Buffer Zone Resources and Socioeconomic Status in Meghauli Village Development Committee, Chitwan National Park

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
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Majoring in
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By
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LETTER OF RECOMMENDATION

This is to certify that Mr. **Ramesh Paudyal** has prepared this dissertation entitled **"Buffer Zone Resources and Socioeconomic Status in Meghauli Village Development Committee, Chitwan National Park"** as partial fulfillment of the requirements for the degree of masters of sciences in Environmental Science majoring in Wildlife Management and he had worked satisfactorily under my supervision and guidance.

This Masters Degree dissertation work embodies his own work and fulfills as per the requirement of Central Department of Environmental Science, T.U.

I therefore recommend this dissertation for approval and acceptance.

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DECLARATION

I, **Ramesh Paudyal**, hereby declare that the piece of work entitled **"Buffer Zone Resources and Socioeconomic Status in Meghauli Village Development Committee, Chitwan National Park"** presented herein is genuine work, done originally by me and has not been published or submitted elsewhere for the requirements of a degree program. Any literature data works done by others and cited within this dissertation has been given due acknowledgement and listed in the references.

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ABSTRACT

To understand ecology, conservation practice and social strata in buffer zone, Meghauli Village Development Committee of Chitwan National Park was examined as a case study. Methods applied were stratified random sampling of households and analysis of vegetation and land use change. Resources such as fuel wood and fodder extraction were higher than the sustainable supply. The annual demand and supply of fuel wood and green fodder from the buffer zone community forest did not match, and the deficits were met mainly through the national park. The buffer zone community forest fulfils only about 11 % of each fodder and fuel wood demand if extraction was sustainable.

The average annual surplus of agricultural production on the study area was 5.66 months which was equivalent to Rs. 12,228.83. However there was more than eight months deficit for landless and more than three months of deficit for caste/ethnic group Majhi/Mushar/Bote. Remittance was the major alternative for the deficit management, followed by wage labor.

Effective alternative energy utilization was poor; only two sampled households had the access to bio gas plant and both of them fall under big farm by land holding size and Brahmin/Chhetri/Thakuri by caste ethnic group. None of the landless were involved in buffer zone management and resources distribution was not in favor of poor as most of the community forests distribute fuel wood by calling tender among the member households of user groups. Due to this fact, crop deficit facing poorer households were willing to harvest resources from the Park even it was illicit activity.

All these suggest that buffer zone communities were not self reliant and had on- going impact on the park resources. Efforts of Integrated Conservation and Development Project (ICDP) via buffer zone management were seemed to be less compatible in meeting the twin goals of conservation and development in Meghauli Village Development Committee.

Key words*:* *Biodiversity conservation, Socio-economy, land use, buffer zone community forest, rhino.*

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Ramesh Paudyal

January, 2008

TABLE OF CONTENTS

List of Tables

List of figures

List of Annexes

ABBREVIATION AND ACRONYMS

BZ	Buffer Zone
BZCF	Buffer Zone Community Forest
BZCFUG	Buffer Zone Community Forest User Group
BZMR	Buffer Zone Management Regulation
CBC	Community Based Conservation
CF	Community Forest
CNP	Chitwan National Park
CS	Cut Stumps
DBH	Diameter at Brest Height
DNPWC	Department of National Parks and Wildlife Conservation
FSSD	Forest Survey and Statistical Division
GIS	Geographical Information System
GN	Government of Nepal
GPS	Global Position System
ha	Hectare
ICDP	Integrated Conservation and Development Project
IUCN	The World Conservation Union
IVI	Importance Value Index
LPG	Liquefied Petroleum Gas
LU	Livestock Unit
MPFSN	Master Plan for the Forestry Sector of Nepal
NTFP	Non Timber Forest Product
PA	Protected areas
PCP	Participatory Conservation Program
PPP	Park People Programs
TDN	Total Digestible Nutrients
TMH	Terai Mixed Hardwood
UNDP	United Nation for Development Programs
VDC	Village Development Committee
WCPA	World Commission on Protected Areas

Chapter 1

INTRODUCTION

1.1 Introduction

National parks and reserves represent the single most important method of conserving biological diversity worldwide (Brandon & Wells, 1992). The establishment of the Yellowstone National park in the United States in 1872 marked a significant step in promoting the concept of national parks. During that period the parks were essentially based on a biocentric approach which mainly recognized the intrinsic values. National parks were considered only for conserving biodiversity and limited to the enjoyment of the people in the recreational context, and they were to be protected by the highest national authority (Nepal & Weber, 1993)

For the first time, the Third World Congress on National Parks held in Bali, Indonesia in October 1982 focused its attention on the relationship between protected areas and human needs stressed the relevance of integrating protected areas with other major development issues (Mishra, 1991)

The conservation in developing countries have now realized that the concept of strict protection is ill-suited to the needs and problems of local, often native people, and thus remains largely an inappropriate western concept. Failing to recognize the perspective of the rural population will inevitably result in the failure of any national park plans (Nepal & Weber, 1993).

Unlike in the past, when indigenous people were evicted from their home lands while creating protected areas, a large number of people today live within the protected areas and they are regarded as potential resources for conservation (Stevens 1997, Colehester 1997, IUCN/WCPA, 2003 as cited in Gurung, 2006). Today, there exists an extensive system of protected areas across the South Asian region protecting diverse ecosystem and habitats of endangered and endemic species of wildlife. However the current system is probably not comprehensive enough to secure the long term survival of current biodiversity level or the continuation of important ecological processes. (IUCN; WCPA, 1998)

One of the major management problems in protected areas in developing countries is the ever more intensifying land use disputes with local, often native people. The customary rights curtailed by the establishment of national parks and their disregard by decision makers have given rise to open conflicts, thus jeopardizing conservation goals. These conflicts have tremendous impacts on the management of natural resources not only with in the park ecosystem but also in its surroundings (Nepal & Weber, 1995[1])

Owing primarily to widespread park-people conflicts and taking a cue from the worldwide trend in participatory management and its own successful experiences in community forestry, Nepal 30 years of community based conservation (CBC) approach has managed its protected areas mainly in response to poor park people relations (Mehta & Heinen, 2001)

The protected areas in Nepal now cover 19.42% of the total land area including nine buffer zones (MFSC/DNPWC 2004/05). Chitwan National Park (IUCN category II Protected Area) was established in 1973 as the first National Park (932 km^2) to conserve remaining wild habitats of several endangered wildlife species including rhino in the Chitwan valley.

In order to implement the Buffer Zone Act of 1993, the Department of National Parks and Wildlife Conservation demarcated a buffer zone for Chitwan National Park with a provision of sharing of 30-50% of park revenue (Heinen and Mehta, 2000). Buffer zone is regarded as a safeguard against the impact on the park by the local community. The demarcation of buffer zone was based on: Areas that are affected by PAs, geographic location of the villages in relation to the PAs, villages that lie with in the PAs and areas that could be practicable and appropriate from the point of buffer zone management (BZMR, 1996). These policies were formulated to encourage self-reliance within the community (Bajimaya 2005). In Chitwan National Park, buffer zone (750 km^2) is spread over 4 districts including 35 VDCs and 2 municipalities having 510 settlements with estimated population of 223,260 (DNPWC, 2000).

Integrated Conservation-Development Projects (ICDPs) attempt to link biodiversity conservation in protected areas with social and economic development in surrounding communities (Brandon & Wells, 1992). The major objectives of ICDPs is to reduce the pressure on protected areas by strengthening park management and/or creating buffer zones around protected areas; providing compensation or substitution to local people for lost access to resources; or encouraging local social and economic development. The most common way to provide benefits was through project components designed to

improve natural resource management outside of protected areas, i.e. agro forestry and forestry, wildlife utilization, irrigation and water management, soil enhancement and erosion control and generally improving agricultural yields (Brandon & Wells, 1992).

Many of the initiatives grouped under the ICDP, have received substantial attention from both conservation and development organizations. But recent analysis of ICDPs found that these projects were experiencing many difficulties in meeting either their conservation or development objectives (Brandon & Wells, 1992).

1.2 Statement of the problem

Declaration of buffer zone is only the first step in implementing the program on the people-park interface; the government needs more information on what projects local people desire and the amount of funding needed to implement the desired project. For such legislation to be successful a clear understanding of factors affecting the socio-economic conditions and attitude of people living around the protected areas are needed (Joshi, 1999). However there appears a wide gap between buffer zone planning and reality, which is partly attributed to lack of legal authority of protected area agencies over these zones (Sayer, 1991 as cited in Nepal & Weber1995[1]). In most developing countries, wildlife damage has been a major problem for villagers around protected areas. Some households lose most of their crop to wildlife from the park (Nepal & Weber, 1993). Because of the myopic conservation planning, the conservation and development strategies applied in the buffer zone of Chitwan National Park are posing similar problem in spite of their short term success of faunal conservation (Yonzon, 2000).

Although community forestry has succeeded in halting resource degradation and conservation of biodiversity, the equity aspect of community forest has not been fully examined (Adhikari et al., 2004). To promote sustainable use of biological resources, there are no ground-based knowledge in biological and ecological science and also, not all things can be preserved through use (Yonzon, 2004). In these contexts, Chitwan generates US$ 0.6 million of revenue each year, mainly through wildlife tourism and disburses 50% of it to the buffer zone management, however weak and the vulnerable groups in the buffer zone of Chitwan National Park are loosing the battle (Paudel, 2004). Only 6% of the households were directly or indirectly employed in the eco-tourism business and thus the business offers little benefits to the local people (Bookbinder et al., 1998)

1.3 Justification of the study

The Chitwan National Park is the most researched park in Nepal, perhaps in the whole of Asia (Haynes 1998). Most studies at CNP have focused on the park-people conflict resulting from resource denial, wildlife damage and poor behavior of the park authorities (Nepal & Weber 1995, Sharma & Shaw 1993, Janawali 1989). Other studies have shown that people living around the park value the park in non consumptive ways such as ecological, aesthetic and bequest values (i.e. for future generations) (Newmark et. al. 1993 as cited in Joshi 1999). However studies examining the complete relation between people's attitude and resources access, wildlife damage and monetary benefit from National park are lacking (Joshi, 1999). This study is different from many other studies in the past. Resources Himalaya Foundation initiated a mentorship research conservation programme in 2006. Under this Programme all 35 VDCs and 2 Municipalities under the buffer zone of CNP would be studied looking at population growth, socioeconomic structure and overall natural resources for subsistence such as labor, fuel wood and fodder in each VDC. By doing so, accurate information would be available for the management because all VDC areas and their forest patches are different. In addition, investigators would have an opportunity to prepare master's dissertations. My study is focused on Meghauli VDC, out of the 17 VDCs of CNP buffer zone selected for the year 2007. The local people's willingness to share management responsibility in the development of a buffer zone and the attitudes towards the park is mainly determined by their household socioeconomic status (in terms of size of land holding and size of livestock herd), frequency of visits to the park, distance between homesteads and the park, level of education, volume of resource extracted from the park, employment in non farm activities, age and volume of crop loss caused by wild animals etc.(DNPWC, 2001). Therefore my study has gathered information on these issues at VDC level, which was lacking earlier.

1.4 Objectives

The broad objective of the study is to extract science-based information on biodiversity conservation through research on socioeconomic status and condition of buffer zone vegetation by presenting the case of Meghauli Buffer zone VDC.

The specific objectives are:

1. Determine resources needs in buffer zone households and their dependency on the park resources.
2. Study the vegetation of the VDC including assessment of fodder and fuel wood needs, annual yields and energy consumption pattern.
3. Study the changes in land use pattern and incidence of rhino occurrence and poaching activities with inclusion of crop depredation and human harassment.

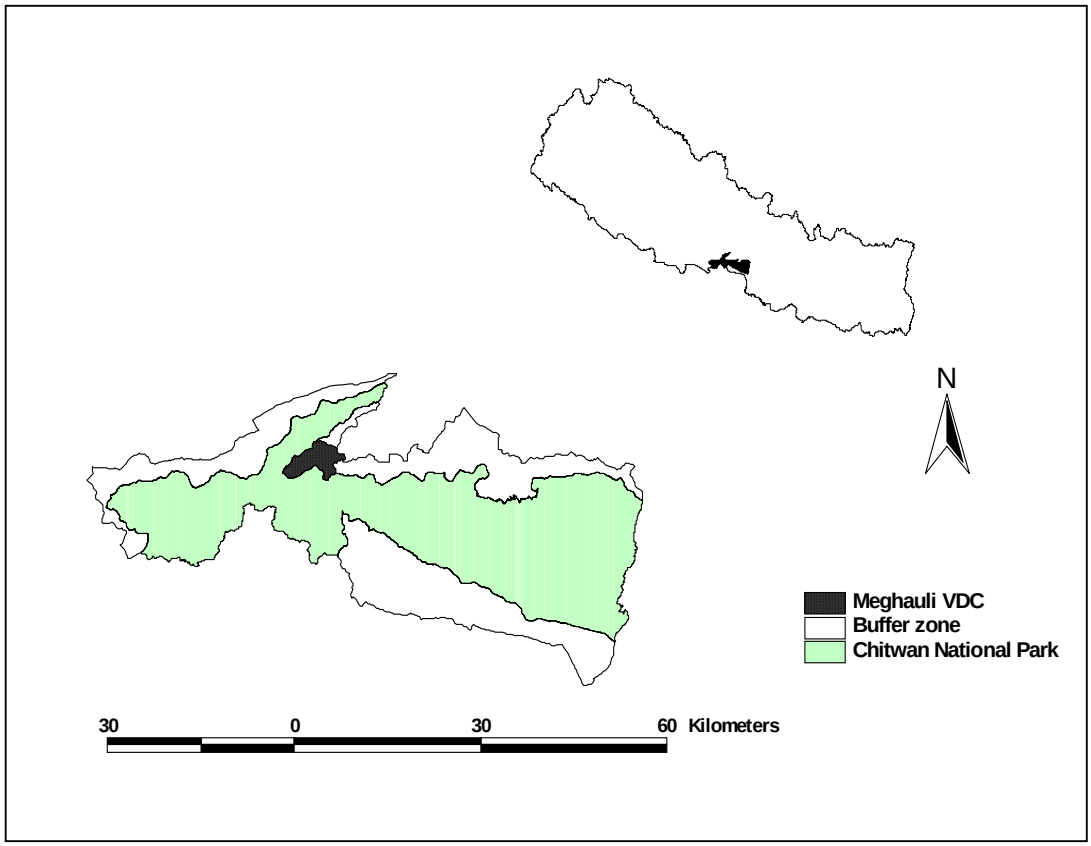
Chapter 2

STUDY AREA

2.1. Location

Meghauli buffer zone Village Development Committee (VDC) (Area: 3067.2 ha) lies in the flood plain of the Narayani and Rapti Rivers in the Central Kashara sector of Chitwan National Park. Its access is 26 km south from Narayanghat. Major land uses include Agricultural land (2773 ha), forest land (119.2 ha), and grass land (175.0 ha) (DNPWC/PPP 2000). The buffer zone area is managed under Meghauli Buffer Zone User Committee (MBZUC). The boundaries of the VDC are Sukranagar VDC and Rapti River in the east, Narayani River (CNP) in the west, Dibyanagar VDC in the north and Rapti River (CNP) in the south.

Fig. 2.1 Study area



2.2. Climate

The climate of the study area is subtropical with high humidity through out the year (Straede et al., 2002). The average maximum monthly temperature is 35.5^0C in July and average mean monthly temperature is 8.07^0C in January. Mean annual rainfall is 2282.66 mm with heavy rainfall in summer monsoon from June to September (Rampur Weather Station, 1997-2006)

2.3. Demography and households characteristics

The total population density of the study area was 5.70 people/ha with average family size of 6.0 (DNPWC/PPP, 2000) living in 33 settlements. It composed of mixed ethnic community, mostly dominated by the Brahmins, Chhetri and Tharu. More than 40% of people can not read and write; about 85% of people are farmers and more than 45% are wage laborers. About 25% of households faced food deficit of six months (DNPWC/PPP, 2000).

2.4. Buffer zone community forest

There are all together eight buffer zone community forests of 9 wards. Each forest has different user committees. The forests are riverine which includes mixed hard wood and Acacia- Dalbergia forest. Major plant species were *Dalbergia sissoo, Acacia catechu* and *Bombax ceiba.* Different mammals including *Rhinoceros unicornis*, *Cervus unicolor, Axix axis, Panthera pardus, Felis chaus, Sus scorfa* etc and different bird species in habit in the community forests.

Forest Resources are strictly protected and cattle grazing are not allowed. With different system in different CF, fuel wood collections are allowed once a year. Fodder collections are allowed twice a year, each for three months, taking nominal fees for each entry.

Chapter 3

LITERATURE REVIEW

Jnawali (1989) reported the negative attitude in local people towards park management due to injuries and harassment to them by rhino.

Sharma (1991) studied park people interaction in CNP and found that without proper support from the locals, conservation efforts cannot sustain.

Shrestha (1994) studied on the resource conflict between park conservation and adjoining settlements and found serious threat to the survival of endangered animals and plants because of poaching and illegal use of park resource and mentioned crop damage, livestock loss and harassment to the people as other major problems.

Joshi (1999) studied the detail socio-economic characteristics of CNP buffer zone residents and concluded that buffer zone residents heavily rely on national park and surrounding forests to meet their basic needs.

Poudyal (2000) found that strict conservation principle is not suited for sustainability of the corridor to maintain the connectivity and landscape linkages and to achieve long term conservation goal.

Jones (2007) mentioned that the current system for community forestry creates sufficient incentives for local cooperation due to the potential for increased access to important resources and a high perception of ownership of community forests among the communities

Pandit (1995) studied the vegetation composition, biomass production and park resources consumption pattern by ethnic groups of adjoining villages of Chitwan National Park. He found that 32 species from grassland were used as fodder but did not studied detail about shrubs and trees.

Straede and Helles (2000) considered annual grass cutting programme as a park people conflict resolution in CNP and presented that 50,000 tones of biomass were removed from the park where as illegally removed fuel wood account to about half of the resources. And they also concluded that BZCF has not been able to substitute fuel wood from National park and suggested for the provision of alternatives.

Park has become the most intensively as well as extensively studied area in south Asia (Yonzon, 2000; DNPWC, 2005)

DNPWC/PCP/UNDP (2001) has reported that although many studies regarding floral composition and structure have been completed, the detail exploration on flora of CNP has remained.

Rijal and Meilby (2006) suggested that lack of knowledge of forest structure; composition and magnitude of human impacts on various components of the ecosystem remain a major limitation for the development of the appropriate participatory management programme for conservation and sustainable utilization of the forests in Nepal.

Nepal and Weber (1995) explored five major causes, i.e. illegal transaction of forest products from the park, livestock grazing in the park, illegal hunting and fishing, crop damage and threats to human and animal life, of park people conflict in the CNP.

Mclean and Straede (2003) challenged the existing conservation paradigm currently practiced by CNP and suggested park management to initiate new policies toward a more collaborative paradigm integrating conservation and development needs.

Shrestha (2007) reported that per capita fuel wood consumption and green fodder need per unit livestock are higher in poorer households than rich households mainly due to access to modern energy sources and large of rich households.

Paudyal (2007) has reported that the buffer zone community forests do not fulfill the annual household fodder and fuel wood demand. The deficit was primarily extracted from Chitwan National Park.

Dhakal (2007) studied the status of biodiversity conservation and vegetation in Kathar VDC and found that resources from BZCF were not sufficient and more than 80% of households met the deficiency of fire wood from private lands and some 17% households entirely depend upon park for fodder.

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Chapter 4

METHODOLOGY

4.1 Household Socio economic Survey

4.1.1 Survey Design and Sample Size

All the 9 wards of the Meghauli VDC are inside the buffer zone. The stratified random sampling was applied for the survey on the basis of the settlement size with two parameters: a) population size and b) land holding size. The sample size (n) for 2756 households of the study area was determined to be 71 at 95% confidence level. (Arkin & Colton, 1963; cited in Sharma 2000).

$$n = \frac{NZ^2P(1-P)}{Nd^2+Z^2P(1-P)}$$

Where,

n = sample size

N = total number of households

Z= confidence level (at 95% level Z =1.96)

P = estimate population proportion (0.05, this maximize the sample size)

d = error limit of 5% (0.05)

Based on land holding size (DNPWC/PPP, 2000) (Annex 4.1), the sample size with in each land group was determined. The no of households to be surveyed on each ward was 71, on the basis of population size within the 9 wards. (Table 4.1)

Random sampling method with out replacement was used for unbiased selection of households. Each sample was drawn through lottery method. 71 cards of 9 wards according to their proportion of population size were put on one lottery box and next 71 cards of households of different land groups of their proportion were put on another lottery box. The lottery was drawn randomly at a time from both lottery box and was repeated for 71 times

without replacement and sample size distribution in each ward with land categories was found out. (Table 4.1)

Table 4.1 Sample size distribution based on land holding size

Ward no.	Total population	Sample size	Sample size on each land holding group				
			Landless (8.0%)	Small farm (25.4%)	Medium farm (38.0%)	Big farm (26.0%)	Large farm (2.7%)
1	1767	7	-	2	3	-	2
2	2212	10	1	3	4	2	-
3	1968	8	1	3	3	1	-
4	1463	6	-	3	2	1	-
5	3263	14	1	3	6	4	-
6	606	3	1	-	1	1	-
7	1327	6	-	2	3	1	-
8	2319	10	1	1	3	5	-
9	1602	7	1	1	2	3	-
Total	**16527**	**71**	**6**	**18**	**27**	**18**	**2**

The assistance of the Meghauli Buffer zone User Committee was taken to list all the settlements and rank them according to their expected population size with in each ward. Then the sample size was distributed to each settlement according to the proportion of their ranking with in each ward. (Annex 4.2). Such stratified sampling method was applied so as to represent all the 33 settlements of the VDC.

