Socioeconomic Status and Vegetation Analysis of Dibaynagar Buffer Zone Village Development Committee, Chitwan National Park

Thesis Submitted in Partial Fulfillment of the Requirements
For the Degree of Master of Science in
Environmental Science

Majoring in
Wildlife Management

From
Central Department of Environmental Science
Tribhuvan University

Submitted by
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February, 2008

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LETTER OF RECOMMENDATION

This is to certify that Mr. **Ishwor Raj Bartaula** has prepared this dissertation entitled **"Socioeconomic Status and Vegetation Analysis of Dibaynagar Buffer Zone 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, **Ishwor Raj Bartaula**, hereby declare that the piece of work entitled **"Socioeconomic Status and Vegetation Analysis of Dibaynagar Buffer Zone 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 study Dibaynagar buffer zone VDC of Chitwan National Park as a buffer zone with the dual objective of conservation and development stratified random sampling of households, analysis of vegetation and land use change were examined. All household socio economic status largely depended on subsistence agriculture. The agriculture land and grassland in Dibaynagar buffer zone VDC decreased by 0.79 % and 93.51 % respectively between 1978-1992. About 31 % of the households has food deficit problem. Due to insufficient of fuelwood in the buffer zone community forest, 87.5 % of the households depended on Chitwan National Park. Only 4.68 % of household has access on modern energy source such as biogas that was in large farm hold size of Tharu caste/ethnic group. Crop damage by rhino is a serious problem in the Dibaynagar Buffer zone VDC. Households suggested for better management of buffer zone community forest were; more plantation, flood control and awareness. Regarding poaching of rhino in Dibaynagar buffer zone VDC even the buffer zone user committee has found involved. Prioritized options for the activities need to conserve rhino were; awareness to all level people, improved security and poacher punished. The forest observed was Acacia-Dalbergia type. Total density of tree species was found 100.86/ha, dominant species was found dalbergia sissoo. Total biomass yield was found 0.96t/ha/yr. Stand size classification showed poles size was found highest. Demand on fodder and fuelwood was found higher then the sustainable yield of BZCF.

Key words: *Protected area, buffer zone community forest, rhino poaching, wildlife depredation, land use.*

ACKNOWLEDGEMENTS

My gratitude goes to supervisor Dr. Pralad B. Yonzon for his continuous guidance and precise support through out the field study to analysis of the data and obtaining the appreciable results in bringing about this report. I am acknowledged to Dr. Arun Rijal for his guidance in vegetation sampling in the field and data analysis. I am indebted to Prof. Dr. Uma Kant Ray Yadav, Head of Central Department of Environmental Science for being a source of inspiration to carry out this study. I am thankful to Dr K. K. Shrestha, Head of Central Department of Botany and all the staffs of National Herbarium and plant laboratary, Godawari for their support on herbarium identification.

I would like to thank Ms Nilam Kayastha for her support on GIS mapping. My thanks go to all the staffs of Central Department of Environmental Science, Resources Himalaya Foundation, Central Library of Tribhuvan University, Department of Forest Library, Department of National Park and Wildlife Conservation Library, and Social Baha Library.

I am pleased to Mr. Ram Krishna Kafle office secretary of Dibaynagar buffer zone committee, Mr. Til Prasad Kafle and Rishi Bhurtel staff of CNP and Krishna Bote forest guard and those other personalities of Dibaynagar VDC who had directly and indirectly co-operated me during my field study. Also, my thanks go to dear friends Ramesh paudyal and Shishir Adhikari for their kind help and constant encouragement during the field study works.

Finally I would like to express my sincere gratitude and respect to parents and family members for their great patience, encouragement in each and every steps of my academic life and my special thanks also Resources Himalaya foundation for giving me mentorship.

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Ishwor Raj Bartaula

February, 2008

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LIST OF ABBREVIATION AND ACRONYMS

BZCF	Buffer Zone Community Forest
BZUC	Buffer zone User committee
CNP	Chitwan National Park
DBH	Diameter at Brest Height
DNPWC	Department of National Parks and Wildlife Conservation
FSSD	Forest Survey and Statistics Division
GIS	Geographical Information System
GPS	Global Position System
HMG	His Majesties government (Now Government of Nepal)
ICDP	Integrated Conservation and Development Project
LPG	Liquefied Petroleum Gas
LSU	Livestock Unit
MPFSN	Master Plan for Forestry Sector Nepal
NTFP	Non Timber Forest Product
NTNC	National Trust for Nature Conservation (Formerly King Trust for Nature Conservation)
PA	Protected Areas
PCP	Participatory Conservation Program
PPP	Park People Programs
TDN	Total Digestible Nutrients
UNDP	United Nation for Development Programs
VDC	Village Development Committee

Chapter 1

INTRODUCTION

1.1 Introduction

Protected areas (PAs) are essentially a "social space" (Ghimire and Pimbert, 1997, cf. Mehta and Heinen 2001) and they cannot be divorced from the human context. The need to protect biological diversity and people who lived in and around national parks is a major challenge facing park managers today (West & Brechin, c.f Fox et al. 1996). Many protected areas in poorer countries have begun to allow limited exploitation of natural resources by local people, thus reducing the conflicts between parks and their neighbors and to bolster protection of the parks (Miller 1984; Sherpa 1988; Upreti 1985; c.f Yonzon and Hunter, 1991). The western concept and its various approaches to nature conservation have been widely criticized in the third world, where ground realities are different (Nepal and Weber, 1993).

Although protected areas have long been recognized as the single most important method of conserving wildlife and preserving biological diversity (Johannesen & Skonhoft, 2005), PAs will never be sufficient to conserve the full range of biological diversity. Furthermore, if communities are not brought into the protected area management, this will even threaten the very survival of the PAs (Oli, 2005). Conflicts arise mainly from cultural and social interventions from outside (Jefferies, 1982: Weber, 1991).

The Integrated Conservation and Development project (ICDP) attempt to link biodiversity conservation in protected areas with social and economic development in surrounding communities (Brandon and Wells, 1992). Despite the widespread implementation of ICDP, sustainability of these ICDP interventions had been raised (Ite and Adams 2000; Wainwright and Wehrmeyer 1998). ICDPs usually do not provide adequate incentives to discourage activities that threaten protected area and the ability of ICDPs to generate livelihood for local residents will rarely be sufficient to assure the preservation of protected area (Christensen, 2004).

In this regard, buffer zones are regarded as one of the suitable strategies for resolving any conflicts caused by firewood, fodder, timber and grazing pressure. An integrated approach to the buffer zone concept emerged from the 1982 National Park Congress in Bali (Nepal and Weber1995a). There has been much confusion about the buffer zone concept regarding its purpose, location, management and criteria to determine the area, shape and permitted uses (Sayer, 1991). The main objective of establishing buffer zone is to meet the natural resources needs of local communities as well as minimizing human impact on protected areas so as to avoid a contentious situation between the park management and people. Buffer zone objectives may improve the lives of these communities and support them to organize themselves into strong, self-governed institutions capable of undertaking pro-conservation and development activities (Bajimaya, 2005). They are often considered a means to substitute local people's use of protected resources (Heinen & Mehta, 2000). Therefore, they may form the best possible ecological boundaries between protected areas and other lands (Wild & Mutebi, 1997; Vanclay, 1993, c.f, Straede & Treue, 2005).

Chitwan buffer zone (750 km^2) was declared in 1996, which comprises of mosaic of indigenous community and hill migrant with a wealth of knowledge on the traditional use and management of biodiversity (Budathoki, 2005). About 43% of buffer zone is covered by forest and serves as main source of forest resources where per capita forest area ranges from 0.1-2.1 ha per household. Chitwan buffer zone spreads over 4 District, 35 VDC and 2 municipalities that have 510 settlements with 223,260 populations (DNPWC, 2000).

The greater one horned Rhinoceros (Rhinoceros unicornis) listed in the CITIES Appendix I and as endangered species in the IUCN Red data book is widely poached with establishment of Chitwan National Park. Rhino have dramatically turned around from brink of extinction because of stringent protective measures. Rhino have increased from 147 animals in 1972 to 544 in 2000 (DNPWC, 2000, cf. Adhikari, 2002) and has subsequently decreased to 372 animals in 2005 (Rhino census, 2005). In recent years, due to political instability in the country, Chitwan had lost 38 Rhinos through poacher in one year (July 2001- June 2002) (Yonzon, 2002) which is equal to total rhino poached in 5 years between 1992-1995.

1.2 Justification of the study

In the context of wide spread poverty and unemployment, the issue of meeting basic survival needs is the major threat to conservation of the biological diversity. Most studies at CNP have focused on the park-people conflict resulting from resources denial, wildlife damage, and poor performance of the park management. However there has been less study on a subject matter in a composite form that strives to interface households well being of buffer zone communities, natural resources availability and long term conservation of biological resources at village level. This study has focused on role of socio-economy of buffer zone household, resources need and access, ecology of community forest, and the land use pattern within the VDC. Information thus produce will help to understand the conservation threats, subsequently guides to develop the program for better management practices for buffer zone management.

1.3 Objectives:

The broad objective of the study is to contribute knowledge about biodiversity conservation through research on socioeconomic structure, activities of the community status of natural resource and its availability at Dibaynagar VDCs Buffer Zone VDC of Chitwan National Park.

Specific objectives:

- To determine fuelwood and fodder need and access in buffer zone households of Dibaynagar VDC through socioeconomic survey.
- To study the vegetation of community forest of Dibaynagar buffer zone VDC.
- To study the change in land use pattern of Dibaynagar buffer zone VDC.
- To study the incidence of rhino occurrence, poaching activities and crop depredation by rhino.

Chapter 2

STUDY AREA

2.1 Location

Dibaynagar buffer zone Village development Committee (VDC) lies in flood plain of the Narayani River located at centre Kasara sector of the Chitwan National Park. Four wards (ward no 2, 3, 4 and 5) are included in the buffer zone. The buffer zone area is managed under Kalabanjar buffer zone user committee. The adjoining VDC are Meghauli, Gunjanagar and Sukranagar.

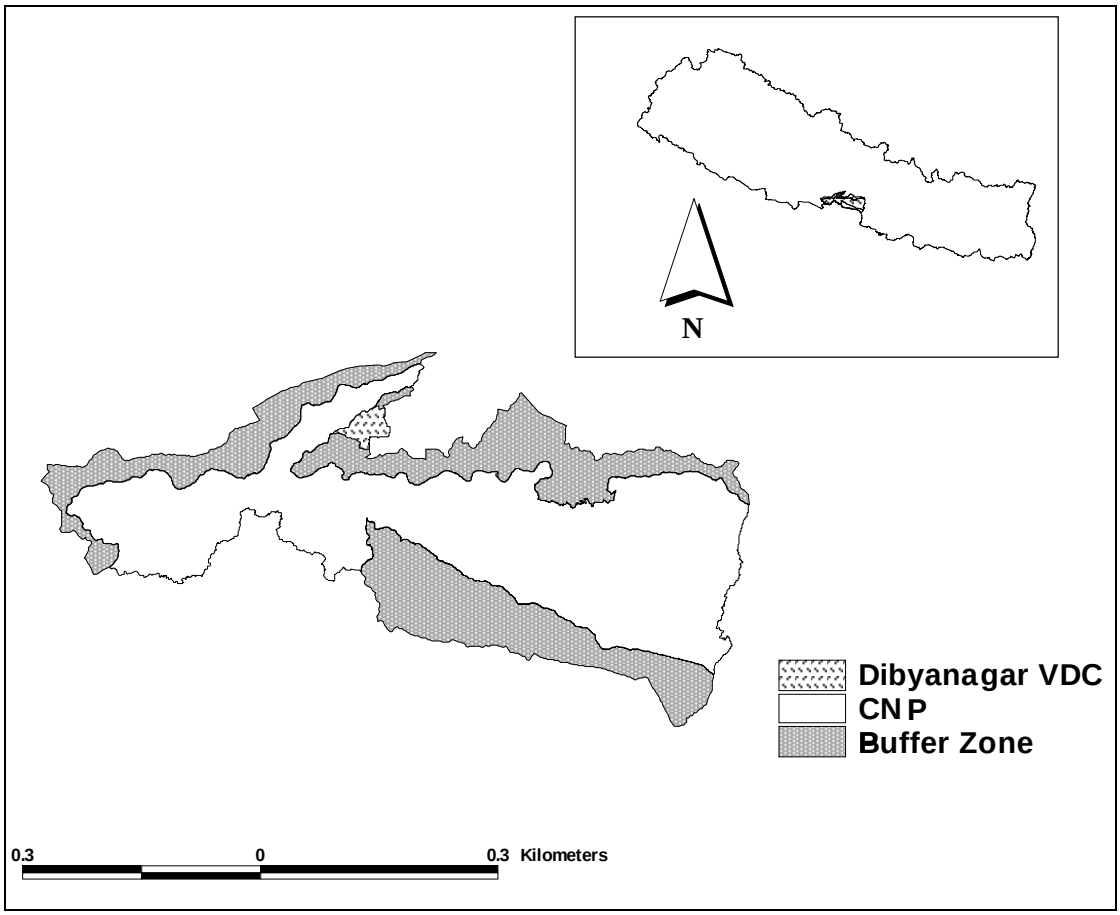

Figure2.1 Location of study area

2.2 Climate

The climate is subtropical with high humidity through out the year (Straede et.al, 2002). The average maximum monthly temperature is 33.51°C in July and average minimum monthly temperature is 8.07°C in January. Mean annual rainfall is

2282.66mm, with heavy rainfall in summer monsoon from June to September (Rampur Weather Station, 1997-2006).

