CHAPTER - I

1. INTRODUCTION

1.1 General Background

Asian elephant (*Elephas maximus*) is one of the largest land mammals and it is believed to have originated in Africa. This species is listed in CITES Appendix I by the World Conservation Union, IUCN (1996). Three species of elephants have survived since origination, the two African and one Asian elephant. African elephants are *loxodonta Africana* and *L .cyclotis* (Roca et al. 2001). The Asian species is a little smaller than African. The elephants are anciently and closely associated with human life, art, literature and even religion.

Asiatic elephants can be identified from others by having a single lip, four nails, smaller ears, slopping back etc. The height of an elephant is approximately 0.9m. Asian elephants' ear flaps measure as big as sixty one centimeter with four visible toes-nails. Asian wild elephants are among the largest mammals (Sukumar 1992).

1.2 Distribution

1.2.1 Global Distribution

The Asian elephants are found in thirteen countries in Asia as in Nepal, India, Bhutan, Bangladesh, China, Burma, Thailand, Cambodia, Laos, Vietnam, Malaysia, Srilanka, Sumatra (Indonesia) and Borneo (Malaysia and Indonesia) (Stromayer 2001).

This species in the wild occupies a total area of approximately 436,230km^2, out of this 131,820 km^2 is under Protected Areas System (Sukumar 1998).A total population of 38,000 to 51,000 Asian wild elephants are remaining today of which more than 16,000 are domesticated (http:// www.elephant.net.co.th/index-29.1.html 26.03.2004). Throughout their range , there may be fewer than ten separate population of wild Asian elephants with more than 1000 individuals; half of these are found in India (Stromayer 2001).The elephants had lost much of their former habited ,thus they are often forced to invade that communities that had displaced them (Caufield 1984). Table 1 displays different population estimates.

Table 1: Estimated number of Asian elephants and their distribution

Name of regions	Minimum number	Probable number	Countries
Indian sub continent	22546	28400	Nepal, Bhutan, Bangladesh, Srilanka
Indo-China + China	1509	1785	Laos, Cambodia, Vietnam, China
Indo- Malayan	10539	12520	Myanmar, Thailand, Malaysia, Borneo (Indonesia and Malaysia), Indonesia
Total	34,594	42,705	

Source: WWF 2000

1.2.2 Elephants in Nepal

In Nepal, the wild elephants are found in broad belt of montane and submontane forest, which has both terrestrial and aquatic floristic community. They are distributed in Jhapa, Morang, Sunsare, Saptari, Udayapur, Parsa, Chitwan, Bara, Bardia, Kailali and Kanchanpur district.

The estimated population of Asian wild elephants in Nepal is about 87 to 108 and distributed in four Geographical sub- divisions, 10 to 15 in Eastern Tarai, 25 in Central Terai, 40 - 46 in mid -western Tarai and 12-18 in Far western Tarai in Nepal (Velde 1999).

The Eastern Terai consists mainly of migratory herds from West Bengal, which come mostly during the harvested seasons of maize and paddy from July to October. They cross the Mechi River to enter Bahundangi Village in Jhapa and then precede West ward along the curia foothills to Morang, Sunsare, Saptari, and Udayapur district (Velde 1999; Yadav 2002).The Eastern population of elephants in Terai is considered to be doomed due to the shrinkage of suitable habitats (Velde 1999). The elephants in central Terai reside in Parsa Wildlife Reserve (PWR) and use the Chitwan National Park (CNP) as dispersal area and they occasionally move to Bara and Rautahat district

(Velde 1999). These elephants have sufficient habitat available to them as they live mostly within the Protected Areas (PAs).

The largest herd of elephants resides in the Mid- Western Terai in Bardia National Park (BNP). This heard consists of migrants from both Dudhawa National Park (India) and Shukulaphanta Wildlife Reserve (SWR). In the far Western Terai, Elephants reside along the Churia foothill forest in SWR. They make accessional trips to India by crossing the Mahakali River.

1.3 Ecology and Behavior

Elephants are generally found in the tall forest of Nepal where the ground is undulating and bamboo trees are in great numbers. It is reported that the elephants regularly come out in the open glades in the rainy season and move back into denser parts of the forest during others season. After the first rain when the new flush appears, elephants remove the tender blades in small clumps without uprooting the plants. This was noticed during April-June. Later, when the grass attains a height of 0.5-1m, entire clumps are uprooted with the trunk, dusted skillfully and the relatively fresh top portion of the leaves consumed, while the basal portion with the root is discarded. When the grasses mature (October-March), the succulent basal portion with the root is consumed after vigorous cleaning and the fibrous blades discarded. Short grasses were generally eaten only during the second wet season when they attained a height of about 0.5m and began to flower. In the dry zone of Srilanka, elephants remove grasses at a shorter stage by scraping the surface of the ground (McKay 1973).

Elephants need a lot of room, and in an ever shrinking world, they are feeling increasingly cramped for space. May be, that is putting the problems lightly. The truth is exploding human population, expanding farm lands; disappearing forests and the insensible craze for ivory have put elephants in a state of permanent siege.

Wild elephants clear paths through forest that are too thick for other animals. Many jungle roads in elephants inhabited woodlands originated in this way. Most elephants browse a height of about 5 meters there by increasing the shaft of sunlight to penetrate

the leafy canopy. An elephant frequently uproot grass and roots and acrates the soil and stimulates the growth of plants that replace the older ones.

Most swamplands, riverine forest and mud wallows frequently visited by elephants are fertilized with dung. An elephant herd may destroy as much vegetation as it consumes. An adult elephant can consume between 250 to 350 kg of solid food per day (Sukumar 1992). They consume on plants like *Zizyphus*, *Albizia*, *Grewia*, *Kydia* and *Dalbergia etc*. Indian elephants have habit of breeding off branches while African elephants are more likely to push over trees.

Elephants draw water in interesting way. It may draw up muddy water and spray itself with the mine. It keeps on Squirting the mud till it is almost completely covered with it. Elephants enter in regular wallowing during the hot season. Dust bathing is also seen when it comes out of water.

Elephants need large quantities of water. An Elephant drinks over 100 liters of water at one time and up to 225 liters of water in a day (Sukumar 1992).

1.4 Human – Elephant conflict

The people exploited the elephant's for a variety of plant resources such as fruits, barks, fodder, fuel and timber (Sukumar 1992). The growing population collected the staple foodstuffs like bananas, bamboos, climbers and wild cassava from the habitated of Elephants. Due to lack of foodstuffs in the forest Elephants come to the village to raid the crops, destroy properties and sometimes kill humans.

Conflict between wildlife and people is an important faction affecting the relationship between protected areas and the people who live near them (Studsord and Wegge 1995; Hill 1998 in Nyhus et al. 2000). Conflict between wild elephants and the people occur to a varying extent throughout the elephants range (Seidenstiker 1984; Sukumar 1998).The conflicts between people and elephants which result crops and properly damage and killing of humans is a serious conservation issue in parts of Asia and Africa (Seidensticker 1984; Sukumar 1989 in Thouless and Sakwa 1994).

1.5 Crop Depredation

Depredation of crops by elephants occurs to varying extents throughout their present range in Asia and Africa, wherever cultivation abuts elephant's habitat. Raiding of agricultural fields by elephants can be explained in terms of proximate factors such as contact with cultivation, especially in fragmented habitats, in the course of there movements for foraging or drinking. However, in ultimate terms crop raiding can be thought of as an extension of their natural optimal foraging strategy (Sukumar 1990).

It is not unusual to see why animals of the protected areas are attracted to areas with grain or other crops. Cultivated crops are richer in protein and carbohydrates as well as some mineral nutrients than most of the wild. Unlike forest plant species, many of which grow in isolated stands or scattered throughout the forest, agriculture crops occur in relatively large, concentrated stands. For this, the animals of the protected areas, to have such items, have not expanded so much energy searching for food.

1.6 Elephant Conservation

In Nepal elephants are protected under the National Parks and Wildlife Conservation Act of 1973. An Elephant Breeding Center (EBC) has been established at Chitwan National Park in 1985 for ex-situ conservation of elephants

Government of Nepal passed a policy in September 2003 for the effective measurement of domesticated elephants in the country (DNPWC 2003).The policy in the execution aims at:-

- Improving the breeding of domesticated elephants by improving the food quality and hygienic condition of the *Hatisar* (*Domesticated* elephants and their handlers) and improving the health care system of the elephants.

- Registering all domesticating elephants and reduce their impact in protected areas and

- Maximizing economic and environmental benefits from the wise management of domestic elephants conserve biodiversity and improve the living standards of the people by deriving benefits from domestic elephants.

1.7 Objectives of the study

From the time immemorial, elephants have affected the local people of Bahundangi VDC either by crop damaging and houses or killing the people. So, the goal of this study is to collect detail information on the impact of elephants at Bahundangi VDC. Following specific objectives have been set to estimate the actual crop loss caused by wild elephants

1. to estimate the actual crop loss caused by wild elephants

2. to study the human harassment due to wild elephants and

3. to analyze the local preventive measures and evaluate their effectiveness

1.8 Limitation of the study

The present study is entirely based on data collected from interviews applying schedule surveys for crop depredation and human harassment by elephants. Only small areas (one Kattha) at the middle part of the cropland which is not damaged by the wildlife were used to estimate the total crop production. Similarly, other wild lives except elephants were ignored because there was not severe damage from other animals.

There are 9 wards in Bahundangi VDC and the present study covered only wards 9, 8, 2 and 1 at eastern side of the VDC, which were seriously affected by the wild elephants. During the study period, the actual crop damaged fields were visited with the local farmers during crop growing season. Different questions were asked to local people. Victims who had encountered elephant attacks were formally interviewed in order to identify actual crop damage.

The study was continued starting from the eastern part of VDC that was visited twice during the crops raiding period. Financial constrain, lack of sufficient equipments and security problem also limited the study.

1.9 Rationale of the study

The rise in HEC has been the result of the relentless rise of the human population in Asia and the resulting loss and fragmentation of elephant habitat. Under pressure from higher population densities and lack fodder elephant populations are increasingly turning to crop raiding for sustenance. The study has provided data on crop depredation in eastern part of Bahundangi VDC in 2008/2009. It has also given information on human harassment and impact on local people due to elephant. The human wildlife conflicts have created tussle between the government and local people and which in turn has become problematic in management of wildlife. This scenario is felt all over the country and especially in Eastern Nepal. The present study aims at analyzing the complex issues of human – wild elephant interference by focusing day to day problems faced by local people in the border region of Eastern Nepal. Along side findings of the study might be applicable to other areas throughout the Terai Arc Landscape (TAL) in relation to the complex issues of human elephant conflict and provide valuable information for the conservation and management of wild elephants in the border region of Eastern Terai.

CHAPTER -II

2. STUDY AREA

2.1 Description of the study area

Bahundangi VDC is located in the north of Jhapa District (Latitude 26º 22' to 26º 50'N and longitude 87° 39'- 88º 12'E and range on an elevation between 125 to 381m above the sea level (GoN/N 2003). In the East, Mechi River borders Darjeeling district of India, in the West is situated Santinagar VDC of Jhapa, in the north is Ilam while at the south is Kakarbhitta. It lies north from the East-West Highway on the bank of Mechi River. It covers an area of 54 km². The total population of the VDC is 22897. The total number of male and female population is 11304 and 11593 respectively. The average family size counted is 5.05 persons. There is total household of 4434 [Appendix (IX)].