4.1.2 Questionnaire Survey

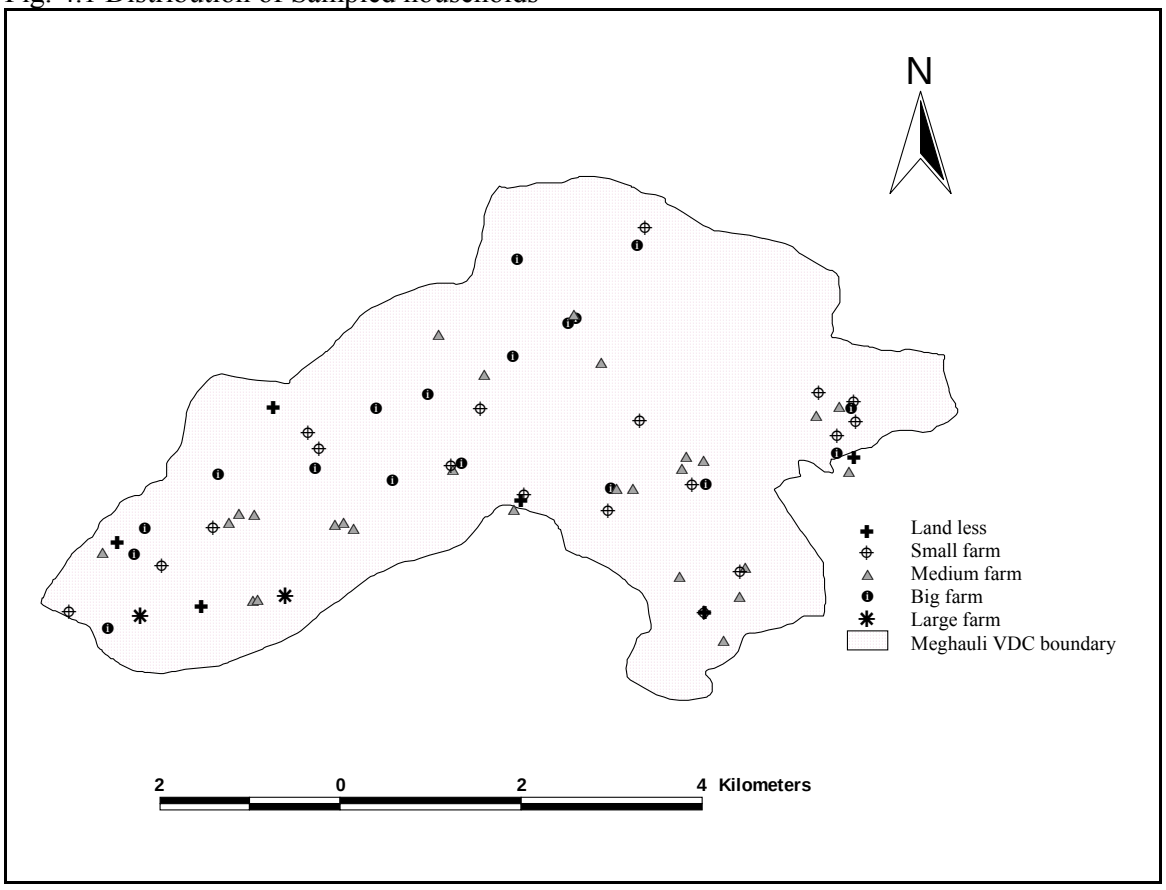
A questionnaire set of structured and semi structured questionnaire with some close ended and some open ended questions is prepared and all the 71 households representing different settlements and land holding categories were interviewed by the same set of questionnaire.

Before conducting the formal questionnaire survey, the questionnaire was pre tested in some households and some modifications were made. A research team of three members (classmates) was mobilized for survey to bring the same level of required information. Before conducting the formal survey, discussions among research members on subject matter was done to obtain the similar and equal understanding for filling the questionnaire. Such discussion was repeated each day after conducting the survey. Interview was made with the family head member as far as possible if such was not possible interview was taken from more informative member of the household.

The questionnaire was developed including three main parts (Annex 4.3)

a. Household information,
b. Buffer zone community forest and buffer zone management issues and
c. Rhino/ wildlife related issues.

Fig. 4.1 Distribution of Sampled households



a. Household Information

Household information was considered necessary to identify the livelihood and occupation, land holding, crop types and its production, livestock holding (including feeding types), resources need (fuel wood and fodder), energy consumption pattern and annual income and expenditure.

b. Buffer Zone-related Issues

To understand buffer zone community forest and buffer zone management issues, information were gathered on buffer zone forest, types of resources extraction, pressure on community forest, resources allocation system, buffer zone budget sufficiency and its transparency and household level participation in Buffer zone management, problems

within the community forest, suggestions / recommendation for better management and resources utilization of community forest.

c. Rhino/Wildlife-related Issues

This part was set to obtain the information on crop and livestock depredation by rhino and other wildlife, compensation measures for the losses, reasons for rhino decline, rhino poaching events, poachers' identity, current ongoing programs to conserve rhino by authorities (buffer zone management committee / buffer zone community forest/ national park) and their effectiveness and suggestions/ recommendations for future initiatives to protect/ conserve rhinos.

4.1.3 Data Conversion

Income from agriculture production noted in local unit (Muri) was converted into standard production unit (kg) by using conversion factors provided by Nepal and Weber, 1993. (Annex 4.4). Both the agriculture production and expenditure were converted into monetary value by multiplying the production and consumption of each crop type by the local market price (Annex 4.5). The sufficiency of the agriculture production was determined by subtracting the consumption from the production and was expressed in terms of surplus, deficit or balanced.

Annual forest resources demand of the sampled household and amount of resources supplied from different sources (e.g. buffer zone community forest, national park, own land and other community forest outside buffer zone) were noted in local unit (bhari). The weight of the Bhari was converted into Kilogram (kg) based on the respondent's perception and experience. Of those who could not convert Bhari into kg were calculated based on the factors given by Nepal and Weber, 1993 (Annex 4.6). The livestock types and their number noted were converted into livestock unit by applying the conversion factors taken from Sharma (2000) (Annex 4.7)

4.1.4 Data Analysis

Data were analyzed using different statistical tools in different computer programs. Raw data and information from the questionnaire were entered into the SPSS program by giving each household the ids from 1 to 71 and by defining variable for all the information. Most of all the calculation and analysis were made on this software program.

Qualitative form of data and information were also entered by coding them and analyzed. Once the basic calculation and data uniformity were completed variables were compared against ethnicity, farm size, and net income. The MS Excel program was used for some of the calculations and analysis.

4.2. Vegetation Survey

Vegetation survey was carried out in the buffer zone community forests of Meghauli VDC during June 2007.

4.2.1 Survey Design and Sample size

A reconnaissance study was carried out prior to the actual vegetation survey and the GPS boundary of the existing forest patches were taken. The maps of the forest patches were prepared and systematic random points were generated within the patches at an interval of 500 m using GIS. All together 30 points were generated on three patches of the total 2187.06 ha forest representing 8 community forests. The latitude and longitude of these random points were noted and with the help of GPS (Garmin e-trex) the points were located in the field and vegetation analysis was carried out making the points on the centre of the quadrates. Out of the 30 random points generated, 4 points laid in River and flood plain. So vegetation analysis was carried out in the remaining 26 plots.

4.2.2 Plot Design

At each sampling points, all together 5 plots were laid out. Quadrate plot of 20x20 m were laid to study tree species (Sah et al., 2002; Rijal & Meilby, 2006). Within the tree plot, nested plot of 5x5 m were laid to the North East and South West corner for the shrub study. Similarly for herb species 1x1m plots nested in shrub plots were laid (Fig.4.2). About 10,400 m^2 areas were surveyed for tree, 1300 m^2 for shrubs and 52 m^2 for herbs.

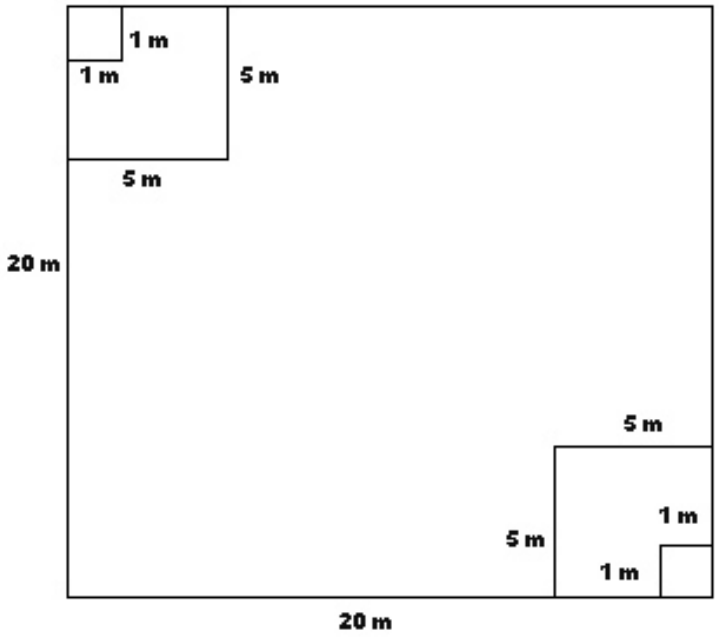
All tree species having DBH greater than 10 cm were taken into account with in 20x20 m plot. DBH and height of all trees were measured with the help of DBH tape and clinometers respectively. Each tree was noted carefully and marked to prevent double counting. Crown coverage percentage of trees with in the sampling plots was estimated by ocular method for the determination of stocking of forest.

Height and number of individuals of all shrub species having height greater than 10 cm, and tree species with less than 10 cm DBH and greater than 10 cm height were taken on

measurement with in nested quadrate of 5x5 m. Similarly the number of individuals of all the herb species and the individual of shrub and tree species less than 10 cm height were counted in 1x1 m nested plot

Number of cut stump of trees species with height and circumference at top, ocular estimation of lopping percentage of tree species, grazing percentage, firing evidence and foot trails passages were noted in 20x20 m plot to quantify human interference, grazing pressure and management practices.

Fig 4.2 Plot Design (Nested quadrate plot)



4.2.3. Classification of Forest

a. Forest Types

According to Master's plan for forestry Sector (GN, 1988a), the buffer zone forest of Meghauli VDC was classified under two types.

1. Khair- Sissoo (KS)
2. Terai Mixed Hardwood (TMH)

b. Stand size

The following stand size classes as used by Forest Inventory Division (FRSC, 1995) were adopted into the study area (Table 4.2).

Table 4.2 Stand size classifications

Symbol	Stand Size	DBH (cm)
1	Sapling	<12.5
2	Poles	12.5 - 25
3	Small saw timber	25 - 50
4	Large saw timber	> 50

c. Stocking

Determination of stocking is based on forest density, i.e. crown cover percentage (FRSC, 1995). Classification of stocking is as follows (Table 4.2.3).

Table 4.3 Stocking of trees

Symbol	Description	% Crown Closure
1	Poorly stocked	10-30
2	Medium	40-69
3	Well stocked	70 or more

4.2.4. Calculation

The formulas used to calculate density, relative density, frequency, relative frequency, basal area, relative basal area, importance value index (IVI), diversity index are given in the (Annex 4.8)

a. Tree Volume

The volume equation used by Forest Inventory Section, Ministry of Forest and Soil Conservation, Nepal (FSSD, 1991) was used for the estimation of resources of the Meghauli Buffer Zone Community Forests. By using the equation the total stem volume of each individual tree was calculated as:

$$Ln (V) = a + b \times Ln(d) + c \times Ln (h)$$

Where, Ln refers to logarithm

V = total stem volume with bark

d = Diameter at breast height

h = Total height

a, b and c are the volume parameters, which are constant for each species but different between species. The volume parameters were obtained from the study carried out by Forest Survey and Statistical Division (FSSD, 1991).

b. Biomass of stems, branches and foliage

INV can also compute the biomass of stem, branches, foliage and whole tree. Stem biomass is obtained by multiplying the stem volume by wood density. Wood density was obtained from Forestry Sector Master Plan, 1988 (GN, 1988 a). For obtaining the biomass of branches (fuel wood) and foliage (fodder), ratio of branch to stem biomass and foliage to stem biomass were applied for various species (GN, 1988a).

c. Estimation of Annual Yield

The Master Plan for the forestry sector of Nepal (MPFSN) has estimated the annual yield of different forest types of Terai for the Central Development Region (table 4.6). The percent annual yield estimated by Master Plan in similar forest types of Central Development Region were applied to estimate the annual yields of Buffer zone forest in the study area.

Table 4.4 Growing stock and annual yield in the natural forest of Terai regions of CDR.

Forest Type	Forest Biomass			Annual Yield (tons/ha)			Percentage Yield		
	Stem	Branch	Leaf	Stem	Branch	Leaf	Stem	Branch	Leaf
TMH	86.1	59	3.7	4.2	2.9	0.2	4.88	4.92	5.41
KS	74.1	50.7	7.4	3.8	2.6	0.4	5.13	5.13	5.41

TMH = Terai Mixed Hardwood forest, KS= Khair Sissoo Forest
Source: GN, 1988a

The annual yield of the Terai mixed hardwood forest and Khair-Sissoo forest were used for the estimation of the annual yield of tree species (*Bombax ceiba, Trewia nudiflora, Accacia catechu, Dalbergia sissoo* etc). Although MPFSN had classified the Siwaliks, of which Chitwan valley is a part, as an area having little fuel wood deficit, the situation for villages adjoining the park should be no different than the Terai region which suffers from a major shortage (Sharma, 1991). Almost all Siwalik area has been protected as national park and the study area lies in the inner Terai having almost similar climatic condition. Therefore the annual yield was calculated on the basis of similar forest types of Terai of the Central Development region.

Defining sustainable wood harvest as the sum of stem and branch growth, and stem and branch mortality with only 15 % of stem growth allocated for timber and rest (85 %) for fuel wood assuming recovery factor for Terai is 90 % (GN, 1988a). The annual

accumulation of dead wood is 4.9 % of the annual yield (GN, 1988a). Hence, for the calculation of fuel wood from dead wood, 4.9 % of total wood was considered as fuel wood.

The yield from leaf biomass can be used as fodder if the tree is fodder species. Similarly, fodder yield from buffer zone forest was calculated on the basis on Total Digestible Nutrient (TDN) yields for various categories of land as mentioned in MPFSN (GN, 1988 b) (Annex 4.9).

$$\text{Estimated fodder yield} = \frac{\text{Total forest area X TDN yield}}{0.25}$$

4.2.5 Cut Stumps and Lopping

The total number of cut stump of tree species was counted within the tree plots, measuring the girth and height at the top of each cut stump. Density of the cut stumps were analyzed for different girth class and species. Five girth class of <10 cm, 10-15 cm, 15-20 cm, 20-25 cm and >25 cm were defined considering the highest (26.5 cm) and lowest (6.5 cm) girth size of the cut stumps found in the sampling plots.

The lopping intensity was assessed in terms of percentage damage done to the individual tree by counting the number of cut branches out of total branches of a tree. The average lopping percent is calculated for different tree species.

4.3. Land use Change Pattern

To study the land use change pattern of Meghauli Buffer zone VDC, LRMP-data (1978) and FINNIDA maps (1992) were compared. The data was analyzed using ESRI's software's Arc info 3.5.2 and Arc view 3.2. From the overlay map of land use of 1978 and of 1992, comparison of areas of the eight lands cover categories was made. And also the overview of land cover changes (%) in the eight categories, including land cover gained and lost from each category during the period between 1978 and 1992 was calculated. More over the land cover changes were verified during the field visit.

Chapter 5

RESULTS

5.1 Socioeconomic survey

5.1.1 General characteristics of the respondents

The general characteristics of the respondents by sex, age group, education, occupation and residence period were as shown in the Table 5.1.

Table 5.1 General characteristics of Respondents

Category		No of respondent	%
By sex	Male	61	85.9
	Female	10	14.1
By age group	<20 years	2	2.8
	20-40 years	29	40.8
	40-60 years	29	40.8
	>60 years	11	15.5
By education	Illiterate	23	32.4
	Under SLC	35	49.3
	Above SLC	13	18.3
By occupation	Farmer	44	62.0
	House Work	1	1.4
	Service	5	7.0
	Business	4	5.6
	Remittance	2	2.8
	Student	6	8.5
	Farmer cum house work	4	5.6
	House work cum business	1	1.4
	Farmer cum business	2	2.8
	Unskilled	2	2.8
By residence period	<15 years	6	8.5
	15-30 years	11	15.5
	30-45 years	16	22.5
	45-60 years	6	8.5
	Generations	32	45.1
Involvement in BZ management	Yes	12	16.9
	No	59	83.1

The no of the male respondent was about six times more than the female respondents. The age of the respondents ranged from 17 to 74 years. More than 80% of the respondents were of the age group above 20 years and below 60 years. About 50% of the respondents had the education level of under SLC followed by more than 30% of illiterate.

The majority of the respondents (62%) were involved in farming as the occupation. Most of the respondent's family (45.1%) has been living on the study area from their generations. Only 8.5% are the newly settlers (<15 years). 12 respondents (16.9%) were involved in BZ management.

5.1.2 Household's socioeconomic status

Some 38% of the sampled households fall under the land holding group of medium farm followed by 25.4% of each small farm and big farm. Households having land large farm were only 2.8%. Landless are 8.5%.

Majority of the households were under the caste/ethnic group Brahmin/Chhetri/Thakuri (43.7%) followed by Tharu (26.8%). Out of the seven caste/ethnic group Newar were in least number (1.4%) (Table 5.2).

Table 5.2 Categorization of households based on land holding size and caste/ethnic group

Caste/Ethnic group	Land holding Size					Total
	Landless	Small farm	Medium farm	Big farm	Large farm	
Brahmin/Chhetri/Thakuri	2	8	13	7	1	31 43.7%
Gurung/Magar/Tamang	1	2	2	1	0	6 8.5%
Newar	0	0	1	0	0	1 1.4%
Tharu	1	4	7	7	0	19 26.8%
Darai/Kumal/Praja	1	3	2	3	1	10 14.1%
Majhi/Mushar/Bote	1	0	1	0	0	2 2.8%
Damai/Kami/Sarki	0	1	1	0	0	2 2.8%
Total	6 8.5%	18 25.4%	27 38.0%	18 25.4%	2 2.8%	71 100.0%

5.1.3 Demographic characteristics

The sex ratio (male/female) is highest in the caste/ethnic groups Darai/Kumal/Praja (1.37) and is lowest in Newar (0.75). The family size ranged from 3 to 17. The average family size is highest in the Darai/Kumal/Praja (9.70) and is lowest in Brahmin/Chhetri/Thakuri (6.42). (Table 5.3)

Table 5.3 Family size by caste/ethnic group

Caste/Ethnic group	No of males	No of females	Sex ratio	Total family size	Average family size
Brahmin/Chhetri/Thakuri	113	86	1.31	199	6.42
Gurung/Magar/Tamang	20	19	1.05	39	6.50
Newar	3	4	0.75	7	7.00
Tharu	68	65	1.05	133	7.00
Darai/Kumal/Praja	56	41	1.37	97	9.70
Majhi/Mushar/Bote	7	7	1.00	14	7.00
Damai/Kami/Sarki	9	8	1.13	17	8.50
Total	276	230	1.20	506	7.13

Average family size was highest in large farm (14.00) and was lowest in small farm (5.22) (Table. 5.4). There is significant positive correlation between land holding size and family size, (Pearson coefficient 0.487, at 0.01 levels, 2 tailed) (Annex 5.1). Out of the 71 households 44 households had the joint family structure (61.97%) and the remaining 27 households had the nuclear family structure (38.03%).

Table 5.4 Family size by land holding

Land holding Size	No of males	No of females	Sex ratio	Total family size	Average family size
Landless	27	19	1.42	46	7.67
Small farm	50	44	1.14	94	5.22
Medium farm	103	86	1.20	189	7.00
Big farm	78	71	1.10	149	8.28
Large farm	18	10	1.80	28	14.00
Total	276	230	1.20	506	7.13

Out of the total individuals of sampled households, 133 (26.28%), were <15 years, 335 (66.21%) were 15-59 years and 38 (7.51%) are > 60 years. With in the land holding group, the percentage of productive population (15-59) years was highest in large farm (71.43%) and was lowest in landless (60.87%) (Table 5.5).