2.3 Demography and household characteristics

The total population of the study area was 2519 in 4 settlement areas, composed of mixed ethnic group mostly dominated by Gurung/Magar/Tamang, followed by Dami/Kami/Sarki group (DNPWC/PPP 2000). Majority of the population are dependent on agriculture followed by service (Government and private) and wage labor. Over 44.3 % of the population remained illiterate and 96.8 % of the household use fuelwood as a source of energy. Some 3.3% of the household use biogas as alternative energy.

2.4 Land use

Cultivated land accounted 99.4 % of the total land area (980.7 ha) while forest and river/sand covered 0.6% and 0.03% respectively of the total (DNPWC/PPP 2000).

2.5 Buffer zone Community forest

Dibaynagar has four community forest which are Hirakunga, Jogikuti, Sweety barda, and Narayanai Bhagaudi community forest with the total area of 360 ha. They are in small isolated patches. The forest type found in Dibaynagar is riverine forest of which dominance species was *Dalbergia sissoo* and other species were *Accacia catechu, Trewia nudiflora*, *Litsea monopetala* and *Bombax ceiba*. Every year some part of the forest is cut down by the Narayani River. Grassland in the BZCF provides good habitat for the wild animals especially rhino.

BZCF opens twice a year with permission taken from the National Park to collect fodder. Nominal fee is charged to the user member to collects fodder.

Chapter 3

LITERATURE REVIEW

Straede et al. (2002) studied the structure and floristic composition of six community forests established through natural regeneration of degraded sal (*Shorea robusta*) forest and of former riverine forest areas which have been cleared and overgrazed and concluded that anthropogenic pressure on CNP is mainly villagers 'traditional dependency' on and extraction of NTFP's which were not found in regenerated community forest. Rijal (1994) performed detail study on the dependency of local people on forest products in Padampur VDC and documented various plant species used by locals. He has also studied the vegetation composition and structure of riverine forests and savannas. DNPWC/PCP/UNDP (2001) has mentioned that the detail exploration of flora of CNP has remained untended although many studies regarding floral composition and structure have been completed.

Straede and Treue (2005) studied the importance of natural resources to the livelihood of Bachhauli and Padampur VDC which showed that products from CNP are of great importance to the livelihood of local people and further added that product collected in the national forest substitute products from the park, while the substitution effect of the community forest is small they illustrates that there is still a gap between local peoples need for supplementing natural resources and right to satisfy them on a legal basis.

Paudyal (2007) conducted the detail socioeconomic study of Piple VDC and concluded that BZCF only fulfils 14.88% and 24.57% of annual household fodder and fuelwood demand. He further said that deficit was primarily extracted from national park. Ghimire (2007) reported that failure of ICDP was evident but social capital has been rapidly gaining its ground in long term conservation. He stated that the local demand for forest resources is fundamental question to the ecological integrity and wildlife conservation of Bhandara buffer zone community forest. Shrestha (1994) studied on the resources 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 resources.

Pandit (1995) studied the vegetation composition, biomass production and park resources consumption pattern by ethnic group of adjoining villages of CNP.

Adhikari et al. (2004), studied the relationship between key household characteristics and common property resources used in order to assess whether poor households are able to gain greater access to community forests as a result of institutional change and concluded that, at least for some key products, poorer households are currently facing more restricted access to community forest than "less poor" or relatively better off households.

Jnawali (1989) reported habitat degradation of northern fringes of CNP due to livestock grazing and other human activities, he has also mentioned the negative attitude in local people towards park management due to injuries and harassment to them by rhino. Similarly, Jnawali (1994) studied the detail socioeconomic study of Bachhauli VDC and conflict of land use due to livestock. Joshi (1999) conducted a detail socioeconomic analysis of buffer zone residents and determined more then 78% of the buffer zone residents have been using the park as a source of their basis needs and 90% of crop depredation is due to rhino. Uprety (1995) studied agriculture and livestock depredation by wild animals and concluded that rhino was found a major crop raiding animals and tiger the main livestock depreding animals. Sharma (1999) studied park-people interaction in CNP and found that without proper support from the local, conservation effort cannot sustain. Nepal and Weber (1995) have identified five major causes of park people conflicts prevailing in the park including illegal transactions of forest products, livestock grazing, illegal hunting and fishing, crop damage and threats to human from wild animals.

Heinen and Mehta (2000) studied the legal and managerial development of buffer zones management in Nepal and raised question whether the managerial and research capacities exist to monitor buffer zones for their effectiveness for both conservation and development. Heinen and Yonzon (1994) reviewed the status of species within Nepal that appear in the schedule of the National Park and Wildlife Conservation Act of 1973. Heinen and Kattel (1992) reviewed the history of modern conservation legislation and analyzed that the earlier legislation in its zeal for preservation of species and areas, effectively omitted Nepal’s rural poor from process of local

conservation. They suggested that conservation in Nepal cannot be separated from and is depended on socioeconomic and political climate in which it occurs. Paudel (2004) have highlighted two issues associated with buffer zone Management in CNP. First, it describes the society–nature relationship among various local social groups and identifies differential impacts of conservation programmes on these groups. Second is social actors that are associated with the buffer zone management programme, where weak and vulnerable groups are ignored.

Budhathoki (2003) argued that conservation model based on the foundation of strict protection has been found to be insufficient during present political crises as protected area enjoy no or little public support and suggest some alternatives mechanism for long term conservation of biological resources in Nepal.

Wells and Sharma (1998) state that substantial economic benefits from protected area tourism are available to help finance this transition, but these benefits are only in limited scale. Bookbinder et al. (1998) have reported only 6% of households earn income directly or indirectly from Ecotourism.

Thanet (2007) studied the potential habitat of rhinoceros in the buffer zone forest of Chitwan National Park, by investing their preferred plant species for diet and suitable habitat. Jnawali and Wegge (1999) stated that both the annual and seasonal diets of rhinoceros in BNP (Bardia National Park) and CNP were dominated by grass species primarily growing in the tall alluvial floodplain grassland. They also reported that in both CNP and BNP, the grasslands are being invaded by different tree species. Laurie (1978) studied the ecology and behavior of rhino in northeast India including CNP and also identified probable areas of rhino translocation in Nepal. He had also warned about probable habitat degradation due to *Mikania micaranta.*

Yonzon (2002) has reported that insurgency facilitated both rhino poachers and timber smugglers with unknown effect on biodiversity and Adhikari (2002) has raised questions over long term rhino conservation, without the pursuit to save the rhino through contemporary knowledge.

Martin (2001) reported that the huge increase in rhino poaching from mid- 1998 to mid-2000 was due to the slackness and ineffective leadership and partly due to the

lack of full time experienced and competent senior officer in the valley to supervise the anti-poaching activities. Adhikari et. al (2005) examined how different policy options might reduce poaching, while at the same time alleviate poverty in the areas surrounding the CNP.

Chapter 4

METHODOLOGY

4.1. Household Socio economic survey

Household socioeconomic survey was conducted in Dibaynagar Buffer zone VDC during June 2007.

4.1.1. Survey design and Sample size

Buffer zone encompasses four wards of Dibaynagar VDC, namely 2, 3, 4 and 5. For household socioeconomic survey of Dibaynagar buffer zone VDC, above-mentioned wards were selected. Stratified random sampling method was applied for the survey on the basis of settlement size (Table 4.1), which was based on population size, and land holding of household with five categories (Table 4.2). (DNPWC/PPP, 2000)

Table 4.1 Distribution of settlement by population size (Source: DNPWC/PPP, 2000)

Symbol	Ward no.	Settlement	Population size
S1	2	Simari	above 800
S2	3	Siswar	201-800
S3	4	Sisai	Upto200
S4	5	Bhagadi	201-801

Table 4.2 Land holding categories

Categories	Land holding (Local unit)	Land holding (ha)
Landless	Landless	LL
Small farms	0-10 Kattha	<0.34
Medium farms	10-20 Kattha	>0.34-6.8
Big farms	1- 4 Bigha	>0.68-2.72
Large farms	> 4 Bigha	>2.72

The sample size (n) of the household in the study area was determined by using following statistical formula (Arkin and Colton, 1963; cited in Sharma, 2000) at 95 % confidence level.

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

Where, n = sample size

N= total number of households

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

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

d=error limit of 5% (0.05)

The sample size for 497 households was found to be 64 households. These 64 households were chosen on the basis of settlement size and land holding. Random stratified sampling method with replacement was used for equal number of sample size distribution in each settlement and land holding categories with equal probability as being unbiased. Each sample was drawn through lottery method. The lottery was drawn randomly at a time from both categories for 64 times and sample size distribution (Table 4.3) in each settlement with land categories was found out.

Table 4.3 Sample size distribution

Ward No	Settlement Name	Household Land holdings					
		LL	0-10 K	10-20K	1-4B	>4 B	Total
2	Simari	-	3	10	11	4	28
3	Siswar	-	1	8	9	2	20
4	Sisai	-	-	-	5	1	6
5	Bhagadi	1	2	5	2	-	10
	Total	1	6	23	27	7	64

4.1.2. Questionnaire survey

Based on landholding size, sixty-four households were selected from different wards and interviewed and filled structured and semi structured questionnaire with some close ended and some open ended questions in the field.

Three members research team (classmates) was mobilized for survey to bring the same level of required information. Interview with family head member was preferred. If such was not possible, interview was taken from adult member of the household.

The questionnaire survey includes mainly three main parts (Annex 17) including household information, Buffer zone community forest and buffer zone management issues and rhino/ wildlife related issues.

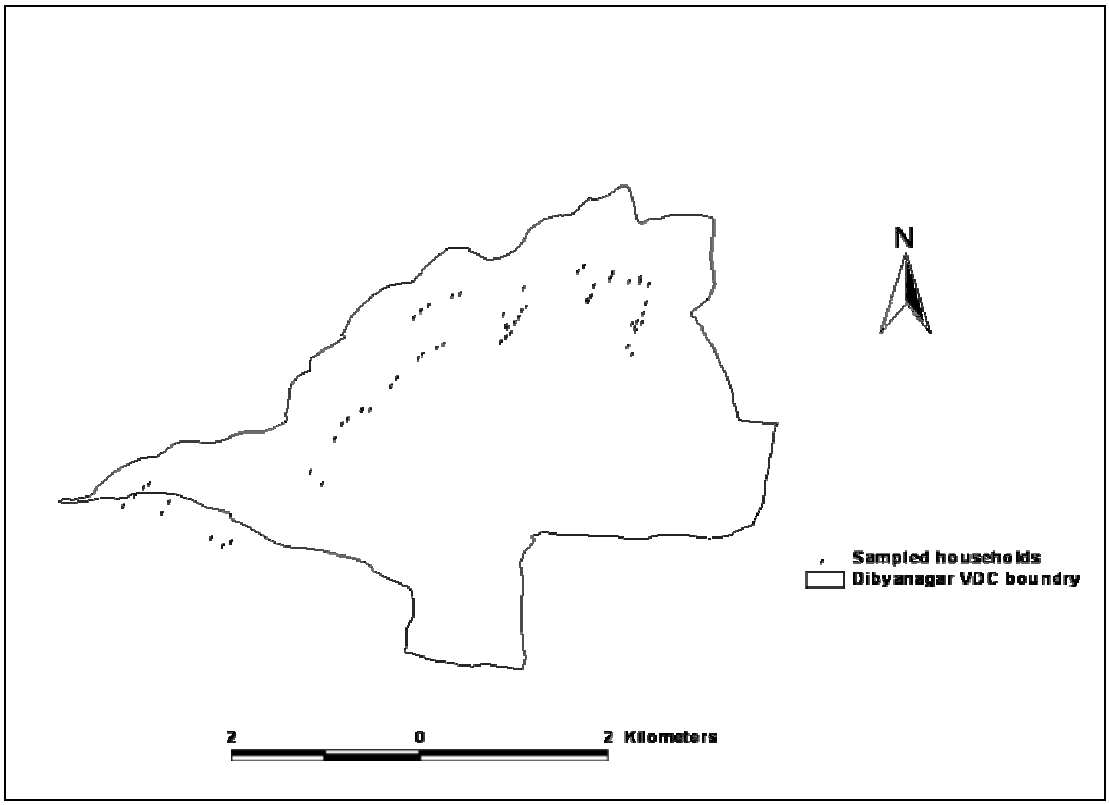

Figure 4.1 Sampled household in Dibaynagar BZ VDC

4.1.3. Household Information

Household information were gathered to identify the livelihood supporting mechanism through occupation of respondent, land holding, crop types and its production, livestock holding (including feeding types), resources need (Fuel wood and fodder) and their access, energy use and consumption pattern.

