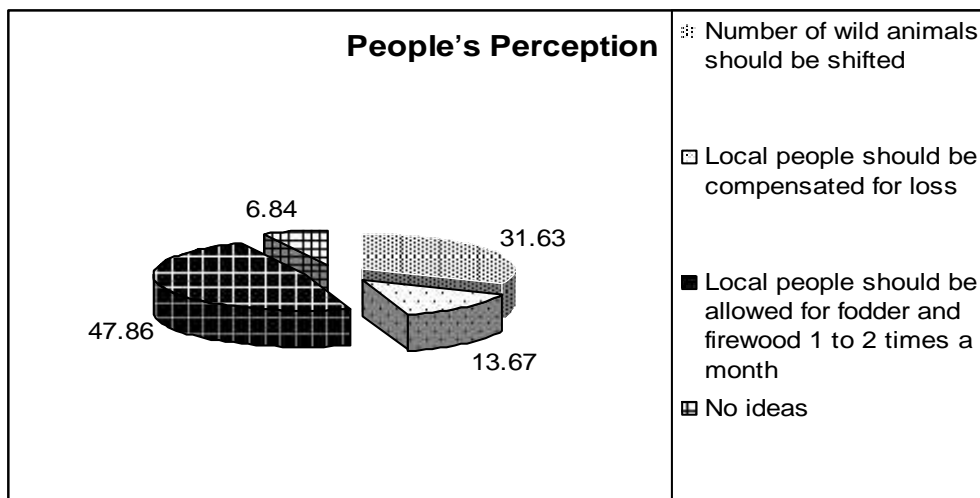


Fig.34: People's Perception in percentage

## 6. DISCUSSION

Human being started agriculture since many years ago to fulfill their basic needs. The Nepalese economy is primarily based on agriculture. The population is growing day by day. There is no sufficient place for the growing population so they started to encroach the jungle. It resulted deforestation, unbalance of ecosystem, flood problems, drought etc. So, due to destruction of wildlife habitat, the animals were compelled to move into crop fields and community forests of the villagers for food. In order to establish wild animals in their in situ state and to control the use of forest, it is necessary to conserve the jungle. Conservation means to protect overall wildlife areas and natural habitat ecosystem.

This study was conducted in the six wards of the Sangla VDC of ShNP, one of the national parks, which is only 13 km from the core city of Kathmandu. Crop damage, human harassment by the wildlife and the illegal activities such as fodder, firewood and timber collection by the local people are the main issues. The aim of this study was to assess the quantity of crop loss by the wild animals, the most destructive wild animal and also to estimate the actual amount and annual monetary value of crops lost through depredation by wildlife.

Simple random sampling method was applied for the study. The total number of surveyed households was 117. Total cultivated land and average land holding per household were 19.01 hectares and 0.95hectares/ household respectively.

Present study showed that paddy, wheat, maize and millet were the major crops of the study area. All the households grow paddy and wheat. In the upland area, near the national park, maize and millet were the major crops, but in the low land area, wheat, paddy were the crops cultivated as major crops. Along with these crops, other crops such as potato, buckwheat, mustard, vegetables etc. were also grown in the study area.

The statistical analysis i.e. **Chi-square test** (  $\chi^2$  ) showed that there is significant difference between Expected and Observed productivity of the crops grown in the study area. This concludes that the loss in production is prevailed there. This loss was found to be done by the wild animals of ShNP as the studied area is in the vicinity of the park.<sup>1</sup>

This study showed that the loss of major crops by wild animals was 23235.50Kg. The percentage of maize loss was the highest among the other crops. The loss of maize was 26.14% of the expected production, millet was 23.51% of the expected production, paddy was 15.07% of the expected production and wheat was 12.57% of the expected production.

Poudyal (1995) showed the loss of wheat was 30.47% of the expected production, maize was 35.12% of the expected production, millet was 47.35% of the expected production and paddy was 2.1% of the expected production in Sundarijal VDC of ShNP. Soti (1995) calculated the percentage of millet loss was higher than other crops like maize, wheat and paddy in ShNP. Paneru (2004) calculated the percentage of maize loss was the highest in the three adjoining VDCs of ShNP.

The study also showed that the **wild boar** was the most destructive wild animal. Other animals like porcupines, birds, squirrels etc. also damage the crops but in small quantity. 52.53% of households said that the wild boar as the main crop raider.

Soti (1995), Poudyal (1995) and Paneru (2004) found wild boar as the most notorious and destructive animal among the animals in ShNP. Poudel (2001) reported that the wild boar and monkey were found to be found to be the most destructive wild animals; it may due to the increasing number. Also there is no any research carried out to know the carrying capacity of wild animals in ShNP and the wild boar being notorious animal.

The study also showed that the paddy, wheat, maize and millet all were affected by the wild animals like wild boar, porcupines, birds and other animals.

Kattel (1993) also identified wild boar, monkey, porcupines and birds as the crop raiders in SWWR. Poudyal (1995), Soti (1995) and Paneru (2004) also found wild boar, monkey, porcupines, birds and other animals as the crop damaging animals.

According to the local representatives, wild animals come out from the park due to low quality wall and habit of wild animals to change taste during different seasons. Whereas, in accordance with the park officers, wild animals visit agricultural fields as animals go in search of preferred food, which is lacking inside the park. This is

because of livestock grazing, collection of the firewood, timber etc. by the local people inside the park.