Table 5.5 Age structure based on the land holding size

Land holding Size		<15 years	15-59 years	>60 years
Landless	N	16	28	2
	%	34.78%	60.87%	4.35%
Small farm	N	26	61	7
	%	27.66%	64.89%	7.45%
Medium farm	N	51	127	11
	%	26.98%	67.20%	5.82%
Big farm	N	33	99	17
	%	22.15%	66.44%	11.41%
Large farm	N	7	20	1
	%	25.00%	71.43%	3.57%
Total	N	133	335	38
	%	26.28%	66.21%	7.51%

Similarly based on the caste/ethnic group the percentage of productive population was highest in Majhi/Mushar/Bote (85.71%) and was lowest in Gurung/Magar/Tamang (56.41%) (Table 5.6)

Table 5.6 Age structure based on caste/ethnic group

Caste/Ethnic group		<15 years	15-59 years	>60 years
Brahmin/Chhetri/Thakuri	N	49	130	20
	%	24.62%	65.33%	10.05%
Gurung/Magar/Tamang	N	15	22	2
	%	38.46%	56.41%	5.13%
Newar	N	2	5	0
	%	28.57%	71.43%	0.00%
Tharu	N	29	96	8
	%	21.80%	72.18%	6.02%
Darai/Kumal/Praja	N	30	60	7
	%	30.93%	61.86%	7.22%
Majhi/Mushar/Bote	N	2	12	0
	%	14.29%	85.71%	0.00%
Damai/Kami/Sarki	N	6	10	1
	%	35.29%	58.82%	5.88%
Total	N	133	335	38
	%	26.28%	66.21%	7.51%

In the study area 21.34% were illiterate, 65.81% were under S.L.C and 12.85% had education above S.L.C The Illiteracy percentage with in the land holding size was highest

in landless (26.09%) and the percentage of above S.L.C education was highest in big farm (16.78%) (Table 5.7). With in the caste/ethnic group, illiteracy was highest in Damai/Kami/Sarki (35.29%) and above S.L.C education was highest in the Newars (28.57%) (Table 5.8)

Table 5.7 Education level based on land holding size

Land holding Size		Illiterate	Under S.L.C.	Above S.L.C.
Landless	N	12	31	3
	%	26.09%	67.39%	6.52%
Small farm	N	18	62	14
	%	19.15%	65.96%	14.89%
Medium farm	N	43	125	21
	%	22.75%	66.14%	11.11%
Big farm	N	32	92	25
	%	21.48%	61.74%	16.78%
Large farm	N	3	23	2
	%	10.71%	82.14%	7.14%
Total	N	108	333	65
	%	21.34%	65.81%	12.85%

Table 5.8 Education level based on caste/ethnic group

Caste/Ethnic group		Illiterate	Under S.L.C.	Above S.L.C.
Brahmin/Chhetri/Thakuri	N	36	124	39
	%	18.09%	62.31%	19.60%
Gurung/Magar/Tamang	N	6	32	1
	%	15.38%	82.05%	2.56%
Newar	N	2	3	2
	%	28.57%	42.86%	28.57%
Tharu	N	36	85	12
	%	27.07%	63.91%	9.02%
Darai/Kumal/Praja	N	19	72	6
	%	19.59%	74.23%	6.19%
Majhi/Mushar/Bote	N	3	9	2
	%	21.43%	64.29%	14.29%
Damai/Kami/Sarki	N	6	8	3
	%	35.29%	47.06%	17.65%
Total	N	108	333	65
	%	21.34%	65.81%	12.85%

Majority of the people were involved in farming. Some 17.39% had the occupation of farming only, 17.59% had farmer cum house work, 0.79% had farmer cum business and 0.99% had farmer cum service. All together 36.76% people had the farming as the primary or secondary occupation. Besides the farming the majority of the people had the house work (6.32%) followed by remittance (5.73%) as the occupation. The students were 36.76% and the individuals of 4.35% had the non occupation. All together 208 individuals (41.11%) represented dependent population (student and non occupation). (Table 5.9)

Table 5.9 Occupation by land holding size

Occupation	Land holding size					
	Landless	Small farm	Medium farm	Big farm	Large farm	Total
Farmer	5	14	31	32	6	88 (17.39%)
House work	6	5	7	12	2	32 (6.32%)
Business	1	2	4	1	0	8 (1.58%)
Service	0	5	11	7	2	25 (4.94%)
Farmer cum House work	3	16	40	28	2	89 (17.59%)
House work cum Business	2	2	0	0	2	6 (1.19%)
Farmer cum Business	0	1	2	0	1	4 (0.79%)
Farmer cum Service	0	0	1	3	1	5 (0.99%)
Unskilled	11	1	0	0	0	12 (2.37%)
Remittance	1	3	13	10	2	29 (5.73%)
Student	16	41	71	48	10	186 (36.76%)
Non Occupation	1	4	9	8	0	22 (4.35%)
Total	46 (9.09%)	94 (18.58%)	189 (37.35%)	149 (29.45%)	28 (5.53%)	506 (100%)

5.1.4 Household Production

Among the paddy producing 66 households 31.8% would have surplus, 45.5% would have deficit and 22.7% would have balanced (Table 5.10). Some 65 households (91.55%) produce maize. Out of which 86.15% had surplus and 13.85% had the deficit. (Table 5.11)

Table 5.10 Production conditions of paddy

Crop type	Land holding size	Production condition			No of producing HH
		Surplus	Deficit	Balanced	
Paddy	Landless	0	1	1	2
	Small farm	1	11	5	17
	Medium farm	6	15	6	27
	Big farm	12	3	3	18
	Large farm	2	0	0	2
	Total	21	30	15	66
	% of Total	31.8%	45.5%	22.7%	100.0%

Table 5.11 Production condition of maize

Crop type	Land holding size	Production condition		No of producing HH
		Surplus	Balanced	
Maize	Landless	1	1	2
	Small farm	11	5	16
	Medium farm	24	3	27
	Big farm	18	0	18
	Large farm	2	0	2
	Total	56	9	65
	% of Total	86.15%	13.85%	100.00%

All the 25 buck wheat producing households had the surplus condition (Table 5.12).

Table 5.12 Production condition of Buck wheat

Crop Type		Production condition	No of producing HH
		Surplus	
Buck wheat	Small farm	7	7
	Medium farm	9	9
	Big farm	9	9
	Total	25	25
	% of Total	100.00%	100.00%

Only 12 households grew wheat. Out of which 83.33% had surplus and remaining 16.67% had the adequate produce (Table 5.13)

Table 5.13 Production condition of wheat

		Production condition		No of producing HH
		Surplus	Balanced	
Wheat	Small farm	3	1	4
	Medium farm	3	1	4
	Big farm	4	0	4
	Total	10	2	12
	% of Total	83.33%	16.67%	100.00%

Out of 34 oil seed producing households, 47.06% had surplus, 29.41% had deficit and remaining 23.53% had the balanced condition. (Table 5.14)

Table 5.14 Production condition of oil seed

		Production condition			No of producing HH
		Surplus	Deficit	Balanced	
Oil seed	Landless	0	1	0	1
	Small farm	1	2	1	4
	Medium farm	6	4	5	15
	Big farm	7	3	2	12
	Large farm	2	0	0	2
	Total	16	10	8	34
	% of Total	47.06%	29.41%	23.53%	100.0%

The mean actual land of production of the landless was 0.17 ha and the average deficit of the agricultural production was Rs 13510/HH/yr. Land holding group of large farm had the highest net agricultural income (total production – total consumption) of Rs 89765.50/HH/yr. Whereas the average net agricultural income of all the sampling households was Rs 12228.83/HH/yr and the mean actual land of production was 0.73ha (Table 5.15). There is significant positive correlation between actual land of production and net agricultural income, (Pearson coefficient 0.839, at 0.01 levels, 2 tailed) (Annex 5.2).

By caste/ethnic group Majhi/Mushar/Bote had the highest deficit of Rs 5985/HH/yr with the 0.24 ha of mean actual land of production. Newar had the deficit of Rs. 1190/HH/yr. Darai/Kumal/Praja had the highest balance of Rs 15377/HH/yr with the highest (0.93ha) mean actual land of production (Table 5.16).

Table 5.15 Balance of the production by land holding size

Land holding Size		Actual land of production (ha)	Total production (Rs)	Total consumption (Rs)	Balance of the production (Rs)
Landless	Sum	1.02	29055.00	110115.00	-81060.00
	Mean	.17	4842.50	18352.50	-13510.00
Small farm	Sum	5.55	349211.50	326454.50	22757.00
	Mean	.31	19400.64	18136.36	1264.28
Medium farm	Sum	15.80	794209.00	591198.00	203011.00
	Mean	.59	29415.15	21896.22	7518.93
Big farm	Sum	23.98	1049512.00	505504.00	544008.00
	Mean	1.33	58306.22	28083.56	30222.67
Large farm	Sum	5.44	270856.00	91325.00	179531.00
	Mean	2.72	135428.00	45662.50	89765.50
Total	Sum	51.79	2492843.50	1624596.50	868247.00
	Mean	.73	35110.47	22881.64	12228.83

Table 5.16 Balance of the production by caste/ethnic group

Caste/Ethnic group		Actual land of production (ha)	Total production (Rs)	Total consumption (Rs)	Balance of production (Rs)
Brahmin/Chhetri/Thakuri	Sum	22.16	1131364.50	683425.50	447939.00
	Mean	.71	36495.63	22045.98	14449.65
Gurung/Magar/Tamang	Sum	3.81	150579.00	111932.00	38647.00
	Mean	.63	25096.50	18655.33	6441.17
Newar	Sum	.41	19920.00	21110.00	-1190.00
	Mean	.41	19920.00	21110.00	-1190.00
Tharu	Sum	14.84	675455.00	440774.00	234681.00
	Mean	.78	35550.26	23198.63	12351.63
Darai/Kumal/Praja	Sum	9.27	437595.00	283825.00	153770.00
	Mean	.93	43759.50	28382.50	15377.00
Majhi/Mushar/Bote	Sum	.48	27800.00	39770.00	-11970.00
	Mean	.24	13900.00	19885.00	-5985.00
Damai/Kami/Sarki	Sum	.84	50130.00	43760.00	6370.00
	Mean	.42	25065.00	21880.00	3185.00
Total	Sum	51.79	2492843.50	1624596.50	868247.00
	Mean	.73	35110.47	22881.64	12228.83

Table 5.17 Overall production condition by land holding size

Land holding Size		Overall production condition		Total
		Surplus	Deficit	
Landless	N	1	5	6
	%	16.67%	83.33%	100.00%
Small farm	N	9	9	18
	%	50.00%	50.00%	100.00%
Medium farm	N	18	9	27
	%	66.67%	33.33%	100.00%
Big farm	N	17	1	18
	%	94.44%	5.56%	100.00%
Large farm	N	2	0	2
	%	100.00%	.00%	100.00%
Total	N	47	24	71
	%	66.20%	33.80%	100.00%

LHS: Land Holding Size

Table 5.18 Overall production condition by caste/ethnic group

Caste/Ethnic group		Overall production condition		Total
		Surplus	Deficit	
Brahmin/Chhetri/Thakuri	N	21	10	31
	%	67.74%	32.26%	100.00%
Gurung/Magar/Tamang	N	4	2	6
	%	66.67%	33.33%	100.00%
Newar	N	0	1	1
	%	.00%	100.00%	100.00%
Tharu	N	13	6	19
	%	68.42%	31.58%	100.00%
Darai/Kumal/Praja	N	6	4	10
	%	60.00%	40.00%	100.00%
Majhi/Mushar/Bote	N	1	1	2
	%	50.00%	50.00%	100.00%
Damai/Kami/Sarki	N	2	0	2
	%	100.00%	.00%	100.00%
Total	N	47	24	71
	%	66.20%	33.80%	100.00%

Overall, 47 households (66.20%) had the surplus crops and 24 households (33.80%) had the deficit. Out of the 6 landless households 5 (83.33%) had the deficit. 50% of the small farm households had the surplus and the remaining 50% had the deficit (Table 5.17) By caste/ethnic group, Damai/Kami/Sarki had the 100% surplus followed by Tharu with 68.4% surplus. Newar had the 100% deficit followed by Majhi/Mushar/Bote with 50% deficit (Table 5.18).

The average surplus of the agricultural production was 5.66 months. Brahmin/Chhetri/Thakuri had the highest surplus of 7.58 months where as Majhi/Mushar/Bote had the highest deficit of 3.50 months. (Table 5.19) By land holding size landless had the average deficit of 8.50 months where as Large farm had the average surplus of 31 months. 11.27% of the total households had the deficit for almost all round the year where as 66.20% of the households had the surplus for more than 12 months (Table 5.20)

Table 5.19 Average surplus/deficit months by caste/ethnic group

Caste/Ethnic group	Avg. surplus/deficit months
Brahmin/Chhetri/Thakuri	7.58
Gurung/Magar/Tamang	3.66
Newar	-1.00
Tharu	5.58
Darai/Kumal/Praja	4.30
Majhi/Mushar/Bote	-3.50
Damai/Kami/Sarki	2.00
Total	5.66

Table 5.20 Average surplus/deficit months by land holding size

Land holding Size	Avg. surplus/deficit months
Landless	-8.50
Small farm	1.11
Medium farm	4.66
Big farm	13.67
Large farm	31.00
Total	5.66

Table 5.21 Frequency of surplus/deficit months

Production condition	Months	No of households	%
Deficit	9-12	8	11.27%
	6-9	4	5.63%
	3-6	7	9.86%
	< 3	5	7.04%
	Total	24	33.80%
Surplus	< 3	7	9.86%
	3-6	10	14.08%
	6-9	7	9.86%
	9-12	5	7.04%
	> 12	18	25.35%
	Total	47	66.20%
Total		71	100.00%

Out of 24 deficit households, 8 families (33.33%) managed their deficiency of agricultural production by remittance (Table 5.22)

Table 5.22 Management sources for deficit months

Options	Frequency	Percent
Wage labor	5	20.83
Service	3	12.50
Business	5	20.83
Remittance	8	33.33
Boating and fishing	1	4.17
Boating and fishing + Wage labor	1	4.17
Loan	1	4.17
Total	24	100.00

5.1.5. Households' Resources Dependency

Out of sampled households, 27 (38.03%) used 3 species of fodder where as 8 households used 5 fodder species. Five households did not use any fodder species (Table 5.23) More than 50% of the households used 4 fuel wood species followed by 22.54% using 5 fuel wood species. One household did not use any fuel wood species (Table 5.24).

Table 5.23 Frequency of fodder species

Fodder species	Frequency	%
0	5	7.04%
2	10	14.08%
3	27	38.03%
4	21	29.58%
5	8	11.27%
Total	71	100.00%

Table 5.24 Frequency of fuel wood species

Fuel wood species	Frequency	%
0	1	1.41%
2	5	7.04%
3	12	16.90%
4	36	50.70%
5	16	22.54%
6	1	1.41%
Total	71	100.00%

More than 50% households used fodder from both the community forest and their own land. 14.1% households entirely depended upon the community forest for fodder. None of the households depend upon the CNP only for the fodder (Table 5.25)

Table 5.25 Fodder access by land holding size

Fodder access	Land holding Size					Total
	Landless	Small farm	Medium farm	Big farm	Large farm	
No use of fodder	1	3	0	0	1	5
						7.0%
Community forest	2	2	4	2	0	10
						14.1%
Own land	0	0	3	2	0	5
						7.0%
CNP + community forest	0	1	1	1	0	3
						4.2%
Community forest + own land	3	9	16	11	0	39
						54.9%

Community forest + Buy	0	1	1	0	0	2
						2.8%
CNP, Community forest and own land.	0	2	1	2	1	6
						8.5%
CNP and own land	0	0	1	0	0	1
						1.4%
Total	6	18	27	18	2	71
	8.5%	25.4%	38.0%	25.4%	2.8%	100.0%

The average fodder demand of the households of the study area was estimated as 38.71 Mt/yr. The value was highest (51.51 Mt/yr) for big farm and least (27.38 Mt/yr) for both small farm and large farm. The average livestock unit of VDC was 2.29/hh. The value was highest for big farm (3.00) followed by landless (2.38) and was least for small farm (1.65). The average fodder quantity per livestock units was highest for medium farm (21.74 Mt/yr/LU) and was least for large farm (8.03 Mt/yr/LU) (Table 5.26). There are significant positive correlations between land holding size and livestock units (Pearson coefficient 0.279 at 0.05 levels, 2 tailed) (Annex 5.3) as well as livestock units and fodder demand (Pearson coefficient 0.681 at 0.01 level, 2 tailed) (Annex 5.4).

Table 5.26 Fodder demand and livestock units by land holding size

Land holding Size	Fodder demand (Mt/yr)	Fodder demand (Mt) /HH	Livestock units	Livestock units/HH	Avg. fodder demand (Mt)/LU
Landless	200.75	33.46	14.29	2.38	18.92
Small farm	492.75	27.38	29.67	1.65	16.07
Medium farm	1073.10	39.74	60.92	2.26	21.74
Big farm	927.10	51.51	53.98	3.00	18.83
Large farm	54.75	27.38	3.41	1.71	8.03
Total	2748.45	38.71	162.27	2.29	18.94

By caste/ethnic group the fodder demand/hh was highest for Damai/Kami/Sarki (45.63 Mt/yr) where as the value was least for Majhi/Mushar/Bote (27.38 Mt/yr). Average livestock units/hh was highest for Newar (3.93) and was least for Majhi/Mushar/Bote (0.68). Average fodder quantity/LU was highest for Majhi/Mushar/Bote (43.78 Mt/yr) and was least for Newar (9.29 Mt/yr) (Table 5.27).

Table 5.27 Fodder demand and livestock units by caste and ethnic group

Caste/Ethnic group	Fodder demand (Mt/yr)	Fodder demand (Mt)/HH	Livestock units	Livestock units/HH	Avg. fodder demand (Mt)/LU
Brahmin/Chhetri/Thakuri	1131.50	36.50	83.82	2.70	13.59
Gurung/Magar/Tamang	255.50	42.58	13.24	2.21	26.74
Newar	36.50	36.50	3.93	3.93	9.29
Tharu	799.35	42.07	37.30	1.96	21.43
Darai/Kumal/Praja	379.60	37.96	19.01	1.90	19.44
Majhi/Mushar/Bote	54.75	27.38	1.35	.68	43.78
Damai/Kami/Sarki	91.25	45.63	3.62	1.81	32.27
Total	2748.45	38.71	162.27	2.29	18.94

The fuel wood quantity per household was 5.02 Mt/yr for the study area. The value was highest for large farm (13.20 Mt/yr) and lowest for medium farm (4.51 Mt/yr). The average fuel wood quantity per person was 0.74 Mt/yr. The value was highest for the small farm (0.96 Mt/yr) and was lowest for big farm (0.60 Mt/yr) (Table 5.28)

Table 5.28 Fuel wood demand by land holding size

Land holding Size	Fuel wood demand (Mt/Yr)	Fuel wood demand (Mt/HH/Yr)	Avg. fuel wood demand (Mt/Person/Yr)
Landless	29.11	4.85	0.73
Small farm	84.76	4.71	0.96
Medium farm	121.80	4.51	0.68
Big farm	94.48	5.25	0.60
Large farm	26.40	13.20	0.89
Total	356.55	5.02	0.74

By caste/ethnic group, the fuel wood quantity per households was highest for Darai/Kumal/Praja (9.93 Mt/yr) and the value was lowest for Newar (1.20 Mt/yr). The average fuel wood quantity per person was highest for Darai/Kumal/Praja (1.26 Mt/yr) and was lowest for Newar (0.17 Mt/yr) (Table 5.29).

More than 35% of households had the fodder access to both park and the community forest and 4.2 % of households depended on the park only for the fuel wood. One household did not use any fuel wood. Some 18.3% of the households collected drift wood besides getting from the community forest or the park (Table 5.30).

Table 5.29 Fuel wood demand by caste/ethnic group

Caste/Ethnic group	Fuel wood demand (Mt/yr)	Fuel wood demand (Mt/HH/Yr)	Avg. fuel wood demand (Mt/Person/Yr)
Brahmin/Chhetri/Thakuri	136.07	4.39	.74
Gurung/Magar/Tamang	25.44	4.24	.59
Newar	1.20	1.20	.17
Tharu	84.92	4.47	.64
Darai/Kumal/Praja	99.32	9.93	1.26
Majhi/Mushar/Bote	4.80	2.40	.34
Damai/Kami/Sarki	4.80	2.40	.28
Total	356.55	5.02	.74

Table 5.30 Fuel wood access by Land holding Size

Fuel wood access	Land holding Size					Total
	Landless	Small farm	Medium farm	Big farm	Large farm	
No use of fuel wood	0	1	0	0	0	1 1.4%
CNP	0	0	2	1	0	3 4.2%
CF	0	2	3	2	0	7 9.9%
Buy	1	0	0	1	0	2 2.8%
CNP + CF	3	6	10	6	0	25 35.2%
CF + own land	0	0	1	0	0	1 1.4%
CF + Buy	0	1	3	0	0	4 5.6%
CNP, CF and own land	1	1	4	6	0	12 16.9%
CNP, CF, own land and buy	0	1	0	0	1	2 2.8%
CF and CDW	0	1	0	0	0	1 1.4%
CF, CNP and CDW	1	4	4	2	1	12 16.9%
CNP and Buy	0	1	0	0	0	1 1.4%
Total	6 8.5%	18 25.4%	27 38.0%	18 25.4%	2 2.8%	71 100.0%

CNP: Chitwan National Park, CF: community forest, CDW: collecting drift wood

The average khar (*Imperata spp*, used for making roof) and khadai (*Saccharum bengalensis* used for partition of room mainly by indigenous community) demand per household were 0.72 Mt/yr and 0.23 Mt/yr respectively. Darai/Kumal/Praja had the highest demand for both khar and khadai. Newar had the least demand for khar and none for khadai (Table 5.31). By land holding size, khar demand was highest for medium farm (0.84 Mt/hh/yr) where as the khadai demand was highest for large farm (0.63 Mt/hh/yr) (Table 5.32).