4.1.4. Buffer zone related issues

This part was made to obtain the household level perception about Buffer zone community forest and buffer zone forest management issues. Questions were set to obtain the information about household level participation in buffer zone community forest, condition of buffer zone forest in past and now-a-days, types of resources extraction, availability of resources, problems, suggestion and recommendation for

better management and resources utilization of community forest with budget sufficiency and its transparency.

4.1.5. Rhino related Issues

This part was set to obtained the information on crop damaged by rhino and compensation measures from the losses, trend of rhino movement, reason 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.

4.1.6. Data Calculation

Actual farm size (landholding) of each sampled households was noted in local unit (Kattha) and converted into hectare (ha) by using the conversion factors as mentioned below given by Nepal and Weber (1993)

Table 4.4 Farm size conversion factor

Farm size in Katha	Conversion factor
1 Biga (20 kattha)	=0.6 ha.
1 Kattha	=0.03 ha.

Livestock of sampled households were listed in number and type in field and they were converted into the standard unit called Livestock Unit, by using the conversion factors as given in Sharma (2000).

Table 4.5 Livestock conversion factor

Livestock Type	Conversion Factor
Cow	0.65
Buffalo	0.81
Goat	0.18

Agriculture production of households was noted in local unit (Muri) and converted into standard unit (Kg), by using following equivalent given by Nepal and Weber, 1993

Table 4.6 Crop production factor

Crop type	local unit Unmilled (Muri)	standard unit.Kg
Paddy	1 =	50
Maize	1 =	69
Wheat	1 =	69
Oil seed	1 =	57

The estimation of annual resources (fuelwood and fodder) need refer to the annual consumption of fuel wood and fodder resources. Resources need or demand of sampled households and their access from different sources (Buffer zone community forest, National Park, Own land and Buying and River) were noted in local unit (Bhari). In addition, weight of the Bhari was converted into Kilogram (Kg) according to respondent perception and experience as possible. Those who could not convert Bhari into Kg following equivalents (Nepal and Weber, 1993) were used. The fodder demand obtained in kilogram was converted into TDN value by multiplying the factor 0.25 (NTNC, 1996)

Table 4.7 Conversion factor for local forest resources unit into standard unit

Local unit	Resource		Standard unit (Kg)
1 Bhari	Fodder	=	50
1 Bhari	Fuelwood	=	40

Source: Nepal and Weber, 1993.

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4.1.7. Data Analysis

Raw data and information from the completed questionnaire were first entered into the MS Excel program in database form. Some necessary calculations were completed within this program. Qualitative form of data and information were also coded and entered for analysis. During data entering, each of the 64 sampled household was kept in the row and each characteristics of the household was placed in column. Once the basic calculation and modification were completed variables were categorized according to needs. For further analysis, the variables were copied to SPSS and comparing mean operation were applied to obtain characteristics of household according to caste/ethnic composition, farm size..

4.2. Vegetation Survey

4.2.1 Survey Design and Sample Size

A reconnaissance survey including field training 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 sampling points were generated within the patches at an interval of 300 m using GIS. All together 29 points were generated. 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 29 points 12 points lies in Forest patch and remaining 17 points lies in Grassland.

4.2.2 Plot Design

At each sampling points all together 5 plots were laid out. First plot was out of 20mx20m shaped nested quadrate for tree species. 5mx5m shaped nested quadrates (figure 4.2) were laid out in South East and North West corner of 20mx20m plot for shrub species. Similarly 1mx1m of two nested quadrates was laid out in similar manner in 20mx20m plot for herb species (Rijal and Meilby, 2006). For tree 11600 m^2 area was surveyed, 1450 m^2 for shrubs and 58 m^2 for herbs.

All tree species having DBH greater than 10 cm were taken into account with in 20mx20m plot. DBH and height of all trees were measured with the help of DBH tape and clinometer respectively. Crown coverage percentage of trees with in the sampling plots was estimated occularly for the determination of stocking of forest. Height and number 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 5mx5m. Similarly the number of all herb species and shrub and tree species less than 10 cm height counted in 1mx1m 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 20mx20m plot to quantify human interference, grazing pressure and management practices.

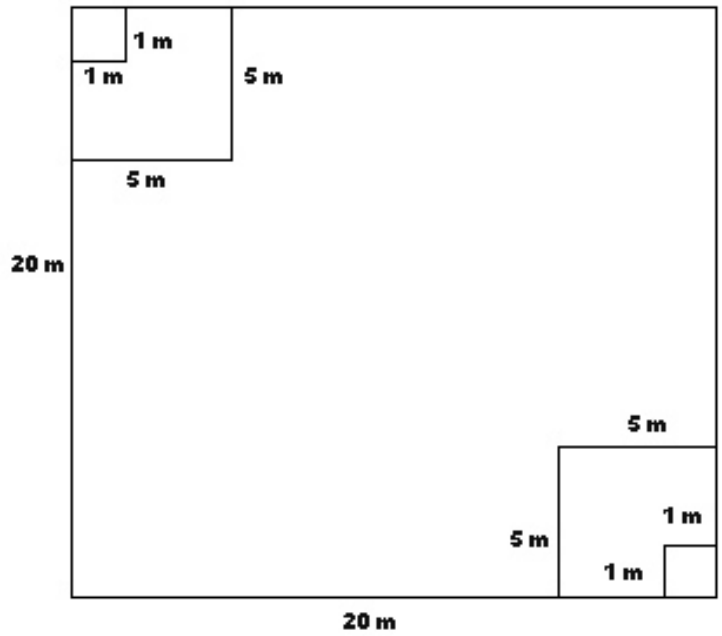

Fig 4.2: Plot Design (Nested quadrate plot)

4.2.3. Stand size

The stand size classification is presented in Table 4.8. The classification is based on Forest Inventory Division (FRSC, 1995).

Table 4.8 Stand size classification

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

4.2.4 Stocking

The classification of stocking of trees is presented in table 4.9. Determination of stocking is based on forest density, i.e. crown cover percentage (FRSC, 1995). Classes of stocking were as follows.

Table 4.9 Stocking of trees

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

4.2.5 Tree Volume

For the calculation of resources of the Dibaynagar Buffer Zone Community Forest FSSD (1991) was followed. INV was used to estimate the volume of each individual tree. The system estimates for computing the total volume of the whole stem is

Ln (V) = a + b x Ln(d) + c x 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).

4.2.6 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 (HMG, 1988 a). For obtaining the biomass of branches (fuelwood) and foliage (fodder), ratio of branch to stem biomass and foliage to stem biomass were applied for various species (HMG, 1988a).

4.2.7 Estimation of Annual Yield

The Master Plan for the forestry sector of Nepal (MPFSN) has estimated the annual yield of all different forest types of Terai for the Central Development Region (Table 4.10). 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.

The annual yield of the Terai mixed hardwood forest was used for the annual yield of tree species (*Bombax ceiba, Litsea monopetala, Trewia nudiflora,*). Although MPFSN had classified the Siwaliks, of which Chitwan valley is a part, as an area having littlte 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).

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

Table 4.10 Growing stock and annual yield (tons/ha) in the natural forest of Terai regions of The Central Development Region, Nepal (Source: HMG, 1988a)

Forest Type	Forest Biomass			Annual Yield			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

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 basin on Total Digestible Nutrient (TDN) yields for various categories of land (HMG, 1988 b) (Annex 16).

Density, relative density, frequency, relative frequency, basal area, relative basal Area and importance value index (IVI) were calculated for tree species. For regeneration of tree species, height classes were made based on Rijal & Meilby (2006) and the lopping intensity was classified based on Silori (2001).

4.3. Land use change pattern

To study of land use change pattern of Dibaynagar Buffer zone VDC, LRMP-data (1978) and FINNIDA maps (1992) were used. The data was analyzed using Arc info 3.5.2 and Arc view 3.2. From the overlay map of land use between 1978-1992, comparison of areas and rates of change of the six three cover categories was made. And also the overview of land cover changes (%) in the three categories, including land cover gained and lost from each category for the period between 1978 and 1992 was calculated.

Chapter 5

RESULTS

5.1.1 General characteristics of the respondent in the study area

The distribution of sample household of the study area according to gender, age group, caste, occupation, education, residence period, and family structure is presented in Table 5.1. The total number of male respondent is three times more than female although the selection of the respondent was unbiased. The age of the respondent ranges from 15 to 74 years, 50 % of the respondents were from 30 to 50 years group. Based on the caste and ethnicity, Tharu/Darai represented more than 50%, and followed by Brahmin/Chhetri (20.31%), Damai/Kami (14.06 %) and Gurung/Magar/Tamang (12.5 %). Majority of the respondent were literate (85.94 %) in which general literate who can read and write were 17.19 %, lower class were 20.31%, higher class were35.94 % and college were 12.5 %.The major occupation of the respondent (62.5 %) was agriculture and rest were involved in service, business, remittance and wage labor. Majority of the respondent (76.69 %) were found to be early settlers (>30yrs), followed by middle (17.19 %) settlers (>10-<=30yrs), and late settlers (<10yrs), (3.12%). Joint family (65.62 %) was more common in the study area.

Table 5.1 Respondent Characteristics in the study area

Category		Number of Respondent	Percentage
By Sex			
	Male	50	78.12
	Female	14	21.88
By Age Group			
	<=30 Years	17	26.56
	>30 to <=50 years	32	50.00
	>50 years	15	23.44
By Caste			
	Brahmin/Chhetri	13	20.31
	Gurung/Magar/Tamang	8	12.50
	Tharu/Darai	34	53.13
	Damai/Kami	9	14.06
By education			
	Illiterate	9	14.06
	General	11	17.19
	Lower Class	13	20.31
	higher Class	23	35.94
	College/University	8	12.50
By Occupation			
	Agriculture	40	62.50
	Agriculture+Business	3	4.69
	Service	6	9.38
	Agriculture+Service	1	1.56
	Wage Labour	1	1.56
	Housework	1	1.56
	Housework+Agriculture	5	7.81
	Remittence	2	3.13
	Business	3	4.69
	Student	2	3.13
By Residence Period			
	Late Settlers(<10yrs)	2	3.12
	middle Settlers(10-20yrs)	11	17.19
	Early Settlers(>30yrs)	51	79.69
By Family Structure			
	Nuclear	22	34.38
	Joint	42	65.62

5.1.2. Households socioeconomic status

a. Demographic characteristics

The household's population of the study area by ethnicity, gender and age is presented in Table 5.2. The total population of the study area was 497, with total male of 263 and 234 female with average family size of 7.7. Average family size of Tharu/Darai (8.82) is higher than other ethnic group. Average family size was found to be higher in large farm size households.

Table5.2 population under gender and ethnic group

Caste/Ethnic group	Male	Female	Total
Brahamin/Chettri	44	35	79
Gurung/Magar	31	24	55
Tharu/Darai	156	144	300
Damai/Kami/Sarki	32	31	63
Total	263	234	497

Based on ethnicity, active age group (15-59yr) was higher in Tharu/Darai group, followed by Brahamin/Chettri group (Table 5.3). Of total 39.63 % of the population were dependent (Table 5.4).

Table 5.3 Different age group based on ethnicity

Caste/Ethnic group	<15 years	15-59 years	>60 years
Brahamin/Chettri	27	46	6
Gurung/Magar	17	31	7
Tharu/Darai	77	201	22
Damai/Kami	21	37	5
Total	142	315	40

Table 5.4 Dependent Population

Dependent Population	Population	%
Old and Young age*	35	17.77
Student**	162	82.23

*Above 70 years and below 4 years of age not going school and, ** student currently undergoing at school and higher class

b. Occupation

Agriculture (24.67%), housework, remittance, service, business, wage labor were major occupations. Remittance was related jobs amounted to (14.67 %) of the total.

Table 5.5 Occupation of the Population

Occupation	Population	%
Agriculture	74	24.67
Housework	27	9
Housework + Businss	2	0.67
Agriculture + Housework	98	32.67
Service	33	11
Agriculture + Service	3	1
Unskilled wage labor	7	2.33
Business	9	3
Agriculture + Business	3	1
Remittance	44	14.67

Occupation adopted by different ethnic group is presented in Table 5.6. Besides agriculture, and housework, the number of population working in a service was predominantly from Tharu/Darai caste groups. The source of income through remittance was higher in Tharu/Darai group, followed by Damai/Kami and Brahamin/Chettri group. Similarly agriculture, service, business, and remittance were common in big farm holding size, while unskilled wage labor is common in landless and small farm size holding (Annex 1)

Table 5.6 Occupation based on Ethnicity

	Ethnicity			
Occupation	Brahamin/Chettri	Gurung/Magar	Tharu/Darai	Damai/kami
Agriculture	10	7	49	8
House Work	2	7	15	3
House Work+ Business	1	1	-	-
Agriculture+ House Work	17	9	63	9
Service	1	2	27	3
Agriculture+ Service	1	-	2	-
Unskilled wage labor	-	-	-	7
Business	5	2	1	1
Agriculture+ Business	3	-	-	--
Remittance	7	6	23	8
Total	47	34	180	39

c. Education

Of total 86.79% of above 4 years of age population were literate (Table 5.7). Illiterate population was 13.21 % of total sampled household and general background population was 45.31 % of sampled household. Lower class and higher school attended population was 29.35% and 39.83 % of the sampled household respectively. The college/University attended population was 10.27 %.