Wild elephants were found frequently visiting in ward no. 1, 2, 8 and 9 as they lie along bank of Mechi River (Yadav 2002). So, these wards were chosen for study of conflict between human and elephant in Bahundangi VDC (Hoare 1999). The total populations of these wards were 8140 among which 3999 were male and 4141 were female. The total number of household is 1562 [Appendix (IX)].

2.2 Climate

The climate here is subtropical with April and May as the warmest period (27.2°C to 41.5°C) and January as the coolest period (0.3°C to 19.2°C). Severe cold wave condition prevailed in the winter season in the southern plain of the country due to the dense foggy weather condition. The average annual maximum temperature is around 32.05°C while the average minimum temperature is 18.12°C. (Figure 14 in appendix VII).

The rainy season starts at the end of June and lasts till the beginning of October. The average annual rainfall is about 145 mm. The monsoon rain is uniformly distributed over time and space. Maximum rainfall occurs in August (Figure 15 in appendix VIII).

2.3 Geology and Soil

Most part of the study area lies in the Terai (Lowland) and a small part of it lies in the Siwalik foothills. The physical relief is mostly leveled with occasional ridges and River valleys. The geological formation of the study area is Siwaliks in the north and alluvial plain in the south. Siwaliks are composed of Tertiary Sandstones, Siltstone, Shale and Conglomerate (Joshi 1986). The structure of the Siwaliks is fragile because of which their origin is thought to be quite recent. Soil is Loamy in the Siwaliks while it is more alluvial in the Terai. The alluvial in the northern Terai is coarser than in the south resulting in deeper water bodies in the Northern Terai (MPFS 1988).

2.4 Flora

The District has about 11% of forest area. Sal forest is the dominant forest type followed by mixed hardwood forest (*Adina cardifolia, Terminalia chebula, Terminalia blerica, Lagerstromia parviflora*) and Pine (*Pinus roxburghii*) forest. The main trees are Sal *(Shorea robusta*) and Sisso (*Dalbergia sisso*) etc. The main grasses include *Napier, Cynodon, Saccharum spontaneum, Thysonolena maxima* etc. (Appendix II).

2.5 Fauna

The major fauna inhabiting the study area include Rhesus Monkey *(Macaca mulata),* Asiatic jackal (*Canis aureu*s), Indian fox (*Vulpes bengalensis*), Squirrel (*Ratufa spp*.). Indian flying fox (*Pteropus giganteus*) among mammals, Woodpecker (*Dandrocopus spp*.), Great tit (*Alauda arvemsis*), Parakeet (*Psittacula spp*.), Crane *(Grus spp.),* Cattle egret *(Babulcus ibis)* among birds, Python *(Python morulas*), Cobra (Naja naja), Garden lizard *(Calotes versicolar),* Monitor lizard *(Varanus bengalensis)* among reptiles and Frog *(Rana trigna)* and toad *(Bufo melanostictus)* among amphibians (Appendix III).

2.6 Social and Economic characters

Bahundangi VDC is inhabited by the middle class migrated from the hills. Bahun, Chhetri, Newar, Rai, Damai, Kami, etc are the main inhabitants of the village. The Villagers of ward no. 2 & 8 seems to be poorer than other wards because their land is nearer of Indian Reserve and due to severe damage of crops by elephants they can not store grains for their livelihood. Their houses are also of traditional types. Most of the

land is used for agriculture. The average landholding per ward is 0.97 ha. So, it is the main occupation of the local people. Many people are conservative and they do not agree with the modern process of farming. Some people do not have land of their own. They settle on the land of the landowner. They cultivate their land and take half of the crops produced.

2.7 Land use pattern

Jhapa district is known as the granary of Nepal. Agriculture is of traditional type. Almost all people adopt similar pattern of farming system. Main crops of the area are paddy, maize, wheat, millet, ginger, and pulse. Tea is also cultivated by some farmers. Land use pattern and figure is in Appendix X.

2.8 Animal husbandry

Animal husbandry forms an integral part of the economy. People mostly keep cow (*Bos indicus*), Buffalo (*Bubalus* sps.), Goat (*Capra hircus*) and Pig (*Sus* sps.). Male buffaloes and oxen are used for hauling and transportation. Goat husbandry is the major source of income.

2.9 Farming system

Paddy and Maize are the major crops in the study area which are grown in the rain-fed lowlands. Farming system is primitive. The work is mainly done manually by draft animals. Some farmers use tractor for soil preparation to grow crops. Compost manure is used as bio-fertilizer. Some farmers used chemical fertilizer and pesticides to increase the yield of crops. Most farmers practice kitchen garden and plant vegetables, fruits, potato, tomato, cauliflower, sweet potato etc. Vegetable farming is one of the major cash crops in the study area. They sell their surplus food grains in the nearby market, Kakarbhitta.

CHAPTER -III

3. LITERATURE REVIEW

The problem between wild animals and people is not a new issue instead of a study of conflict between them which is a relatively recent phenomenon that stared after the establishment of the National Parks and Wildlife Reserves on the country. The study has even more recent origins in Nepal. Therefore, very few works are available on the topic.

Many researchers carried out the investigations associated with the park and people conflicts. Mishra (1971) studied the crop damaged by the wild elephant in Palamu district, Bihar. He suggested that at least 50% of the value of the damaged crop should be paid as compensation and the rest for the damaged fields waived to maintain the brighter future of the elephants in Palamu district (India).

There are already as many as sixteen conservation areas in Nepal (DNPWC 2010) but not a single one of them has ever been studied completely. So far, Milton and Binney (1980), who submitted a report on resolving resources conflicts between wildlife conservation and agricultural land used in Padampur Panchayat, it was discovered that crop loss inflicted by the wild life was the main problem of the inhabitants of the areas adjoining parks. He also found that economic loss ranges from 50 - 100 % in the villages. This was of course, not a small loss.

The worship of elephants as God-Ganesh, which originated in the Third or Fourth century must have created a strong ethos against the elephants (Freeman 1980). The rate of the ivory trade was responsible for the decline of the Asian elephant. Ivory object were known from the pre-dynastic Egypt, Greece, Rome and the Islamic countries. This invention of gun-powder reduced the effectiveness of elephants used in war; however, elephants certainly fought in direct battle lines along with explosives weapons during the fourteen century (Sukumar 1986, Santosh et al. 1991).

Malaria control programme was initiated during the 1950’s which allowed settlements to take place and almost the whole area was now under cultivation (Jackson 1987).

Since the initiation of this programme it was estimated that there has been a 50% decline in the extent of forest cover in the low lands causing loss of habitat for elephants (Smith and Mishra 1992).

Jnawali (1989) studied the case of human harassment and damage to the crops by Greater one-horned rhinoceros in Sauraha adjacent to CNP. The economic loss was reported as Rs. 172,000 of which 68.6% occurred with in a distance of 500 meters. The highest economic loss 27.6% occurred to less than 500 meters.

Sharma (1991) studied crop loss by two methods, namely interview and Net Area Damage (NAD). He found real crop damage was five times less by NAD method than interview. He also reported that Paddy was severely damaged followed by wheat, corn, oilseeds, lentils, and vegetables.

The Decline of elephants in Nepal did not occur until the 10^{th} century (Smith and Mishra 1992). Poaching of elephants for sports was never very common in Nepal because of the symbolic role of the elephants as a religious status.

Protection of elephants has been carried out around the world with various degree of success. In many protected areas where, elephants once found, there has always been a concern over the elephant's impact on vegetation and the risk of irreversible habitat change (Lindsay 1993). The increase in elephants numbers often leads to a decline in woody vegetation and even a local extinction of certain trees, animal species and management of increasing elephant population in several areas were then related to change in land-use pattern taking place within an involvement in a relative equilibrium because there were feedback mechanism which restore the equilibrium (Craig 1992).

Tchamba and Seme (1993) indicated that elephant feeding on crops was related to seasonal movements and optional foraging strategy. In the case of elephants, the optional foraging theory assumes that the fitness of the foraging animals was a function of the efficiency of foraging terms of (1) Energy maximization (2) Nutrient maximization and (3) Secondary properties. (Succulent and Medicinal properties etc.) (Pyke 1983, Pulliam et al 1973).

The involvement of local people in the management of protected areas for mutual benefit is widely accepted today. Wildlife conservation in Nepal has been quite successful from the point of view habitats of several threatened species. Park- People conflicts are prevalent in all the protected areas of Nepal, although the extent of conflicts varies due to separate legislation (Heinin 1993).

The migratory route of elephant's were also considered to be the centre of anthropogenic disturbance due to large concentration of human and livestock population inside as well as on the fringes of various Sanctuary (Silori and Mishra 1995).

Kasu (1996) identified two types of problems concerning conflict in PWR that were a) problems created due to reserve and b) Problems created due to local people. He reported that wild elephants, wild boar and chital were 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 damaged by wild animals amounted to Rs. 3,191.48.

Baral (1999) studied wild boar-man interaction in BNP, estimated a heavy economic loss of Rs. 20,95,346 of which 52.73% occurred in Thakurdwara and 47.27% in Shivapura. Highest economic loss (28.32%) occurred to paddy crops, followed by potato (15.40%), maize (15.21%), wheat (133.80), mussuro (12.42%) and Yam (7.57%).

Studies of conservation of Asian wild elephant interface had been carried out by Yadav (2002) in Eastern Nepal. The conflicts had created great problems between both the government and local people in relation to the management of wild elephants.

Increase in insulating of protected areas, failing management and ineffectiveness law enforcement set the stage for the classical elephant problem on natural resources, their impact on the woody vegetation in protected areas and surroundings (Pamo and Tchamba 2001).

Yadav (2002) had indicated that small herds of elephants reside the whole year in Eastern Nepal. But he had not indicated their population size and distribution. Elephants were distributed in Bauban, Panchpokhari, Navajyoti, Magurnadi and Chulthe communities and forest of Jhapa. This distribution can be attributed to the lack of sufficient food and suitable habitat.

Five people were killed and a womwn was injured in an attack by a mad wild elephant in Siraha, Saptri and Udaypur district (http://www.gorkhapatra.org.np/content.php;Dec.4, 2007).

Bahundangi has lost 24 inhabitants to the unruly giants in the past 15 years. According to the Kuldip Giri, the village secretary this year alone 19 have been injured, 13 houses demolished and nearly 10 million worth's of crop have been destroyed (Adhikari 2009).

CHAPTER - IV

4. METHODOLOGY

4.1 Reconnaissance survey

The reconnaissance survey of the proposed study areas was carried out in first week of May 2008. These surveys are just for identifying so it does not take a long time. During this time conflicted areas and land use pattern were identified. The survey included field observation and interaction with local people. After then only four wards; 9, 8, 2 and 1 were selected from Bahundangi VDC, where elephants were frequently visited. So, these wards were chose to study a conflict between human and elephants

4.2 Data collection.

This study was totally based on primary and secondary data. Primary data were collected from the field through questionnaire survey.

4.2.1 Questionnaire survey

A total of 156 households (with the head of the family and in some cases the person above 21 yrs) will be interviewed using the semi-structured questionnaires. The interview focus on family composition, economic condition of the respondents, ethinicity, land, occupation and conflict issues such as crop damage and human harassment. Altogether Nineteen questions were asked to respondent, another set of questionnaire containing ten questions were asked to VDC authorities. The questionnaire set is given in Appendix (1-2).