Table 5.31 Khar and Khadai demand by caste/ethnic group

Caste/Ethnic group	Khar demand (Mt)	Khar demand/HH	Khar demand/ person	Khadai demand (Mt)	Khadai demand/HH	Khadai demand/ person
Brahmin/Chhetri/Thakuri	18.08	.58	.11	2.45	.08	.01
Gurung/Magar/Tamang	5.63	.94	.17	2.00	.33	.05
Newar	.44	.44	.06	.00	.00	.00
Tharu	14.55	.77	.13	6.65	.35	.06
Darai/Kumal/Praja	10.17	1.02	.12	4.25	.43	.05
Majhi/Mushar/Bote	1.50	.75	.11	.80	.40	.06
Damai/Kami/Sarki	1.00	.50	.06	.00	.00	.00
Total	51.37	.72	.12	16.15	.23	.03

Table 5.32 Khar and Khadai demand by land holding size

Land holding Size	Khar demand (Mt)	Khar demand/HH	Khar demand/ person	Khadai demand (Mt)	Khadai demand/HH	Khadai demand/ person
Landless	3.94	.66	.10	1.80	.30	.03
Small farm	8.60	.48	.10	2.80	.16	.03
Medium farm	22.58	.84	.14	4.25	.16	.02
Big farm	15.00	.83	.11	6.05	.34	.05
Large farm	1.25	.63	.04	1.25	.63	.04
Total	51.37	.72	.12	16.15	.23	.03

Majority of the households (66.2%) did not need khadai. Only 33.8% of the households had demand for khadai and all of them had to depend on parks because of the absence of kahdai on the community forest. (Table 5.33)

Table 5.33 Khadai access by land holding Size

Khadai access	Land holding Size					Total
	Landless	Small farm	Medium farm	Big farm	Large farm	
No use of khadai	4	13	20	9	1	47 66.2%
Parks	2	5	7	9	1	24 33.8%
Total	6 8.5%	18 25.4%	27 38.0%	18 25.4%	2 2.8%	71 100.0%

More than 60% of the households had the access to community forest for the fulfillment of the khar demand. Only 4 households entirely depend upon the parks for the khar (Table 5.34).

Table 5.34 Khar access by land holding size

Khar access	Land holding Size					Total
	Landless	Small farm	Medium farm	Big farm	Large farm	
No use of khar	1	6	5	3	1	16 22.5%
Parks	0	0	1	3	0	4 5.6%
Community forest	4	11	18	11	1	45 63.4%
Parks + community forest	1	1	3	1	0	6 8.5%
Total	6 8.5%	18 25.4%	27 38.0%	18 25.4%	2 2.8%	71 100.0%

More than 33% of the households had to entirely buy for the timber use whereas 14 households completely depended upon the park (Table 5.35).

Table 5.35 Timber access by land holding Size

Timber access	Land holding Size					Total
	Landless	Small farm	Medium farm	Big farm	Large farm	
No use of timber	0	1	0	0	0	1 1.4%
Parks	2	4	6	2	0	14 19.7%
Buy	2	4	12	6	0	24 33.8%
Parks + CF	1	0	4	2	0	7 9.9%
CF + Buy	1	1	1	3	0	6 8.5%
Parks, CF, own land and buy	0	2	1	0	2	5 7.0%
CNP and CDW	0	0	0	1	0	1 1.4%
CF, CNP and CDW	0	0	0	1	0	1 1.4%
CNP and buying	0	6	3	3	0	12 16.9%
Total	6 8.5%	18 25.4%	27 38.0%	18 25.4%	2 2.8%	71 100.0%

CDW: collecting drift wood.

5.1.6 Alternative Energy use

Nearly 79% households used kerosene and all used electricity for lighting their home. Some 8.45% used LP gas and only 2.82% used biogas for cooking purpose. Both the two biogas using households fall under the Brahmin/Chhetri/Thakuri by caste/ethnic group and big farm by land holding size (Table.5.36 and 5.37).

Out of the electricity users, 71 households, 23.94% used hook for illegal supplystealing the current. By land holding size, 80% of the landless and by caste/ethnic group 80% of Darai/Kumal/Praja used electricity illegally.

Table 5.36 Alternative energy use by caste/ ethnic group

Caste/Ethnic group		Alternative energy				Total
		Kerosene using HH	Electricity using HH	LP gas using HH	Bio gas using HH	
Brahmin/Chhetri/Thakuri	N	27	31	4	2	31
	%	87.10%	100.00%	12.90%	6.45%	100.0%
Gurung/Magar/Tamang	N	5	6	0	0	6
	%	83.33%	100.00%	0.00%	0.00%	100.0%
Newar	N	1	1	0	0	1
	%	100.00%	100.00%	0.00%	0.00%	100.0%
Tharu	N	14	19	1	0	19
	%	73.68%	100.00%	5.26%	0.00%	100.0%
Darai/Kumal/Praja	N	7	10	0	0	10
	%	70.00%	100.00%	0.00%	0.00%	100.0%
Majhi/Mushar/Bote	N	1	2	0	0	2
	%	50.00%	100.00%	0.00%	0.00%	100.0%
Damai/Kami/Sarki	N	1	2	1	0	2
	%	50.00%	100.00%	50.00%	0.00%	100.0%
Total	N	56	71	6	2	71
	%	78.87%	100.00%	8.45%	2.82%	100.0%

Table 5.37 Alternative energy use by land holding size

Land holding size		Alternative energy				Total
		Kerosene using HH	Electricity using HH	LP gas using HH	Bio gas using HH	
Landless	N	3	6	1	0	6
	%	50.00%	100.00%	16.67%	0.00%	100.0%
Small farm	N	14	18	3	0	18
	%	77.78%	100.00%	16.67%	0.00%	100.0%
Medium farm	N	22	27	1	0	27
	%	81.48%	100.00%	3.70%	0.00%	100.0%
Big farm	N	15	18	1	2	18
	%	83.33%	100.00%	5.56%	11.11%	100.0%
Large farm	N	2	2	0	0	2
	%	100.00%	100.00%	0.00%	0.00%	100.0%
Total	N	56	71	6	2	71
	%	78.9%	100.0%	8.5%	2.8%	100.0%

Table 5.38 Cause of not installing biogas plant by land holding Size

Causes		Land holding Size					Total
		Landless	Small farm	Medium farm	Big farm	Large farm	
Economic Constraint	N	4	10	17	6	0	37
	%	66.7%	55.6%	63.0%	37.5%	.0%	53.6%
Sufficiency of fuel wood	N	0	2	3	4	0	9
	%	.0%	11.1%	11.1%	25.0%	.0%	13.0%
Inability of rearing livestock	N	1	5	3	2	1	12
	%	16.7%	27.8%	11.1%	12.5%	50.0%	17.4%
LF and diminish of tank	N	0	0	2	1	1	4
	%	.0%	.0%	7.4%	6.3%	50.0%	5.8%
Due to being joint family	N	0	1	0	2	0	3
	%	.0%	5.6%	.0%	12.5%	.0%	4.3%
Having no knowledge about it	N	1	0	1	1	0	3
	%	16.7%	.0%	3.7%	6.3%	.0%	4.3%
Combination of EC, sufficiency of FW and LF	N	0	0	1	0	0	1
	%	.0%	.0%	3.7%	.0%	.0%	1.4%
Total	N	6	18	27	16	2	69
	%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

LHS: Land holding size, EC: Economic constraints, FW: Fuel wood, LF: Land flooding

More than 50% of the households did not install the biogas plant due to the economic constraints. Over 17% of the households were enable to rear livestock for the bio gas plant. Over 4% of the households had no knowledge about the installation of biogas plant (Table 5.38).

5.1.7 Buffer Zone Community Forest

There were altogether 8 community forests of which 5 were registered (Table 5.39). More than 95% of the households were the member of CF user group (Table 5.40). Members of more than 15% of households were involved in the BZ management (Table 5.41) and 75% were respondent themselves.

Table 5.39 Buffer Zone community forests

S.N.	Name of CF	Area (ha)	Ward no	Remarks
1	Rapti Niyantran	450*	1	
2	Narayani	130	2	
3	Bardaha	250*	3	Registered
4	Bardaha	1000*	4,6 and 7	
5	Radhakrishna	66.88	5	Registered
6	Malika	30	8	
7	Hariyali Rapti Tatha Betari	61.18	9	Registered
8	Sadabahar	199	5 & 9	Registered
		Total area 2187.06 ha		

* represent estimated areas
Data source: Meghauli Buffer Zone user Committee

Table 5.40 Membership of CF by land holding size

Land holding Size		Do you have general membership of CFUG		Total
		Yes	No	
Landless	N	6	0	6
	%	100.0%	.0%	100.0%
Small farm	N	17	1	18
	%	94.4%	5.6%	100.0%
Medium farm	N	27	0	27
	%	100.0%	.0%	100.0%
Big farm	N	16	2	18
	%	88.9%	11.1%	100.0%
Large farm	N	2	0	2
	%	100.0%	.0%	100.0%
Total	N	68	3	71
	%	95.8%	4.2%	100.0%

Table 5.41 Involvement in BZ management

Land holding Size	Is/was any member of your family been involved in BZ mgmt?			
		Yes	No	Total
Landless	N	0	6	6
	% row total	.0%	100.0%	100.0%
	% of column total	.0%	10.2%	8.5%
Small farm	N	3	15	18
	% row total	16.7%	83.3%	100.0%
	% of column total	25.0%	25.4%	25.4%
Medium farm	N	5	22	27
	% row total	18.5%	81.5%	100.0%
	% of column total	41.7%	37.3%	38.0%
Big farm	N	4	14	18
	% row total	22.2%	77.8%	100.0%
	% of column total	33.3%	23.7%	25.4%
Large farm	N	0	2	2
	% row total	.0%	100.0%	100.0%
	% of column total	.0%	3.4%	2.8%
Total	N	12	59	71
	% row total	16.9%	83.1%	100.0%
	% of column total	100.0%	100.0%	100.0%

Fig. 5.1 Buffer zone CF status

Some 49 respondents considered their community forest as good. Four respondents did not comment (Fig 5.1). Most of the respondents (78.87%) said that their community forest was improving and better than the past (fig 5.2). But more than 80% of the respondent commented that their community forest was not full filling their demand. Four households did not use the community forest (Fig 5.3).

Fig. 5.2 Condition of BZCF in compared to past

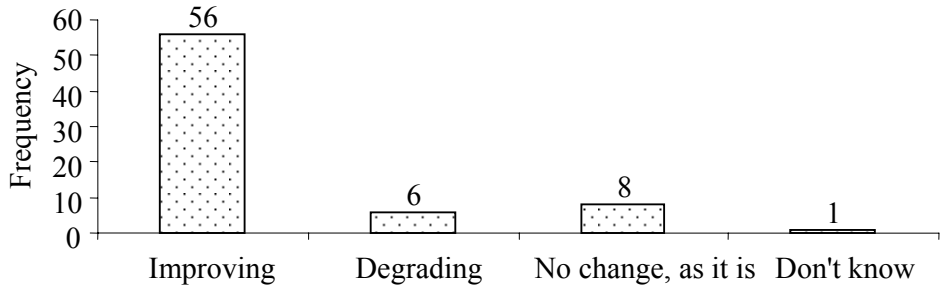
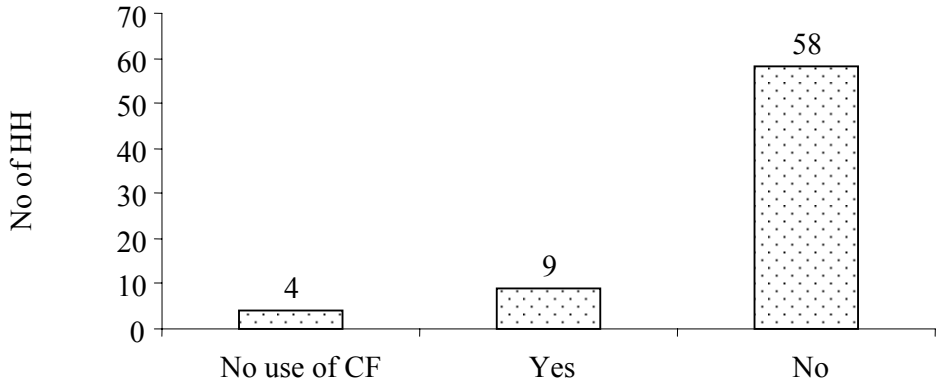


Fig. 5.3 Is CF fulfilling your demand?



The average deficit per households of fuel wood, fodder, khar and khadai were 3.36 Mt/yr, 2.15 Mt/yr, 0.07 Mt/yr, and 0.22 Mt/yr respectively. Deficit of fuel wood per households was highest for Large farm (18 Mt/yr). There is significant positive correlation between land holding size and fuel wood deficit. (Pearson coefficient 0.360 at 0.01 level, 2 tailed) (Annex 5.5). Both the fodder and khar deficit per households were highest for big farm, 4.12 Mt/yr and 0.2 Mt/yr respectively where as the khadai deficit per household was highest for Large farm (0.63 Mt/yr) (Table 5.42)

Table 5.42 Resources deficiency of CF

Land holding Size	Deficit amount of fuel wood (Mt/HH)	Deficit amount of fuel wood (Mt/ind)	Deficit amount of fodder (Mt/HH)	Deficit amount of fodder (Mt/ind)	Deficit amount of khar (Mt/HH)	Deficit amount of khar (Mt/ind)	Deficit amount of khadai (Mt/HH)	Deficit amount of kahdai (Mt/ind)
LL	3.88	.58	.00	.00	.00	.00	.30	.03
SF	3.53	.71	1.00	.23	.00	.00	.16	.03
MF	2.19	.32	2.25	.28	.05	.01	.16	.02
BF	3.16	.36	4.12	.60	.20	.02	.31	.04
LF	18.00	1.15	.00	.00	.00	.00	.63	.04
Total	3.36	.48	2.15	.31	.07	.01	.22	.03

LL: Landless, SF: Small farm, MF: Medium farm, BF: Big farm, LF: Large farm

Average fuel wood deficit month was 6.33 and fodder was 0.58 months. Fuel wood deficit months were highest for large farm (9 months) followed by landless (8.58 months). In the case of fodder the value was highest for big farm (1.11 months) followed by medium farm (0.56 months) (Table 5.43).

Table 5.43 Average months of resources deficiency

Land holding Size	Avg. deficit months of fuel wood	Avg. deficit months of fodder
Landless	8.58	.00
Small farm	6.67	.33
Medium farm	5.48	.56
Big farm	6.22	1.11
Large farm	9.00	.00
Total	6.33	.58

All the households of the landless and large farm had the fuel wood deficit where as they had no fodder deficit. The fodder deficit households were highest (22.22%) in the big farm (Table 5.44).

Table 5.44 Resources deficit households

Land holding Size		Fuel wood deficit HH	Fodder deficit HH
Landless	N	6	0
	%	100.00%	.00%
Small farm	N	15	2
	%	83.33%	11.11%
Medium farm	N	21	5
	%	77.77%	18.51%
Big farm	N	14	4
	%	77.78%	22.22%
Large farm	N	2	0
	%	100.00%	.00%
Total	N	58	11
	%	81.69%	15.49%

Table 5.45 Alternatives for the deficit management

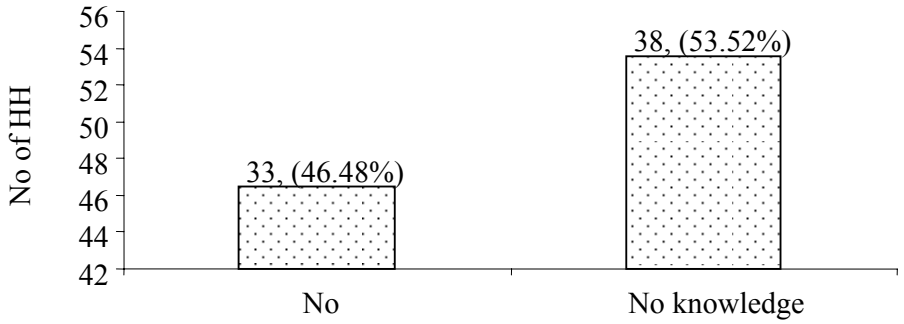
Alternatives		Land holding Size					Total
		Landless	Small farm	Medium farm	Big farm	Large farm	
Buy	N	1	1	1	1	0	4
	%	16.67%	6.67%	4.55%	6.25%	.00%	6.56%
Go to CNP	N	5	9	17	11	0	42
	%	83.33%	60.00%	77.27%	68.75%	.00%	68.85%
By + go to CNP	N	0	2	0	2	1	5
	%	.00%	13.33%	.00%	12.50%	50.00%	8.20%
CDW	N	0	1	1	0	0	2
	%	.00%	6.67%	4.55%	.00%	.00%	3.28%
CDW + go to CNP	N	0	2	2	2	1	7
	%	.00%	13.33%	9.09%	12.50%	50.00%	11.48%
CDW + Buy + go to CNP	N	0	0	1	0	0	1
	%	.00%	.00%	4.55%	.00%	.00%	1.64%
Total	N	6	15	22	16	2	61
	%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

CDW: collecting drift wood.

Out of the sampled households, one household did not use fuel wood, 9 households said that their demand were fulfilled by the community forest and 3 fuel wood using

households did not use the community forest. Therefore 61 households had to find the alternatives for the demand fulfillment of fuel wood. Out of the 61 households, 68.85% had only the option of going to CNP. 10 households (14.49%) collect drift wood besides buying and going to CNP (Table 5.45).

Fig 5.4 Is budget allocation for BZ by CNP sufficient?



53.52% of the households did not have knowledge about the budget allocation by CNP. Remaining 46.48% of households argued that that the budget allocation was not sufficient. (Fig 5.4)

5.1.8 Rhinos and Other Wild Animals Related Issues

44 households had ever faced the problem of rhino. Out of that 38 households had faced the crop damage by rhino (Fig. 5.5 & 5.6).

Fig 5.5 Have you ever face the problem of rhino?

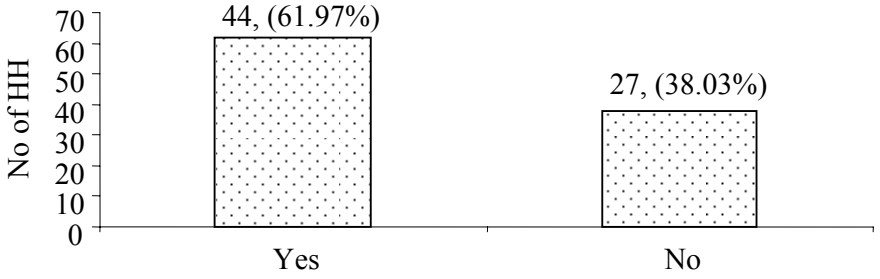
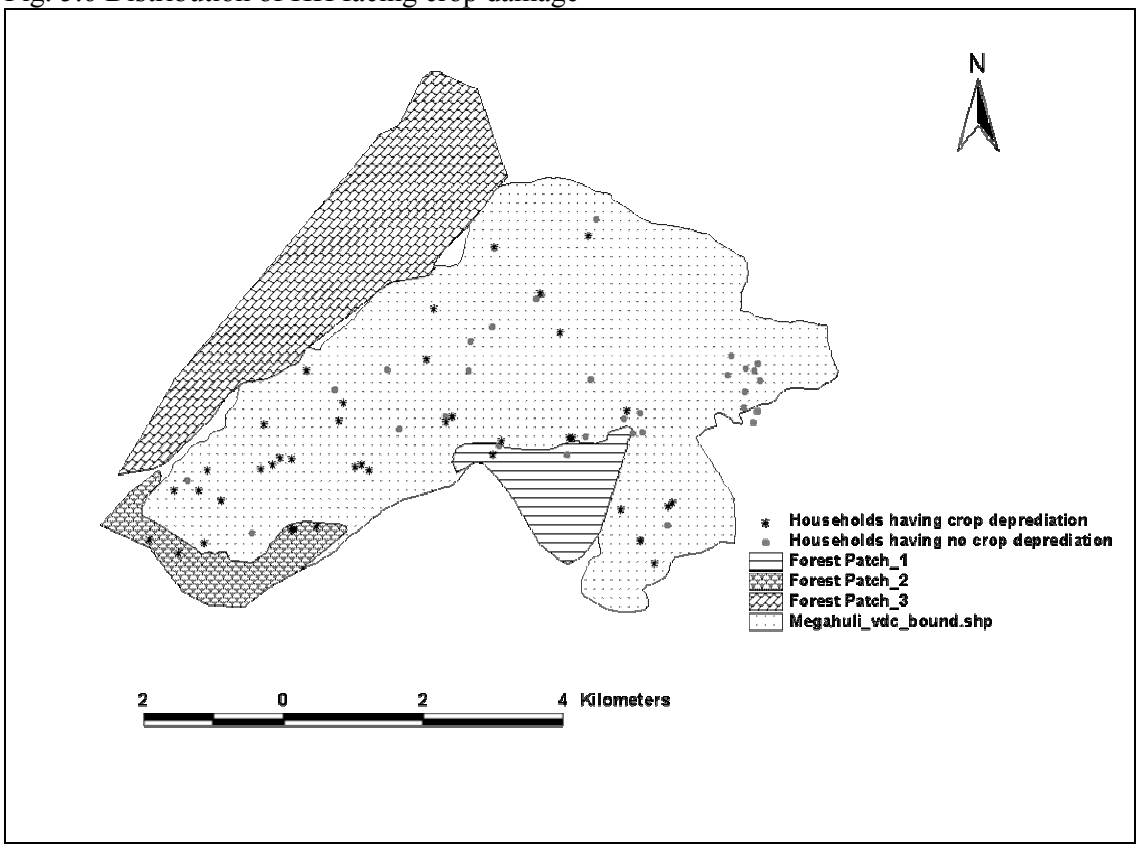


Fig. 5.6 Distribution of HH facing crop damage



About 30% of the households said that the rhino was most frequent i.e. 9-12 months a year. In 18.31% of the households, the rhino frequency was none (Table 5.46).