Table 5.7 Education Status

Education	Population*	% Population	HH Numer	%HH
Illiterate	63	13.21	43	67.19
General	35	7.34	29	45.31
Lower Class	140	29.35	53	82.81
High School	190	39.83	56	87.5
College/University	49	10.27	28	43.75

*above 4 years of age are taken

Literacy rate was higher in Brahmin/Chettri (89.74%) group compared to other caste/ethnic group and followed by Tharu/Darai group (Fig:5.1,Annex 2). Based on land holding size, big farm holders had more access on all level of education compared to other farmland holding size. Landless and small farm size holders have no access on college education. (Fig: 5.2 ,Annex 3)

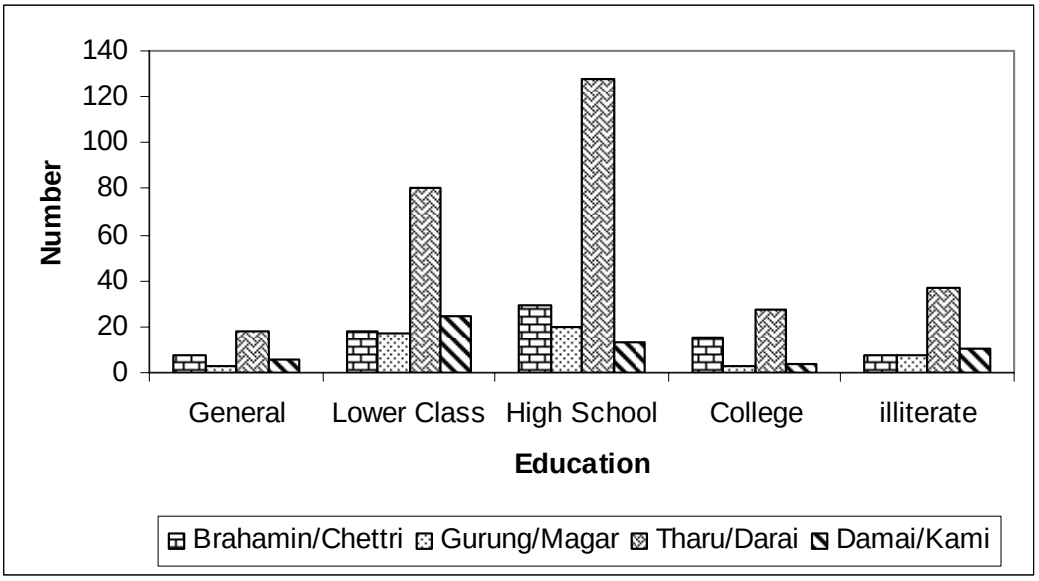

Figure 5.1: Educational status based on Ethnicity

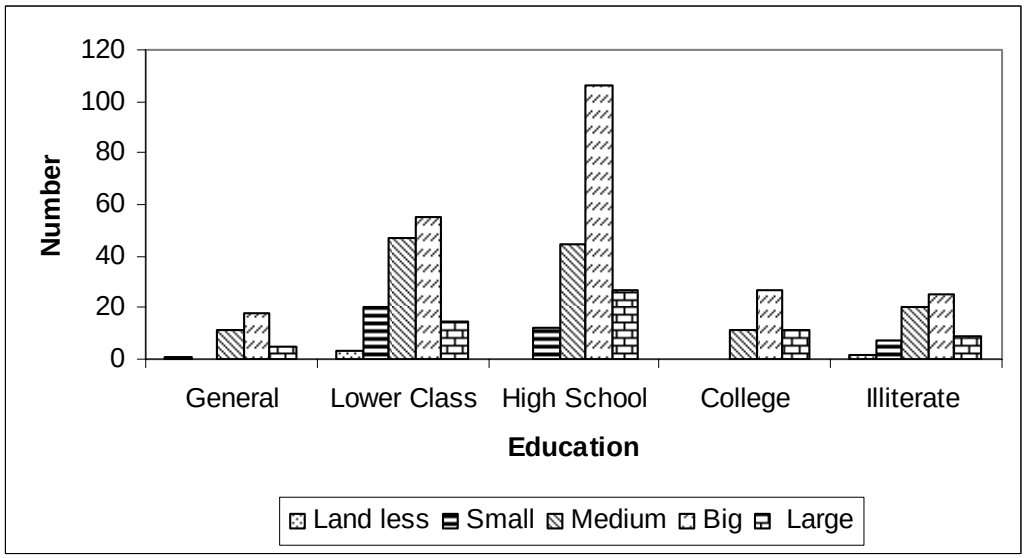

Figure 5.2: Educational based on land holding size

d. Farm production and Deficit Management

Paddy, maize, and buckwheat were the major food production in the study area and household involved in the cultivation were 96.87 %, 96.87 % and 85.93 % respectively. Similarly, wheat and oilseed were produced by 7.81 % and 6.25 % of household respectively (Table 5.8).

Table 5.8 Household involvement in crops production and their status

Crops type	Household % involved in cultivation	No of household		
		deficit	balance	surplus
Paddy	96.87	28	8	28
Maize	96.87	1	4	57
Wheat	7.81	-	1	3
Pulse	89.06	19	36	2
Oilseed	6.25	2	2	-
Buckwheat	85.93	-	-	55

Some 31.25 % of the households had food deficit. Of these, 100 % from landless, 83.3 % belonged to small, 47.82 % belonged to medium and 11.11 % belonged to big farm household. Similarly, 42.19 % of household had surplus of food and 26.56 % of household are balanced (Table 5.9). Land less households were dependent on the wage labor. Whereas Small, medium and big household were dependent on the selling agriculture product, business, wage labor, remittance and service. However, large

households were capable to fulfill their demand from selling agriculture products (Table 5.10)

Table 5.9: Overall surplus/ deficit /balance of the food

	Status		
Land holding Size	Surplus	Deficit	Balanced
Land less (1**)	-	1	-
Small (6)	1(16.7*)	5(83.3)	-
Medium (23)	2(8.69)	11(47.82)	10(43.47)
Big (27)	17(62.96)	3(11.11)	7(25.92)
Large (7)	7(100)	-	-
Total (64)	27(42.19)	20(31.25)	17(26.56)

*The number in parenthesis indicate the percentage and ** indicates no of household

Table 5.10Activities done for the deficit management

Land Holding Size	Activities	No of HH	%
Land less	Wage labor	1	100
	Total	1	
Small	selling agriculture product	1	16.67
	Business	1	16.67
	selling agriculture product+ Remittance	1	16.67
	wage labor +remittance	1	16.67
	Wage labor+ Service	1	16.67
	Service+ Remittance	1	16.67
	Total	6	
Medium	selling agriculture product	7	30.43
	selling agriculture product +service	4	17.39
	selling agriculture product +wage labor	1	4.35
	Business	2	8.70
	selling agriculture product+ Remittance	4	17.39
	wage labor	1	4.35
	wage labor +remittance	1	4.35
	Remittance	1	4.35
	Service	1	4.35
	Selling agriculture product+ Business	1	4.35
	Total	23	
Large	selling agriculture product	21	77.78
	selling agriculture product+ service	1	3.70
	selling agriculture product +wage labor	2	7.41
	selling agriculture product+ Remittance	2	7.41
	wage labor	1	3.70
	Total	27	
Very Large	selling agriculture product	7	100
	Total	7	

e. Residence period and Ethnicity

The early settlers who were living more than 30 years comprised 79.7 %, middle settlers and late settlers comprised 17.2 % and 3.1 % respectively (Table 5.11).

Table 5.11 Distribution of Household by settlement period

Category Settlers	No of HH	%
Late Settlers (<=10yrs)	2	3.1
Middle Settlers (>10-<=30yrs)	11	17.2
Early Settlers (>30yrs)	51	79.7

The residence of household based on ethnic group is presented in Figure 5.3. In the study area, the Tharu/Darai ethnic group were early settlers and 15.38 % of Brahamin/Chettri group were late settlers.

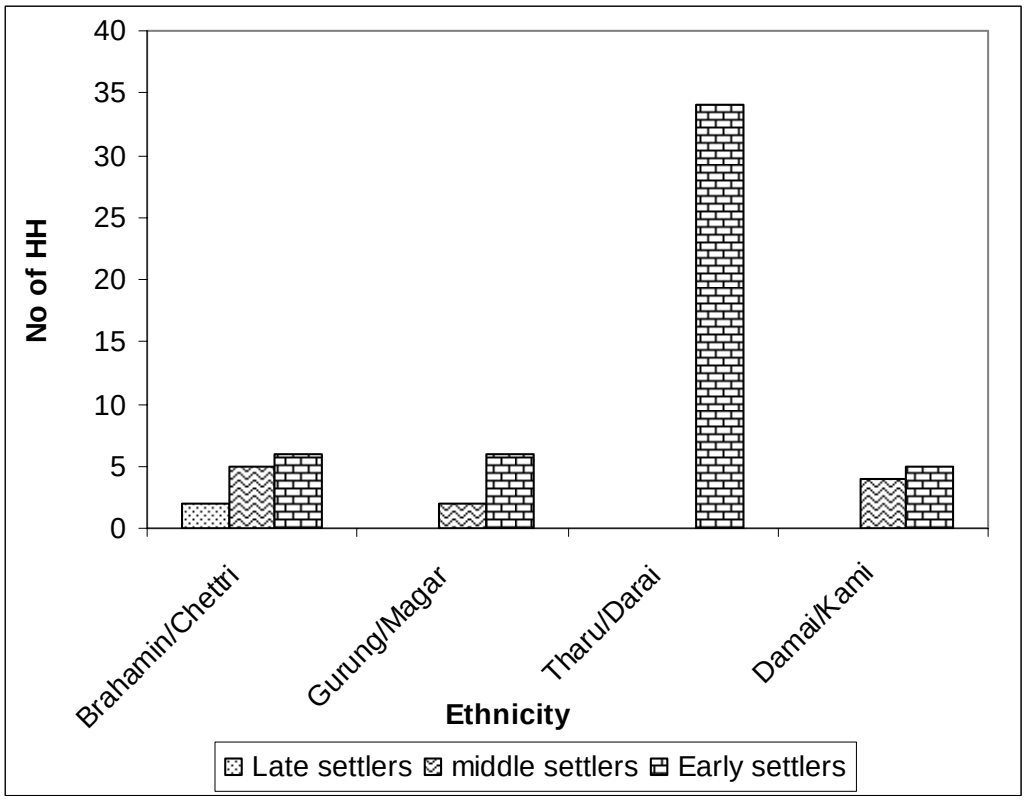

Figure 5.3 Residence status of different ethnic group

f. Livestock Holding

Altogether 342 livestock were found in the study area with average of 5.34 livestock per household. Buffalo, cow and goat/sheep were major livestock types in the study area. Big farm size holding has large number of livestock About 61 household (95.31 %) had one of the above mentioned livestock. Among households without livestock, one was landless, one from small size farm holder, one from medium size farm holder. Based on caste/ethnicity, Tharu/Darai group had the highest number livestock, followed by Brahmin/Chettri group. Gurung/Magar group had less number of livestock compared to other caste groups (Annex 4)

Table 5.12 Distribution of livestock based on farm size

Land holding Size	Buffalo	Cow	Goat / Sheep
Small	3	6	5
Medium	17	32	64
Big	49	39	92
Large	15	4	16
Total	84	81	177

Total livestock unit was 151.87 with mean LSU of 2.37. Small household occupy 4.1 % of livestock with mean LSU of 1.2. Medium household occupy 33.04 % of livestock with mean LSU of 1.97. Big household occupy 52.63 % of livestock with mean LSU of 3.02. Large household occupy 10.23 % of livestock with mean LSU of 2.51 (Table 5.13). Based on ethnicity Damai/Kami group has highest number of livestock unit followed by Brahamin/Chettri group (Annex 5).

Table 5.13 Livestock unit based on the Land Holding size

Land holding Size	No of HH	Mean LSU	Total LSU
Landless	1	0	0
Small	6	1.2	7.23
Medium	23	1.97	45.41
Big	27	3.02	81.6
Large	7	2.51	17.63
Total	64	2.37	151.87

For buffalo, stall feeding is the most common in the study area followed by the combination of stall feeding and grazing practices. For cow and goat/sheep both stall feeding and grazing practices were done (Table 5.14).

Table 5.14 Household livestock feeding types

	Household's Livestock Feeding types					
	Stall Feed		Grazing		Both	
Livestock	HH Number	Livestock Number	HH Number	Livestock Number	HH Number	Livestock Number
Buffalo	29	45	0	0	14	39
Cow	9	19	6	12	20	50
Goat/Sheep	14	44	7	21	20	112

g. Household energy consumption pattern

Kerosene and electricity were used by 92.2 % of household respectively. While LPG (Liquefied petroleum gas) was used by 7.8 % of household and biogas was used by 4.7 % of household (Table 5.15).