Loss of crops due to wild animals varied in different stages of crops and it depends on the availability of palatable food in adjoining areas. Different animals preferred different stages of same crop. Wild boar preferred the crop mostly at milky stage while porcupine preferred the crop at the milky grain stage. Birds damage the crops at seedling stage and at the ripening time. According to Soti (1995), Poudyal (1995), Gurung (2002) and Paneru (2004), wild boar raid wheat at milky stage porcupines are however not interested in wheat in ShNP. In the study, porcupines were also found damaging the crops. It may be due to the shortage of the crops.

According to NPWC Act Section 5, the activities like fuel wood, timber, fodder and NTFPs collection, poaching, animal grazing etc. are not allowed inside the park. Though these activities are prohibited, most of the people inside the park have to rely upon the resources. In the study, it was observed that local people collecting firewood, fodder and timber from the forest and taking their livestock for free grazing inside the national park. Though there is no solid data about these illegal activities, almost all people in the study area had reared livestock and were dependent on the park resources. It may be due to poverty, lack of alternatives, less knowledge about the conservation.

The animal grazing, firewood, timber and fodder collection activities can be minimized by alternative natural resource creation and use activities as it enables the communities to be self – reliant in fuel, fodder and timber resources and reduces dependency on the park resources. Rayamajhi (2000) reported that plantation activities have substantially reduced the pressure on forest resources. Rayamajhi (2000) and Bajimaya (2004) reported that Biogas installation and Improved Cooking Stoves (ICS) had reduced consumption of fuel wood considerably.

Crop depredation by wild animals depends on various factors like; distance from the park boundary, the regional variations in crop raiding animals' population and its fluctuations over time, the number of crop raiding animals in the park, nature of barriers between the cropping land and the park and types of preventive measures used by farmers.



The study showed that, *wild boar*, the most destructive wild animal among others as mentioned above, attacks on crops mostly at night time whereas porcupines, birds attack on crops in the morning and day time.

Local people had adopted different kinds of preventive measures. Among the techniques used, the mostly used was to guard overnight on wood constructed platforms or "Chhapro" in the field and guarding crops by shouting and clapping and chasing the wild animals making house by beating empty tin for chasing wild animals was also used by the local people. It was found that the highest percentage of household (41.02%) using shouting and clapping method for preventing the damage caused by the wild animals.

The main cause of agricultural loss and harassment to the local people occurs due to the lack of any effective physical barrier private/ public areas and park. Bad planning and ignoring people's need are responsible for today's problem in ShNP. Again no improvement and no techniques have been developed as remedy to problems, which remains unsolved for the local farmers.

The study also showed that there were some records of severe attack of wild animals on the local people last year and few years' back in the study area. But this year, only the harassment has been reported.

## 7. CONCLUSIONS AND RECOMMENDATIONS

### 7.1 Conclusion

This study was conducted in the six wards of the Sangla VDC. The aim of this study was to quantify the amount of crop damage and assess the most destructive wild animal. For this, different methods had been done in these six wards.

The local people of these wards are mostly engaged in agriculture and livestock rearing. There is no other income generating activities except these. The villagers of these areas cannot survive without these professions, but the pressure of crop damage by wild animals and the restriction of park on resources use for fodder, firewood etc. has created problems to the local people.

The statistical analysis showed that, there is significant difference between the expected productivity and observed productivity of the crops which evidence on the prevailing situation of the crop destruction in the study area.

As this study was conducted to assess the total crop damage by wild animals, it was found to be 23235.50 kg. Mainly the lost percentage of maize was the highest i.e. 26.14 % among the crops. The lost percentage of paddy, wheat and millet was found to be 15.07 %, 12.57 %, 23.51 % respectively. The loss amount of maize, millet, paddy and wheat was found to be 6944 kg, 3640 kg, 7944 kg and 4707.50 kg respectively.

The study also showed that the total monetary value of the lost crops was NRs. 6,28,138 which is 17.13 % of the expected production. It was NRs. 5368.70 per household on an average. By this study, it was found that the local people were very much affected by the wild animals.

In the study, *wild boar* was found to be the most destructive animal. Porcupines, birds and other animals were also found to be crop raider but these animals were not much destructive. *Wild boar* attacks on crops mostly in the night whereas porcupines, birds and other animals attack on crops mostly in the morning and day time. It was found

that the wild animals damage the crops at different stages. The crops were heavily damaged from the milky stage to ripening time. Local preventive methods adopted by the local people to chase the wild animals away from the field were little effective since the methods used were labour intensive and primitive.

The study also showed that there was a report of 4.22 % of peoples injured due to the wild animals.

## **7.2 Recommendations**

Following recommendations are proposed to resolve the problem of the villagers.

1. High concrete boundary wall should be made around the park and re-fenced with barbed wire in broken places.
2. Income generating activities like off - farm Employment Opportunities should be given to the villagers to combat the economic loss due to depredation.
3. Conservation education for the villagers should be given from time to time so that they could know the importance of the National Park.
4. Local people's participation should be given due importance in park planning and management activities.
5. For proper management inside the park, it should be needed to raise nutritious food supply and space and also planting with preferred plant species inside the park.
6. To control the crop loss from biological point of view, food habit study can be done and local people should be encouraged to grow less preferable crops and other varieties of unpalatable crops.
7. Firewood collection and fodder collection should be allowed at a fixed time period every year.
8. There should be regular research on the number of the wild animals inside the park.
9. Increasing species population should be maintained within the certain level by species population management program such as the translocation of certain

pest animals. Maintaining wildlife population at a sustainable level is beneficial for both the animal species and the local residents.