Table 5.46 Rhino frequency

Frequency	No of HH	Percent
None	13	18.31%
Rarely (1-3 months)	7	9.86%
Occasionally (3-6 months)	12	16.90%
Frequently (6-9 months)	18	25.35%
Most frequently (9-12 months)	21	29.58%
Total	71	100.00%

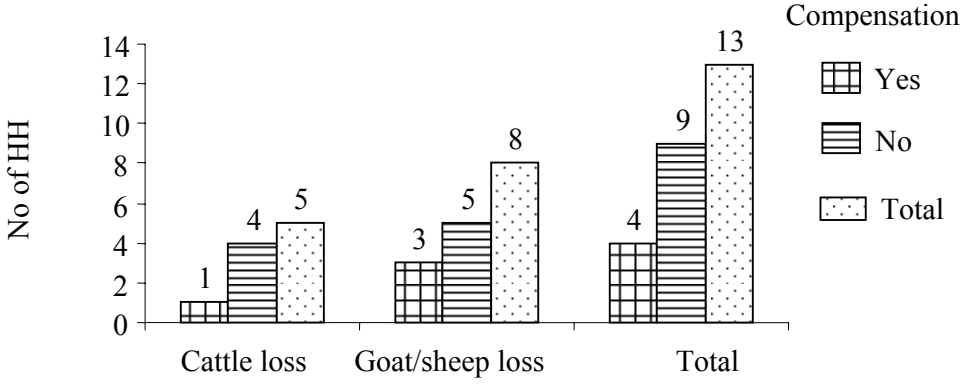
Only 23 households had suffered from other crop damaging animals. Out of that 15 households had the crop damage due to wild pig followed by 4 households due to both wild pig and chital (Table 5.47).

Table 5.47 Crop damaging other animals

Crop damaging other animals	Frequency	Percent
Non	48	67.60%
Elephant	1	1.41%
Wild pig	15	21.13%
Chital	2	2.82%
Both wild pig and chital	4	5.63%
Wild pig, chital and monkey	1	1.41%
Total	71	100.00%

There were all together 39 households in the past which had reported crop damage and none of them had got the compensation.

Fig. 5.7 Compensation for livestock loss



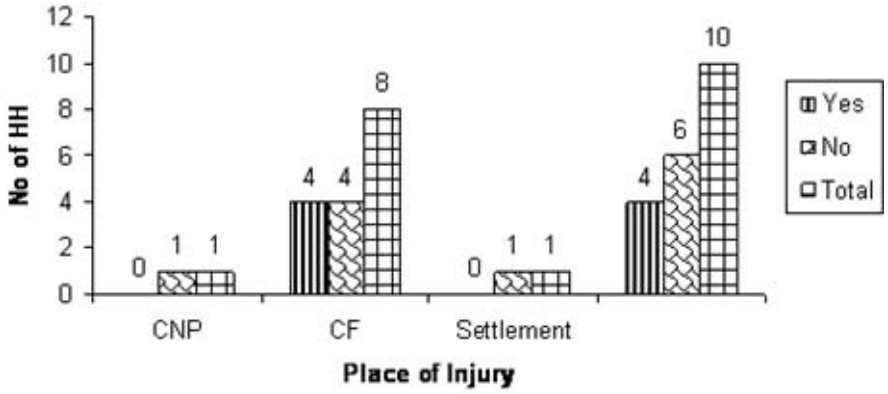
In total there were 13 households having livestock loss due to wild animals out of that only 4 households had got the compensation.

Table 5.48 Place and time of injury by rhino

Place	Time				Total
	With in 1 year	1-2 years ago	3-5 years ago	>5 years ago	
CNP	0	0	1	0	1
Community forest	2	5	0	1	8
Settlement	0	0	0	1	1
Total	2	5	1	2	10

Out of the total 10 cases of injury caused by rhino in sampled households, 8 were with in the community forest (Table 5.48). Of these, only 4 individuals received the compensation (Fig 5.8). Individuals injured in CNP and settlement did not get any compensation.

Fig 5.8 Compensation of rhino injury



Out of the total 5 cases of loss of life by rhino, 4 were within the community forest and within the last 5 years. Only one occurred in the CNP (Table 5.49). All the 4 cases of the loss of life in community forest got the compensation but none in CNP (Fig 5.9).

Table 5.49 Place and time of loss of life by rhino

Place	Time			
	1-2 years ago	3-5 years ago	>5 years ago	Total
CNP	1	0	0	1
Community forest	1	2	1	4
Total	2	2	1	5

Fig. 5.9 Compensation for loss of life by rhino

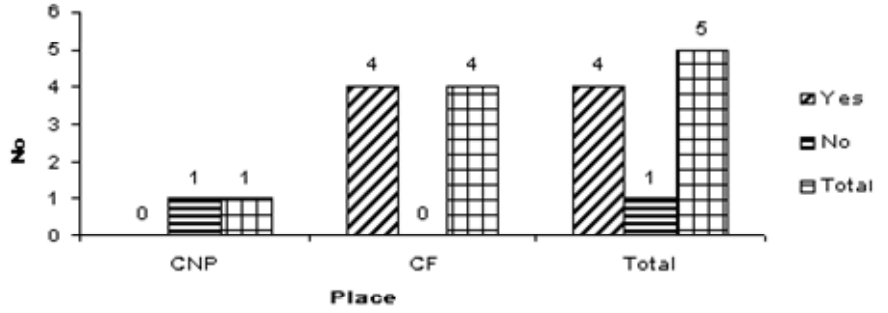
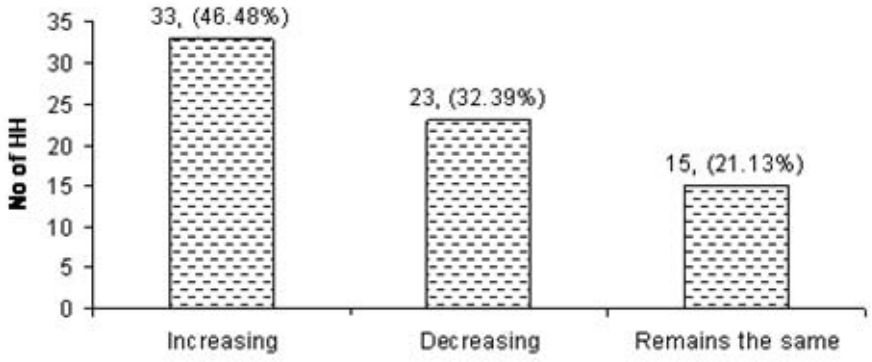


Fig. 5.10 Rhino movement



Some 33 respondents said rhino movement to be increasing and 15 respondents said remains the same (Fig. 5.12) Out of the 23 respondents saying rhino movement to be decreasing, 11 gave the cause to be the fencing of the community forest, 3 said habitat loss and 8 did not know the cause (Table 5.50).

Table 5.50 Cause of Rhino decrease

Causes	Frequency	Percent
Fencing	11	47.83%
Habitat Loss	3	13.04%
Both poaching and habitat loss.	1	4.35%
Don't know	8	34.78%
Total	23	100.00%

More than 60% of the respondents did not respond about the frequency of rhino poaching. 28.17% of the respondents said that the frequency of rhino poaching was 1-3 no/yr (Table 5.51).

Table 5.51 Frequency of Rhino Poaching

No/yr	No of HH	Percent
No response	44	61.97%
1-3	20	28.17%
3-5	7	9.86%
Total	71	100.00%

Majority of the respondents (40) said that rhinos were being killed for earning more money, 4 for livelihood and 1 respondent said the cause to be lack of awareness. Some 23 respondents did not respond (Table 5.52).

Table 5.52 Why Rhinos were being killed?

Causes	Frequency	Percent
No response	23	32.39%
For earning more money	40	56.34%
For livelihood	4	5.63%
For both the money and livelihood	3	4.23%
Lack of awareness	1	1.41%
Total	71	100.00%

On the question, what kind of activities and opportunities would stop rhino poaching, 12 respondents said that no opportunities would stop the poachers so strong punishment should be given to those who were involved in poaching. Ten respondents said provision of employment and 7 said awareness (Table 5.53).

Table 5.53 Activities and opportunities to stop rhino poaching

Opportunities	Frequency	Percent
No response	29	40.85%
Management for livelihood	4	5.63%
Provision of employment	10	14.08%
No opportunities but strong punishment should be given	12	16.90%
Alleviation of poverty	3	4.23%
Awareness	7	9.86%
People participation	1	1.41%
Awareness and vocational training	2	2.82%
Awareness and alleviation of poverty	2	2.82%
Awareness and provision of employment	1	1.41%
Total	71	100.00%

About 18 respondents said that none of the activities had been done to stop rhino poaching and 28 respondents said various awareness related activities that were done for BZCF protection and rhino conservation. 17 respondents were unknown about those activities (Table 5.54).

Table 5.54 Activities done to stop Rhino Poaching

Activities	Frequency	Percent
Non	18	25.35%
Don't know	17	23.94%
Awareness about the Rhino conservation by drama, postures and pamphlets and youth campaign	25	35.21%
Awareness about the utilization of BZCF resources and do not go to the CNP	1	1.41%
Awareness to villagers about monitoring the strange peoples if entered to the forest	2	2.82%
Electric fencing is proposed and is coming on near future	1	1.41%
Establishment of Army post	1	1.41%
Hodding board and radio broadcasting	1	1.41%
Peoples are promoted to install bio gas plant so that they don't go to forest.	1	1.41%
Provision and management of ward forest so as to decrease the pressure on the CNP	1	1.41%
Arrested the involved persons if got any secret information of poaching plan.	1	1.41%
Rhino count and training to forest guards	1	1.41%
Wire fencing of the community forest	1	1.41%
Total	71	100.00%

More than 30% of the respondents could not suggest any activities that need to be done to conserve rhino. 8 respondents suggest for awareness as well as provision of employment or farmland to landless or poor living near to the park. Other 8 respondent said that the rules and regulation should be implemented strictly and punishment to poachers should be strong (Table 5.55).

Table 5.55 Activities needs to be done to conserve Rhino

Activities	Frequency	Percent
Don't know	23	32.39%
Anti poaching units are to be mobilized and the local people are to be employed as secret informant against the poachers.	4	5.63%
Awareness as well as provision of employment or farmland to landless or poor living near to the park.	8	11.27%
Every people should know the value of Rhino conservation instead of being lured on instant benefit.	2	2.82%
Effective rhino conservation programs should be launched and good water habitat should be developed for Rhinos even in the C.F.	1	1.41%
Electric fencing should be made that lowers the loss of people by the Rhino and the people will have positive attitude	1	1.41%
Government should be responsible and security and monitoring should be made strong and effective	4	5.63%

Identification of the poachers and the monitoring in the forest if strange person entered the forest	2	2.82%
Management for the animals on the CNP should be systematic so as to prevent them to enter the village	4	5.63%
Management of the grass land inside the park and strict punishment to the poachers	1	1.41%
Not only the park but also the local people should be equally responsible and help to identify and arrest the poachers	3	4.23%
Patrolling should be done on the areas of higher poaching vulnerability.	1	1.41%
Post should be increased and the insider hotels should be removed from the Park.	2	2.82%
Strict forbidden to enter the CNP	1	1.41%
Construction of tower and provision of light for night vision and patrolling.	1	1.41%
The forest should be well managed	1	1.41%
The rules and regulation should be implemented strictly and punishment to poachers should be strong	8	11.27%
The security posts should be increased and should be on village too.	4	5.63%
Total	71	100.00%

Out of the total 3 cases of injury caused by tiger, 2 were within the community forest and one was in the CNP. But none of them received compensation. (Table 5.56 & Fig. 5.11)

Table 5.56 Place and time of injury by tiger

Place	Time	Total
	>5 years ago	
CNP	1	1
Community forest	2	2
Total	3	3

Fig. 5.11 Compensation of injury by tiger

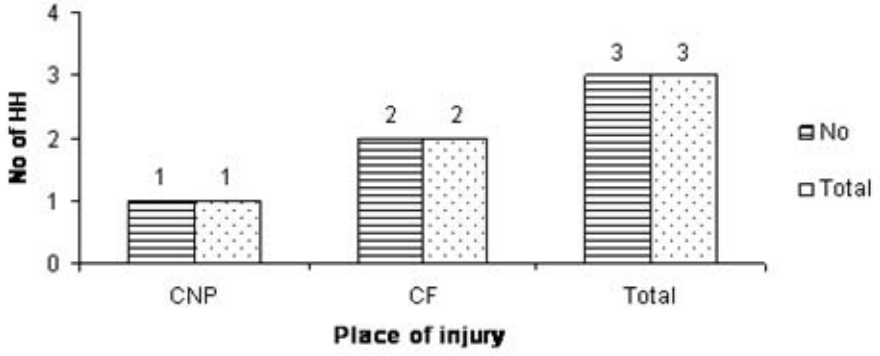
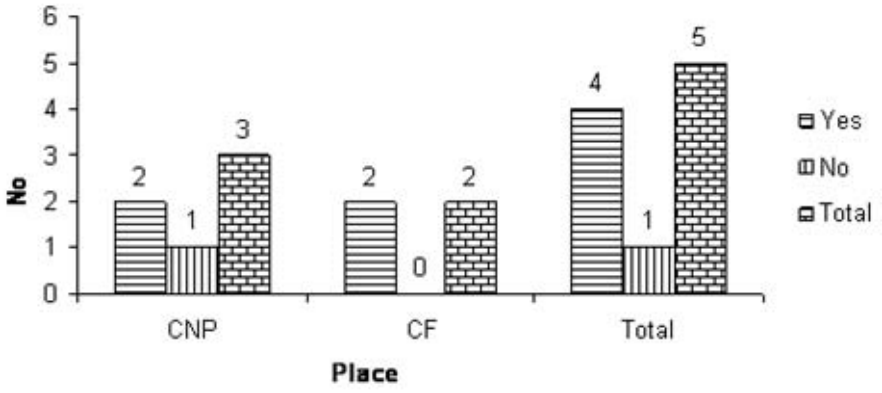


Table 5.57 Place and time of loss of life by tiger

Place	Time of killing				Total
	With in 1 year	1-2 yrs ago	2-3 yrs ago	>5 yrs ago	
CNP	1	1	0	1	3
Community forest	0	0	2	0	2
Total	1	1	2	1	5

Fig. 5.12 Compensation for loss of life by tiger



Out of the total 5 cases of human death by tiger, 3 were with in the CNP and remaining two were with in the community forest (Table 5.57). Out of those total cases, only one in CNP did not receive any compensation (Fig 5.12).

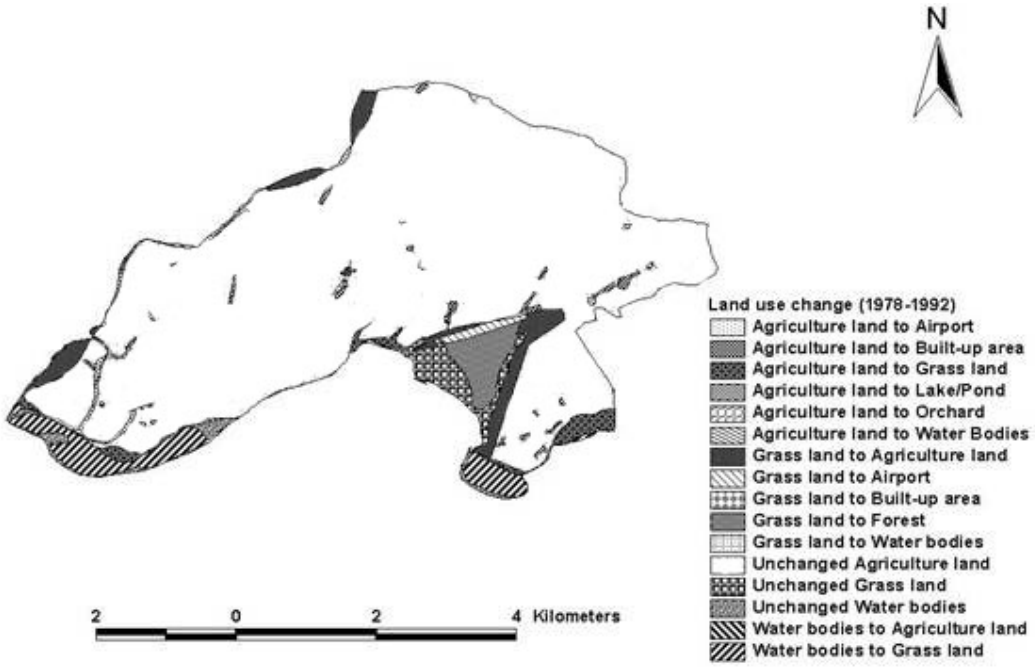
5.2 Land Use Change

A majority of land use in 1978 was agriculture land followed by grass land and water bodies only. There were not forest, orchard, built up area and lake/ponds (Annex 5.6). Airport, Built up area, Forest, Lake/Pond, and Orchard were added cover types in 1992 land use map (Annex 5.7). The 1992 map showed least decline in agricultural land and higher (45.78%) decline in water bodies from 1978-1992. Forest covered about 65 ha in 1992 from 0 ha in 1978 followed by built up area with significant coverage. Grass land was declined by more than 10%. (Table 5.58 and Fig. 5.13)

Table 5.58 Land use change in Meghauli VDC (1978-1992)

Cover type	1978		1992		Change	
	Area (ha)	% of land cover	Area (ha)	% of land cover	Area (ha)	% of change
Agriculture land	2637.78	86.54	2621.30	86.00	-16.48	0.63
Airport	0.00	0.00	14.78	0.48	14.78	-
Built-up area	0.00	0.00	29.77	0.98	29.77	-
Forest	0.00	0.00	64.99	2.13	64.99	-
Grass land	262.61	8.62	234.29	7.69	-28.32	10.78
Lake/Pond	0.00	0.00	0.25	0.01	0.25	-
Orchard	0.00	0.00	2.56	0.08	2.56	-
Water bodies	147.55	4.84	80.00	2.62	-67.55	45.78
Total	3047.94	100.00	3047.94	100.00	0	

Fig. 5.13 Land use change



5.3 Vegetation Analysis

All together 65 plant species from more than 30 families were recorded from the buffer zone community forests of Meghauli VDC (Annex 5.8).

5.3.1 Trees

i) Importance Value Index of Trees

The density, frequency, basal area and IVI value of tree species is presented in Table 5.59. A total of 5 species from three families were recorded. Total density of trees was 121.15/ha. Of which highest density was of *Dalbergia sissoo* (73.08/ha), followed by *Bombax ceiba* (30.77/ha). Total basal area was 3.60m²/ha, with *Dalbergia sissoo* having highest relative basal area. The IVI value showed that *Dalbergia sissoo* is the most dominant species in the study area.

Table 5.59 Importance value index (IVI) of tree species

Name of the Species	Density (Ind. per ha)	Relative Density (%)	Frequency (%)	Relative Frequency (%)	Basal Area (m^2/ha)	Relative Basal Area (%)	IVI (%)
Acacia catechu	12.50	10.32	50.00	20.59	0.20	5.13	36.04
Bombax ceiba	30.77	25.40	71.43	29.41	0.18	27.64	82.45
Dalbergia sissoo	73.08	60.32	92.86	38.24	0.99	61.14	159.70
Trewia nudiflora	3.85	3.17	21.43	8.82	2.20	5.51	17.51
Trichilia connaroides	0.96	0.79	7.14	2.94	0.02	0.57	4.31
Total	121.15	100.00	242.86	100.00	3.60	100.00	300.00

ii) Height Class and Stand Size Classification of Trees

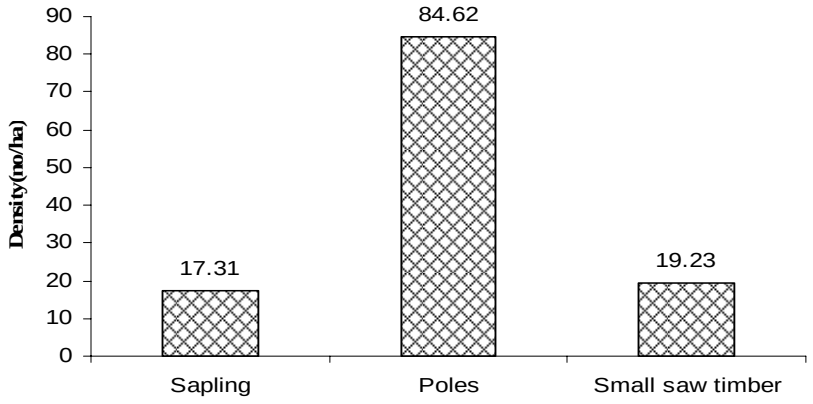
From height class classification of trees, highest density was found in 10-20 m followed by less than 10 m with least value in > 30m (Table 5.60).