4.2.2 Secondary data collection

Secondary data were collected from records and reports from different sources of VDC. Other secondary sources were journals, books, articles and dissertation works.

4.3 Sampling

The sample size for this study was determined on the basis of the number of households existing in the study area. Household number was available from the VDC

office. A simple random sampling method was adopted. Some information was taken from village secretary and local leaders.

4.3.1 Selection of sampling wards

All the wards of VDC were not equally affected by the wild elephants. Only the ward no. 1, 2, 8 and 9 were seriously affected by the wild elephants. These wards were taken as the main affected areas. A total of 10 percent households were selected randomly without replacement basis from the total household in each wards. Hence, al together, 156 households were selected from four wards (Yadav 2002). (Table 2)

Table 2: Sample size in each affected ward of Bahundangi VDC

Wards	1	2	8	9	Total
Total Households	660	139	432	331	1562
No. of HH Sampled	66	14	43	33	156

Source: Bahundangi VDC office records of population census 2001

4.4 Field Survey

A structured questionnaire cannot cover aspect of the reality. Therefore, a field survey was conducted.

4.5 Total Expected Production Survey

A structured questionnaire may not cover aspect of the reality. Therefore, a field survey was conducted to identify the real loss from wild elephants.

The expected production of crops was the production that could be harvested where there was no damage from wildlife. For the calculation of expected production, one khatta land was taken separately for each crop. The land was fenced against depredation from wild elephants. The land was well irrigated and supplied with required fertilizer for paddy, maize and millet. The total expected production was calculated on the basis of a production in one khatta.

Mathematically,

Production of Paddy in one khatta = X kg.

Production of Paddy in one bigha(0.66 ha) = Xkg x 20 khatta

Production of Paddy in one hectare = $\frac{\text{X kg. x 20 khatta}}{0.66}$

4.6 Data Analysis

To find Per head / hectare, total loss of each crops was estimated in NC / hectare and it was multiplied by total sampled household of the VDC and was divided by the total population (Survey household population) (Limbu 1998).

Mathematically,

$$\text{Per head loss / hectare} = \frac{\text{Total loss NC/ha x Total household}}{\text{Total population of sampled household}}$$

The total loss in rupees was estimated by multiplying with the market price of the crops during that period and the estimated loss / hectare was taken in Kg.

The following formulae are used to calculate the loss per unit area.

$$xLy = \frac{xE - xA}{xLc}$$

Where, x = Specific crop: if Paddy, then (P) is used, if Maize (M) is used similarly

xLy = the loss in yield of the crop x per unit area of land

xE = expected production of crop x.

xA = actual production of crop x.

xLc = total land coverage under crop x.

xl = xE – xA

Where, x = Specific crop

L = Total loss

E = Expected production of crop x.

A = Actual production of crop x.

The crop loss was the difference between expected and actual production of different crops.

Besides, these statistical inferences, various tables and diagrams have been used to simplify the presentation of data.

CHAPTER – V

5. RESULTS

5.1 Analysis and status of the study area

5.1.1 Land composition

Out of 156 household questionnaire 6.41%, 21.15%, 22.43%, 23.71%, 12.2%, 6.41%, 6.41% and 1.28% of house owners were landless, below 1 Bigha, 1-2 Bigha, 2-3 Bigha, 3-4 Bigha, 4-5 Bigha, 5-10 Bigha and above 10 Bigha respectively.

	Equivalent	
16 Anna =	1	Ropani
13 Ropani =	1	Bigha
1 Bigha =	0.66	Hectare
1 Bigha =	20	Kattha
1 Ropani =	0.0523076	Hectare

Table 3: Status of land composition

S. No.	Area of the field	Number of Responded	% of Responded Person	Total Responded
1	Landless	10	6.41	
2	Below 1 Bigha	33	21.15	
3	1 - 2 Bigha	35	22.43	
4	2 - 3 Bigha	37	23.71	156
5	3 - 4 Bigha	19	12.2	
6	4 - 5 Bigha	10	6.41	
7	5 – 10 Bigha	10	6.41	
8	Above 10 Bigha	2	1.28	
	Total	156	100%	

So, the highest and lowest response was recorded in respondent having land of 2 – 3 Bigha and above 10 Bigha.

5.1.2 Agriculture Productivity

Among 156 households responded on the agricultural productivity, 9.61 %, 70.51 % and 19.87 % were responded as increasing, decreasing and remain same respectively.

Table 4: Status of agriculture productivity

S. No.	Agricultural Productivity	Number of Responded	Percentage of Responded	Total Responded
1	Increasing	15	9.61	
2	Decreasing	110	70.51	156
3	Same	31	19.87	
	Total	156	100	

According to this data, the highest response was recorded on decreasing (70.51%) and lowest on increasing (9.61%). Most people explained the cause of decreasing agricultural productivity was due to the damage caused by wild elephants, lack of irrigation and drought. People who responded to increasing agricultural productivity said it was due to availability of chemical fertilizer and proper knowledge of cultivation.

5.1.3 Number of surveyed household and its percentage

There were 1562 houses in the study area. It was very difficult to take samples all the houses. So, only 156 houses were taken as sample during study period. Population of sampled household was 873.

Table 5: Number of population in sampled households

Ward No.	Distance from Jungle boundary(km)	Total Households	Affected Survey household	Percent	Number of population in Sampled household
1	5.3	660	66	42.30	354
2	3.8	139	14	8.97	96
3	9.5	728	-	-	-
4	4.9	774	-	-	-
5	5.4	580	-	-	-
6	4.1	430	-	-	-
7	4.5	360	-	-	-
8	1.5	432	43	27.56	249
9	1.5	331	33	21.15	174
Total		4434	156	100	873

5.1.4 Total cultivated land and land holding per family

The study covered the area of 220.40 hectares. This was calculated only for those which were in ward no 1, 2, 8 and 9.The table below showed the land under cultivation and land holding per family.

Table 6: Ward wise distribution of cultivated land

Ward No.	Total cultivated land (Ha)	Percent(%) in terms of total cultivated land	Land holding per family
1	73.50	33.34	1.11
2	19.33	9.04	1.42
8	86.58	39.3	2.01
9	40.36	18.31	1.22
Total	220.40	100%	1.44

The above table showed an average landholding per family as 1.44 ha. It is calculated by dividing total cultivated land by total number of affected surveyed household.

5.1.5 Land coverage of different crops in different areas

The study was mainly focus on 3 different crops i.e. paddy, maize and millet which were heavily damaged by frequent elephant attack. Beside these crops coconut, bettle nut, banana, ginger were also damaged by wild elephants. In the study area, about 100% of the total households cultivated paddy every year. Similarly, 142 households (91.02%) cultivated maize and 36 households (23.07%) cultivated millet every year.

Table 7: Area coverage in different household in number and land volume (Ha)

Ward No.	Paddy growing HH	Paddy land	Maize growing HH	Maize land	Millet growing HH	Millet land
1	66	66.48	60	56.8	10	3.22
2	14	18.43	12	14.23	5	0.99
8	43	72.74	40	66.38	10	8.30
9	33	35.70	30	30.24	11	3.621
Total	156 (100%)	191.35 (86.81%)	142 (91.02%)	167.65 (76.06%)	36 (23.07%)	16.13 (7.31%)

Paddy was planted in summer and maize in winter. After harvesting maize, paddy was sown in the same field. Millet was planted in the rainy season. Most of the houses cultivated millet in the same field after harvesting paddy. Out of the 220.40 ha land, 191.35 ha (86.81%) land was used for paddy plantation, 167.65 ha (76.07%) for maize and 16.13 ha (7.31%) for millet.

5.1.6 Crop production

Paddy, Maize and Millet were the main crops in the Bahundangi VDC. Besides this wheat, ginger, potato and green vegetables were also planted. The total production of paddy, maize and millet in sampling households of wards 1, 2, 8 and 9 were 521,861 kg, 233,691 and 10,263 kg respectively.

Table 8: Total crop yield (kg) and it % from sampled household

Ward No.	Paddy		Maize		Millet	
	Yield(kg)	Percent (%)	Yield(kg)	Percent (%)	Yield(kg)	Percent (%)
1	175,854	33.7	79175	33.88	2049	19.96
2	50263	9.63	19835	8.48	630	6.13
8	198,381	38.01	92529	39.6	5281	51.45
9	97363	18.65	42152	18.03	2303	22.43
Total	521861	100%	233691	100%	10263	100%

Table 8 showed that the highest percent of paddy produced in ward no. 8 and the lowest in ward no. 2. Similarly, maize and millet was also produced highest in ward 8 and the lowest in ward no 2.