10. Planning, Monitoring and Evaluation activities in the park should be done at regular intervals. Traditional resource management systems, such as community controlled grazing and forest guardianship would be strengthened, and low - level technologies should be introduced where appropriate.

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# ANNEX-1

## Questionnaire for the Local Villagers

Name:

V.D.C.:

Ward No.:

Gender: Male

Female

Age:

Ethnicity:

1. How much land do you have?

..... Ropani ..... Ana

2. How much is Khet and how much is Bari?

a) Khet ..... Ropani ..... Ana

b) Bari ..... Ropani ..... Ana

3. How much land do you cultivate? All or Net?

a..... Ropani      b. .... Ana

4. Which crop do you grow in how much land?

a.Paddy ..... Ropani ..... Ana

b.Wheat ..... Ropani ..... Ana

c.Maize ..... Ropani ..... Ana

d.Millet ..... Ropani ..... Ana

e.Others ..... Ropani ..... Ana

5. What is their average yield?

Pathi / Ropani

a.Paddy

b.Wheat

c.Maize

d.Millet

e.Others

7. Which crop do you grow much?

Paddy/Wheat/Maize/Millet/Others

8. What is the total production of these crops? (in Muri )

- a.Paddy
- b.Wheat
- c.Maize
- d.Millet
- e.Others

9. Do you have any problem from park animals?

Yes  No

10. If yes, which are the main wild animals?

Wild boar/ Porcupines/ Birds/ Others

11. What kind of problems do the wild animals create?

- a. Crop damage
- b.Human harassment
- c. Others

12. Which animal damages the most and in which crops?

Wild boar/ Porcupine/ Birds/ Others

- a.Paddy
- b.Wheat
- c.Maize
- d.Millet
- e.Others

13. How much damage do the animals do?

Kg / Ropani

- a.Paddy
- b.Wheat
- c.Maize
- d.Millet
- e.Others

14. If there was no such wildlife damage problems, what would have been the total production?

Pathi

- a.Paddy
- b.Wheat
- c.Maize
- d.Millet
- e.Others

15. When do they damage most?

Wild boar/ Porcupine/ Birds/ Others

- a. Young stage (Just growing leaves)
- b. Matured stage ( Green crops)
- c. Plants beginning to produce seed
- d. Ripening time (Ready to harvest)

16. Do you apply technique to protect the crops from damage?

Yes No

17. If yes, what kind of technique do you apply?

- a. Shouting and following
- b. Spending nights on Machan
- c. Following with fire and shouting
- d. Making noise by beating empty tin.
- e. Other

18. How much they are effective?

- a. Very much.    b. little effective    c. Ineffective

19. Is there any attack from the park animal to the people?

Yes       No

20. If yes which animal attack the people and when? (Describe the situation)

21. Do you receive any help or medical facilities from the park authorities when injured by the park animals?

Yes       No

22. Do you have livestock?

Yes       No

23. If yes, which livestock do you have and how many?

- a. Cow
- b. Buffalo
- c. Goat
- d. Others

24. How do you feed your livestock?

- a. Grazing      b. Stall-feeding

25. Does the park give compensation to your loss?

Yes       No

26. If yes, what kind of compensation do they give?

27. Do you have access to the forest products?

Yes       No

28. If yes, what kind of forest products you are allowed to collect?

29. Do you find any difference in the management after it has been converted into national park?

Yes  No

30. If yes, what kind of differences do you find?

31. Do you have any suggestion to improve the situation?

- a. Government should compensate loss
- b. Number of park animals should be reduced
- c. Fences should be constructed around the park
- d. Other

## ANNEX-2

### Questionnaire for the Park Authorities

1. Is there any problem the government has to face due to the habitation of the local people around the national park?  
Yes  No
2. If yes, what type of problems does the park face?
  - a. Killing the wild animals
  - b. Excessive collection and damage to the forests products
  - c. Others
3. Have you got any complains of crop damage, human harassment, livestock depredation by the local people?  
Yes  No
4. Does the park give any compensation for the loss?
5. Are the local people allowed to enter into the park?
6. Are the local people aware of the importance and policies of the national park?
7. Have there any illegal work done inside the park by the local people?
8. What action do the park authorities take when they got hold of people involved in such activities, inside the park?
9. What do you think why the park animals come out from the park and do the damage?
  - a. Scarcity of the food inside the park
  - b. Love to eat crops
  - c. Lack of the walls to control their movement
  - d. Other
10. Have you taken any step to control the park animal's movement towards the settlement land?
11. The park is being handed over the KMTNC, can KMTNC resolve the problems?