Table 5.60 Height class classification of trees

Height class (m)	Number/ha	%
< 10	35.6	29.4
10-20m	69.2	57.1
20-30m	15.4	12.7
>30m	1.0	0.8
Total	121.2	100.0

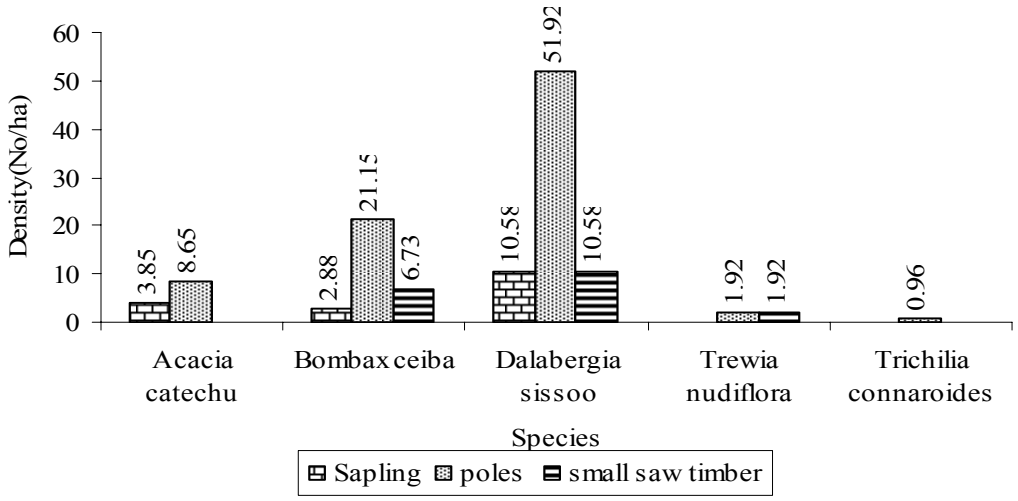
From the stand size classification of tree (Fig 5.14) highest density was found for poles (69.84%) followed by small saw timber (18.25%) and sapling (11.91%). Large saw timber was absent in the study area (Annex 5.9)

Fig. 5.14 Stand size classification of trees



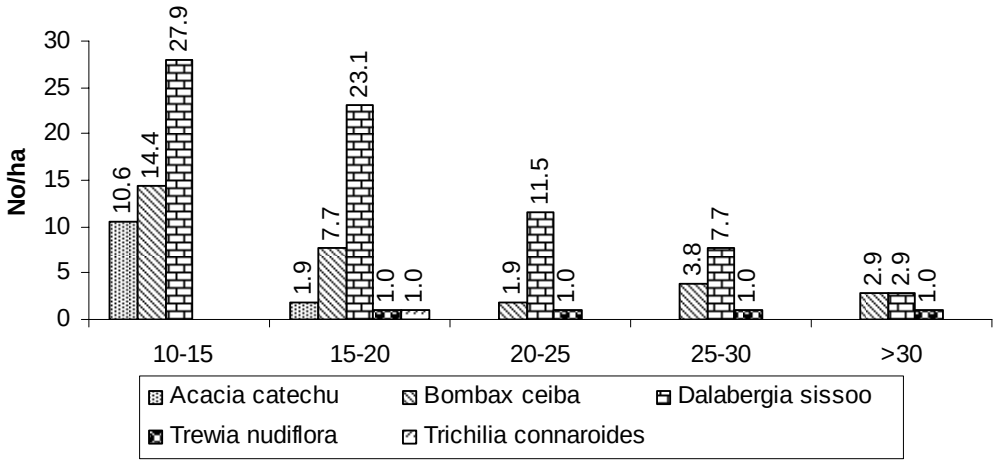
The DBH of the trees ranged from 10.2 cm (*Dalbergia sissoo)* to 35.5 cm *(Bombax ceiba). Dalbergia sissoo* dominated all species in sapling, poles and small saw timber categories followed by *Bombax ceiba* in poles and small saw timber categories and *Acacia catechu* in sapling categories (Fig 5.15 & Annex 5.10)

Fig. 5.15 Stand size classifications of trees by species



The number of trees in DBH class 10-15cm was highest followed by 15-20 cm. The least number of trees was in the class >30 cm. *Dalbergia sissoo* was dominant in all categories at 5 cm interval (Fig 5.16 & Annex 5.11)

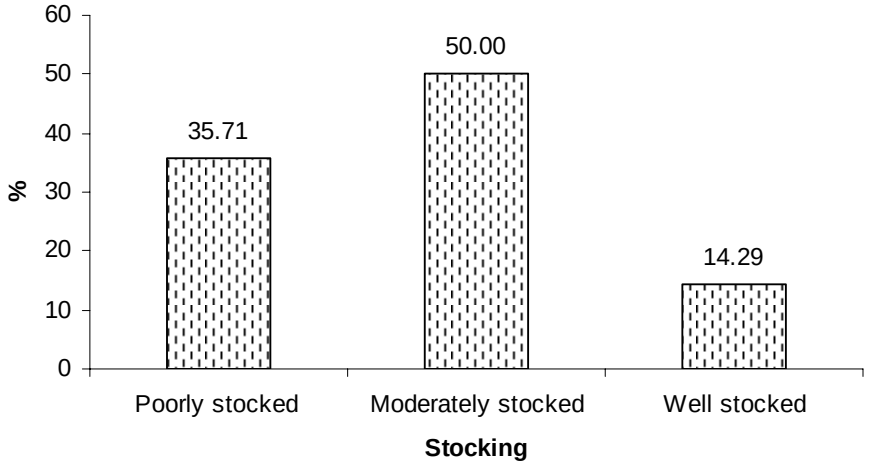
Fig 5.16 DBH category at 5 cm interval



iii) Stocking of trees

The overall forest condition was poor to moderately stocked. Only 14.29% of the sample plots were well stocked (Annex 5.12)

Fig. 5.17 Stocking of trees



iv) Volume and Biomass of tree species

The total volume and biomass of tree species is presented in Table 5.61 Total tree volume in the study area was 11.78m³/ha. Of these *Dalbergia sissoo* occupied 72.16% of the total volume. Total biomass was found to be 17.26t/ha, of which *Dalbergia sissoo* occupied 65.11% followed by *Bombax ceiba* (27.09 %).

Table 5.61 Tree Volume and biomass of tree species

Species	Volume (m³/ha)	% of volume	Steam Biomass (t/ha)	Branch Biomass (t/ha)	Leaf Biomass (t/ha)	Total Biomass (t/ha)	% Biomass
Acacia catechu	0.56	4.75	0.54	0.28	0.03	0.84	4.89
Bombax ceiba	2.27	19.27	3.03	1.48	0.16	4.68	27.09
Dalbergia sissoo	8.50	72.16	6.63	4.54	0.07	11.23	65.11
Trewia nudiflora	0.41	3.48	0.30	0.15	0.02	0.46	2.66
Trichilia connaroides	0.04	0.34	0.03	0.01	0.00	0.04	0.24
Total	11.78		10.50	6.45	0.27	17.26	

v) Annual yield and sustainable resource supply

Table 5.62 Annual Yields and Sustainable resources supply

Na me of the Species	Steam annual Yield (t/ha/yr)	Branch annual Yield (t/ha/yr)	Leaf annual Yield (t/ha/yr)	Total biomass yield (t/ha/yr)	Sustainable fuel wood yield (t/ha/yr)	% of sustainable fuel wood yield	Sustainable fodder yield (t/ha/yr)	% of Sustainable fodder yield
Acacia catechu	0.0276	0.0141	0.0016	0.0433	0.0339	4.83	0.0014	10.58
Bombax ceiba	0.1479	0.0730	0.0087	0.2296	0.1788	25.49	0.0078	58.81
Dalbergia sissoo	0.3402	0.2327	0.0036	0.5765	0.4697	66.95	0.0032	24.23
Trewia nudiflora	0.0145	0.0072	0.0008	0.0226	0.0176	2.51	0.0008	5.7
Trichilia connaroides	0.0013	0.0006	0.0001	0.0020	0.0016	0.22	0.0001	0.68
Total	0.5317	0.3276	0.0148	0.8741	0.7016	100.0(	0.0133	100.00

Annual yield from buffer zone community forest of Meghauli VDC was 0.8741t/ha, of which *Dalbergia sissoo* contributes 65.95% followed by *Bombax ceiba* (26.26%). Sustainable fuel wood supply was found to be 0.7016 t/ha/yr. Of which 66.95 % was from *Dalbergia sissoo* and 25.49% from *Bombax ceiba*. Sustainable fodder supply was highest from *Bombax ceiba* followed by *Dalbergia sissoo* (Table 5.62).

The annual demand and supply of fuel wood and green fodder from the buffer zone community forest did not match, and even the resources extractions were higher than the sustainable supply (Table 5.63)

Table 5.63 Forest resources supply and demand

Total Forest Area	2187.06 ha*
Total Estimated Fuel Wood Demand	13840.17 t/yr
Total Estimated Green Fodder Demand	106686.31 t/yr
Total Estimated Sustainable Fuel Wood Supply From BZCF	1534.44 t/yr
Total Estimated Sustainable Green Fodder Supply From BZCF	12597.12 t/yr
Total Estimated fuel wood extraction from BZCF	4580.01 t/yr
Total estimated green fodder extraction from BZCF	100760 t/yr
Over extraction of fuel wood from BZCF	3045.57 t/yr
Over extraction of green fodder from BZCF	97610.63 t/yr
Deficit fuel wood	12305.56 t/yr
Deficit green fodder	94089.19 t/yr

* Estimated area: 1700 ha, Measured area: 487.06 ha

vi) Regeneration of tree species

The regeneration in the tree species was highest in the height class of < 1m followed by 1-2 m and 2-3 m, with the least value in 3-4 m. (Fig 5.18 & Annex 5.13). *Dalbergia sissoo* had the highest regeneration on each height classes (Fig. 5.19 & Annex 5.14).

Fig. 5.18 Regeneration of tree species by height class

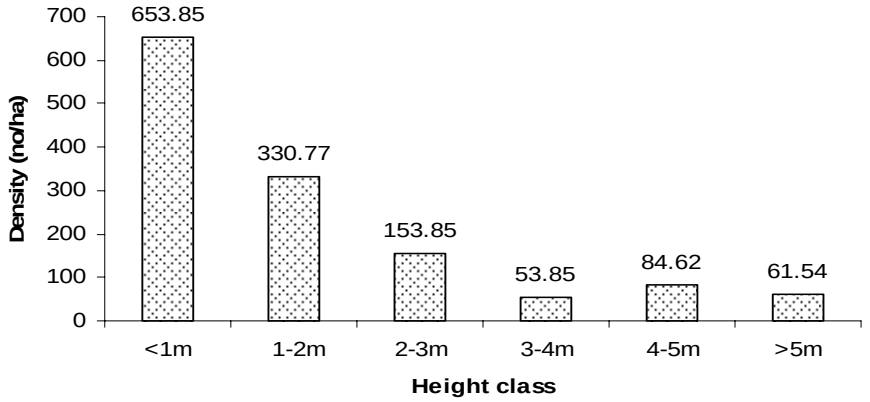
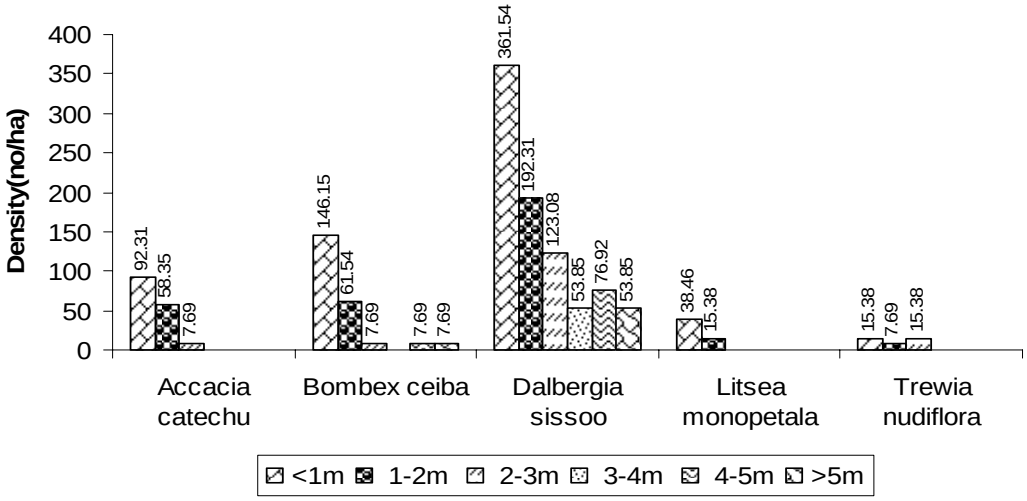


Fig. 5.19 Regeneration of tree species by height class



vii) Human Interference in the CF

a) Cut stumps and lopping intensity of tree species

Table 5.64 Cut stump density by girth class

Girth class	No of CS	CS/ha
<10 cm	4	3.85
10-15 cm	8	7.69
15-20	2	1.92
20-25	0	0.00
>25	1	0.96
Total	15	14.42

The total density of cut sump was 14.42/ha. The density/ha of the cut tree species were highest for the girth class 10-15cm (7.69/ha). Among these, *Dalbergia sissoo (*11.54/ha) had the highest cut stump density followed by *Bombax ceiba* (1.92/ha). Average girth of the cut stumps was 11.22 cm; the value was highest for Dalbergia sissoo followed by Acacia catechu. However the average height was highest for Dalbergia sissoo followed by Bombax ceiba (Table 5.64).

Table 5.65 Cut stumps density and lopping % of tree species

Name of species	Avg. no. of Branch	Avg. Lopping (%)	No of CS/ha	No of LT/ha	% of CS	Avg. girth (cm)	Avg. height(m)
Acacia catechu	4.08	4.10	0.96	12.50	7.69	11.20	0.30
Bombax ceiba	3.75	7.01	1.92	30.77	6.25	9.50	0.37
Dalbergia sissoo	3.93	8.79	11.54	73.08	15.79	12.96	0.39
Trewia nudiflora	6.00	3.57	-	3.85	-	-	-
Trichilia connaroides	4.00	0	-	0.96	-	-	-
Total	3.97	5.25	14.42	121.15	11.90	11.22	0.35

Average lopping was 5.25% for all trees in the study area, the value being highest for Dalbergia sissoo followed Bombax ceiba (Table 5.65). 31.75% of the total trees were lopped in the range of least to medium damage intensity. Dalbergia sissoo had the highest (34.21%) of lopped trees (Table 5.66)

Table 5.66 Density of lopped trees by species

Species	No of lopped trees/ha	No of Live trees/ha	% of lopped trees
Acacia catechu	2.88	12.50	23.08
Bombax ceiba	9.62	30.77	31.25
Dalbergia sissoo	25.00	73.08	34.21
Trewia nudiflora	0.96	3.85	25.00
Trichilia connaroides	0.00	0.96	0.00
Total	38.45	121.15	31.75

Table 5.67 Lopping intensity by species

Lopping damage	Scale	Species	Density (No/ha)	Total Density (No/ha)
Least	≤ 25% damage	*Acacia catechu*	2.88	26.91
		Bombax ceiba	8.65	
		Dalbergia sissoo	14.42	
Medium	26-50% damage	*Trewia nudiflora*	0.96	11.54
		Bombax ceiba	0.96	
		Dalbergia sissoo	10.58	
High	51-75% damage	-	-	-
Very High	>75% damage	-	-	-
	Total		38.45	

About 27 trees/ha were least damaged followed by followed by 11.54 trees/ha having medium damage. None of the trees had the high and very high damage. In total 38.54 trees/ha had the lopping damage. (Table 5.67)

b) Grazing and forest fires

No evidences of the cattle grazing were found in all the community forest. However evidences of goat and sheep grazing were found in two plots laid on community forest of ward no. 2. The evidences of controlled burning of ground vegetation were found in 7 plots.

5.3.2 Shrub Strata

There were altogether 58 plant species in the shrub strata of study area. The total density of plant species in shrub plot was found to be 12669.18/ha. The highest density was of *Commelina spp.* (1346.15/ha) followed by *Pogostemon bengalensis* (953.85/ha). Similarly the species like *Desmodium spp*, Pater, *Dalbergia sissoo*, *Eupatorium adenophorum, Ageratum houstonianum* etc had the higher density in compare to other species. *Arbus precatorius Mallotus phillipinses, Solanum xanthocarpum* etc had the least density. *Dalbergia sissoo* had the highest frequency (65.38%), followed by *Eupatorium adenophorum* (40.38%) and *Bombax ceiba* (34.62 %). The least frequency was 1.92 % (Table 5.68).

Table 5.68 Density and frequency of species in shrub strata

Species	Density (ind/ha)	Relative Density	Frequency	Relative frequency
Acacia catechu	138.46	1.09	15.38	2.85
Ageratum conyzoides	384.62	3.04	23.08	4.27
Ageratum houstonianum	661.54	5.22	11.54	2.14
Arbus precatorius	7.69	0.06	1.92	0.36
Arisyma spp.	7.69	0.06	1.92	0.36
Artemisea spp.	200.00	1.58	7.69	1.42
Bidens spp.	46.15	0.36	5.77	1.07
Boehmeria rofundifolia	446.15	3.52	9.62	1.78
Bombex ceiba	207.69	1.64	34.62	6.41
Callicarpa macrophyla	138.46	1.09	11.54	2.14
Calotropis gigantiea	15.38	0.12	1.92	0.36
Chrysopogan aciculatus	161.54	1.28	15.38	2.85
Clerodendron viscosum	546.15	4.31	5.77	1.07
Codariocalyx motoriur	23.08	0.18	1.92	0.36
Colebrookea oppositifolia	438.46	3.46	21.15	3.91
Commelina spp.	1346.15	10.63	5.77	1.07
Cynodon dactylon	92.31	0.73	1.92	0.36
Dalbergia sissoo	846.15	6.68	65.38	12.10
Desmodium spp	946.15	7.47	21.15	3.91
Diplazium sp.	7.69	0.06	1.92	0.36
Ehretia laevis	15.38	0.12	1.92	0.36
Eichornia spp.	100.00	0.79	1.92	0.36
Eupatorium adenophorum	707.69	5.59	40.38	7.47
Eupatorium odoratum	15.38	0.12	1.92	0.36
Ficus spp	38.46	0.30	1.92	0.36
Flumingia microphylla	15.38	0.12	5.77	1.07
Gonostegia hirta	446.15	3.52	1.92	0.36
Grewia tiliaefolia	7.69	0.06	1.92	0.36
Ipomea fistula	61.54	0.49	7.69	1.42
Justicia spp.	76.92	0.61	7.69	1.42
Lantana camara	15.38	0.12	3.85	0.71
Latre jhar*	176.92	1.40	15.38	2.85

Leea aspera	53.85	0.43	5.77	1.07
Litsea monopetala	53.85	0.43	7.69	1.42
Mallotus phillipinses	7.69	0.06	1.92	0.36
Marsdenia royeli	30.77	0.24	1.92	0.36
Micania micarantha	492.31	3.89	15.38	2.85
Mimosa pudica	46.15	0.36	5.77	1.07
Morus macroura	23.08	0.18	5.77	1.07
Muraya koenigii	38.46	0.30	5.77	1.07
Oplismenus burmanii	230.77	1.82	3.85	0.71
Paduwa jhar*	153.85	1.21	9.62	1.78
Pater*	861.54	6.80	7.69	1.42
Phyllanthus glaucus	7.69	0.06	1.92	0.36
Pogostemon bengalensis	953.85	7.53	28.85	5.34
Polygonum sps.	92.31	0.73	3.85	0.71
Premna integrifolia	15.38	0.12	3.85	0.71
Pteris spp	515.38	4.07	13.46	2.49
Sida cordifolia	261.54	2.06	3.85	0.71
Solanum aerianthum	76.92	0.61	11.54	2.14
Solanum xanthocarpum	7.69	0.06	1.92	0.36
Stephania elegans	69.23	0.55	5.77	1.07
Sterculia vilosa	23.08	0.18	1.92	0.36
Trewia nudiflora	38.46	0.30	7.69	1.42
Un id. 1	23.08	0.18	1.92	0.36
Urena spp	53.85	0.43	3.85	0.71
Woodifordia fruticosa	15.38	0.12	1.92	0.36
Zizyphus mauritiana	184.62	1.46	19.23	3.56
Total	12669.18	100.00	540.33	100.00

* Local name

5.3.3 Herb Strata

Table 5.69 Density and frequency of species in herb strata

Plant species	Density(no/ha)	Relative density	Frequency	Relative frequency
Acacia catechu	384.62	0.25	3.85	2.90
Ageratum sp.	13269.23	8.65	13.46	10.15
Bidens spp.	2884.62	1.88	3.85	2.90
Bombax ceiba	576.92	0.38	5.77	4.35
Cissus repens	769.23	0.50	1.92	1.45
Cynodon dactylon	8269.23	5.39	7.69	5.80
Dalbergia sissoo	384.62	0.25	3.85	2.90
Desmodium sp.	27692.31	18.05	9.62	7.25
Eupatorium adenophorum	2884.62	1.88	5.77	4.35
Ganostegia hirta	2884.62	1.88	1.92	1.45
Gramineae	9615.38	6.27	1.92	1.45
Imperata cylindrica	52115.38	33.96	25.00	18.84
Justicia spp.	384.62	0.25	1.92	1.45
Kodo ghans *	769.23	0.50	1.92	1.45
Micania micarantha	384.62	0.25	1.92	1.45
Mimosa pudica	2500.00	1.63	9.62	7.25

Oplismenus burmanii	1923.08	1.25	1.92	1.45
Saccharum spontaneum	16730.77	10.90	11.54	8.70
Scroplulariaceae family	769.23	0.50	1.92	1.45
Trifolium spp.	6153.85	4.01	9.62	7.25
Un id. 1	576.92	0.38	1.92	1.45
Urena sp.	1346.15	0.88	3.85	2.90
Zizyphus mauritiana	192.31	0.13	1.92	1.45
Total	153461.54	100.00	132.69	100.00

*Local name

Total 23 plants species were recorded in the Herb plots. The total density of plants in herb strata was 153461.54/ha of which *Imperata cylindrica* (52115.38/ha) had highest density followed by *Desmodium sp*. (27692.31/ha). The species like *Saccharum spontaneum* (16730.77/ha) and *Ageratum spp.* (13269.23/ha) had also more density relative to other species. *Zizyphus mauritiana and Urena sp. had the least density. Imperata cylindrical* (25 %) had highest frequency followed by *Ageratum sp*.(13.46 %) and Saccharum spontaneum (11.54 %). The density and frequency of other species in herb strata are presented in Table 5.69

5.3.4 Diversity Index

Table 5.70 Shannon Diversity Index of plants strata

Strata	Shannon Diversity Index
Tree	0.45
Shrub	1.44
Herb	0.94

Shannon Diversity index was found highest for the shrub strata (1.44) followed by herb strata (0.94).