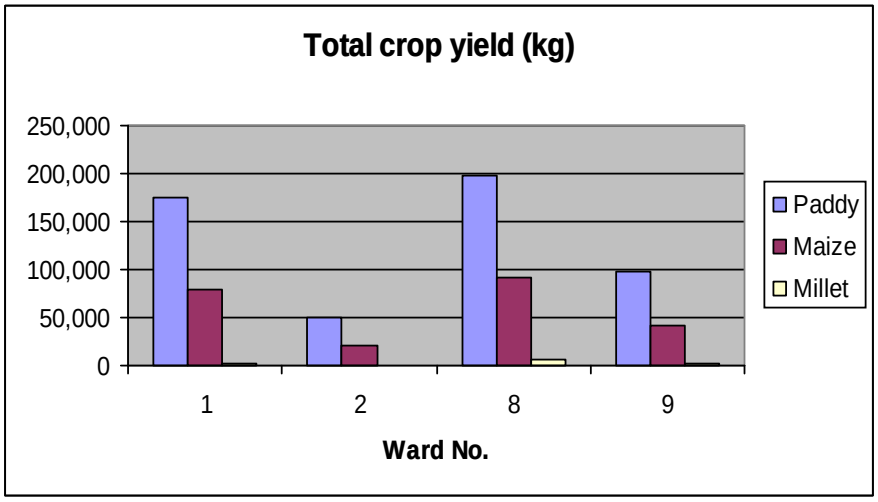

Figure 1: Crop yield (kg) in different wards of study area

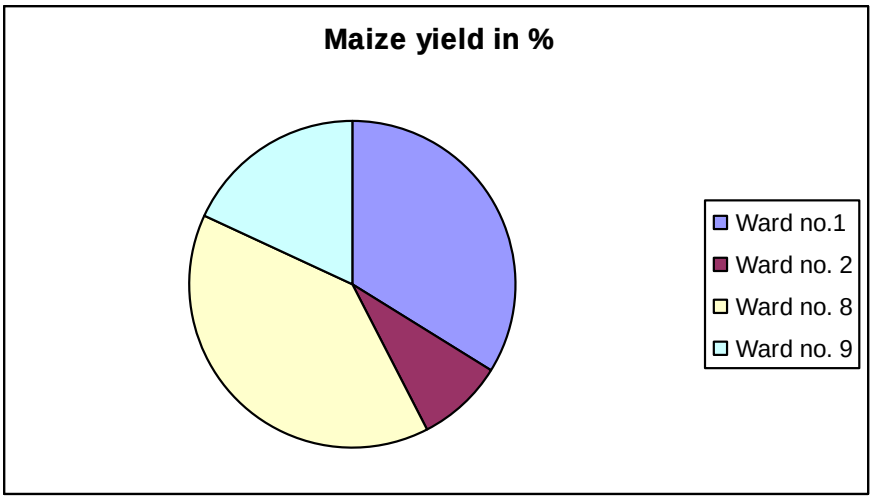

Figure 2: Maize yield (%) in different wards of study area

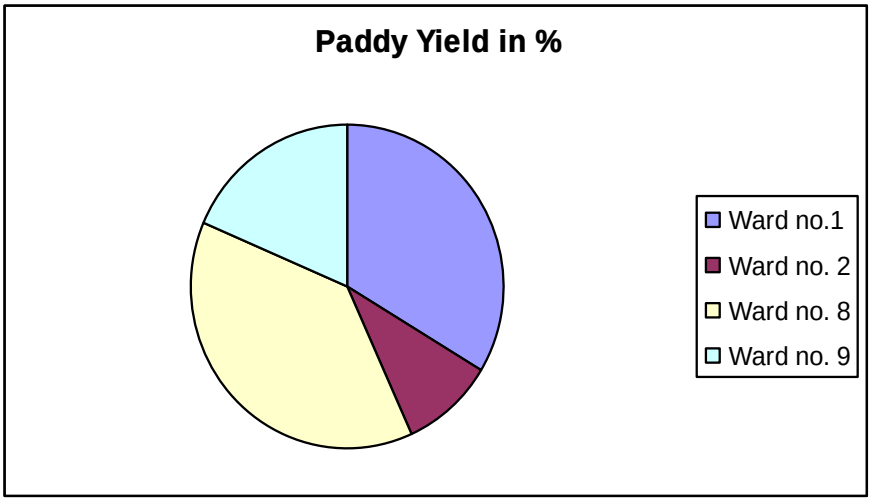

Figure 3: Paddy yield (%) in different wards of study area

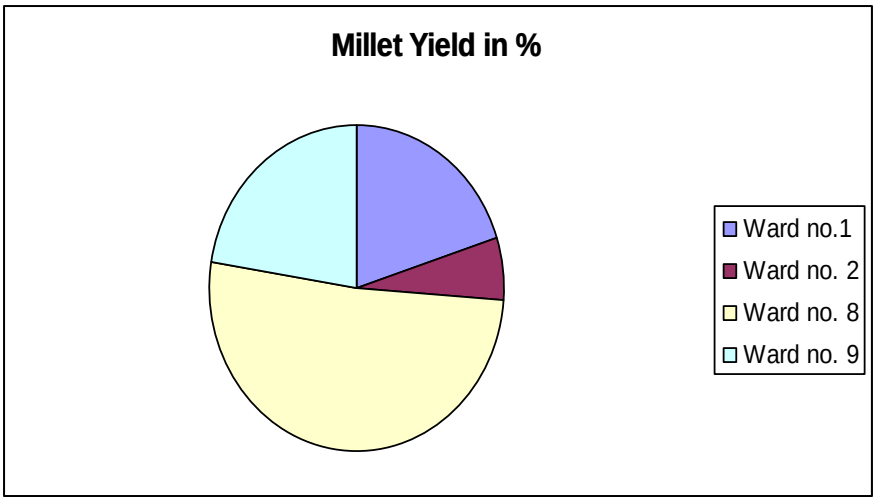

Figure 4: Millet yield (%) in different wards of study area

Table 9: Total production and production percentage (%) of crops

S.N.	Crop	Total production(kg)	Percentage (%)
1	Paddy	521,861	68.14
2	Maize	233,691	30.51
3	Millet	10263	1.34
	Total	765,815	100%

Above table showed the production of paddy (68.14%) was followed by maize (30.51%) and millet (1.34%).

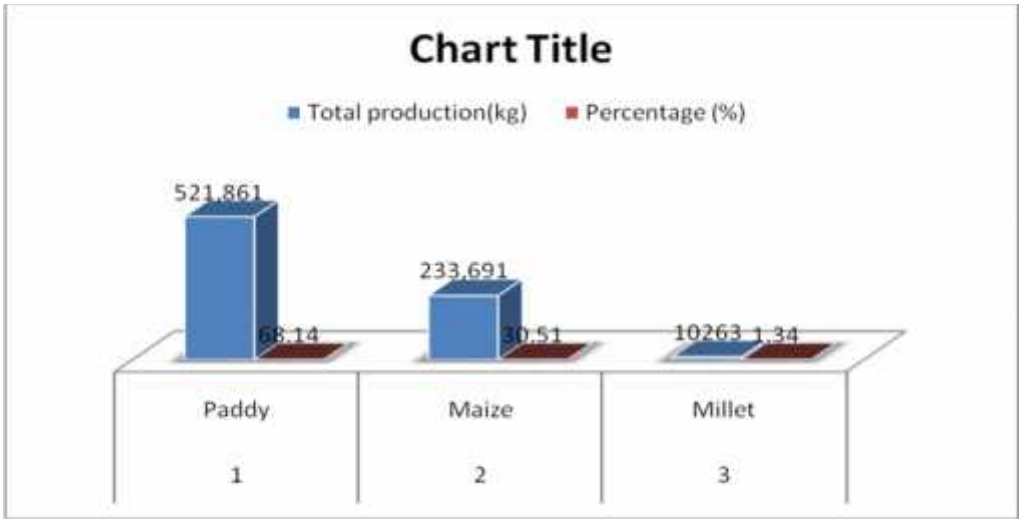

Figure 5: Total production and production percentage (%) of crops of study area

5.1.7 Total expected Production

The expected production of the crop was the production that would be harvested when there was no damage from wildlife.

(Where, Production of Paddy in 66.48 ha. = $\frac{2100 \times 66.48}{0.66}$ kg = 2, 11, 527 kg (In ward No.1)

Similarly, calculation of expected production of maize and millet was same as paddy.

Table 10: Expected production (in kg)

Ward No.	Paddy	Maize	Millet
1	211,527	103,272	3903
2	58,640	25,872	1200
8	2,31,445	1,59,892	10060
9	1,13,590	54,981	4389
Total	6,15,202	3,44,017	19,552

Paddy was the dominant crop in the study area. Almost each household grew paddy, maize and millet. About 6, 15,202 kg of paddy was expected in a year to be harvested from the study area in 191.35 ha and 3, 44,017 kg of maize and 19,552 kg of millet was expected in 167.65 ha and 16.13 ha land respectively.

5.1.8 Total loss of different crops in different Areas.

The total loss was the difference between the expected production and actual production of different crops. The total loss of different crops was as follows.

Paddy:

As mentioned earlier paddy was the dominant crop in the study area. The entire sampled households grew paddy in their whole land.

Table 11: Total loss of paddy (kg) in terms of expected production

Ward No.	Total Expected Production (in kg)	Total Actual Production (in kg)	Total Loss (in kg)	%
1	211527	175854	35673	16.86
2	58640	50263	8377	14.28
8	231445	198381	33064	14.28
9	113590	97363	16227	14.28
Total	615202	521861	93341	15.17

In total 615,202 kg of paddy was expected from 191.35 hectare of land but farmers could only harvest 521,861 kg of paddy. 93,341 kg of paddy was lost due to wild elephants.

Maize:

Maize was second major crop and the entire sampling household grew it in winter season.

Table 12: Total loss of maize (kg) in terms of expected production

Ward No.	Total Expected Production (in kg)	Total Actual Production (in kg)	Total Loss (in kg)	%
1	103272	79175	24097	23.33
2	25872	19835	6037	23.33
8	159892	92529	67363	42.13
9	54981	42152	12829	23.33
Total	344017	233691	110326	32.06%

The total expected production of maize was 344,017 kg from 167.65 hectare of land. But farmers could harvest only 233,691 kg of maize.

Millet:

About 7.31% of land was occupied by millet in rainy season.

Table 13: Total loss of millet (kg.) in terms of expected production

Ward No.	Total Expected Production (in kg.)	Total Actual Production (in kg.)	Total Loss (in kg.)	%
1	3903	2049	1854	47.50
2	1200	630	570	47.5
8	10060	5281	4779	47.50
9	4389	2303	2086	47.52
Total	19552	10263	9289	47.50

The total expected production of millet was 19,552 kg from 16.13 hectare of land but farmers could harvest only 10,263 kg of millet.

Table 14: Total loss of crops (kg) in sampled houses in respective wards

Ward No.	Paddy Damaged (kg.)	Percent %	Maize Damaged (kg.)	Percent %	Millet Damaged (kg.)	%
1	35673	38.21	24097	21.84	1854	19.25
2	8377	8.97	6037	5.47	570	6.13
8	33064	35.42	67363	61.05	4779	51.44
9	16227	17.38	12829	11.62	2086	22.45
Total	93341	100%	110326	100%	9289	100%

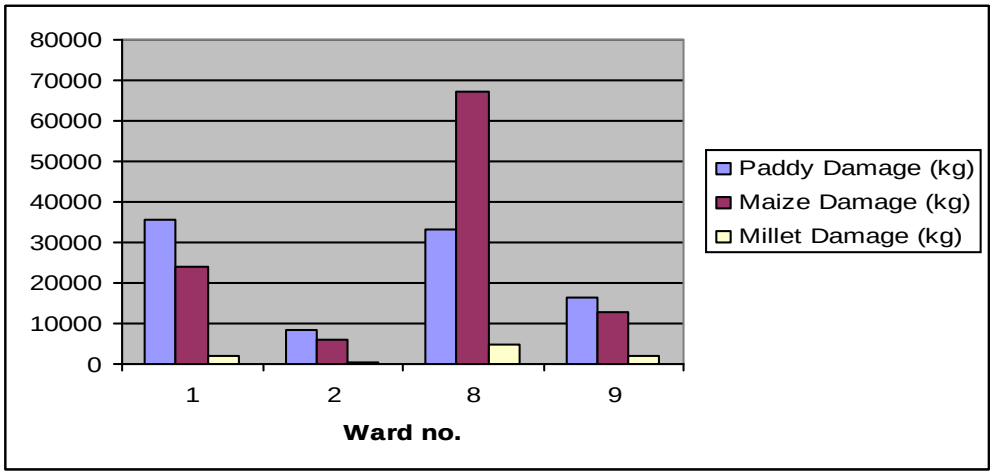

Figure 6: Total loss of crops in terms of expected production of study area

Table 15: Total loss of crops (kg) in terms of expected production and loss percentage

Crops	Expected Production (kg.)	Damaged Crops (kg.)	% loss in expected production	% loss in total damage
Paddy	615202	93341	15.17	43.87
Maize	344017	110326	32.06	51.80
Millet	19552	9289	47.50	4.36
Total	978771	212956	21.75	100%

As ward no. 8 was nearer to Jungle, large amount of crop was lost.

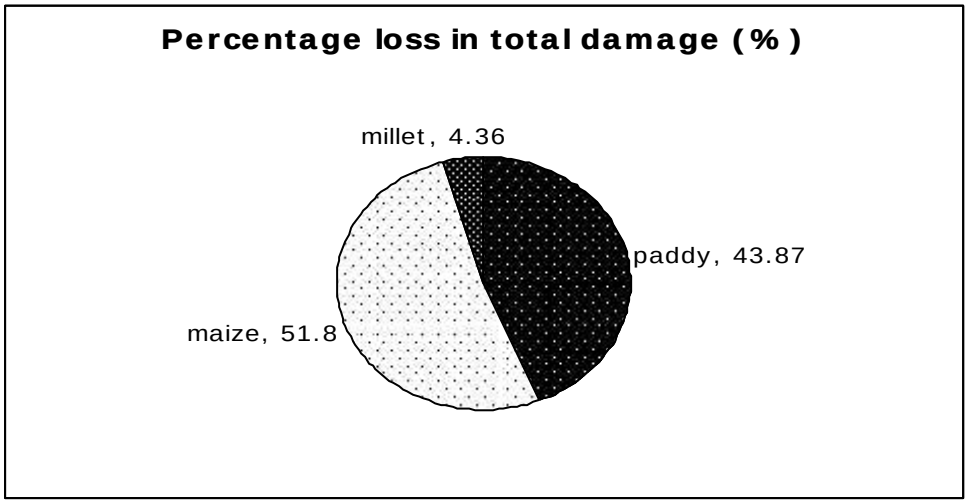

Figure 7: Percentage (%) of crops loss of study area

5.1.9 Market price and monitory value of damaged crops

The monitory value was calculated on the basis of market price of different crops. The market price of different crops was taken from Kakarbhitta bazaar. The table below shows the economic loss of crops in Bahundangi VDC.