Table 5.15 Household's energy sources

Energy Used	No of HH	%HH
Kerosene	59	92.2
Electricity	59	92.2
LPG	5	7.8
Biogas	3	4.7

The household distribution of energy use types varied with the household farm size. Almost 92 % of all farm size household used kerosene for lighting purpose. Similarly 92.2 % of household had access of electricity. Of these, 100 % landless, 66.6 % small, 47.8 % medium and 11.1% big household were using electricity illegally. Almost 7 % and 4 % of the household had access of LPG (Liquid Petroleum Gas) and biogas (Table 5.16).

Table 5.16 Energy use and Land holding size

Land holding	No of HH	Kerosene	Electricity	Electricity Theft	LPG	Biogas
Landless	1	1		1		
small	6	6	2(33.3)	4(66.6)	1(16.6)	
Medium	23	20(86.9)	9(39.1)	11(47.8)	3(13.1)	
Big	27	25(92.5)	22(81.5)	3(11.1)	1(3.7)	1(3.7)
Large	7	7	7			2(28.6)
Total	64	59	40	19	5	3

*The figure in parenthesis indicates percentage.

Based on ethnicity, all ethnic group uses kerosene and electricity but electricity use illegally were 46.2 % from Brahamin/Chettri group, 25 % from Gurung/Magar, 23.5 % from Tharu/Darai and 33.3 % from Damai/Kami group. 55.55 % of Damai/Kami caste group has no access of electricity. Biogas plants was used only by Tharu/Darai household and LPG were used by Brahamin/Chettrri and Gurung /Magar households (Table 5.17).

Table 5.17 Energy consumption based on Ethnicity

Ethnicity	N	Kerosene	Electricity	Electricity theft	LPG	Biogas
Brahamin/Chettri	13	12(92.3*)	7(53.8)	6(46.2)	3(23.1)	-
Gurung/Magar	8	7(87.5)	6(75)	2(25)	2(25)	-
Tharu/Darai	34	31(91.2)	26(76.4)	8(23.5)	-	3(8.8)
Damai/Kami	9	9	1(11.1)	3(33.3)	-	-
Total	64	59	40	19	5	3

* The figure in parenthesis indicates percentage.

h. Household Resources need and access

Total annual green fodder and fuel wood need was 2482200 kg and 163840 kg in the study area with mean annual need per household 38784.4 kg and 2560 kg respectively. According to farm size, big farm holding size need more fodder with the average of 47800 kg/yr. similarly large farm holding size consume 41142.8 kg/yr, medium farm holding size consume 33417.4 kg/yr, and small household consume 22500 kg/yr of fodder. Fuel wood consumption was found high in large farm holding size with average of 4285.71 kg /yr followed by big farm holding size (Table 5.18).

Table 5.18 Need of fodder and fuel wood according to farm size

Land holding Size	Fodder (Kg / year)	Fuel wood (kg / year)
Land less (1)	-	1600
Small (6)	135000	10400
Medium (23)	768600	46800
Big (27)	1290600	75040
Large (7)	288000	30000
Total (64)	2482200	163840

Sources for the green fodder were own land, community forest, and national park. In the study area only 1.6 % of household that were dependent fully on community forest. About 37.5 % of household were totally dependent on their own land for green fodder, these household were 10 from big farm holders, 6 from medium and large farm holders each and 2 from small farm holders size, but 48.4 % of household were dependent on both community forest and own land for green fodder. There was no household that totally dependent on National Park for green fodder but 1.6 % of household said that they use National Park and own land and 6.3 % of house hold said that they use National Park ,community forest and own land for green fodder (Table 5.19)

Table 5.19 Different sources for green fodder

Farm size	No of HH	Non-user	*OL	**CF	CF+OL	***NP+OL	NP+CF+OL
Landless	1	1	-	-	-	-	-
Small	6	1(16.7)	2(33.3)	-	3(50)	-	-
Medium	23	1(4.3)	6(26.1)		15(65.2)	-	1(4.3
Big	27	-	10(37)	1(3.7)	12(44.4)	1(3.7)	3(11.1)
Large	7	-	6(85.7)	-	1(14.3)	-	-
Total	64	3(4.7)	24(37.5)	1(1.6)	31(48.4)	1(1.6)	4(6.3)

*OL= Own Land, ** CF=Community forest, ***NP= National Park
Number in parenthesis represents percentage.

The household fuel wood access from five different sources is presented in Table 5.20. About 87.5 % of sampled household were using the national park as a source of fuel wood of which 31.25 % of household fully dependent on national park for the fuel wood. While 29.09 % of sampled household were using community forest as a

source of fuel wood of which only 4.69 % fully dependent on community forest. The other source for fuel wood were own land, river and buy from market.

About 87.5 % of sampled household were using Park as a source of fuel wood. Out of this 66.66 % belonged to small farm hold, 86.95 % belonged to medium farm hold, 92.5 % belonged to big farm hold, and 85.71 % belonged to large farm holding size , but about 30 % of household use community forest. However, about 30 % of household buy fuel wood from local market, similarly 14 % of households were also use own land as a source of fuel wood, of this 42.85 % belonged to large farm holders,14.81 % belonged to big farm holders, and 8.69 % belonged to medium farm holders. About 9.37 % of household collect fuel wood from river (Table 5.21 and Annex 6)

Table 5.20 Source for fuel wood

source	Frequency	Percent
Parks	20	31.25
Community forest	3	4.69
Buy	4	6.25
Parks + community forest	11	17.19
Community forest + own land	1	1.56
Park + Own land +Buy	3	4.69
Park + Buy	11	17.19
Park + Own land	1	1.56
River + Own land + Park	1	1.56
Park + River	5	7.81
Park + Community forest +Buy +River	1	1.56
Park + Community forest +Own land	3	4.69

Table 5.21 Source of fuel wood and farm holding size

Farm holding size	Fuel wood source*				
	NP	CF	OL	Buy	River
Landless (1)	1	1			
Small (6)	4(66.66)	1(16.66)		1	1
Medium (23)	20(86.95)	5(21.73)	2(8.69)	6(26.08)	3(13.04)
Big (27)	25(92.5)	11(40.74)	4(14.81)	8(29.6)	2(7.4)
Large (7)	6(85.71)	1(14.28)	3(42.85)	4(57.14)	
Total (64)	56(87.5)	19(29.68)	9(14.06)	19(29.68)	6(9.37)

*NP=national Park, CF=Community Forest, OL=Own Land
Number in parenthesis represent percentage.

5.1.3 Buffer zone community forest

a. Buffer zone household member

About 47 sampled households (73.14 %) were general member of BZCF where as 17 household (26.6 %) were not the member of community forest. those were one from Brahmin/Cheetri, one from Gurung/Magar and fifteen from Tharu/Darai group. Two from small, five from medium, six from big and four from large land holding size households were not the member of the community forest

Among 64 sampled households, 15 households (23.43 %) told that they are not allowed to use the resources from BZCF.

b. Resources use from BZCF by households

Khar, fodder, and fuel wood are the resources extracted from the BZCF by sampled households. Among 64 sampled households, 19 households (29.69 %) are the non-user of the BZCF (Table 5.22). Based on farm holding size those who doesn't use BZCF are 33.33 % from small, 26.08 % from medium, 22.22 % from big and 71.42 % from large Land holding size (Annex7)

Table 5.22 Type of resource extraction from BZCF

Resources use	No of HH	Percent
Non user	19	29.69
Khar	8	12.5
Fuel wood	1	1.56
Fodder+Khar	17	26.56
Khar+Fuel wood	1	1.56
Fodder+Khar+Fuel wood	18	28.13
Total	64	100

c. Perception on the condition of BZCF

The household perception on the condition of buffer zone condition forest in present and past is presented in Figure 5.4. Among 64 household 21.88 % household did not response the question. At present 14.06 % felt the forest condition was poor, 17.04 % felt the condition was satisfactory, 37.50 % considered good and 6.25 % felt as very good. Similarly 3.13 % and 9.38 % have no idea about the condition forest in present and past respectively. However, 1.56 % feels that forest is very good in the past (Annex 8).

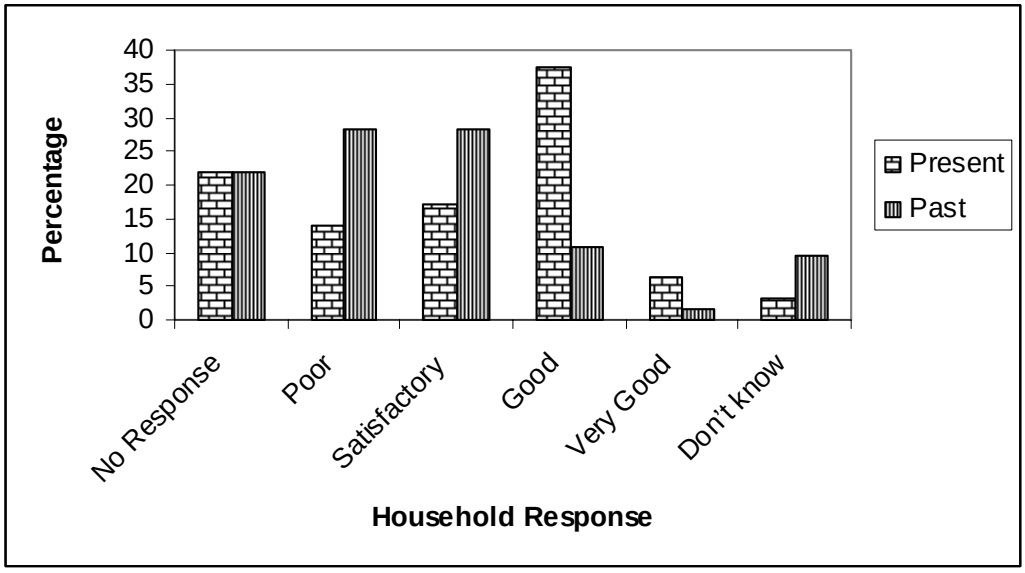

Figure 5.4 Household Perception on the condition of BZCF

d. Perception on buffer zone budget

Most of the respondent (75 %) answered that there was insufficient budget for buffer zone community forest. but 25 % respondents were unknown about the budget allocation for buffer zone (Table 5.23)

Table 5.23 Perception on buffer zone/BZCF budget

Budget	respondent	%
Insufficient	48	75
Unknown	16	25

e. Problem in community forest

The problem faced by household from the community forest is presented in Table 5.24. Sampled households pointed 14 different problems at the BZCF. Out of them, wild animal problem in BZCF was highly prioritized. Similarly, river cutting and flooding, insufficiency of resources due to sparse forest, forest dying due to invasive species, no strong management, insufficient of fuel wood were other issues. 4.65 % households were unknown about the problems.

Table 5.24 Problem in community forest

Problem	Frequency	%
Wild animal problem	20	23.26
River cutting and flooding	14	16.28
Insufficiency of resources due to sparse forest	12	13.95
No strong management	4	4.65
Forest dying due to invasive species	5	5.81
Unknown about the problem	4	4.65
insufficient of fuel wood	3	3.49
Not Register forest	2	2.33
problem of security	1	1.16
No response	15	17.44
cannot be use resources when needed	1	1.16
Forest is degraded	2	2.33
Steeling resources	1	1.16
No knowledge about conservation	2	2.33

f. Household Suggestion for better management of BZCF

The result of household suggestion for better management of BZCF is presented in Table 5.25. Of total 21.35 % respondent had no suggestion as they said they have no idea. About 16.85 % response was for more plantations and 13.48 % response was for awareness and gabion walls to check river cutting/ flood control. likewise 8.99 % response were suggest for managed conservation by fencing, better protection from wildlife, enforce strong management team, removal of invasive species, control of livestock grazing, conservation with utilization, control burning, and alternative skill development were other suggestion for the better management of BZCF.

Table 5.25 Suggestion for better management of BZCF

Response	Frequency	%
No suggestion/Don't know	19	21.35
More Plantation	15	16.85
Gabion walls to check river cutting/Flood control	12	13.48
Awareness	12	13.48
Managed conservation by fencing	8	8.99
Better protection from wildlife	6	6.74
Enforce strong management team	5	5.62
Removal of invasive species	5	5.62
Control of livestock grazing	2	2.25
Conservation with utilization	2	2.25
Control burning	2	2.25
alternative skill development	1	1.12

5.1.4 Rhino/Wildlife related issues

a. Rhino Movement

There was high rhino movement in the past causing severe crop damage. However, at present, only 39 respondents (60.94 %) said that rhino movement increases into their area, while19 respondent (26.69 %) said that rhino movement has decrease into their area. The movement of rhino increased reported were respondent who are close to near by forest. About 46 respondents said that rhino give them serious problem by damaging crop. About 21.9 % respondent said that rhino give them more than 9 months problem, similarly 29.7 % said 6-9 month, 12.5 % said 3-6 month, 9.4 % said 1-3 month and 26.6 % respondent said that rhino did not give them problem.

b. Crop damage by rhino and compensation measures

Crop damage was major problems due to rhino. Of total 44 sampled households (68.75 %) were reported that rhino damage their crops. Paddy (60.93%) was found to be lost by high number of household, thereafter Buckwheat (50%) and Maize (48.43%), while Wheat and Vegetable loss was reported from only two household (Table 5.26)

Table 5.26 Crop damage by rhino.