## ANNEX- 3

### Protected Areas of Nepal

S.No	Name of Protected Areas	Gazetted Year	Area (sq.km)
<b>National Parks</b>			
1.	Royal Chitwan National Park (World Heritage Site 1984)	1973	932
2.	Langtang National Park	1976	1710
3.	Rara National Park	1976	106
4.	Sagarmatha National Park (World Heritage Site 1979)	1976	1148
5.	Shey-Phoksundo National Park	1984	3555
6.	Khaptad National Park	1984	225
7.	Royal Bardia National Park	1984	968
8.	Makalu-Barun National Park	1991	1500
9.	Shivapuri National Park	2002	144
	<b>Total</b>		<b>10288</b>
<b>Wildlife Reserves</b>			
1.	Royal Suklaphanta Wildlife Reserve	1976	305
2.	Koshi Tappu Wildlife Reserve	1976	175
3.	Parsa Wildlife Reserve	1984	499
	<b>Total</b>		<b>979</b>
<b>Hunting Reserve</b>			
1.	Dhorpatan Hunting Reserve	1987	1325
	<b>Total</b>		<b>1325</b>
<b>Consevation Areas</b>			
1.	Annapurna Conservation Area	1992	7629
2.	Kanchanjunga Conservation Area	1997	2035
3.	Manasulu Conservation Area	1998	1663
	<b>Total</b>		<b>11327</b>

<b>S.No</b>	<b>Name of Protected Areas</b>	<b>Gazetted Year</b>	<b>Area (sq.km)</b>
	<b>Buffer Zones</b>		
1.	Royal Chitwan National Park	1996	750
2.	Royal Bardia National Park	1996	328
3.	Langtang National Park	1998	420
4.	Shey-Phoksundo National Park	1998	1349
5.	Makalu-Barun National Park	1999	830
6.	Sagarmatha National Park	2002	275
7.	Royal Suklaphanta Wildlife Reserve	2004	243.5
8.	Koshi Tappu Wildlife Reserve	2004	173
9.	Parsa Wildlife Reserve	2005	298.17
	<b>Total</b>		<b>4666.67</b>

Source: Department of National Park and Wildlife Conservation



## ANNEX- 4

### List of Mammals of ShNP

Family	Scientific Name	Common name	Local Name
CANIDAE	<i>Canis aureus</i>	Jackal	Syal
CALLOSCICURINAE	<i>Drenomys lokriah</i>	Orange bellied H.Squirrel	Sunaulo lokharkee
FELIDAE	<i>Felis bengalensis</i>	Lepoard cat	Chari bagh
FELIDAE	<i>Felis chaus</i>	Jungle cat	Ban Biralo
HYSTRICIDAE	<i>Hystrix indica</i>	Porcupine	Dumsi
LEPORIDAE	<i>Lepus nigricolls</i>	Hare	Kharayo
CERCOPITHECIDAE	<i>Macaca mulatta</i>	Assamese monkey	Bandar
CERCOPITHECIDAE	<i>Macaca mulatta</i>	Rhesus monkey	Bandar
	<i>Manis spp.</i>	Pangolin	
MUSTELIDAE	<i>Martes flavigula</i>	Yellow throated Himalyan marten	Malsapro
CERVIDAE	<i>Muntiacus muntjak</i>	Barking Deer	Ratuwa Migra
MURIDAE	<i>Mus cervicolor</i>	Fawn-Clouded mouse	Khathe musa
BOVIDAE	<i>Naemoredus goral</i>	Grey H.Ghoral	Ghoral
OCLIOTONIDAE	<i>Octotona royali</i>	Royel's Pika	Musae Kharayo
FELIDAE	<i>Panthera pardus</i>	Leopard	Chituwa
FELIDAE	<i>Pardofelis nubolosa</i>	Clouded Leopard	Dwanse Chitwa
MURIDAE	<i>Rattus rattus</i>	Khumbu rat	Himali Musa
CERCOPITHECIDAE	<i>Semnopithecithecus entellus</i>	Langur	Dheduwa
SORICIDAE	<i>Soriculus caudatus</i>	Horsefield Serew	Chuchundro
SORICIDAE	<i>Soriculus nigrescene</i>	Sikkim large clawed serew	Chuchundro
SUIDAE	<i>Sus scrofa</i>	Wild Boar	Bandel
URSIDAE	<i>Ursus thibetanus</i>	Himalyan black bear	Kalo Bhalu
VIVERRIDAE	<i>Viverra zibetta</i>	Large Civet	Zik/Sili/Bhavan
PHOLIDOTAE	<i>Manis spp</i>	Pangolin	Salak
MURIDAE	<i>MUS musculus</i>	Mouse	