Table 16: Economic loss of different crops

S.N.	Different crops	Total loss in kg	Market price (Rs/kg.)	Total loss in Rs.
1	Paddy	93341	11.75	Rs. 1096756.8/-
2	Maize	110326	10	Rs.1103260 /-
3	Millet	9289	13	Rs. 120757 /-
4	Bamboo	2120 trees	1 pole Rs. 40	Rs. 84,800 /-
5	Coconut	130 trees	100 fruits/tree 1 fruit = Rs.10	Rs. 1,30,000 /-
6	Bettle nut	248 trees	1 pole Rs.40	Rs. 9,920 /-
	Total			Rs. 25,45,493.8/-

Table 16, showed that the total economic loss of crops was Rs 2,545,493.8/- due to crop raiding by wild elephants. In the study area Rs.1, 096,756 /- of paddy was lost. The monitory value of maize and millet loss was Rs.1, 103,260 /- and Rs. 120757 /-

respectively. Similarly, the monitory value of Bamboo, Coconut and Bettle nut loss was Rs. 84,800 /-, Rs. 1, 30,000 /- and Rs.9920 /- respectively. On an average each household lost approximately Rs 16,317.26/- annually due to crop depredation by wild elephants.

Table 17: Per head loss (NC)/hectare due to crop damage by wild elephants

S.N.	Crops	Estimated loss per/ha (kg.)	Market rate per kg.	Total loss/ha(NC)	Per head loss/ha(NC)
1	Paddy	487.8	Rs.11.75	Rs.5731.65	Rs. 1,024.21
2	Maize	658.07	Rs. 10	Rs. 6580.7	Rs. 1,175.93
3	Millet	575.84	Rs.13	Rs. 7485.92	Rs. 1,337.69

Table 17, showed that per head loss/ha for paddy, maize and millet was Rs.1024.21/-, Rs. 1,175.7/- and Rs. 1,337.7 /- respectively.

Where,

$$\text{Per head loss / hectare (NC)} = \frac{\text{total loss NC/ha x Total sampled Household}}{\text{Total Population of sampled household}}$$

5.2 Frequency and Seasonality of crop raiding (N = 156)

The incidences of crop damage by elephants in Bahundangi VDC were high in the months of June-July and November-December. Medium intensity of damage occurred in May, October, January and September and low intensity of crops damage occurred in February, March and April.

Table 18: Seasonal intensity of crop damage (%) based on questionnaire (N=156)

Month	High	Medium	Low
January		32.05	
February			25.04
March			23
April			21.3
May		33.90	
June	76.92		
July			
August	90.38		
September			
October			
November	73.71	36.0	
December	77.56	32	

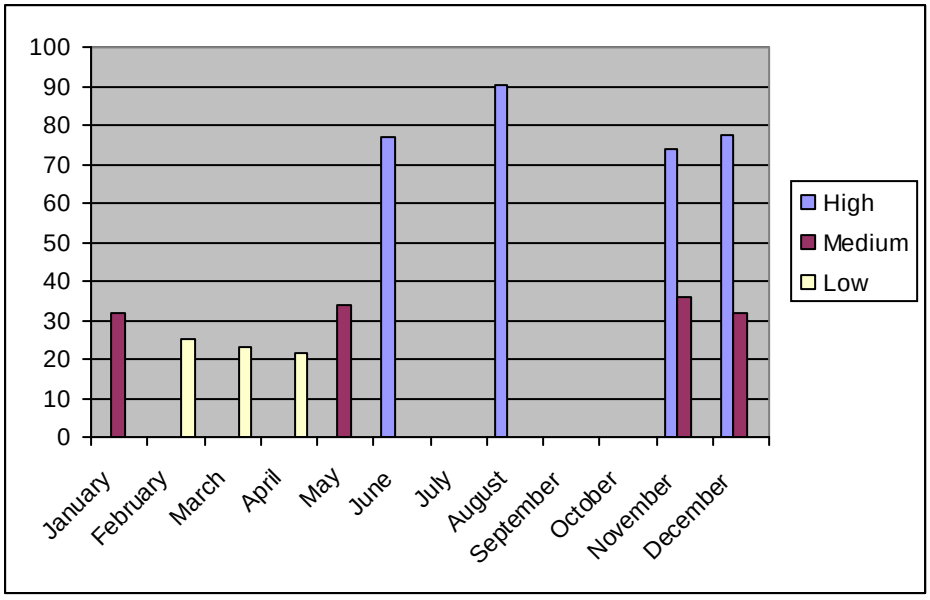

Figure 8: Perception of respondents regarding seasonal intensity of crop damage in Bahundangi VDC

There were two peak seasons for crop raiding in this VDC and across Nepal-India border as well. In the June-July, the elephant raided maize and barkhedhan (Paddy of rainy season) and dry season paddy was damaged in October-December.

5.3 Extent of crop damage by elephant with calves

About 69.87% of the respondent reported that crop was damaged more when elephant came with calves compared to without calves. However, some of the respondents disagreed with them. 14.74% reported that crop damage was less with calves, 10.25% reported almost equal damage with and without calves and 5.12% did not have any idea. The reason for high damaging was calves were usually very active.

Table 19: Response of elephants with baby

Ward No.	Sampled HH	Less	%	More	%	Equal	%	Do not know	%
1	66	8	12.12	48	72.72	7	10.60	3	4.54
2	14	3	21.42	8	57.14	2	14.28	1	7.14
8	43	9	20.93	28	65.11	4	9.30	2	4.65
9	33	3	9.09	25	75.75	3	9.09	2	6.06
Total	156	23	14.74	109	69.87	16	10.25	8	5.12

It was obvious from the above table that elephants with baby damaged the crop more than without baby.

5.4 Crop damage and crop preference at different stages of growth

The survey showed 60 percent respondents replied that elephant preferred maize, while 30 percent and 10 percent agreed paddy and millet was more preferred respectively.

5.5 Household food sufficiency

Out of the total sampled household, 73 respondents had sufficient food from own production while 83 had food deficit. In spite of knowing the severe problems of elephants, they cultivated land for their livelihoods as the majority of them were farmers.

Table 20: Responding household food sufficiency

Ward No.	Sample size	Sufficient	Percent	Deficit	Percent
1	66	40	60.60	26	39.4
2	14	5	35.71	9	64.28
8	43	17	39.53	26	39.4
9	33	11	33.33	22	66.7
Total	156	73	46.80%	83	53.20%

5.6 Reason for elephant visiting

The attraction of wild elephants towards human settlements was due to crop fields. The main reason for the field raiding was due to lack of sufficient food in the jungle. Food in the jungle could not fulfill all their food requirements due to flooding in rainy season because of Mechi River is near to the jungle (plate11&12). The reason for elephants visiting settlements cited by respondent was given below.

Table 21: Reason and percent of elephant visiting in settlements

S.N.	Reasons	Number of respondents	Percent
1	Lack of sufficient food in Jungle	75	48.07
2	To change the taste	12	7.7
3	Lack of proper fences in border	23	14.74
4	Liking of field crops	27	17.30
5	Lack of suitable habitat	19	12.2
	Total	156	100%

5.7 Human Harassment

Another serious problems experienced by the local people was fear of wild elephants attack. Quite a number of people were chased, attacked and even killed by wild elephants. Wild elephants from the jungle frequently attacked people. This problem was most acute in the areas adjoining jungle.

No such accidents occurred during my visit to the study area. But according to the villagers, many accidents had occurred in the previous year. A total of 19 people were killed by elephants in Jhapa district in a period of 20 years (1988-2008). Among 19 people, 8 people were killed by wild elephants in Bahundangi VDC of Jhapa District

Table 22: Number of victims attacked by elephants

S.N.	Name	Age	Consequences of attack	Mode of attack	Date
1	Pampha Devi Guragain	35	Killed	While chasing	1988
2	Tara Dahal	45	Killed	While chasing	1990
3	Mrs. Lal Bdr. Bishawakarma	40	Killed	Suddenly attacked	1992
4	Prem Baral	35	Killed	During Encounter	1995
5	Shyam Adhikari	46	Injured, bones of right leg was broken	Trampled by Baby elephant	1999
6	Saraswoti Kafle	39	Injured, badly hurt in the chest by stone	While chasing, accidentally the stone hurt in the chest	2000
7	Yubraj Dahal	42	Injured, right leg broken	Attacked but elephant ran away after people's shouting	2000
8	Rana Bdr. Diyali	62	Killed	Suddenly attacked	2002
9	Shambu Thapa	22	Killed	Sleeping inside the house	2002
10	Durga Thapa	16	Killed	Sleeping inside the house	2002
11	Dibakar Naupane	42	Injured	Going field for irrigation	2002
12	Mohan Bhujel	35	Injured, right hand broken	Chasing away the elephant	2002
13	Prem Khadka	19	Injured, bones of left hand broken	While guarding of crops	2004
14	Chandra Bdr. Dangi	22	Killed	While chasing away	2007

Table 23: Distribution of victims on the basis of Age and Sex

S.N.	Age (Yr.)	Sex		Total	%	Remarks
		Male	Female			
1	10-20	1	1	2	14.28	78.6% of the victims belong to age from 21-50 years.
2	21-30	2	-	2	14.28	
3	31-40	2	3	5	35.71	
4	41-50	4	-	4	28.57	
5	51-60	-	-	-	-	
6	61-70	1	-	1	7.14	
	Total	10	4	14	100	

Above table shows that, 78.6% of the victims are 21 to 50 year in age.

Table 24: Number of casualties and injuries on the basis of Age and Sex

S.N	Age (Yr.)	Number killed	Number injured	Total	Remarks
1	10-20	1	1	2	Among 14 victims 5 males and 3 females were killed and remaining 5 males and 1 female were injured.
2	21-30	2	-	2	
3	31-40	3	2	5	
4	41-50	1	3	4	
5	51-60	-	-	-	
6	61-70	1	-	1	
	Total	8	6	14	

Above table showed that, 5 males victims aged between (22-61) years were killed and 3 females victim aged between (16-40) were killed and remaining 5 males and 1 female were only injured. Most of the injured victims were of age between 19-50 years.

5.8 Other Economic Burden

The estimated economic burden per household due to expenditure on elephant control ranged from Rs. 7,180 – Rs. 8,400.

Box: 1

Economic burden due to expenditure on elephant control at Bahundangi VDC.

Direct and indirect cost had been incurred during the controlling of elephants.