Crops	Amount(Kg/yr)	N of HH	Average Loss (Kg/yr)
Paddy	7093	39	181.87
Maize	2962	31	95.54
Buckwheat	2414	32	75.43
Pulse	255	9	28.33
Wheat	340	2	170
Vegetable	50	2	25
Oilseed	20	1	20

Livestock loss was reported from 9 households. 13 livestock were found to be killed by wild animals. Three households reported that bear eat their beehive, 6 households reported that their goat/sheep were eaten by tiger, 2 from jackal and 2 households reported that their cattle and buffalo were killed by tiger. Livestock loss due to

wildlife reported were 21.73 % from medium and 14.81 % from big land holding size. Similarly, beehive loss reported were 8.69 % from medium and 3.7 % from big land holding size (Table 5.27)

Table 5.27 Livestock loss due to wild animal

	Wild animal		
Livestock	Tiger	Jackal	Bear
Goat/Sheep	8	2	-
Cattle	1	-	-
Buffalo	2	-	-
Beehive	-	-	7

Household said that they did not have compensation for crop damage by rhino. Among nine households who lost their livestock only one household got compensation.

c. Cause of rhino decrease

Upon sampled household 39 household said that rhino has increased but 19 sampled household said that the movement of rhino has decreased and 6 household said rhino movement has remain same. The main reason for rhino decrease were poaching, habitat loss, and natural death, 4 sampled household said that they have no idea abut rhino decrease (Table 5.28)

Table 5.28 Cause of rhino decrease

Cause of Rhino decrease	Frequency	Percent
unknown	4	6.25
Poaching	6	9.38
Habitat Loss	6	9.38
Habitat Loss+Poaching	5	7.81
Natural death+ Habitat loss+Poaching	2	3.13
Natural death+Poaching	2	3.13

Household respondent that the main reason for rhino poaching is for money/employment (35.94 %), other reason for rhino poaching were high income in short period, benefit from low security, lack of awareness, encourage from high level poacher, and for livelihood. 31.25 % respondent said that they had no idea why rhino is poached (Table 5.29).

Table 5.29 Reason for rhino poaching

Reason	Frequency	%
Unknown	20	31.25
for Money/employment	23	35.94
Benefit from low security	5	7.81
Encourage from high level poacher	4	6.25
for livelihood	2	3.13
Lack of awareness	4	6.25
High income in short period	6	9.38

d. Opportunities for poacher to stop rhino poaching

Of total 23.44 % of respondents hoped provision of employment could stop rhino poaching, and other recommended were strict law and policy, management for livelihood, security high, empower anti poaching unit, alternative job and skill development. However about 20.31% household did not response the question (Table 5.30).

During the study, I found both BZUC president and vice president were accused of rhino poaching. The vice president of the BZCM was sentenced to jail, later.

Table 5.30 Opportunities to stop rhino poaching

Opportunities	Frequency	%
No response	13	20.31
Provision of employment	15	23.44
Awareness among poacher	3	4.69
strict law and policy	8	12.5
Management for livelihood	6	9.38
No opportunities will stop it	3	4.69
security high	5	7.81
Alternative job and skill development	3	4.69
Empower Anti poaching unit	4	6.25
send to prison	4	6.25

e. Activities done by the authorities to stop rhino poaching

About 29 % of households knew nothing about the activities done by authorities to conserve rhino. Similarly, 35.94 % of respondent said that awareness program was

done. Other programs were poster and pamphlets. About 20.31% of respondent blamed that nothing program has been done by authorities to conserve rhino (Table 5.31).

Table 5.31 Activities done by authorities to stop rhino poaching

Activities	Frequency	%
unknown	18	28.13
awareness program	23	35.94
nothing	13	20.31
Poster and pamphlets	3	4.69
establishment of security post	7	10.94

f. Household's suggestions for activities need to conserve rhino

Respondents gave the highest priority for awareness to all level people. Similarly, improved security, electric fencing, restriction of unknown person to enter inside the forest, mobilization of local people were also highly prioritized. Other prioritized activities were restriction rhino to enter into the village, importance of rhino, habitat management inside the park, establishment of antipoaching unit, poacher should be strictly punished, punished to high level poacher, removal of hotel from inside the park. 19.12 % respondents were unknown about what activities could conserve rhino. (Table 5.32)

Table 5.32 Household's suggestions for activities need to conserve rhino

Activities needs to be done to conserve Rhino	Frequency	%
unknown	13	19.12
awareness to all level people	11	16.18
improved security	8	11.76
electric fencing	7	10.29
restriction of unknown person to enter inside the forest	5	7.35
mobilization of local people	5	7.35
restriction rhino to enter into the village	4	5.88
habitat management inside the park	3	4.41
Know importance of rhino	3	4.41
establishment of Anti Poaching Unit	2	2.94
poacher should be strictly punished	2	2.94
no need to conserve rhino	2	2.94
high level poacher should be punished	2	2.94
hotel should be remove from park	1	1.47

5.1.5 Land use pattern in Dibaynagar VDC (1978-1992)

The total land Occupied by Dibaynagar VDC is 1866.0 ha. There were three categories of land in Dibaynagar VDC in 1978 (Annex 9), which were Agriculture, Grassland and Water bodies. Agriculture land occupied 98.54 % of land followed by grassland and water bodies. However, in 1992 it increased to seven categories of land Forest, Lake/Pond, Built up area and Orchard were added (Annex 10). Agriculture land was the major land type in 1992, but it decreased by 0.79% as compare to 1978, while Grassland decreased by 93.51 % (Table 5.33).

Table 5.33 Different Land cover Area between 1978 and 1992

Land cover Categories	Area in 1978 (ha)	% of land cover in 1978	Area in 1992 (ha)	% of Land cover in 1992	Difference in Land Cover 1978-1992 (ha)	Change in Cover 1978-1992 (%)	% Unchanged land cover Between 1978- 1992 (ha)
Agriculture Land	1838.73	98.54	1824.20	97.76	-14.53	-0.79	98.47
Grassland	25.70	1.38	1.67	0.09	-24.03	-93.51	-
Water bodies	1.57	0.08	16.53	0.89	14.96	952.47	15.28
Forest	0	0.00	7.48	0.40	7.48	0.40	-
Lake/Pond	0	0.00	1.63	0.09	1.63	0.09	-
Builtup Area	0	0.00	11.32	0.61	11.32	0.61	-
Orchard	0	0.00	3.17	0.17	3.17	0.17	-

Out of 1838.73 ha of agriculture land in 1978, 98.47% remained unchanged, remaining changed into grassland, Water bodies, Forest, Lake/Pond, Builtup area, orchard. Hundred % of Grassland area was changed into other categories. Similarly, out of 1.57 ha of water bodies in 1978, 15.28 % remained unchanged (Table 5.34 and Figure 5.5)

Table 5.34 Land Cover change into different categories in between 1978 and 1992

Land Cover Categories	Area in ha						
	Agriculture Land	Grassland	Water bodies	Forest	Lake/Pond	Builtup Area	Orchard
Agriculture Land	1810.66	1.67	10.07	0.21	1.63	11.32	3.17
Grassland	12.21	-	6.22	7.27	-	-	-
Water bodies	1.33	-	0.24	-	-	-	-
Forest	-	-	-	-	-	-	-
Lake/Pond	-	-	-	-	-	-	-
Builtup Area	-	-	-	-	-	-	-
Orchard	-	-	-	-	-	-	-

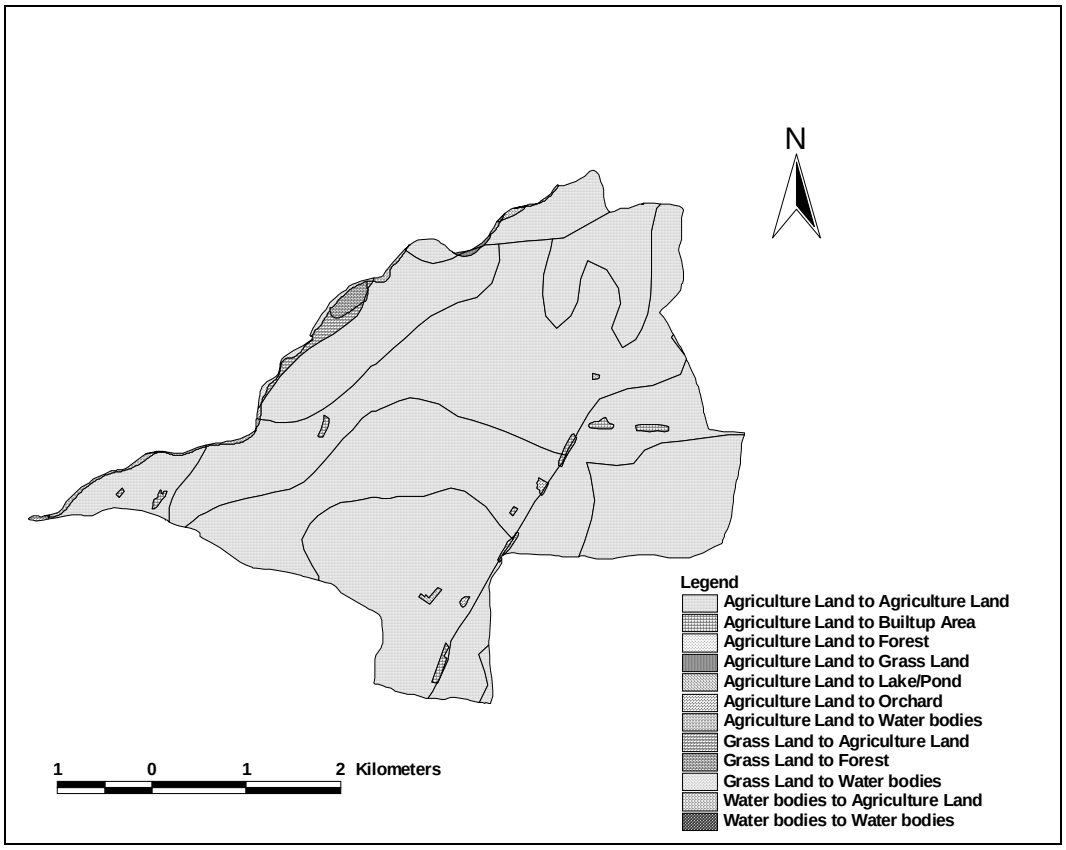

Figure 5.5 Land use change of Dibaynagar VDC (1978-1992)

5.1.6 Vegetation analysis

a. Tree Species

Six tree species of five families were found in the study area. But in tree plot five species from four families only found. The diameter of tree ranges from >10 to 41.83 cm with total density of tree was 100.86 per hectare, of which *Dalbergia sissoo*

having highest density of 69.83/ha, and followed by *Bombax ceiba* (12.07/ha) and other species were Litsea *monopetala*, *Trewia nudiflora* and *Acacia catechu* with low density (Table 5.35). Total basal area was 4.43m²/ha. Of which highest was found in *Dalbergia sissoo*. The relative basal area was also highest in *Dalbergia sissoo* (75.85%) and followed by *Bombax ceiba* (9.48%). The IVI showed that *Dalbergia sissoo* were dominant species in the study area.

Table 5.35 Importance Value Index (IVI) of tree species

Species	D(no/ha)	RD	F	RF	BA(m²/Ha)	RBA	IVI
Acacia catechu	5.17	5.13	13.79	15.38	0.2	4.51	25.02
Bombax ceiba	12.07	11.97	20.69	23.08	0.42	9.48	44.53
Dalbergia sissoo	69.83	69.23	37.93	42.31	3.36	75.85	187.39
Litsea monopetala	8.62	8.55	6.9	7.69	0.19	4.29	20.53
Trewia nudiflora	5.17	5.13	10.34	11.54	0.26	5.87	22.53
Total	100.86		89.65		4.43		

D = Density, RD = Relative density, F = Frequency, RF = Relative frequency, BA= Basal Area, RBA = Relative Basal Area, IVI = Important Value Index

b. Volume and Biomass of Tree Species

The total volume and Biomass of tree species is presented in Table 5.36. The Total tree Volume and Biomass in the study area was found to be 13.82 m³/ha and 18.11 t/ha respectively. *Dalbergia sissoo* had occupied 86.57 % of total volume and 87.24 % of Biomass, *Bombax ceiba* had occupied 5.39 % of total volume and 4.58 % of Biomass. *Acacia catechu, Trewia nudiflora and Litsea monopetala* constitute very small percentage of Volume and Biomass.