Source: Shivapuri National Park Headquarter

## ANNEX -5

### Meteorological Data

#### Rainfall of Budhanilkanthal Station for the Year 1995 to 2005

Latitude: 27° 47'N

Longitude: 85° 22' E

Elevation: 1490 m

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1995	6.60	30.80	34.00	6.00	232.20	562.00	498.20	460.60	139.20	21.80	49.40	7.00	2,047.80
1996	66.80	12.40	2.60	52.20	72.00	451.40	384.00	637.60	344.40	79.70	-	-	2,103.10
1997	21.20	10.60	16.00	166.00	95.60	241.80	756.80	491.00	177.60	17.80	22.70	76.00	2,093.10
1998	-	34.20	84.80	50.00	183.00	339.40	505.90	520.20	257.80	38.20	10.40	-	2,023.90
1999	5.60	1.40	-	8.80	194.00	426.60	639.20	555.20	305.50	198.00	-	-	2,334.30
2000	-	9.40	14.00	69.80	282.40	415.40	684.00	474.00	203.90	13.20	-	-	2,166.10
2001	-	13.60	-	11.40	212.00	532.00	465.80	538.60	226.50	83.40	-	-	2,083.30
2002	-	-	13.70	120.00	330.20	242.80	791.20	721.20	200.20	DNA	9.20	-	2,428.50
2003	19.80	64.20	73.60	75.80	82.80	206.80	716.40	536.10	DNA	DNA	3.80	18.60	1,797.90
2004	31.40	-	48.20	117.80	236.20	203.00	651.10	591.40	226.50	DNA	DNA	-	2,105.60
2005	61.20	17.80	63.40	30.80	64.20	257.80	406.80	440.40	211.20	124.80	-	-	1,678.40
<b>Average</b>	<b>19.33</b>	<b>17.67</b>	<b>31.85</b>	<b>64.42</b>	<b>180.42</b>	<b>352.64</b>	<b>590.85</b>	<b>542.39</b>	<b>229.28</b>	<b>72.11</b>	<b>9.55</b>	<b>9.24</b>	<b>2,078.36</b>

Source: Department of Hydrology and Meteorology

### Maximum Temperature of Budhanilkantha Station for the Year 1995 to 2005

Latitude: 27°47' N

Longitude: 85° 22' E

Elevation: 1350 m

year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Maximum
1995	16.10	18.10	23.30	27.20	29.80	26.70	26.60	27.80	27.10	25.20	22.20	18.30	29.80
1996	16.90	19.40	24.00	27.20	29.00	26.60	26.70	27.20	26.90	24.90	22.20	18.90	29.00
1997	15.80	17.30	22.90	23.00	27.00	27.60	27.60	27.40	26.30	23.50	21.00	17.00	27.60
1998	16.80	19.30	20.90	25.00	27.70	28.80	27.00	26.80	27.40	26.00	23.20	20.20	28.80
1999	18.90	23.20	25.50	29.80	27.70	27.10	26.20	26.70	27.10	24.90	22.20	19.30	29.80
2000	17.90	17.60	22.90	26.70	27.70	27.50	27.00	27.60	26.40	25.10	22.50	18.50	27.70
2001	18.00	21.10	23.90	25.20	26.70	28.10	27.80	28.00	26.90	25.90	23.20	20.50	28.10
2002	19.70	20.80	21.10	24.70	24.20	26.30	27.60	27.50	26.60	DNA	22.40	18.10	27.60
2003	17.60	18.20	21.50	26.40	27.30	27.30	27.30	27.20	DNA	DNA	21.70	17.80	27.30
2004	16.70	19.60	25.30	25.40	26.90	27.10	26.40	27.30	26.10	24.10	DNA	18.80	27.30
2005	16.30	19.20	23.00	26.40	26.70	28.80	27.20	26.30	27.50	24.20	21.20	18.90	28.80
<b>Average</b>	<b>17.34</b>	<b>19.44</b>	<b>23.12</b>	<b>26.09</b>	<b>27.34</b>	<b>27.45</b>	<b>27.04</b>	<b>27.25</b>	<b>26.83</b>	<b>24.87</b>	<b>22.18</b>	<b>18.75</b>	

### Minimum Temperature of Budhanilkantha Station for the Year 1995 to 2005

Latitude: 27°47' N

Longitude: 85° 22' E

Elevation: 1350 m

year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Minimum
1995	3.40	5.30	8.90	12.70	17.60	20.10	20.00	19.50	18.00	13.90	9.10	5.10	3.40
1996	3.40	5.90	10.80	12.40	16.40	18.30	20.10	19.10	17.70	13.70	8.80	4.90	3.40
1997	3.40	4.00	9.60	10.70	14.20	17.80	19.70	19.60	18.30	11.30	8.50	4.70	3.40
1998	3.40	5.70	7.70	12.50	16.40	19.80	20.10	19.90	18.40	16.00	10.50	5.70	3.40
1999	3.90	7.90	9.70	14.20	16.00	18.70	19.50	19.60	17.40	13.80	9.10	6.30	3.90
2000	2.90	3.50	6.10	11.70	15.50	18.30	19.50	19.60	17.90	13.70	10.70	4.30	2.90
2001	3.50	7.20	8.30	12.30	15.10	19.90	19.90	19.90	18.20	14.20	12.40	5.30	3.50
2002	3.60	4.40	10.00	11.90	16.10	17.90	18.30	19.10	17.40	DNA	9.00	5.10	3.60
2003	3.60	4.40	10.00	11.90	16.10	17.90	18.30	19.10	17.40	DNA	9.00	5.10	3.60
2004	3.20	6.10	11.80	12.90	15.70	18.30	19.30	19.40	18.30	12.80	DNA	4.20	3.20
2005	2.60	5.70	9.50	10.50	14.30	18.90	19.90	19.50	19.10	13.30	8.70	4.10	2.60
<b>Average</b>	<b>3.35</b>	<b>5.46</b>	<b>9.31</b>	<b>12.15</b>	<b>15.76</b>	<b>18.72</b>	<b>19.51</b>	<b>19.48</b>	<b>18.01</b>	<b>13.63</b>	<b>9.58</b>	<b>4.98</b>	