A. Direct estimated cost per year per affected household was:

1. Torch and batteries: 2 Torch lights per year.
   200 x 2 = Rs. 400 - Rs. 500
2. Kerosene: 11 liters per month for 4 months. June-August and November-December.
   Total estimated cost/year = 11x 4 x Rs. 54 = Rs.2376 – Rs. 2400
3. Foggy light: Rs. 800 – Rs. 1000
4. 12 volts battery for foggy light = Rs. 2500 – Rs. 3000
   Expenditure on battery charge: Rs. 35 /charge, for 3 time/ week.
5. Explosives (fire crackers) for 4 months: Rs. 100 x 4 = Rs. 400 – Rs. 500

B. Indirect Cost

Involved cost of marking watching huts, tree towers, burning of straw, maintenance of strips on farmlands and indirect expenditure on medical treatment.

Indirect cost: Rs. 600 – Rs 1000

The total estimated economic loss per year per household was Rs. 7180 – Rs. 8400.

The above cost was mostly borne by wards 1, 2, 8 and 9 which had to control elephants**.**

5.9 Local Preventive Measures

Local people had adopted various methods to protect their crops from wild elephants. About 51.31% of people shouted and chased elephants with fire and foggy lights. While other less common methods to deter elephants to beat tins and boxes, chasing with stones, watching elephants from towers (plate 2) and machan, electric barriers around the houses, vehicles used and so on.

Table 25: Methods used to deter elephants in Bahundangi VDC (N =156)

S.N.	Methods	Response	
		Number	Percent
1	Shouting and chasing with fire and Foggy light	80	51.3
2	Beating tins and boxes	30	19.33
3	Watching tower and Machan	15	9.61
4	Chasing with stones	20	12.82
5	Vehicles	5	3.20
6	Others (electric fences or planting thorny barriers around houses).	6	3.84
	Total	156	100%

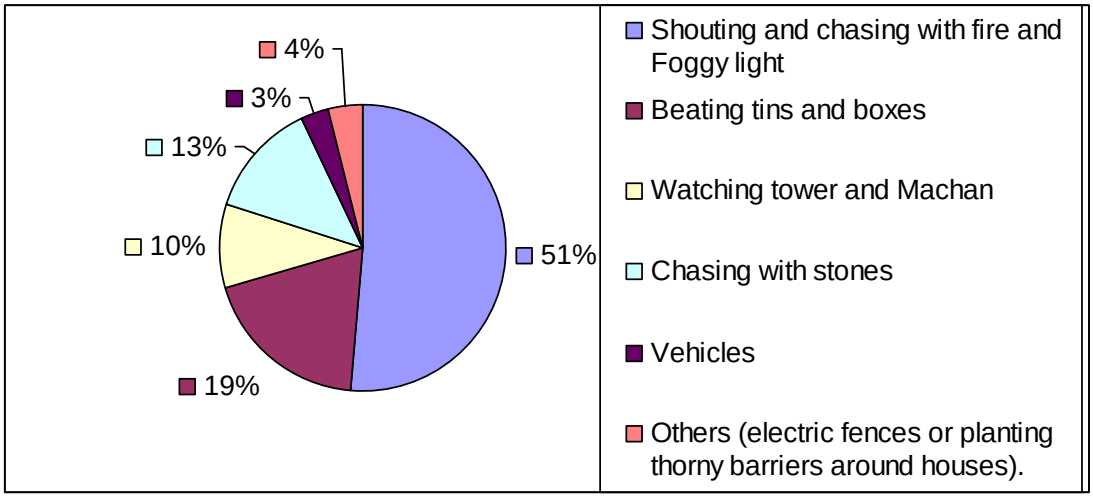

Figure 9: Methods used to deter elephants in Bahundangi VDC

The Jhapa district office had allocated Rs. 50,000 for elephant control and crop protection every year. This money had been spent on purchasing scaring devices such as foggy lights and alkaline batteries. The district forest office had distributed 20-30 foggy lights in Bahundangi VDC. The DFO had formed elephant controlling groups in the past but that did not work well. That's why elephant scaring devices had been distributed from 2001 to the affected areas.

In 2002, the Ministry of Forest and Soil Conservation (MoFSC) allocated Rs. 10, 00,000 to Bahundangi VDC to construct 17 concrete watch view towers at the passes (*gauda*) of Mechi River enroute to Bahundangi to scare and drive away the Indian

elephants. Recently Bahundangi VDC had come up with a new idea to manage elephant through the plantation of *Agava Americana indica* (locally called "*hattibar"*, century plant or "*ketuke*") along the entry point of elephants between Bahundangi and Mechi River. Two thousand saplings of "*Hattiba*r" were brought from Sikkim by the VDC office and planted along the entry points in wards 1, 2, 8, and 9 of Bahundangi VDC. The idea was to deter the elephants with the pricking of the thorns. It was expected that if the *hattibar* grew well within a year time they would attain a height of over 6 feet and provide a formidable barrier for the entry of elephants.

5.9.1 Compensation and evaluation of effectiveness

Bahundangi VDC office had been providing financial support of Rs. 500 to people whose houses had been damaged by elephants and Rs. 2,500 to families whose member had been killed by elephants, but it was not in regular budget of the VDC. Mechinagar municipality had also been contributing to houses dismantled by elephants. The UNHCR and Nepal Red Cross Society had provided clothes, tents and money to families of elephant victims in Bahundangi since 2002 but it was only an emergency support and not a continuous aid. The Forest User Group (FUG) of Panchpokhari community forest had been giving Rs. 500 to every house damaged by elephants and five cubic meter of timber.

The raiding of crops by elephants is one of the major components of human-elephant conflict, causing loss of livelihood and retaliation against elephants. To mitigate the conflict, various intervention methods were in use by farmers, yet there have been few rigorous assessments of their effectiveness. An assessment of efficacy of interventions in use by communities in Bahundangi VDC. During my field visit, I found the main effectiveness were shouting and chasing with fire and foggy lights. My study highlights the importance of evaluating of intervention methods to determine effectiveness. I proposed the use of fences, spotlights and chilli fences be promoted in that area in conjugation with long term habitat protection.

5.10 Mode of wild elephant Incursion

On seeing a person, most of the elephants stand for a while then they charge towards the person with their trunk and lift the victim up and throw away. Again, they moved towards the victim and trample the victim over. In most cases, wild elephant attacked only when they were annoyed. Sometimes they also attacked inside the house.

CHAPTER -VI

6. DISCUSSION

The present study was conducted in Bahundangi VDC of Jhapa District which has been facing the serious problems of wild elephants for many years. It is the migratory route for the elephants. Due to the scarcity of food in the Indian reserve (West Bengal India) which is nearest to the Mechi River and during the rainy season flooding in the reserve caused elephant to move in other places for food. So, they come to the Bahundangi VDC which lies near the forest.

Elephants are distributed in eastern community forest in Bauban, Panchpokhari, Navajyoti, Magurmadi and Chulthe of Jhapa district. This distribution can be attributed to the lack of sufficient food and suitable habitant. Although various grass species (*Saccharum,Bambusa* sps. *Panicum, Sorgum, Paspalum*) , sedges, succulent plants, tree barks, shrubs and trees (*Acacia* sps., *Lizyphus* sps., *Bauhinia* sps., *Abbizza* sps., *Dalbergia* sps.) , woody lianas, climbers and creepers which form food for elephants are available in the forest but the resources may not be sufficient to support elephant population for entire year.

In Eastern Nepal, elephants are categorized into local and migratory. Local elephants are distributed in *Bauban*, Panchpokhari, Navajyoti, Magurmadi and Chulthe community forest of Jhapa district for whole year near by the Mechi River. They don't damage crops severely. The estimated populations of such elephant are at 8 to 9 in number but they usually visited singly. They are also larger in size in comparison to migratory elephants. Simillarly, Yadav (2002) had indicated that small herds of elephants reside whole year in eastern Nepal. The migratory elephants are smaller in size than residental elephants and they are very destructive. This may be due to new environment which is the factor for wildlife to stimulate for working destructive work in herds and also due to reproductive stage. They usually come from West Bengal (India) to Bahundangi VDC during harvesting period of paddy, maize and millet etc According to local people; they exceed 85 to 125 also. So, the elephant problem is being serious problem everyday.

Among paddy, maize, and millet the most affected crop was maize (51.80%) followed by paddy (43.87%) and millet (4.36%). Like Kasu Wild elephants mainly raided maize, paddy and millet during the harvesting period from June- July, and November–December. Wild elephants also damaged Bamboo, Bettle nut and Coconut trees. Crop damage depends on various factors like nature of crop and preventive measures used by farmers, the number of elephants and distance from jungle boundary. The main reasons for field attack were lack of sufficient food in the jungle followed by liking of crop field and lack of incomplete electric fences in boundary of reserve area of West Bengal India.

The study also calculated the average loss of each household due to crop damaged by wild elephants which was Rs. 16,317/- and total loss from the sampling household was Rs. 25, 45,493.8/-. From this study, it was also found that per head loss in NC/Hectare of paddy, maize and millet were Rs. 1024.21/-, Rs. 1175.93/- and Rs. 1337.69/- respectively. The total paddy loss was 93,341 kg (43.87%), maize 1, 10,326 kg (51.80) and millet 9289 kg (4.36%) which is greater than the data of Kasu 1996.

Similarly, Kasu (1996) in Parsa wildlife Reserve calculated the loss as 23,857 kg for paddy which was 77.52 percent of the total paddy damaged. Similarly total loss of wheat and maize were 4896 kg and 2022 kg or 15.91 percent or 6.57 percent respectively. This amount is damaged only by elephants but there is also possibility of destruction from Deer and Boar. And Kasu (1996) found that Elephants, Deer and Boar destroyed 15.19 percent, 52.20 percent and 32.61 percent respectively of total crops damaged. Sharma (1991) calculated by NAD (*Net Area Damage*) method that Rhino (*Rhinoceros unicornis*), Wild boar (*Sus scrofa*) and chital (*Axis axis*) destroyed 43.7 percent, 28.3 percent and 18.3 percent of total crops damaged respectively in Chitwan National Park. Limbu (1998) in Koshi Tappu Wildlife Reserve calculated 85.15 percent, 14.84 percent total crop damaged by wild buffalo and wild boar respectively.

Elephants with calves damaged more crops than without calves. The basic reason for high damaged by elephants with calves was that calves were very innocent and active and usually entered into the houses and fields randomly. The cow elephants usually

came to search, protect and rescue her calf. In the process, elephants may cause a lot of damage to crops, destroy houses and sometimes even cause human casualties.

Local harassment was another serious problem in the Bahundangi VDC. Mainly villagers were assaulted by wild elephants in pervious years. This study showed that 5 males and 3 females were killed by wild elephants. Similarly, 5 males and 1 female were injured. Most of the victims were of age between 21-50 years. Among 14 victims, aggressive elephants also killed a couple sleeping in the house. They were Shambhu Thapa and Durga Thapa. Sambhu Thapa was killed by taking him out of the house but his wife was killed inside the house in the year of 2002. Most of the accidents occurred out side the house. Similarly, Jnawali (1989) identified 78 accidents occurred in 1978-1988 in Chitwan National Park, among 78 people being attacked by Wild animals 23 were killed and 55 injured. Most of the accidents (57.7%) occurred outside the Park during grazing cattle, collecting fuel wood; fodder and fence materials etc. according to Shrestha (1994), 10 people were attacked in which 2 victims were killed and remaining were seriously injured occurred outside the house. Kasu (1996) showed that there were no assaults from wild animals in Parsa Wildlife Reserve.