Chapter 6

DISCUSSION

6.1 Households' socioeconomic status

6.1.1 Demographic Characteristics

With growing population pressure, relations between people and the protected areas will only improve when people see direct benefit from these areas. When local people do not benefit from conservation, they lack commitment to conservation objectives and conflict often ensues (Mwamfupe, 1998). Local people can perform many kinds of park management roles depending upon their attitude, interests, as well as formal education and training offered and received (Nepal & Weber 1995[1]).

Contrary to the assumptions of many conservationists and development agencies that Third World rural populations are almost entirely antagonistic to conservation and ignorant to conservation issues (Infield, 1988 as cited in Badola, 1998) in the area of this study the people have positive attitude towards the conservation and management of their adjacent protected area, the Chitwan National park. But some negative attitude could be due to some recent loss incurred, e.g. crop damaged and loss of livestock or human life due to wild animals.

The various resources extraction activities from the BZCF as well as the CNP and their conservations are directly concerned with the socioeconomic condition of the households residing in the buffer zone areas. Whole of the Meghauli VDC was already demarcated as the buffer zone areas which comprises populations from various ethnic groups and social status having differing well being in the community. Brahmin/Chhetri/Thakuri were dominant followed by Tharu. There was significant increase in the families of the Brahmin/Chhetri/Thakuri compared to previous study (PPP, 2000). More than 45% of the households were residing in the study area from their generations. More than 60% of the households had joint family. The average family size was lowered as compared to DNPWC/PPP, 2000 (7.51) and was higher than (BZCFUG official record-2004 (6.0)). The value was highest for Darai/Kumal/Praja and Big farm holders. The reason may be due to the majority of the joint family in these categories. There was significant increase in the literacy rate compared to previous study (57% in PPP, 2000). The percentage of

above SLC education has increased from 4.2% (PPP, 2000) to 12.85%. The population under 15 years age group (26.28%) in the sampled households was very low compared to DNPWC/PPP, 2000 (44.8%) at Meghauli VDC as well as whole buffer zone area of CNP (41.5%) given by DNPWC/PCP/UNDP, 2001.

The governments has made legal provision of running hotels and lodges in and around protected areas to improve the socio economic conditions of local peoples (DNPWC 2006) but only 0.79% of the sampled population were employed in the hotels inside the park.

The majority of the women in the study area assist the males on the farming even covering their house works. Nearly 56% of the individuals have received remittance as the occupation. PPP, (2000) did not recorded any households to have remittance as the alternative source of income. Remittance has been considered as the important option by the people having less land for production. People are increasingly going to the foreign country to earn money mostly because of the lack of job in Nepal due to the political instability and decreased farm land production. Only about 60% of the populations are economically active because more than 40% are dependent population (student and non occupation)

6.1.2 Crop Production and Agricultural Income

The average farm size of the sampled households (0.73 ha) was smaller compared to whole VDC (1.19 ha/hh) DNPWC/PPP (2000). This may be due to the increase in population that led land fragmentation with family separation. The households in the VDC were 2331 in 2000 (DNPWC/PPP, 2000) and in 2004 it reached to 2756 (BZCFUG official record, 2007).

Only paddy and maize are the major crops that the majority of the households produce. Though the existing land gives a very good production of wheat, very few households produce it. Only the households having no rhino depredations can grow wheat because it is the most rhino preferred crop (Janawali, 1989) and villagers said in some cases rhino caused loss of more than 50% of the wheat production. Almost all the buck wheat producing households produced it for the income generation, instead of daily consumption.

More than 90% of the households are involved in the farming, and the economic status and social well being of the people of the study area has been significantly determined by the land holding size. The minimum land of requirement for the balance of the

agricultural production was 0.48 ha per household. More than 10% of the households had the deficit for almost all round the year who had the highest compulsion to collect fuel wood from the CNP as they have to expense more of their income to buy crops. They were almost unable to use the fuel wood from the CF as most of the CFs did not distribute the resources on free of cost, so such households were tending to almost free access.

If poorer households are not well compensated by increasing their access to forest resources, social conflicts may emerge and threaten sustainability of management institutions (Adhikari & Lovett, 2005).

Majority of the Tharus households had the wall of Khadai even those having big farm and better income generating sources. The Tharus need more khadai in compare to other caste/ethnic group. Out of the 55 khar demanding households 45 access to CF. But all the 24 khadai demanding households access to park for khadai due to lacking of it in the CF.

6.1.3 Buffer zone resources demands

Due to less involvement of the poorer households in the forest management activities, they are currently facing more restricted access to community forests than less poor or relatively better off households due to restrictions posed on collecting various forest products (Adhikari et. al. 2004). Therefore landless or small farm households are relatively less able to rear livestock and hence their fodder demand is relatively less in comparison to medium farm or big farm households. The fodder demand per households was high for big farm. But by the caste ethnic group lower caste households had the higher fodder and fuel wood demand. Either big farm holder or landless demanded more fuel wood.

6.1.4 Alternative Energy Consumption

Both the two bio gas using households fall under the Brahmin/Chhetri/Thakuri by caste/ethnic group and big farm by land holding size. Sharma 1991 also reported that upper Hindus caste families only had the access to bio gas plants. Some of the electricity using households steals the current by using hooks. By land holding size, 80% of the landless and by caste/ethnic group 80% of Darai/Kumal/Praja use the hooks for using electricity. Due to the lack of monitoring by electricity corporation and people's low income level the trend of stealing the electricity was significant in the VDC.

At least 18 households had the sufficiency of livestock units for the installation of bio gas plant. The total livestock unit of the sampled households was sufficient for installing 50 bio gas plants in all over the sampling households. The households residing near by to the confluence of the two Rivers Narayani and Rapti especially ward no 1 and 2 had the problem of land flooding and diminish of the tank during the monsoon. So they were not installing the bio gas plant in spite of their interest, economic condition as well as ability of rearing livestock.

6.1.5 Buffer Zone CF Management and Resources Supply

The community forests of Meghauli VDC cover about 2187 ha of land. However this area includes all the forest covers, grass land and shrub lands. The major problems in the forest are flooding by the monsoon Rivers and coverage of most of the forest areas by alien species like *Miccania micrantha*, *Eupatorium spp.*, *Justicia spp. etc*. Besides that many of the sissoo were infected with disease and some were dead. Most community forests in the lowland are plantations based on *Dalbergia sissoo*, which is susceptible to diseases when planted in monoculture on waterlogged sites (Jackson 1994 as cited in Straede et. al. 2002).

The per- household forest area of Meghauli VDC is 0.79 ha, which is about 15 times more compared to (DNPWC/PCP/UNDP, 2001) The forest areas are extended also out side the boundary of the VDC. Out of the eight community forest of nine wards, Radhakrishna, Hariyali Rapti Tatha Batari, Sadabhar and Bardaha (combined of ward no 3 and ward nos 4, 6 and 7) are registered. Before registration, the CF for ward nos 3, 4, 6 and 7 was combined. But now ward no 3 had separated its forest of 250 ha but still had the same name to that of existing combined CF of ward nos 4, 6 and 7. Besides having the single CF of each remaining wards, ward nos 5 and 9 have also a combined forest called as Sadabhar. There were 58 user groups; out of that 36 were male groups, 14 female groups and 8 were mixed. More than 95% of the households had general membership of CF user groups and any members of more than 15% of households were involved in the BZ management. The involvement in the BZ management was dominated by Medium farm but with in the land holding group, % involvement in the BZ management was highest in big farm. Similarly Brahmin/Chhetri/Thakuri were dominant in the BZ management activities. There exist a low levels of influence of lower caste households in decision making processes as well as lack of productive assets e.g. land, livestock etc. that drive the demand of biomass resources (Adhikari et. al. 2004).

In spite of the good and improved condition, the CFs are not fulfilling the demand of more than 80% of households. The per capita fuel wood deficit was higher than the per capita fodder deficit. Similarly the per capita khadai deficit was higher than the per capita khar deficit. This was due to the unavailability of sufficient khadai in the CF. The average deficit months of fodder was highest for large farm followed by landless where as average deficit of fodder was highest for big farm followed by medium farm. There are more than 80% of households having fuel wood deficit and 15% of households having fodder deficit. Average fuel wood deficit of the study area was more than 6 months where as that of fodder was negligible.

More than 75% of households go to CNP as an alternative for the deficit management. Generally CNP gives permission of 3- 5 days per year to collect the resources basically khar, Khadai and fell and dead trees parts mostly in the winter season under the effective monitoring and supervision. As most of the CFs do not provide free access to the fuel wood, many households, during this time, try to collect sufficient amount of fuel wood for the whole year. However during this limited period of time more benefits are achieved by: i. households near the park, ii. households of large family size, and iii. households having higher adult ratio. Besides depending to CNP some households buy the deficit resources and some fulfill their deficiency of fuel wood by capturing the drift wood in the Rapti and Narayani River during the monsoon.

Different CF had different practice of resources distribution. For example in Radha Krishna CF all the extractable wood resources are collected by using wage labor and taken out to village and are sold with in the member of user groups by calling the tender once a year. The average tender rate is Rs 600-800/gada. For grass the forest entrance is allowed by selling tickets 2 times a year, with each time of three months. In average each ticket costs Rs 25-50 for the period of three months. In the case of other CF, larger saw woods are taken out by the forest user committee and sold by calling the tender and remaining are allowed to collect by local people themselves under the effective monitoring and supervision. Bardaha CF had good source of income by selling sand and gravel. The total income of all the CF of Meghauli VDC is about 10 lakh per year.

The peoples involved in the buffer zone management said that the budget allocated by CNP and the incomes of the CFs are used for the better management of the forests, and local development activities such as construction of roads, culverts and bridges, education, health and sanitation, fencing of forests, support for bio gas installation etc. But those out side the buffer zone management complained that budget utilization was

not fair. Meghauli was among those VDCs which receive higher proportion of budget allocation from CNP. However, more than 50% of respondents had no knowledge about the budget allocation.

6.1.6 Human-wildlife conflicts

The crop depredation in the adjacent region of the park was highest by Rhinoceros followed by wild pig and chital Wheat was not cultivated widely in the study area mainly due to rhino preference for damage. Households near to CF and CNP loss more of their crops in compare to households of far distances. None of the households had got the compensation of their crop damage and many of them even did not complained about this because of the more tedious and time consuming process of the compensation. More of the suffered argued that they did not get the compensation of actual loss of crop but got only the amount of the initial input e. g. cost of seed and in some cases money of very low estimation than the actual present value of loss. However some studies showed that local people say more amount of crop depredation than the actual loss (Upreti, 1995). During the cropping seasons the farmers built machan at which they sat out at night to guard their crops. They chased the animals by shouting, showing fire and making noise by hitting tins etc. Whenever they failed to guard, they suffer from crop damage (Nepal & Weber 1993). Households near to BZCF are also suffered from the livestock loss and many of them did not get compensation or got very low amount after the completion of a long process of verification.

Majority of the human injury and loss of life by rhinos were with in the CF and with in the last 5 years period. Only 50% of rhino injury in CF got the compensation, however all the human loss event in the CF got the compensation of about Rs 25000 each. But human loss in the CNP did not get the compensation which appears to be valid. The loss of human life, livestock and crop to animals from the parks and the restrictions arising from the park regulations were the basic cause of conflicts in the vicinity of CNP (Nepal & Weber, 1993)

Though, the newly released census (Rhino count 2005) figures revealed that the population of rhinos in CNP had dropped from 544 in 2000 to 372 in 2005- a 31% decline in 5 years period, the rhinos movement in the vicinity of human are increasing. This may be due to the presence of more grass land and water bodies in the flood plain out side the CNP and presence of dense CFs near to flood plains and the adjacent luring agricultural

lands of seasonal crops. Due to the fencing of Meghauli air port, present in between settlements and Radha Krishna CF, the rhino movement in ward no five had decreased.

6.1.7 Rhino Poaching

Every settlement near to Chitwan National Park is a potential shelters for rhino poachers and all rhino habitats lie adjacent to settlements (Adhikari, 2002). Majority of the respondents did not respond to the poaching related questions. More than 50% of respondents argued that Rhinos are being killed only for earning money and very few for livelihood, as an ultimate option for gaining the basic needs of life. Despite the provision of a stiff penalty of up to NRs 1,00,000 or an imprisonment of up to 15 years in jail or both, for the poaching of tigers, rhinos and other protected species or illegal trade in their body parts, wildlife crimes do occur in the country (DNPWC, 2005). Poaching of rhinos and penalty for poaching are not new in Nepal and both the punishment and basic opportunities would be unable to stop the rhino poaching because illicit money was much more attractive than the odds of being caught (Adhikari, 2002). For the successful conservation of the rhino to continue in Nepal, more financial resources need to be allocated in keeping with the large sums of money raised from tourists who come to see the rhinos (Martin, 2001)

Poachers from study area

62 years old, Moti Lal Damai resident of Meghauli-8 has been killed in an encounter on 22nd December 2005 and Lal Bahadur alias Dasharath Mahato, 65 years old resident of Meghauli- 8 was arrested in the same incident.

Bir Bahadur Kumal (36 years, ward no 2) and Lalu Kumal (51 years, ward no 1) were arrested by the APU of CNP and Shri Purano Gorakh Gana of Nepalese Army in charge of poaching rhinos and involvement in horn trade on 26th March, 2006.

Suk Ram Kumal, (37 years, ward no 1) was arrested in charge of rhino poaching and involvement in rhino horn trade in 10 June 2006.

Source: DNPWC, 2006

However respondents argued that management of livelihood, provision of employment or farm land to landless or poor, alleviation of poverty, awareness etc and, as well as strict implementation of rules and regulations and strong punishment to poachers will help to control the rhino poaching. The involvement in the poaching activities was seen higher from the Kumal caste/ethnic group and those who are the resident close to the park. As the leader and coordinators of the poachers group are not exposed even to the local poachers, only poor and those who have low political powers are being arrested. In the neighboring VDC of the study area, even the board member of the CFUG were accused to

be involved in the poaching activities however no such case was found in the Meghauli VDC.

6.2 Land use Change

DNPWC/PCP/UNDP, (2001) had reported the decrease in trend of forest and grass land while increase in shrub land and water bodies and increase in agriculture land by 1.06% in whole buffer zone. However opposite results were found in the case of Meghauli VDC. There is decrease in agriculture land, shrub land and water bodies and add up and significant increase in the forests area followed by built up area Air port and orchard which were absent in 1978. This may be due to the increase in settlements with increasing population and increase in awareness among the local peoples for the plantation and conservation of forest resource for its sustainable utilization.

6.3 Vegetation

Only five tree species were reported with in the sampling plots of the study area. However Rijal (1994) had reported 16 tree species in the riverine forest of the CNP. D. sissoo had the highest density, frequency and basal area and hence the highest IVI representing the major characteristics of the riverine forest. Density of Dalbergia was many times higher than the value reported by Rijal (1994).

Growing stock of tree in the study area was very low compared to estimation by GN (1988a). It has estimated that growing stock 76.69m3/ha for Khair-Sisso forest and 107.74m3/ha for Terai mixed hardwood forest of the Central Development Region. The growing stock of *D. sissoo* and *Acacia catechu* was only 11.81% and of mixed hard hood forest only 2.52%.The growing stock of the present study are lowered compared to estimation of GN (1988a) mainly due to the fact that majority of the portion of BZCF was plantation and regenerated forest. GN (1988a) had estimated for whole CDR including protected area. FRSC (1995) had reported the growing stock of *D. sissoo* (1.4 m^3/ha), *B .ceiba* (5.4m^3/ha) and *T. nudiflora* (1.3m^3/ha). *B. ceiba* and *Trewia nudiflora* have lower growing stock while *D. sissoo* has the higher compared to FRSC (1995).

The average biomass for Khiar-sissoo and mixed hardwood forest of terai of CDR are 132.13 ton/ha and 148.87 ton/ha respectively (GN, 1988a) which are higher compared to present study. Average biomass per ha of *D. sissoo-Acacia catechu* and Mixed hardwood

forest are only 9.13% and 3.49% respectively compared to GN, (1988a). Estimated biomass by GN (1988a) was higher due to inclusion of protected area and other government forest and the majority of the portion of BZCF of the study area is plantation and regeneration.

The annual demand and supply of fuel wood and green fodder from the buffer zone community forest did not match, and even the resources extractions were higher than the sustainable supply. The buffer zone community forest would fulfils only 11 % of each fodder and fuel wood demand if extraction was sustainable but in the present level of extraction, it fulfills about 94% of annual fodder demand and 33 % of fuel wood demand. The deficits were met mainly through national parks.

Five regenerating tree species were recorded in the study area with the density about 10 times more than that of trees. The chance of regenerating species to develop into mature tree was very low, due to the fact that most of the CFs are in the flood plains of Narayani and Rapti river which are flooded in each year and most the seedling and sapling are washed out during the Monsoon. Instead, the fast growing alien species cover the under story during the winter season and check the growth of tree seedlings or saplings.

The condition of the forest was poor to medium stocked, lopping intensity was least and majority of the cut stumps were <15 cm in girth. Similarly the numbers of broken and sliding trees were recorded in the significant in number during the study. This overall condition indicates that many of the small trees are broken and slide down by the flood during the monsoon and easy extraction of the fuel wood had been made by cutting such trees.

Rijal, 1994 reported that *Coffea bengalensis* followed by *Chlorodendron viscosum* were among the most distributed shrub species in the riverine forests. But the present study showed that *Commelina spp* and *Pogostemon bengalensis* had the higher density. Some of the alien species like *Eupatorium adenophorum, Miccania micarantha* etc had the higher density and frequency in this study. Decrease in diversity and increase in such invasive species is the sign of degradation of the forest (Dhakal, 2007). Human induced activities are the major reasons for the degradation of Tropical forests which causes decline in the primary forest regenerative species and increase in exotic shrub, grass and vines for example L. camera, Imperata cylindraca, E. odonatum, M micranthaetc (Islam et. al. 2001 as cited in Dhakal, 2007)

Chapter 7

CONCLUSION

In the Meghauli VDC, farm size was the determining factor for household well being and resources utilization. Forest yield and demand for forest products do not match and deficits are met mainly through park resources. Though the CF forests area was high, demand of resources were not being fulfilled as large areas were grass lands and were available for resources extraction during the dry seasons only because Monsoon Rivers completely cover these areas. The spread of alien species like *Mikania micarantha were* causing serious biological threat to forest integrity and wildlife habitat.

Bio gas utilization was negligible and households living adjacent to confluence of the two Rivers were not installing the bio gas due to land flooding problem in spite of good economic condition, willingness as well as livestock rearing ability. Human wildlife conflicts were serious, but people showed positive attitudes towards the wild animals and park conservation may be due to the good level of literacy and awareness. However they were demanding for either good level of compensation measures or checking of wild animals to enter their farm lands. The Meghauli VDC is among those, which receive higher proportion of the budget allocation by CNP. However many of the local people have no knowledge about this.

Chapter 8

RECOMMENDATIONS

Based on the above mentioned conclusion (Chapter 7) following recommendations are made

1. Participation of poor and lower caste/ethnic groups in the buffer zone management.
2. Effective and accessible subsidies for the energy alternatives such as bio gas plant installation.
3. Poverty alleviation related opportunities and capacity enhancement of people living close to park.
4. Pro poor community forestry and development of leasehold forestry for the promotion of income generating activities.
5. Electric fencing of the community forests so as to control the wild animal's depredation.
6. Plantation and agro-forestry in the CF.
7. Promotion of improved fire wood stove.

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Annexes

Annex 4.1 Land holding categorization

Symbol	Land holding size	Land holding in ha
Landless	Landless	0
Small farm	0-10 Kattha	0-0.34
Medium farm	10-20 Kattha	0.34-0.68
Big farm	1-4 Bigha	0.68-2.72
Large farm	>4 Bigha	>2.72

Annex 4.2 Sample size distribution on settlements

Ward no	Ranking of settlement based on population size (Decreasing order)	Sample size
1	Andhrauli	2
	Laukhuri	2
	Bharatpur	1
	Swargadwari	1
		6
2	Laukhuri	2
	Parsabazar	2
	Jogitol	1
	Sisabas	1
	Majuwatar	1
		7
3	Jitpur Bazar	2
	Panjana	2
	Salbas	1
	Pahadi Jitpur	1
		6
4	Sajhapur	1
	Bhangaha	1
	Seruwa	1
	Jitpur	1
		4
5	Telauli	6
	Meghauli	4
	Patihani	3
	Gauutamnagar	1
		14
6	Pipara	1
	Baluwa	1
	Dadreni	1
		3
7	Magani	2
	Bankatta	2
	Jhauretadi	1
	Gautamnagar	1
		6

8	Parsadhap Dhebauli Janakpur	5 3 2 **10**
9	Dharampur Buddhanagar	4 3 **7**

Annex 4.3 Household questionnaire surveys

RESPONDENT INFORMATION

Respondent Name: Date:
Caste/Ethnic Group: Lat:
Sex: Long
Age (yrs):
Education:
Occupation:
Current Address (VDC/Ward):
Residence Period (Year):
Family Structure: a) Nuclear b) Joint
Name of the data Collector:

Please provide some information of individuals who belong to this household (Begin with the oldest person)

Individual ID (Full Name)	Relation to Respondent	Sex	Age (Yrs)	Marital Status (M/U)	Occupation			Education
					I	II	III	

FARM SIZE AND PRODUCTION

Land Type	Area			Land Type
	Bigha	Kattha	Dhur	
Land owned				Parti/Ailani
Shared Tenant				Parti/Ailani

1. What type of crop do you grow?

Crop Type		Area			Production		Consu-mption (Kg)	Surplus (Kg)	Deficit (Kg)	Deficit Period (Month)
		Bigha	Kattha	Dhur	Mann	Kg				
Food Crop	Wheat									
	Paddy									
	Maize									
Pulses										
Cash crop	**Vegetables**									
	Oil seeds									
	Others									

2. How will you manage for the deficit months?
   Buy/Borrow/Barter/Wage lobor /others.....

3. If surplus what do you do with the surplus crops?
   Store /Sale/ others.....

LIVESTOCK'S TYPE AND HOLDINGS

Types of Animals	Numbers	Stall Feeding	Grazing	Both

FOODER/FUELWOOD/TIMBER

Season/ Month	**Fodder**		
	Species	Quantity	Access

Fuel Wood		
Species	Quantity	Access

Timber		
Species	Quantity	Access

ALTERNATIVE ENERGY

Fill in the information energy consumption (Record use for the each month, Liter for Kerosene, No. of Cylinder for Gas, Number of Batteries)

Source	Amount	Expenditure	Season	Remark
Kerosene				
Electricity				
Solar				
LP Gas				
Battery				
Other				

1. Do you have biogas plant in your house? Yes/No
2. If Yes,

Installed Date	**Biogas**	
	Capacity (cb.m)	Expenditure

3. Did you receive any support from others while installing Biogas? Yes/No
   .....
4. How much Livestock's are needed to operate your biogas plant?