Source Department of Hydrology and Meteorology

## ANNEX-6

### Tabular Representation of Data

**Table 6.1: Ward wise Distribution of Cultivated Land and Land Holding per Household**

Ward No.	No. of surveyed household	Total land (ha)	Land holding per Household	% in terms of total cultivated land
1	16	2.69	0.17	14.15
2	38	6.78	0.18	35.67
3	18	3.03	0.17	15.94
4	18	2.85	0.16	14.99
7	11	1.41	0.13	7.42
8	16	2.25	0.14	11.83
<b>Total</b>	<b>117</b>	<b>19.01</b>	<b>0.95</b>	<b>100</b>

**Table 6.2: Ward wise Distribution of Households growing Paddy**

Ward No.	Household Surveyed	Household growing Paddy	Percentage (%)
1	16	16	100
2	38	38	100
3	18	18	100
4	18	18	100
7	11	11	100
8	16	16	100
<b>Total</b>	<b>117</b>	<b>117</b>	<b>100</b>

**Table 6.3: Ward wise Distribution of Households growing Wheat**

Ward No.	Household Surveyed	Household growing Wheat	Percentage (%)
1	16	16	100
2	38	38	100
3	18	18	100
4	18	18	100
7	11	11	100
8	16	16	100
<b>Total</b>	<b>117</b>	<b>117</b>	<b>100</b>

**Table 6.4: Ward wise Distribution of Households growing Maize**

Ward No.	Household Surveyed	Household growing Maize	Percentage (%)
1	16	16	100
2	38	38	100
3	18	18	100
4	18	9	50
7	11	4	36.36
8	16	16	100
<b>Total</b>	<b>117</b>	<b>101</b>	<b>86.32</b>

**Table 6.5: Ward wise Distribution of Households growing Millet**

Ward No.	Household Surveyed	Household growing Millet	Percentage (%)
1	16	16	100
2	38	38	100
3	18	18	100
4	18	9	50
7	11	4	36.36
8	16	16	100
<b>Total</b>	<b>117</b>	<b>101</b>	<b>86.32</b>

**Table 6.6: Ward wise Distribution of Households growing Other Crops**

Ward No.	Household Surveyed	Household growing Other Crops	Percentage (%)
1	16	16	100
2	38	30	78.95
3	18	13	72.22
4	18	9	50
7	11	4	36.36
8	16	12	75
<b>Total</b>	<b>117</b>	<b>84</b>	<b>71.79</b>

**Table 6.7: Land Coverage of Paddy in Different Wards**

Ward No.	Total cultivated land (ha)	Paddy grown (ha)	Percentage (%)
1	2.69	1.54	57.25
2	6.78	3.82	56.34
3	3.03	1.75	57.75
4	2.85	2.27	79.65
7	1.41	1.23	87.23
8	2.25	1.2	53.33
<b>Total</b>	<b>19.01</b>	<b>11.81</b>	<b>62.12</b>

**Table 6.8: Land Coverage of Wheat in Different Wards**

Ward No.	Total cultivated land (ha)	Wheat grown (ha)	Percentage (%)
1	2.69	1.54	57.25
2	6.78	3.82	56.34
3	3.03	1.75	57.75
4	2.85	2.27	79.65
7	1.41	1.23	87.23
8	2.25	1.2	53.33
<b>Total</b>	<b>19.01</b>	<b>11.81</b>	<b>62.12</b>

**Table 6.9: Land Coverage of Maize in Different Wards**

Ward No.	Total cultivated land (ha)	Maize grown (ha)	Percentage (%)
1	2.69	1.10	40.89
2	6.78	2.96	43.66
3	3.03	1.20	39.60
4	2.85	0.42	14.74
7	1.41	0.10	7.09
8	2.25	1.05	46.67
<b>Total</b>	<b>19.01</b>	<b>6.83</b>	<b>35.93</b>

**Table 6.10: Land Coverage of Millet in Different Wards**

Ward No.	Total cultivated land (ha)	Millet grown (ha)	Percentage (%)
1	2.69	1.05	39.03
2	6.78	2.25	33.18
3	3.03	1.06	34.98
4	2.85	0.42	14.74
7	1.41	0.10	7.09
8	2.25	0.9	40
<b>Total</b>	<b>19.01</b>	<b>5.78</b>	<b>30.40</b>

**Table 6.11: Land Coverage of Other crops in Different Wards**

Ward No.	Total cultivated land (ha)	Other crops grown (ha)	Percentage (%)
1	2.69	0.10	3.72
2	6.78	0.71	10.47
3	3.03	0.22	7.26
4	2.85	0.10	3.51
7	1.41	0.08	5.67
8	2.25	0.15	6.67
<b>Total</b>	<b>19.01</b>	<b>1.36</b>	<b>7.15</b>

**Table 6.12: Types of Problem in Percentage**

Ward No.	Crop Damage	Human Harassment
1	81.25	0.00
2	52.68	1.52
3	100	0.00
4	100	0.00
7	100	0.00
8	100	1.06
<b>Total</b>	<b>88.99</b>	<b>4.22</b>