Table 5.36 Volume and biomass of tree species

Species	Volume (m³/Ha)	% volume	Steam Biomass (t/ha)	Branch Biomass (t/ha)	Leaf Biomass (t/ha)	Total Biomass (t/ha)	% Biomass
Acacia catachu	0.49	3.54	0.47	0.32	0.005	0.80	4.39
Bombax ceiba	0.74	5.39	0.54	0.26	0.03	0.83	4.58
Dalbergia sissoo	11.96	86.57	9.33	6.38	0.09	15.80	87.24
Litsea monopetala	0.27	1.94	0.19	0.09	0.01	0.29	1.60
Trewia nudiflora	0.36	2.59	0.26	0.12	0.01	0.39	2.15
Total	13.82		10.79	7.17	0.145	18.11	

c. Sustainable Resources Yield

Annual Yield and sustainable supply of the BZCF is presented in Table 5.37. Total annual yield from Dibaynagar BZCF is 0.9262t/ha/yr, of which 0.81 t/ha/yr from *Dalbergia sissoo,* 0.0408 t/ha/yr from *Acacia catechu,* 0.0404 t/ha/yr from *Bombax ceiba* , 0.0195 t/ha/yr from *Trewia nudiflora* and 0.0143 t/ha/yr from *Litsea monopetala*. Sustainable fuelwood supply from BZCF was 0.7516 t/ha/yr of which 87.93% from *Dalbergia sissoo* and 4.42% from *Acacia catechu*. Total Sustainable green fodder supply from leaf was 0.0076t/ha/yr.

Table 5.37 Annual Yields and Sustainable Resources Supply

Species	Steam yield (t/ha/yr)	Branch yield (t/ha/yr)	Leaf yield (t/ha/yr)	Total biomass yield (t/ha/yr)	Sustainable fuelwood supply From BZCF (t/ha/yr)	% of sustainable fuel wood supply	sustainable fodder supply from leaf (t/ha/yr)
Acacia catachu	0.0241	0.0165	0.0003	0.0408	0.0332	4.4200	0.0002
Bombax ceiba	0.0262	0.0126	0.0016	0.0404	0.0314	4.1739	0.0015
Dalbergia sissoo	0.4787	0.3274	0.0050	0.8112	0.6609	87.9321	0.0045
Litsea monopetala	0.0094	0.0042	0.0007	0.0143	0.0110	1.4627	0.0006
Trewia nudiflora	0.0126	0.0061	0.0008	0.0195	0.0151	2.0146	0.0007
Total	0.5509	0.3668	0.0084	0.9262	0.7516	-	0.0076

d. Sustainable Forest Resources Supply and Estimated Demand

Demand on resources (fuelwood and green fodder) was found to be higher than the supplying capacity of the BZCF (Table 5.38)

Table 5.38 Supply and demand of forest resources.

Total Forest area	360.0 ha*
Total Estimate Green fodder need (t/yr)	19275.83
Total Estimate Fuel wood need (t/yr)	1272.32
Sustainable Green Fodder supply From BZCF (t/yr)	2073.6
Sustainable Fuelwood supply From BZCF (t/yr)	270.58
Deficit Green Fodder (t/yr)	-17202.23
Deficit Fuelwood (t/yr)	-1001.47

*including grassland area.

e. DBH Classification of Trees

From the DBH classification of trees in the study area poles 56.41% represent the highest, followed by small saw timber with 28.21 % and sapling with 15.38 %. Large saw timber was absent in the study area (Figure 5.6 and Annex 11)

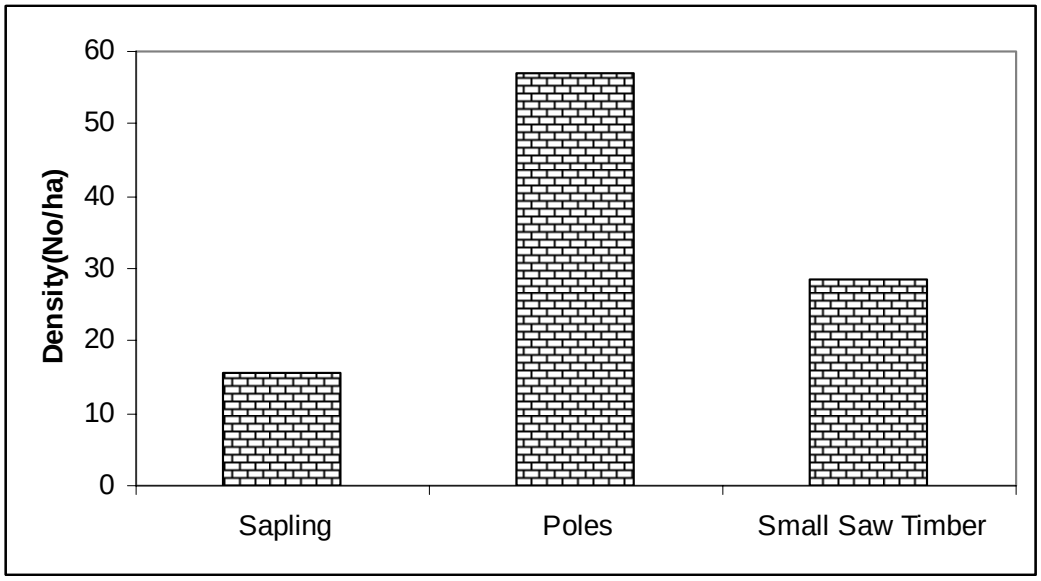

Figure 5.6 DBH class of trees

Dalbergia sissoo dominated all species in sapling, poles and small saw timber categories followed by *Bombax ceiba* in sapling and small saw timber categories and *Litsea monopetala* in poles categories (Figure 5.7 and Annex 12).

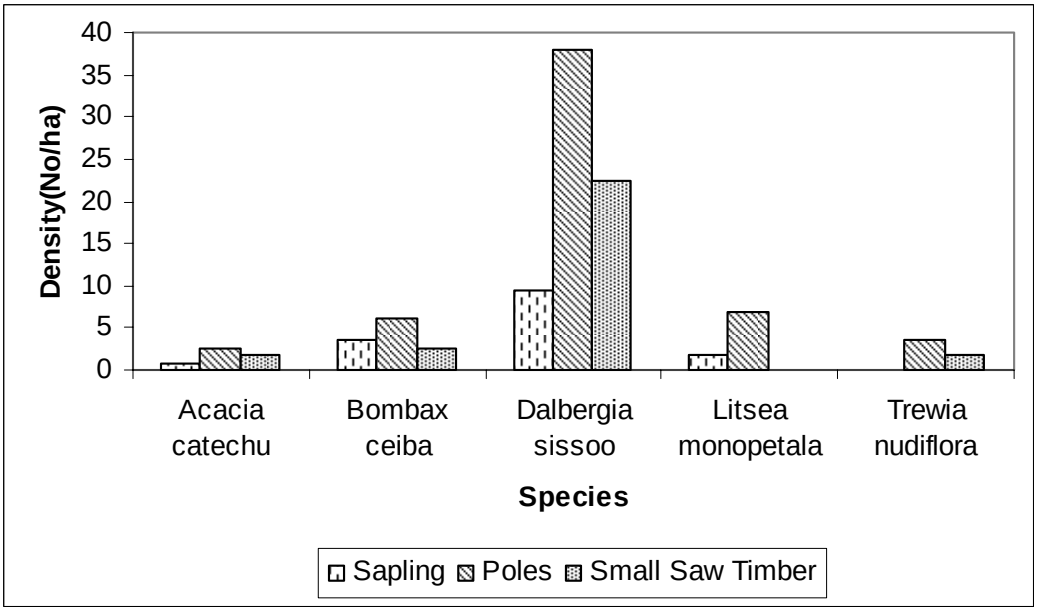

Figure 5.7 DBH class of each species

The number of trees in-group 10-15cm was highest (28.20%) followed by 16-20cm (24.78%), the least number of tree was in group 41-45cm (1.71%). *Dalbergia sissoo* species were dominant in the DBH class at 5cm interval (Figure 5.8 and Annex 13)

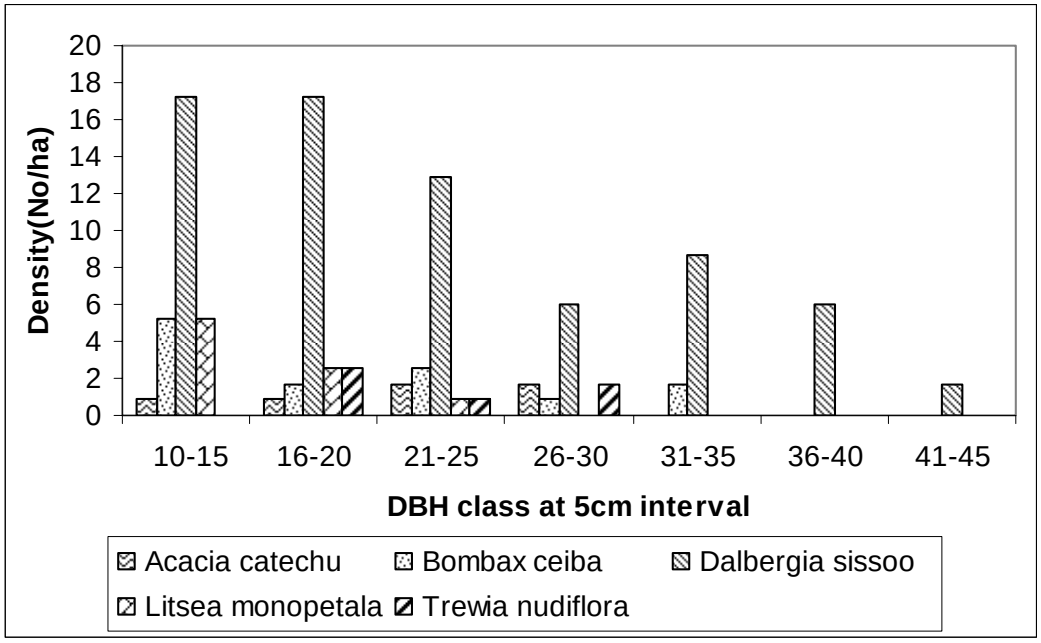

Figure 5.8 DBH category at 5cm interval

f. Shrubs

There were 53 plant species of 30 families (Annex 15). The total density of plant species in shrub plot was found 19696.55/ha. The highest density was of *Ageratum sp*. (3786.21/ha), followed by *Desmodium sp*. (2579.31/ha). Similarly, other species are *Ganostegia hirta, Dalbergia sissoo, Pogostemon benghalensis, Eupatorium adenophorum, Colebrookea oppositifolia* had higher density in compare to other species. *Dalbergia sissoo* had the highest frequency (63.79 %), followed by *Desmodium* sp. (46.55) and *Colebrookea oppositifolia* (29.31 %). The least frequency was 1.72 % (Table 5.39).

Table 5.39 Density and Frequency of species in shrub strata

Plant species	Density(no/ha)	Relative Density	Frequency	Relative frequency
Abel moselus spp.	6.90	0.03	1.72	0.38
Acacia catechu	213.79	1.08	15.52	3.38
Adina cordifolia	6.90	0.03	1.72	0.38
Ageratum spp.	3786.21	19.09	22.41	4.89
Arisaema spp.	34.48	0.17	1.72	0.38
Asparagus racemoscus	482.76	2.43	5.17	1.13
Boehmeria rofundifolia	262.07	1.32	12.07	2.63
Bombax ceiba	131.03	0.66	17.24	3.76
Callicarpa macrophyla	82.76	0.42	8.62	1.88
Chrysopogan aciculatus	379.31	1.91	8.62	1.88
Clerodendron spp.	20.69	0.10	1.72	0.38
Clerodendron viscosum	220.69	1.11	6.90	1.50
Colebrookea oppositifolia	834.48	4.21	29.31	6.39
Commelina sp	41.38	0.21	1.72	0.38
Cucurbitaceae family	117.24	0.59	5.17	1.13
Dalbergia sissoo	1282.76	6.47	63.79	13.91
Desmodium sp	2579.31	13.00	46.55	10.15
Dioscorea spp.	20.69	0.10	3.45	0.75
Dryopteris cochleata	668.97	3.37	5.17	1.13
Elephantopus Scaber	34.48	0.17	1.72	0.38
Equisetum diffusum	241.38	1.22	1.72	0.38
Eupatorium adenophorum	931.03	4.69	24.14	5.26
Euphorbia hirta	517.24	2.61	1.72	0.38
Ficus spp.	20.69	0.10	3.45	0.75
Flemingia macrophylla	6.90	0.03	1.72	0.38
Ganostegia oppositifolia	144.83	0.73	3.45	0.75
Gonostegia hirta	2068.97	10.43	17.24	3.76
Gurmi *	6.90	0.03	1.72	0.38
Ipomoea quamoclit	13.79	0.07	1.72	0.38
Latre jhar *	475.86	2.40	6.90	1.50
leea aspera	6.90	0.03	1.72	0.38
Litsea monopetala	41.38	0.21	3.45	0.75
Marsdenia roylei	75.86	0.38	6.90	1.50
Micania micarantha	517.24	2.61	17.24	3.76
Mimosa pudica	310.34	1.56	15.52	3.38
Muraya coenigii	82.76	0.42	3.45	0.75
Oplismenus burmanii	144.83	0.73	5.17	1.13
Paduwa jhar *	151.72	0.76	5.17	1.13
passiflora spp.	6.90	0.03	1.72	0.38
Phragmaties karka	131.03	0.66	3.45	0.75
Physolis spp.	475.86	2.40	6.90	1.50
Pogostemon benghalensis	986.21	4.97	22.41	4.89
polygonum spp.	241.38	1.22	1.72	0.38
Premma integrifolia	20.69	0.10	1.72	0.38
Pteris sp.	400.00	2.02	10.34	2.26
Solanum erianthum	41.38	0.21	3.45	0.75
Solanum capsicoidis	6.90	0.03	1.72	0.38
Solanum xanthocarpum	6.90	0.03	1.72	0.38
Tetrastigma serrulatum	117.24	0.59	3.45	0.75
Trewia nudiflora	20.69	0.10	5.17	1.13

Unyu*	296.55	1.50	6.90	1.50
Urena sp.	13.79	0.07	1.72	0.38
Zizipus mauritiana	103.45	0.52	3.45	0.75
Total	19834.48	100.00	458.62	100.00

***** Local name

g. Herbs

Total 34 plant species from 18 families were found in the Herb plot (Annex15). The total density of herb was 283275.86/ha of which *Saccharum spontaneum* (11896.55/ha) had highest density followed by *Imperata cylindrica* (95344.83/ha), *Trifolium sp*. (6724.14/ha), *Digitaria setigeria* (6379.31/ha) had also more density relative to other species. *Imperata cylindrica* (84.48%) had highest frequency followed by *Saccharum spontaneum* (72.41%) and *Ageratum sp*. (22.41%). The frequency of other species is presented in Table 5.40.