Livestock	Numbers	Fodder requirement

5. If No, why are you not having Biogas plant. Are there any constraints?
   .....
6. Do you have any plans to install biogas plant? Yes/No
   .....

BUFFERZONE COMMUNITY FOREST. HOUSEHOLD PARTICIPATION AND ISSUES

1. Have you been involved in Buffer zone management? Yes/No
2. Are you member of User group? Yes/No
3. What is your User Group name?
   .....
4. What is your position in User group: General Member or if any other specify……
5. Any other household member involved in Buffer zone management council, UC, UG?

Date	Buffer zone Management UC/UG	Status	Relation with respondent

6. What type of resources do you bring from your BZCF?
   …….
7. What do you say about your BZ community forest status?
   Very Good/ Good/Satisfactory/ Bad/Very Bad
8. What was the condition of your Buffer zone CF in Past/ Present?

.....

9. Are available resources from your community forest fulfilling your demand? Yes/No
   If No and if you buy from your CF/ Others CF/Go to RCNP/ how much you need?

Resources	Time	Demand	Amount Paid (Rs)	Access
Fodder (Bhari/Kg)	Daily/Monthly/Weekly/Yearly			
Fuelwood (Bhari/Kg)	Daily/Monthly/Weekly/Yearly			

10. Do you have any idea of resources allocation system in your BZCF? Yes/No
    If yes, on what basis
    Well being/Population/ No. of livestock/Profession/Others.....
    .....
11. Is there any land categorization for different purposes in your BZCF? Yes/No.....
    If yes, are there following zone
    Pasture land/Recreation zone/Habitat management zone/Fodder zone/Fuel wood zone/ Soil mining zone/others.....

12. What sort of problem do you find in your CF?
    .....
    …….
13. Do you have any suggestions/ recommendations for better management of your CF resources utilization as well as conservation?

    .....
14. What do you think about Budget allocated by CNP for Buffer zone VDC for management? Is it being spending wisely for conservation as well as development of your area? Yes/No

.....

RHINO RELATED ISSUES

1. Have you ever face the problem of Rhino? Yes/No

2. Do rhino comes every year around your area? Yes/No

Season/Month	No. of Rhino

3. What kind of problem Rhino brings to you?
   Crop Damage/Physical Damage/ Human Loss/Injury/Others……

4. Crop Damage caused by Rhino/Wildlife

Wildlife	Crop	Time of Damage				Damage amount/Year in local unit	Compensation Amount (Rs)
		Morning	Day Time	Evening	Night		

5. Livestock Loss by Wild animals

Wildlife	Livestock	Number of Loss	Time in Year and month	Compensation

6. Frequency of Human Loss by wild animals

Wild animal	Date/Time	Killed	Injured	Compensation

7. Are you satisfied with compensation measures for loss made by wildlife? Yes/No
8. If No, what do you think it should be?

   .....

9. How many Rhino you have observed into your area?

Time	Season/Month/Year	Place	Number of Rhino
Past Years			
Recent Years			

10. Do rhino comes every year around your area. Yes/No
11. How do you defense against rhino movement into your area?

    …….

12. What do you know about Rhino movement into your area?

    Increasing/ decreasing/remains the same/No idea

13. If decreasing, do you know why it is happening?

    Natural death/ Killing (Poaching)/Habitat loss/Translocation /Any others……

14. What is the frequency of rhino poaching (this year, last year)
15. Do you know when and where Rhino were killed?

Date	Place

16. Do you know what types of people are involved in Rhino poaching?

    a)Poor/Medium/Rich b)Educated/Uneducated

17. Do you know any household who have been accused of rhino poaching? Yes/No, If yes

Name	Address	Involved date

18. What do you think, why they are killing the rhino?

.....

19. Would any opportunities to poachers help stop killing? Yes/No
If Yes what.....

20. What kind of activities are/ were done by BZCF/BZMC/Park management to stop Rhino poaching?

.....

21. Do you think existing activities/policies/conservation practices have helped conserve Rhino?

……

22. If No, What do you think what kind of activities/polices/conservation practices will help conserve rhino?

.....

Annex 4.4 Unit conversions by crop types

Crop type	Local unit (Muri)	Standard unit (Kg)
Paddy	1=	50
Maize	1=	60
Wheat	1=	69
Oil seed	1=	57

Source: Nepal & Weber, 1993

Annex 4.5 Local market prices by crop types (Oct. /Nov. 2007)

Crop type	Price (Rs)/100 Kg
Paddy	1000-1300
Maize	1300
Wheat	1450
Buck wheat	1300
Oil seed	3200

Data source: Local whole seller

Annex 4.6 Unit conversions of resources

Resources	Local unit (Bhari)	Standard unit (Kg)
Fodder	1=	50
Fuel wood	1=	40

Source Nepal & Weber, 1993

Annex 4.7 Livestock units conversion factor

Livestock	Units
Buffalos	0.81
Cattle (Cows/Ox)	0.65
Goat/Sheep	0.18

Source: Sharma (2000)

Annex 4.8 Formulas for vegetation data calculations

1. Density (No/ha) = $\frac{\text{Total number of plant species in study area}}{\text{Study area}} \times 1000$

2. Relative Density (%) = $\frac{\text{Density of a species}}{\text{Sum of density of all species}} \times 100$

3. Frequency (%) = $\frac{\text{Number of quadrates in which a species occurred}}{\text{Total number of sampling units}} \times 100$

4. Relative frequency (%) = $\frac{\text{Frequency of a species}}{\text{Sum of frequency of all species}} \times 100$

5. Basal Area (m^2) = $\frac{\Pi d^2}{4}$

   Where, d = Diameter at the Breast Height of tree

6. Relative Basal Area = $\frac{\text{Basal area of a species}}{\text{Sum of basal area of all species}}$

7. Importance Value Index (IVI) = RD+ RF + RBA

8. Shannon Diversity Index ($\overline{H}$) = $-\sum (ni/N) \log (ni/N)$

   Where, ni = Importance value for each species
   N = Total of importance values

Annex 4.9 Fodder yield for various land categories

Land category	TDN Yield (t/ha/yr)
Hard wood forest, grazing	0.34
Conifer forest, grazing	0.1
Mixed forest, grazing	0.15-0.2
Forest plantation/hand cutting	**1.44**
Shrubs/burnt forest, grazing	0.77
Waste land/ over grazed land, grazing	0.24
Flat land, grazing	0.58

Source HMG, 1988 b

Annex 5.1 Correlation between actual land of production and family size

		Total family size	Actual land of production
Total family size	Pearson Correlation	1	.487(**)
	Sig. (2-tailed)	.	.000
	N	71	71
Actual land of production	Pearson Correlation	.487(**)	1
	Sig. (2-tailed)	.000	.
	N	71	71

** Correlation is significant at the 0.01 level (2-tailed).

Annex 5.2 Correlation between actual land of production and net agricultural income

		Actual land of production	Net agricultural income
Actual land of production	Pearson Correlation	1	.838(**)
	Sig. (2-tailed)	.	.000
	N	71	71
Net agricultural income	Pearson Correlation	.838(**)	1
	Sig. (2-tailed)	.000	.
	N	71	71

** Correlation is significant at the 0.01 level (2-tailed).

Annex 5.3 Correlation between actual land of production and livestock units

		Actual land of production	Livestock units
Actual land of production	Pearson Correlation	1	.279(*)
	Sig. (2-tailed)	.	.018
	N	71	71
Livestock units	Pearson Correlation	.279(*)	1
	Sig. (2-tailed)	.018	.
	N	71	71

* Correlation is significant at the 0.05 level (2-tailed).

Annex 5.4 Correlation between Livestock units and fodder demand

		Livestock units	Fodder demand
Livestock units	Pearson Correlation	1	.681(**)
	Sig. (2-tailed)	.	.000
	N	71	71
Fodder demand	Pearson Correlation	.681(**)	1
	Sig. (2-tailed)	.000	.
	N	71	71

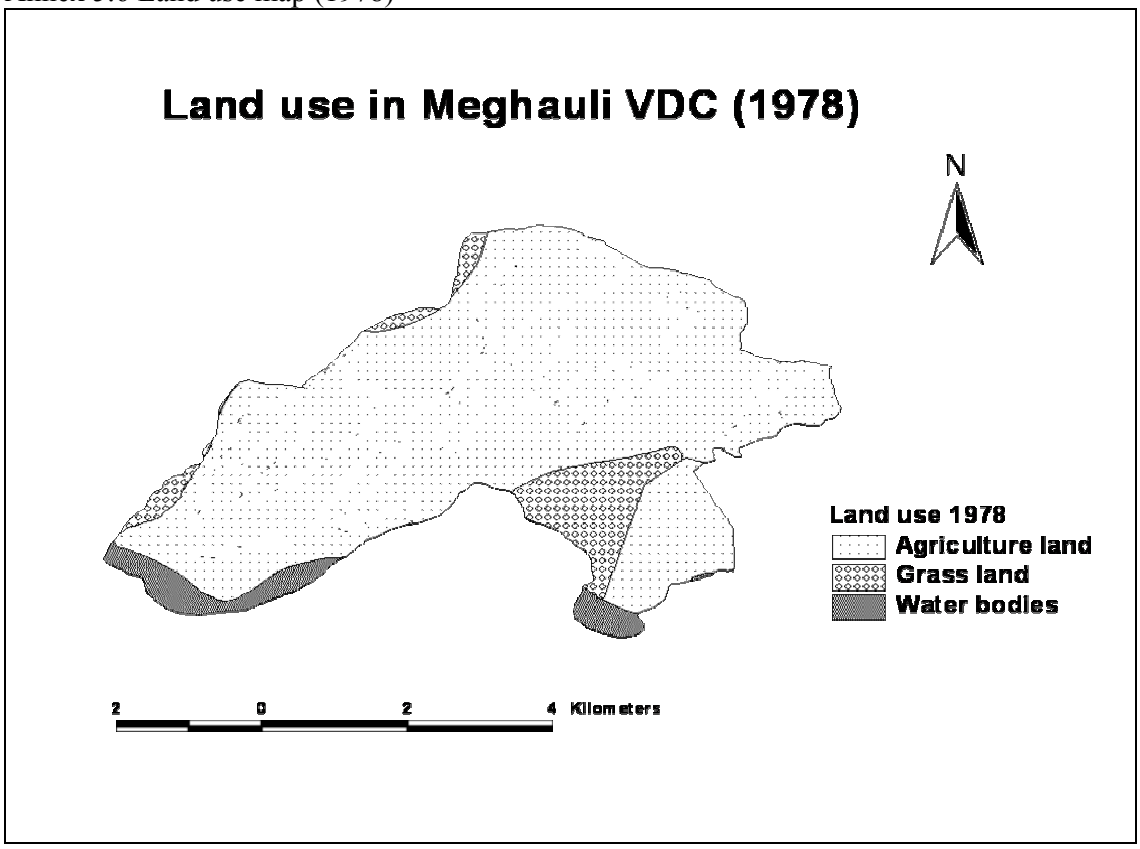
** Correlation is significant at the 0.01 level (2-tailed).

Annex 5.5 Correlation between actual land of production and fuel wood deficit

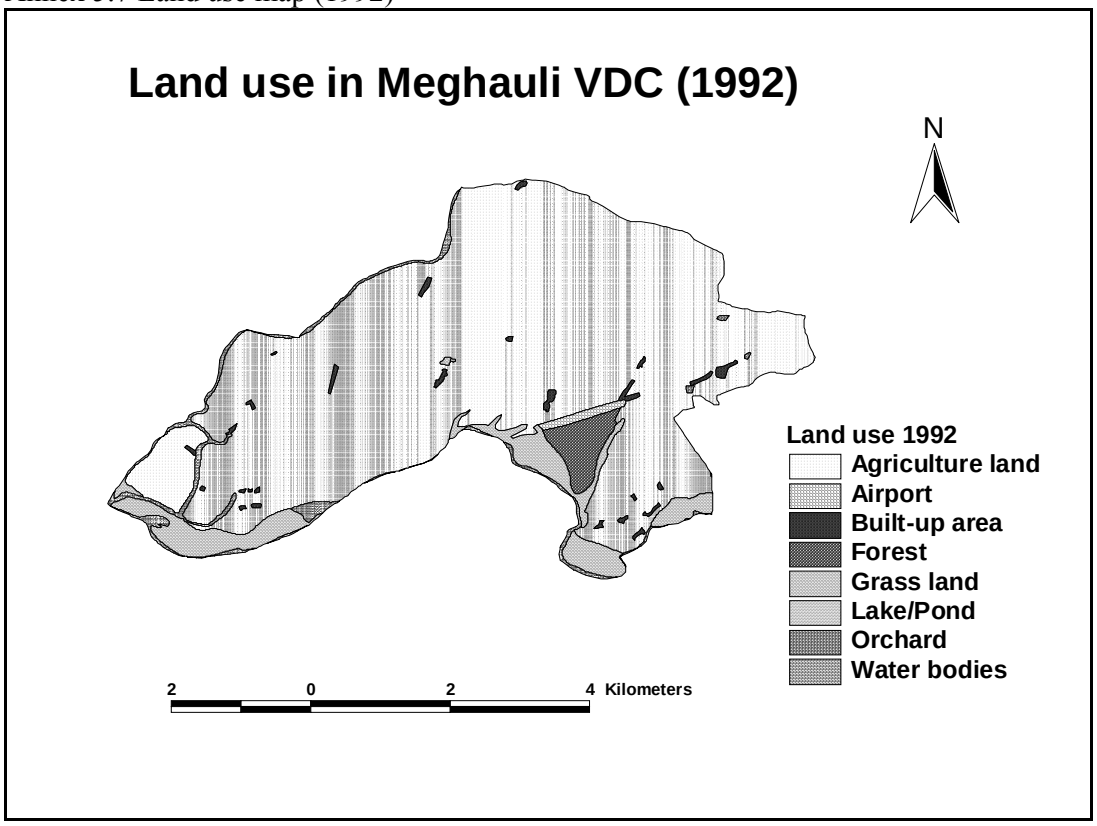
		Actual land of production	Fuel wood deficit
Actual land of production	Pearson Correlation	1	.360(**)
	Sig. (2-tailed)	.	.002
	N	71	71
Fuel wood deficit	Pearson Correlation	.360(**)	1
	Sig. (2-tailed)	.002	.
	N	71	71

** Correlation is significant at the 0.01 level (2-tailed).

Annex 5.6 Land use map (1978)



Annex 5.7 Land use map (1992)



Annex 5.8 List of plants found in study area

SN	Species	Family
1	*Acacia catechu*	Leguminosae
2	*Ageratum conyzoides*	Leguminosae
3	*Ageratum houstonianum*	Leguminosae
4	*Arbus precatorius*	-
5	*Arisyma spp.*	-
6	*Artemisea spp.*	Compositae
7	*Bidens spp.*	Compositae
8	*Boehmeria rofundifolia*	Udificaceae
9	*Bombex ceiba*	Bombacaceae
10	*Callicarpa macrophyla*	Vebernaceae
11	*Calotropis gigantea*	Asclepiadaceae
12	*Chrysopogan aciculatus*	Gramineae
13	*Cissus repens*	Vitaceae
14	*Clerodendron viscosum*	Verbenaceae
15	*Codariocalyx motorius*	Leguminosae
16	*Colebrookea oppositifolia*	Labiatae
17	*Commelina spp.*	Commelinaceae
18	*Cynodon dactylon*	Gramineae
19	*Dalbergia sissoo*	Leguminosae
20	*Desmodium spp*	Leguminosae
21	*Diplazium sp.*	-
22	*Ehretia laevis*	Cordiaceae

23	*Eichornia spp.*	-
24	*Eupatorium adenophorum*	Compositae
25	*Eupatorium odoratum*	Compositae
26	*Ficus spp*	Euphorbiaceae
27	*Flumingia microphylla*	Leguminosae
28	*Ganostegia hirta*	Urticaceae
29	*Grewia tiliaefolia*	Tilaceae
30	*Imperata cylindrica*	Gramineae
31	*Ipomoea fistula*	Convolvulaceae
32	*Justicia spp*	-
33	**Kodo ghans**	-
34	*Lantana camara*	Verbenaceae
35	**Latre jhar**	-
36	*Leea aspera*	Leeceae
37	*Litsea monopetala*	Lauraceae
38	*Mallotus phillipinses*	Euphorbiaceae
39	*Marsdenia royeli*	Asclepiadaceae
40	*Micania micarantha*	Compositae
41	*Mimosa pudica*	Leguminosae
42	*Morus macroura*	Moraceae
43	*Muraya koenigii*	Rutaccaeae
44	*Oplismenus burmanii*	Poaceae
45	**Paduwa jhar**	-
46	**Pater**	-
47	*Phyllanthus glaucus*	Euphorbiaceae
48	*Pogostemon bengalensis*	Labiatae
49	*Polygonum sps.*	Polygonaceae
50	*Premna integrifolia*	Verbenaceae
51	*Pteris spp*	Pteridaceae
52	*Saccharum spontaneum*	Gramineae
65	Scroplulariaceae family	Scroplulariaceae
53	*Sida cordifolia*	Malvaceae
54	*Solanum aerianthum*	Solanaceae
55	*Solanum xanthocarpum*	Solanaceae
56	*Stephania elegans*	Menispermaceae
57	*Sterculia vilosa*	Staphyleaceae
58	*Trewia nudiflora*	Leguminosae
59	*Trichilia connaroides*	Meliaceae
60	*Trifolium spp*	Leguminosae
61	**Un id. 1**	-
62	*Urena sp.*	Pteridaceae
63	*Woodifordia fruticosa*	Lythraceae
64	*Zizyphus mauritiana*	Rhannaceae

Annex 5.9 Stand size Classification of trees (no/ha)

Stand size	DBH class (cm)	No/ha	%
Sapling	≤12.5	17.31	14.29
Poles	>12.5 - ≤25	84.62	69.84
Small saw timber	>25 - ≤50	19.23	15.87
Large saw timber	>50	0	0.00

Annex 5.10 DBH classification by tree species (no/ha)

Species	Sapling	Poles	Small saw timber
Acacia catechu	3.85	8.65	-
Bombax ceiba	2.88	21.15	6.73
Dalbergia sissoo	10.58	51.92	10.58
Trewia nudiflora	-	1.92	1.92
Trichilia connaroides	-	0.96	-

Annex 5.11 DBH class of each species (no/ha) at 5 cm interval

	DBH class				
Species	10-15	15-20	20-25	25-30	>30
Acacia catechu	10.58	1.92	-	-	-
Bombax ceiba	14.42	7.69	1.92	3.85	2.88
Dalbergia sissoo	27.88	23.08	11.54	7.69	2.88
Trewia nudiflora	-	0.96	0.96	0.96	0.96
Trichilia connaroides	-	0.96	-	-	-

.

Annex 5.12 Stocking of trees

Stocking	Crown cover	Area (m^2)	%
Poorly stocked	10-39%	2000	35.71
Moderately stocked	40-69%	2800	50.00
Well stocked	>70%	800	14.29

Annex 5.13 Regeneration of tree species by height class

Height Class	Density(no/ha)	RD(%)
<1m	653.85	48.85
1-2m	330.77	24.71
2-3m	153.85	11.49
3-4m	53.85	4.02
4-5m	84.62	6.32
>5m	61.54	4.60
Total	1338.48	

Annex 5.14 Regeneration of tree species by species Vs height class

	Density(no/ha) at different height class					
Species	<1m	1-2m	2-3m	3-4m	4-5m	>5m
Acacia catechu	92.31	53.85	7.69	-	-	-
Bombax ceiba	146.15	61.54	7.69	-	7.69	7.69
Dalbergia sissoo	361.54	192.31	123.08	53.85	76.92	53.85
Litsea monopetala	38.46	15.38	-	-	-	-
Trewia nudiflora	15.38	7.69	15.38	-	-	-
Total	653.85	330.77	153.85	53.85	84.62	61.54