Local villagers had adopted different kinds of preventive measures. For instance, spending night in watch towers and machan, use of noise making tools, use of foggy lights and fire, beating tins and boxes, chasing with stones to deter the elephants etc. Shouting and chasing with fires and foggy lights, beating tins and boxes, spending whole night in watch towers and machan were more popular methods. But they did not practice on plantation of alternative crops like sunflower, mulberry, tobacco in the area to avoid elephants and consequent crops damage. Chemical repellants can be effective against elephants. Natural chemicals that can deter elephants should be identified.

According to the villagers, spending whole nights in watch towers and machans had an adverse effect on the people's health as well as on the efficiency of villagers' work.

The main reason of agricultural loss and harassment to the local people occurred due to lack of complete physical barriers between private areas and forest. Physical

barriers had been adopted only in 5 km but there was a total of 12 km where electric fences have to be adopted. Lack of planning, lacking of alternative practices for agriculture, ignoring people's needs were responsible for today's problem in Bahundangi VDC. So, the problems are growing more serious than ever.

Compensation schemes for damaged caused by elephants may mitigate HEC to some extent but they can not be a permanent solution to HEC due to numerous practical problems in paying it. Compensation makes people more positive towards the conservation of wild elephants and reduces hostility with the elephants. But over dependency on compensation may reduce people's initiative to guard crops and properties. Sometimes the compensation schemes for crop damaged by elephants are abused. People seem to exaggerate the amount of damage for getting higher amount of compensation. Similar study in Northern India, for example showed that thirty percent of claims were found to be false. (William and Johnsingh 1996).

CHAPTER – VII

7. CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

The aims of the study were to find out the actual crop loss caused by wild elephant, study the human harassment due to wild elephant, impact on local people by wild elephant and to analyze the local preventive measures. To evaluate problem created due to elephant which included crop damage and human harassment being one of the major part. The study was conducted at ward no. 9, 8, 2 and 1 of Bahundangi V.D.C.of Jhapa district. Crop depredation was very serious in Bahundangi V.D.C. The total loss of Rs. 2,545,493.8 was estimated. Maize and paddy were seriously damaged.

Human harassment was another serious problem in the study area. Many people had been killed and injured by wild elephant. But according to the local villagers they did not get any cash compensation for their treatment from the VDC.

Many people of the study area were economically poor. So they felt difficult to live a sustainable life. As a rural area with illiterate people, their economic status was falling further below due to these problems.

7.2 Recommendations

The problems of elephants in eastern Nepal cannot be eliminated but it can be controlled by proper management interventions. The following are relevant management recommendations.

(1) Management of staple foods for elephants

The elephants knew most of the plants which we cultivated in our own fields (Sukumar 1989). So the concerned authorities should cultivate palatable plants like banana, cassava, broom grass, bamboo etc as elephant fodder in forest.

(2) Provision of Equipments and materials for elephant Control

The district forest offices of eastern Nepal should be provided with vehicles with special siren, special torchlight, and shotguns with bullets, field gears such as tents, sleeping bags, and utensils etc for patrolling and chasing elephants.

(3) Construction of watch towers

To protect crops permanent and safe watch towers should be built near the crop fields or elephants entry points. Many crop fields of wards 9, 8, 2 and 1 are situated in the bank of Mechi River. These crop fields are far from the home to take care. The guarding group needs some places to stay in night. 18 permanent and safe towers for guarding groups are built in 2004 along the Mechi River on the entry points of the elephants. The number of these towers should be increased.

(4) Training to Guarding Groups

Guarding groups should be sufficiently trained to deter elephants. Government should provide training to such groups, which should guard crops in turn.

(5) Night vision binoculars

Night vision binoculars should be provided to all guarding groups along the Mechi Riverside. The device will help to see the elephants in night from a distance so the guarding groups can be alert to chase them.

(7) Tea cultivation

Tea cultivation (plate13) is recommended in waste and degraded lands. Elephants do not move through tea gardens as the hard rootstock of tea plants hurt their legs.

(8) Elephant Repellants

Chili peppers may be burnt to deter elephants in Eastern Nepal like Kenya. Natural chemicals that can deter elephants should be identified and applied.

(9) Bee-hive keeping

Bee-hive keeping in the elephant affected area is practiced in Bahundangi VDC. The hive is kept in such away that when elephants touch the strings connected to hives; the hives fall down on the ground and bees coming out from the hive to sting the

elephant. However, bees can attack man and they should be conscious for self protection, living indoors.

(10) Cactus Plantation

Cactus Plantation in the elephant affected area may also be other measure to deter elephants. Special type of cactus plant called *"Hattibar"* in Nepali is being used as fence to deter elephant in affected area. This practice should be extended.

(11) Management of forest Corridors

The forest corridor in eastern Nepal has been broken at several places. Government should protect the corridors and check their encroachment for the conservation of elephants and other fauna and flora.

(12) Trans boundary co-operation between India and Nepal

Elephants know the borders, thus Trans boundary co-operation between India and Nepal should be initiated to manage the migratory elephant herd.

(13) Awareness Programmes about importance of wildlife

The government and other organizations should launch some awareness programme concerning the importance of wildlife and natural resource conservation, environment conservation and forest resource conservation from time to time focusing on elephant. Conservation education is the best long-term solution to wildlife management.

(14) Effective Compensation Scheme

To create positive attitude among the local people towards elephants the government should provide compensation to the victims of elephant damage. Compensation should be based on actual quantities of crop damaged, houses and properties destroyed and the nature of human injuries and casualties. A local committee should be formed with local leaders and government representatives to evaluate the damage and recommend compensation.

PLATES

Plate-1
Ripe paddy trampled by elephants

Plate-2
Elephant guarding tower

Plate–3
Author interviewing with local people

Plate–4
Electric fence at the edge of Mechi River

Plate–5
Foot print of elephant

Plate–6
Foot print of elephant

Plate 7 & 8– Houses demolished in search of grains.

Plate–9
Local people showing Beetle nut destroyed by elephants.

Plate–10
Paddy cultivation near by Mechi River.

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Plate -11
Mechi River

Plate -12
Livestock grazing inside the Mechi River

Plate- 13
Tea cultivation

Plate- 13
Torch light

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APPENDIX I

HOUSEHOLD QUESTIONNAIRE

Name: …….. Age: ……..

Sex: …… Address: …….. Village / Tole.....

Group- A (General)

1. How many members are there in your family?

2. How much land do you have?

   Bigha……. Kattha……..

3. What are the sources of income?

   (a). Agriculture (b) Service (c) Business (d) Others

Group- B (Crop damage and Local Harassment)

1. What type of Crop do you plant in Growing seasons?

Seasons	Crop types
(a) …….	…….
(b) ……	……
(C) ……	…….
(d) ……..	……

2. Do the elephants damage your crops?

   (a) Yes (b) No

3. What type of crop do elephants destroy and in which seasons?

Seasons	Damage Crop types
(a) …….	…….
(b) ……	……
(C) ……	…….
(d) ……..	……

4. At what time do elephant destroy the Crop?

(a) Evening (b) Night (c) Dawn (d) Others

5. In which season's elephants come most?

6. Do elephant come from east at same time every year?

(a) Yes (b) No

7. What are reasons of elephant arriving from India?

(a) Regular migration (b) Lack of Food in Reserve

(c) To change taste (d) Lack of complete fence in the boarder

(e) Liking of crop field (f) others

8. How much crop do you produce in a year?

Crop types	Production
(a) …….	…….
(b) ……	……
(C) ……	…….
(d) ……..	……

9. How much crop did elephant destroy in this year?

Crop types	Production
(a) …….	…….
(b) ……	……
(C) ……	…….
(d) ……..	……

10. Do you think elephant with babies damage more?

(a) Yes (b) No (c) Equal (d) Do not know

11. Have you applied any techniques for the protection of crop and house?

(a) Yes (b) No

12. If yes, what are the techniques that you apply?

(a) Shouting and chasing with fire and foggy light

(b) Beating tins and boxes

(c) Chasing with stones

(d) Watch tower and Machan

(e) Vehicles

(f) Others

13. Which techniques are most effective?

14. Is the damage problem increasing in spite of applying techniques?

(a) Yes (b) No

15. What are the less and high number of elephant damaging crop at one time?

Number ……

16. Do elephant attack local people?

(a) Yes (b) No

17. If yes, what is the name of the person and date of attack?

Name: ……. Date: ……

18. What was the incident?

……..

19. If, injured by elephant, do you receive any compensation or medical help from concerned authorities?

(a) Yes (b) No

APPENDIX II

C. INSTUTIONAL QUESTIONNAIRE

Interviews with concerned intuitions regarding Crop damage by elephants.

1. Name: …… Age: …… Sex: Male / Female

Institutions: VDC DDC DFO CDO

2. Do the effected people come to complain about crop damage?

(a) Yes (b) No

3. If yes, how many times do they come with complaints in a year?

(a) 2 times (b) 3 times (c) 4 times

4. Do you know how many elephants come every year in the crop field?

(a) Below 5 (b) 5 – 10 (c) 10 – 15 (d) 15 – 20 (e) Above 20

5. How often Elephants attack and chase people?

(a) Very often (b) Seldom

6. Has any controlling measures or protection been adapted by GON authorities?

(a) Yes (b) No

7. If yes, what types of control measures have been adapted?

(a) Construction of watch tower and machan

(b) *Hattibar* plantation

(c) Army patrolling

(d) Electric fences

(e) Trenches

(f) Bee – keeping programme

(g) Others

8. What is your opinion about Compensation?

9. How can the conflict between human and wild elephants be solved?

10. Any suggestion you would like to give?

APPENDIX III

Table 26: Main flora of the Study Area

Local Name	**Scientific Name**
Sal	*Shorea robusta*
Sisoau	*Dalbergia silo*
Simal	*Bombax ceiba*
Haldu/Karma	*Adina cordifolia*
Barro	*Terminalia belerica*
Harro	*T. chebula*
Saj or Asna	*T. tomentosa*
Kusum	*Schleicheria trijunga*
Kabhro	*Ficus lacor*
Timilo	*Ficus auriculata*
Khanayo	*Ficus semicordata*
Kimbu	*Morus rubra*
Bayar	*Zizyphus mauritiana*
Amala	*Phyllanthus emblica*
Chilaune	*Schima wallichii*
Bot dhayaro	*Lagerstromia parviflora*
Kumhi	*Careya arborea*
Bhoral	*Bauhinia valhii*
Kutmero	*Listea monopelata*
Koiralo	*Bauhinia variegate*
Khari	*Celtis australis*
Pipala	*Piper longum*
Tama bans	*Dendrocalamus hamiltonii*
Ban Kera	*Musa Balbisiana*
Kans	*Saccharum spontaneum*
Boruwa	*S. munja*
Bhalaya	*Semicarpus anacardium*

APPENDIX IV

Table 27: Main Fauna of the Study area

Common Name	**Scientific Name**
Rhesus Monkey	*Macaca mulatta*
Common Langur	*Prebytis entellus*
Asian Wild Elephant	*Elephas maximus*
Asiatic Jackal	*Canis aureus*
Indian Fox	*Vulpes bengalensis*
Indian Wild Fox	*Cuon alpinus*
Squirrel	*Ratufa spp.*
Jungle cat	*Felis chaus*
Barking Deer	*Muntiacus muntjak*
Hog Deer	*Axis porcinus*
Indian Hare	*Lepus nigricollis*
Indian Percupine	*Histris indica*
Chital	*Axis axis*
Small Indian Mongoose	*Herpestes auropunctatus*
India Flying Fox	*Pteropus gigantes*
Woodpecker	*Dendrocopus spp.*
Bulbul	*Pyconomatus jacosus*
Kalij Peasant	*Lophusa leucomeluna*
Swam Patridge	*Francolinus gularis*
Warbler	*Sylvia species*
Great Tit	*Alauda arvemsis*
Indian Bull frog	*Rana tigrina*
Cattle Egret	*Bubulcus ibis*
Common Crane	*Grus grus*
Sarus Crane	*Grus antigone*
Cobra	*Naja naja*
Monitor Lizard	*Varanus bengalensis*
Garden Lizard	*Calotes versicolor*
Asiatic Rock Python	*Python molurus*

APPENDIX V

Table 28: Local market price for the year 2008 / 2009 in Jhapa district

Crops	**Local Market price (Rs. / Kg.).**
Paddy	Rs. 11.75
Maize	Rs. 10
Millet	Rs. 13
Ginger	Rs. 35
Mustard	Rs. 40
Wheat	Rs. 13
Potato	Rs. 9
Beetle nut	1 pole Rs. 40
Coconut	1 fruit Rs. 10
Bamboo	1 pole Rs. 40
Banana	-
Tea	Rs. 18 / plant

Source: GoN / Khadya Sasthan, Kakarbhitta.