**Table 6.13(a): Loss of Paddy**

Ward No.	Paddy grown (ha)	Expected Production (Kg)	Actual Production (Kg)	Loss in Kg	Percentage (%)	Loss per ha
1	1.54	8520.00	7640.00	880.00	10.33	571.43
2	3.82	11964.00	10220.00	1744.00	14.58	456.54
3	1.75	8080.00	5960.00	2120.00	26.24	1211.43
4	2.27	9200.00	8320.00	880.00	9.57	387.66
7	1.23	8560.00	7440.00	1120.00	13.08	910.57
8	1.2	6400.00	5200.00	1200.00	18.75	1000.00
<b>Total</b>	<b>11.81</b>	<b>52724.00</b>	<b>44780.00</b>	<b>7944.00</b>	<b>15.07</b>	<b>756.27</b>

**Table 6.13(b): Difference between observed and expected production of Paddy**

Ward No.	Expected Production (E) Kg/ha	Observed Production (O) Kg/ha	O - E	(O - E) <sup>2</sup>	$\frac{(O - E)^2}{E}$	Tabulated value of $t^2_{5, 0.05}$
1	5532.47	4961.04	571.43	326530.6	59.02	11.070
2	3131.94	2675.39	456.55	208437.9	66.55	
3	4617.14	3405.71	1211.42	1467538.4	317.85	
4	4052.86	3665.20	387.66	150280.27	37.08	
7	6959.35	6048.78	910.57	829137.72	119.14	
8	5333.33	4333.33	999.99	999980	187.49	
<b>Total</b>	<b>29627.09</b>	<b>25089.45</b>	<b>4537.62</b>	<b>3981904.8</b>	<b>787.13</b>	

Source (Tabulated  $t^2_{5, 0.05}$ ): "A First Course In Statistics With Applications", By A.K.P.C. SWAN (Pg 429)

**Table 6.14 (a): Loss of Wheat**

Ward No.	Wheat grown (ha)	Expected Production (Kg)	Actual Production (Kg)	Loss in Kg	Percentage (%)	Loss per ha
1	1.54	5285.00	4935.00	350.00	6.62	227.27
2	3.82	9408.00	7938.00	1470.00	15.62	384.82
3	1.75	5005.00	4445.00	560.00	11.19	320.00
4	2.27	6877.50	6195.00	682.50	9.92	300.66
7	1.23	6265.00	5425.00	840.00	13.41	682.93
8	1.2	4305.00	3500.00	805.00	18.69	670.83
<b>Total</b>	<b>11.81</b>	<b>37145.50</b>	<b>32438.00</b>	<b>4707.50</b>	<b>12.57</b>	<b>431.08</b>

**Table 6.14(b): Difference between observed and expected production of Wheat**

Ward No.	Expected Production (E) Kg/ha	Observed Production (O) Kg/ha	O - E	(O - E) <sup>2</sup>	$\frac{(O - E)^2}{E}$	Tabulated value of $t^2_{5, 0.05}$
1	3431.82	3204.55	227.27	51656.19	15.05	11.070
2	2462.83	2078.01	384.82	148086.43	60.13	
3	2860	2540	320	102400	35.80	
4	3029.74	2729.07	300.66	90396.44	29.84	
7	5093.49	4410.57	682.92	261503.72	51.34	
8	3587.5	2916.67	670.83	450012.88	125.44	
<b>Total</b>	<b>20465.38</b>	<b>17878.87</b>	<b>2586.4</b>	<b>1104055.6</b>	<b>317.6</b>	

**Table 6.15 (a): Loss of Maize**

Ward No.	Maize grown (ha)	Expected Production (Kg)	Actual Production (Kg)	Loss in Kg	Percentage (%)	Loss per ha
1	1.10	2835.00	2625.00	210.00	7.41	190.90
2	2.96	10062.50	7017.50	3045.00	30.26	1028.72
3	1.20	4567.50	2541.00	2026.50	44.37	1688.75
4	0.42	2345.00	2117.50	227.50	9.70	541.67
7	0.10	1260.00	980.00	280.00	22.22	2800.00
8	1.05	2695.00	1540.00	1155.00	42.86	1100.00
<b>Total</b>	<b>6.83</b>	<b>23765.00</b>	<b>16821.00</b>	<b>6944.00</b>	<b>26.14</b>	<b>1225.01</b>



**Table 6.15(b): Difference between observed and expected production of Maize**

Ward No.	Expected Production (E) Kg/ha	Observed Production (O) Kg/ha	O - E	(O - E) <sup>2</sup>	$\frac{(O - E)^2}{E}$	Tabulated value of $t^2_{5,0.05}$
1	2577.27	2386.36	190.91	36446.63	14.14	11.070
2	3399.49	2370.78	1028.71	1058244.2	311.29	
3	3806.25	2117.5	1688.75	2851876.5	749.26	
4	984.9	889.35	95.55	9129.80	9.27	
7	126	98	28	784	6.22	
8	2566.67	1466.67	1100	1210000	471.43	
<b>Total</b>	<b>13460.58</b>	<b>9328.66</b>	<b>4131.92</b>	<b>4166481.1</b>	<b>1561.6</b>	

**Table 6.16 (a): Loss of Millet**

Ward No.	Millet grown (ha)	Expected Production (Kg)	Actual Production (Kg)	Loss in Kg	Percentage (%)	Loss per ha
1	1.05	1725.00	1500.00	225.00	13.04	214.28
2	2.25	6527.50	4712.50	1815.00	27.80	806.67
3	1.06	2562.50	1952.50	610.00	23.80	575.47
4	0.42	1275.00	1200.00	75.00	5.88	178.57
7	0.10	700.00	525.00	175.00	25.00	1750.00
8	0.9	1625.00	885.00	740.00	45.54	822.22
<b>Total</b>	<b>5.78</b>	<b>14415.00</b>	<b>10775.00</b>	<b>3640.00</b>	<b>23.51</b>	<b>724.53</b>