APPENDIX VI

A. Local name, Common name and Scientific name of the crops grown in the study area.

Local name	**Common name**	**Scientific name**
Dhan	Paddy / Rice	*Oryza sativa*
Makai	Maize	*Zea mays*
Kodo	Millet	*Eleusine coracana*

B. Growing season of the crops grown in the study area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Paddy						———	———	———	———			
Maize				———	———	———						
Millet					———	———						

APPENDIX VII

Table 29: Monthly variation in average monthly temperature (°c) for the year 2006 Jan. – 2006 Dec. recorded at Jhapa District

S.N.	Month	Average High Temperature (°c)	Average low Temperature (°c)
1	January	25.5	8.2
2	February	29.3	14.1
3	March	32.7	15.8
4	April	33.7	14.7
5	May	33	21.7
6	June	35.2	24.7
7	July	33.8	24.7
8	August	33.7	24.5
9	September	35.8	24.2
10	October	32.1	20.4
11	November	30.8	14.4
12	December	28.8	10.1

Source: Koshi Basin Office, Dhahran.

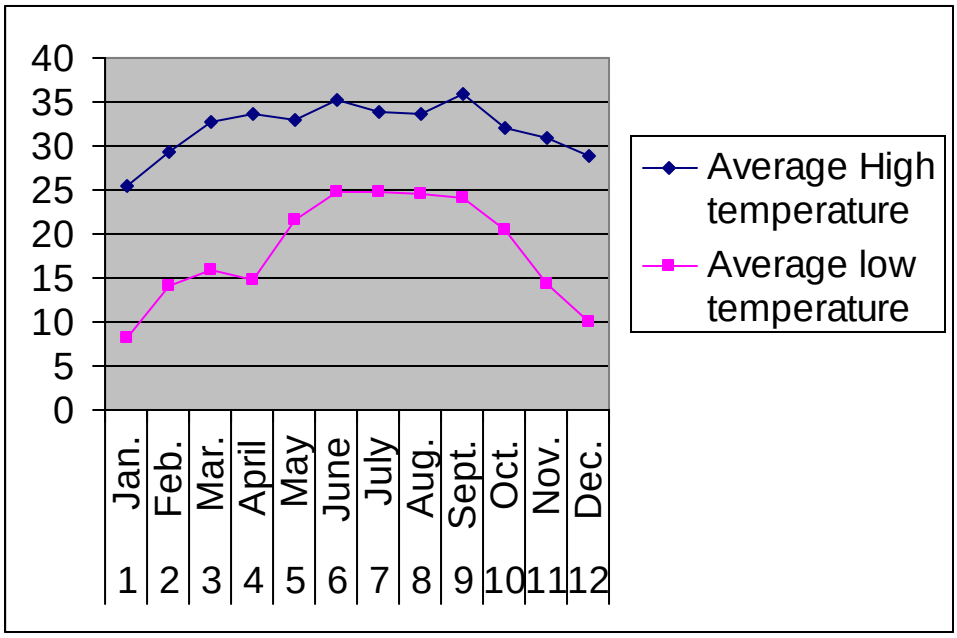

Figure 10: Monthly Variation in average monthly temperature (°C) for the year 2006 - 2007 recorded at Jhapa District

APPENDIX VIII

Table 30: Monthly variation in average monthly Rainfall (mm) for the year 2006 Jan. – 2006 Dec. recorded at Jhapa District

S. N.	Month	Rainfall (in mm) at different Places of Jhapa District.					
		Kankai	Kechana	Chandraghadi	Sanischare	Damak	Anarmuni
1	January	0	0	0	0	0	0
2	February	2.9	0	0	0	16.3	0
3	March	7.2	6.7	2.1	7.6	7.4	16.2
4	April	46.6	106.4	159	74	54.3	48.8
5	May	110.9	142.4	285.2	99	76.4	51.1
6	June	198.6	280.2	461.7	231.2	214.3	221.4
7	July	436.8	956.6	755.8	458.8	273.3	395.4
8	August	757.8	229.7	318.6	639.8	748.1	702.8
9	September	110.2	251.1	242.2	110.2	113.9	131.4
10	October	91.1	82.1	89.4	92.4	77.1	129.2
11	November	0	0	0	0	0	0
12	December	0	0	0	0	0	0

Source: Koshi Basin Office, Dhahran

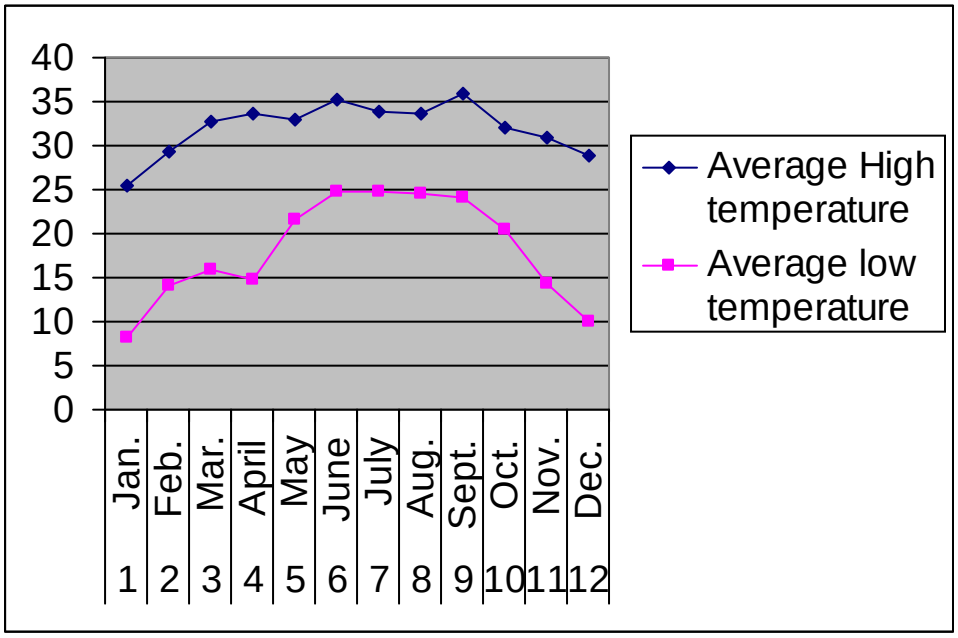

Figure 11: Monthly Variation in average monthly temperature (°c) for the year 2006 - 2007 recorded at Jhapa District

APPENDIX IX

Table 31: Population of ward wise and sex – wise distribution

Ward No	Total Households	Population				Total Population
		Male	Percent	Female	percent	
1	660	1587	14.03	1706	14.71	3293
2	139	346	3.06	385	3.32	731
3	728	1873	16.56	1966	16.95	3839
4	774	1914	16.93	1967	17.04	3881
5	580	1384	12.24	1406	12.18	1790
6	430	1162	10.27	1176	10.14	2338
7	360	972	8.6	937	8.08	1909
8	432	1157	10.23	1184	10.21	2341
9	331	909	8.04	866	7.5	1775
Total	4434	11304	100.00	11593	100.00	22897

Source: Bahundangi VDC office records of population census 2001

Table 32: Number of selected household and its sex- wise distribution

Ward No	Total Households	Population				Total Population
		Male	Percent	Female	percent	
1	660	1587	39.68	1706	28.32	3293
2	139	346	8.65	385	6.4	731
8	432	1157	28.93	1966	32.63	3839
9	331	909	22.73	1967	32.65	3881
Total	1562	3999	100	6024	100	1790

Source: Bahundangi VDC office records of population census 2001

APPENDIX X

Table 33: Land use pattern in Jhapa district

S.N	Land utilization	Area in Hectare	Percentage of Total Areas
1	Agriculture land	91,252	62.29
2	Forest area	16,056	10.95
3	Grazing land	1743	1.19
4	Tea land	6,975	4.76
5	Bettle nut land	1,810	1.23
6	Settlements	20,782	14.18
7	Water bodies, Roads and others	7,881	5.37
Grand total		1,46,499	100

Source: District Development Committee (Jhapa) 2006-2008

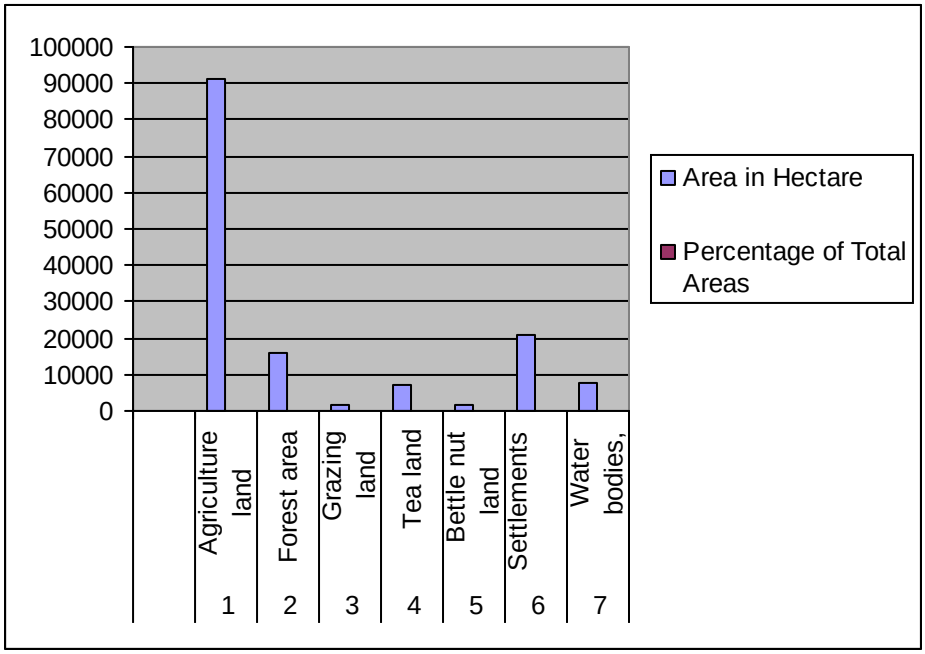

Figure 12: Land use pattern in Jhapa District