**Table 6.16(b): Difference between observed and expected production of Millet**

Ward No.	Expected Production (E) Kg/ha	Observed Production (O) Kg/ha	O - E	(O - E) <sup>2</sup>	$\frac{(O - E)^2}{E}$	Tabulated value of $t^2_{5,0.05}$
1	1642.86	1428.57	214.29	45920.2	27.95	11.070
2	2901.11	2094.44	806.67	650716.48	224.29	
3	2417.45	1841.98	575.47	331165.72	136.99	
4	535.5	504	31.5	992.25	1.85	
7	70	52.5	17.5	306.25	4.38	
8	1462.5	796.5	666	443556	303.29	
<b>Total</b>	<b>9029.42</b>	<b>9717.99</b>	<b>2311.43</b>	<b>1472656.8</b>	<b>698.75</b>	

**Table 6.17: Percentage of Household affected by Wild animals**

Ward No.	Wild boar	Porcupines	Birds	Others
1	62.5	81.25	31.25	31.25
2	52.68	26.37	31.57	0
3	100	11.11	0	0
4	0	0	100	55.55
7	0	0	100	100
8	100	0	0	0
<b>Total</b>	<b>52.53</b>	<b>19.79</b>	<b>43.80</b>	<b>31.13</b>

**Table 6.18: Market Price and Monetary Value of Damaged Crops**

Crops	Total Loss(Kg)	Loss percentage (%)	Market Rate Per Kg (Rs.)	Total Monetary Value (Rs.)
Paddy	7944.00	15.07	35	2,78,040
Wheat	4707.50	12.57	28	1,31,810
Maize	6944.00	26.14	22	1,52,768
Millet	3640.00	23.51	18	65,520
<b>Total</b>	<b>23235.50</b>			<b>6,28,138</b>

**Table 6.19: Wild Animals Damaging Paddy**

Animal	Household Growing Paddy	Percentage (%)
Wild boar	14	11.96
Porcupine	24	20.51
Bird	57	48.72
Other	28	23.93

**Table 6.20: Wild Animals Damaging Wheat**

Animal	Household Growing Wheat	Percentage (%)
Wild boar	14	11.96
Porcupine	22	18.8
Bird	56	47.86
Other	24	20.51

**Table 6.21: Wild Animals Damaging Maize**

Animal	Household Growing Maize	Percentage (%)
Wild boar	64	54.70
Porcupine	22	18.80
Bird	42	35.89
Other	22	18.80

**Table 6.22: Wild Animals Damaging Millet**

Animal	Household Growing Millet	Percentage (%)
Wild boar	51	43.59
Porcupine	17	14.53
Bird	39	33.33
Other	28	23.93

**Table 6.23: Percentage of Households Using Techniques**

Ward No.	% of Households using Techniques
1	50
2	52.63
3	61.11
4	66.67
7	63.63
8	62.5

**Table 6.24: Preventive Methods Used by Local People**

S. No.	Methods	Household No.	Percentage (%)
1	Shouting and clapping	48	41.02
2	Spending night on machan	19	16.24
3	Following with fire and shouting	20	17.09
4	Making noise by beating empty tin	24	20.51
5	Other	22	18.80

**Table 6.25: Total Livestock and their Percentage in Surveyed Household**

Livestock	Ward No.1	Ward No. 2	Ward No. 3	Ward No. 4	Ward No. 7	Ward No. 8	Total	Percentage (%)
Cow	14	18	14	10	7	10	73	19.62
Buffalo	9	5	7	8	0	6	35	9.41
Goat	28	43	29	38	9	28	175	47.04
Others	0	26	38	16	0	9	89	23.92
<b>Total</b>	<b>51</b>	<b>92</b>	<b>88</b>	<b>72</b>	<b>16</b>	<b>53</b>	<b>372</b>	<b>99.99</b>

**Table 6.26: Percentage of Livestock in Different Wards**

Livestock	Ward No. 1	Ward No. 2	Ward No. 3	Ward No. 4	Ward No. 7	Ward No. 8
Cow	19.18	24.66	19.18	13.69	9.59	13.69
Buffalo	25.71	14.28	20	22.86	0.00	17.14
Goat	16	24.57	16.57	21.71	5.14	16
Others	0.00	29.21	42.69	17.98	0.00	10.11

**Table 6.27: People's Perception**

S. No.	Methods	Household No.	Percentage (%)
1	Number of wild animals should be reduced	37	31.63
2	Local people should be compensated for loss	16	13.67
3	Local people should be allowed for fodder and firewood, 1 to 2 times a month	56	47.86
4	No ideas	8	6.84

**ANNEX-7**  
**Plates**



Plate 1: Questionnaire survey with respondent



Plate 2: Villager showing the depreded field



Plate 3: Raiding of millet by wild boar



Plate 4: Destroyed maize field by wild boar



Plate 5: Mass destruction of maize by wild boar



Plate 6: Maize eaten by wild boar