Table 5.40 Density and Frequency of species in Herb strata

Species	Density (no/ha)	Relative density	Frequency	Relative frequency
Acacia catechu	517.24	0.18	3.45	1.10
Ageratum sp.	20172.41	7.12	22.41	7.18
Amele pate *	517.24	0.18	1.72	0.55
Asparagus racemoscus	344.83	0.12	1.72	0.55
Boehmeria rofundifolia	689.66	0.24	1.72	0.55
Bombax ceiba	517.24	0.18	3.45	1.10
Callicarpa macrophylla	344.83	0.12	1.72	0.55
Chrysopogan aciculatus	1379.31	0.49	3.45	1.10
Clerodendron viscosum	689.66	0.24	1.72	0.55
Colebrookea oppositifolia	2241.38	0.79	5.17	1.66
Cucurbitaceae	344.83	0.12	1.72	0.55
Cynodon dactylon	2068.97	0.73	3.45	1.10
Dalbergia sissoo	3620.69	1.28	13.79	4.42
Desmodium sp.	1896.55	0.67	6.90	2.21
Digitaria setigeria	6379.31	2.25	8.62	2.76
Dryopteris cochleata	344.83	0.12	1.72	0.55
Eupatorium adenophorum	6206.90	2.19	10.34	3.31
Ghurmi *	172.41	0.06	1.72	0.55
Gonostegia hirta	4310.34	1.52	6.90	2.21
Imperata cylindrica	95344.83	33.66	84.48	27.07
Latre ghar *	2931.03	1.03	6.90	2.21
Mikania micarantha	2586.21	0.91	1.72	0.55
Mimosa pudica	1379.31	0.49	5.17	1.66
Muraya koenigii	1206.90	0.43	3.45	1.10
Oplismenus burmanii	517.24	0.18	1.72	0.55
Padua ghar *	1206.90	0.43	3.45	1.10
Pogostemon benghalensis	2241.38	0.79	5.17	1.66
Pteris sp.	172.41	0.06	1.72	0.55

Saccharum spontaneum	111896.55	39.50	72.41	23.20
Solanum capsicoidis	1206.90	0.43	1.72	0.55
Tetrastigma serrulatum	2413.79	0.85	5.17	1.66
Trewia nudiflora	172.41	0.06	1.72	0.55
Trifolium sp.	6724.14	2.37	13.79	4.42
Zizipus mauritiana	517.24	0.18	1.72	0.55
Total	283275.86	100.00	312.069	100.00

* Local name

h. Regeneration of Tree Species

The density of regeneration species with their height class is presented in Figure 5.9. The regeneration of 6 species from 5 different families was found in the study area. The total density of plant species was 1889.67/ha. The highest density was found for height class below 1m (1282.76/ha), followed height class 1-2m (393.10/ha). The lowest density was found in the height class 4-5m (6.90/ha) (Annex 14)

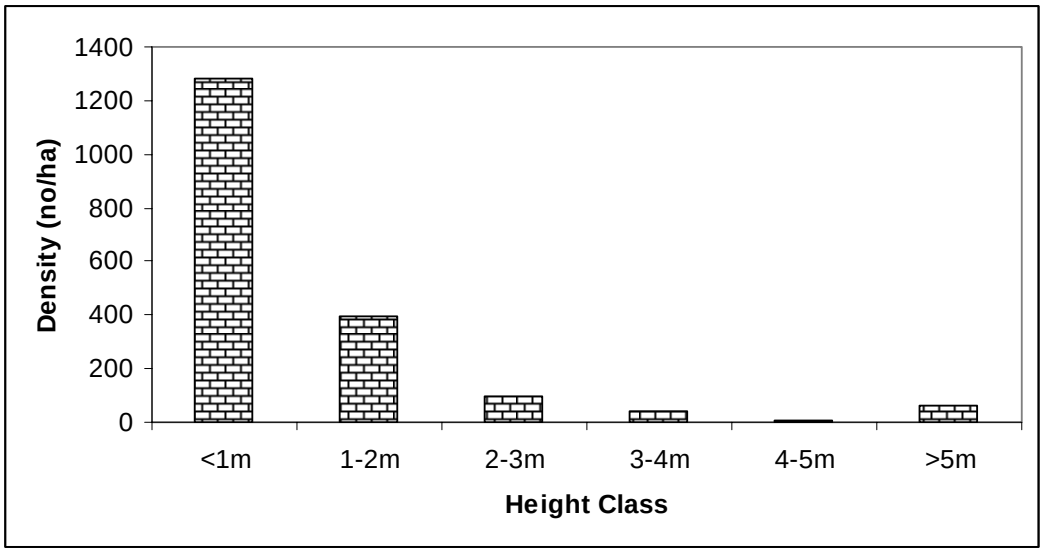

Figure 5.9 Regeneration of tree species by height class

Among the observed species, the highest density was observed for *Dalbergia sissoo*, followed by *Accacia catechu* and *Bombax ceiba*. The lowest density was observed for *Adina cardifolia*. Among all the species *Dalbergia sissoo* was found in all (<1 to >5m) height class (Table 5.41)

Table 5.41 Regeneration of tree species in the study area

Species	Density(no/ha) at different height class						Total
	<1m	1-2m	2-3m	3-4m	4-5m	>5m	
Accacia catechu	172.41	34.48	20.69	6.90	-	-	234.48
Adina cordifolia	-	-	6.90	-	-	-	6.9
Bombax ceiba	96.55	48.28	6.90	-	-	-	151.73
Dalbergia sisso	972.41	289.66	55.17	41.38	6.90	62.07	1427.59
Litsea monopetala	13.79	20.69	6.90	-	-	-	41.38
Trewia nudiflora	27.59	-	-	-	-	-	27.59
Total	1282.76	393.10	96.55	48.28	6.90	62.07	1889.67

i. Anthropogenic Pressure on the BZCF

The total density of cut stump was 12.92/ha. the density/ha of the cut tree species were highest for the girth class 21-30cm (5.17/ha) and the least was in girth class 31-40cm. cut stump was recorded for the girth class 21-30cm were *Dalbergia sissoo* (3.45/ha), *Bombax ceiba* (0.86/ha) and *Acacia catechu* (0.86/ha). In addition, for girth class 31-40cm only *dalbergia sissoo* (1.72/ha) was present (Table 4.42)

Table 5.42 Cut Stump Density

Species	Density(no/ha)of cut stump by different girth class				Total
	<=10cm	11-20cm	21-30cm	31-40cm	
Acacia catachu	0.86	-	0.86	-	1.72
Bombax ceiba	-	0.86	0.86	-	1.72
Dalbergia sissoo	2.59	0.86	3.45	1.72	8.62
Litsea monopetala	-	0.86	-	-	0.86
Total	3.45	2.58	5.17	1.72	12.92

The lopping intensity with density/ha of lopped species in BZCF is presented in Table 5.43. The total density/ha by lopping intensity were recorded highest for *Dalbergia sissoo* (13.8/ha), *Trewia nudiflora (*3.45/ha*), Litsea monopetala (*3.45/ha*), Bombax ceiba* (1.72/ha), *Acacia catechu* (0.86/ha*)*

Table 5.43 Lopping intensity of trees

Species	Lopping damage			
	Least (<=25%damage)	Medium (26-50%damage)	Large (51-75%damage)	Very high (>75%damage)
Acacia catachu	0.86	-	-	-
Bombax ceiba	1.72	-	-	-
Dalbergia sissoo	11.21	2.59	-	-
Litsea monopetala	3.45	-	-	-
Trewia nudiflora	0.86	2.59	-	-
Total	18.1	5.18	-	-

From the coverage study, the forest was found in poor condition as 41.67 % of sample plot was poorly stocked, 8.33 % of sample plot was found medium stock and 50 % of sample plot was well stocked.

Table 5.44 stocking of tree

Stocking	Area (m^2)	%
Poorly stocked	2000	41.67
Medium	400	8.33
well stocked	2400	50

j. Species Diversity

Shannon diversity index was calculated for tree, shrub, and herb species (Table 5.45). Highest diversity was found in shrub strata followed by herb strata.

Table 5.45 Shannon diversity index of plant species

Shannon diversity index	Total
Tree	0.445
Shrub	1.3
Herb	0.79

Chapter 6

DISCUSSION

6.1 Demographic character, household occupation and food security

Average family size (7.76/hh) in the sampled households were high compared to National-5.6/hh, District average-5.4/hh of Chitwan and also high compared to 6.16/hh for whole buffer zone area (CBS, 2001; DNPWC/PCP/UNDP, 2001). It was also higher than the family size of the Dibaynagar VDC-5.11/hh as estimated by DNPWC/PPP (2000). According to caste/ethnic group, Tharu/Darai (53.12 %) were dominant in the study area. This may be because they are the indigenous group (Paudel, 2004). In the study area, joint family was most common. The population under 15 yrs of age (28.57 %) in the sampled household is least compared to DNPWC/PPP (2000) at Dibaynagar VDC and centre Kasara buffer zone area of Chitwan National Park (42.2 %) given by DNPWC/PCP/UNDP (2001) and the dependent population was 39.6% in the sampled household.

The major occupation of the population was agriculture (59.33 %), which was lower compared to whole VDC (76.7 %) and district (73.5 %) given by DNPWC/PPP(2000). Among the sampled household 14.67% responded at least a member from their family engaged in work outside the country, but DNPWC/PPP (2000) reported that nobody has gone outside the country for the job. The population involved in the private as well as government service (11 %) was almost equal to the DNPWC/PPP (2000) but was lower compared to DNPWC/PCP/UNDP (2001) at Center Kasara sector buffer zone (22.7 %). Similarly, the population involved in the business was 4.66 %, which was almost equal to DNPWC/PPP (2000) for Dibaynagar VDC and DNPWC/PCP/UNDP (2001) for Center Kasara sector. But population depended on wage labor (2.33 %) was lower compared to the DNPWC/PPP (2000).

Farm size is the determining factor for food security, but in the present study not only the landless but big farmers also have food deficit. Food deficit household (31.25 %) was higher compared to DNPWC/PPP (2000), of which 100 % were from land less, 83.3 % from small, 47.82 % from Medium and 11.11 % from big land holding size. The variation may be due to the different sample size. Wage labor, service, and remittance have become major activities of these households to cope with food

scarcity. Accesses on business, service and remittance have become extra source of income of some sampled households.

6.2 Education status

Literacy rate in the sampled household were 86.79 %, which was higher compared to DNPWC/PPP (2000); DNPWC/PCP/UNDP (2001); Shrestha (2007). This shows the increasing trend of literacy rate. Literate (69.18 %), below SLC was higher but above SLC (10.27 %) was lower compare to Shrestha (2007). Based on the land holding size, education above SLC was found higher in large farm holding size (16.41 %), followed by big farm (11.68 %).This may be due to better economic condition. Brahmin/Chhetri group (19.2%) has higher education followed by Tharu/Darai group (9.3 %) which is similar to Shrestha (2007).

6.3 Livestock and access of energy

Livestock particularly have been recognized as agents of detrimental change in the composition, structure, and development of plant communities (Fleischner, 1994 c.f, Vavra et al.2007). About 96% percent of the households close to park and 94% close and far from forest raised livestock (Nepal and Weber 1993). The percentage of household having livestock (95.31 %) was similar to Joshi (1999) but higher compared to Shrestha (2007) for Kumroj VDC, Jnawali (1994) for Bachhauli VDC and Ghimire (2007) for Bhandara VDC. The average livestock head (LSH) (5.34LSH/hh) in the sampled household was higher compared to Centre Kasara sector of buffer zone given by DNPWC/PCP/UNDP (2001), DNPWC/PPP (2000) for Dibaynagar VDC and Ghimire (2007) for Bhandara VDC. The present study showed the increasing trend of livestock number which may lead to fodder supply deficiency in buffer zone community forest and may increase dependency in National Park.

Based on farm holding size, mean livestock unit (2.37LSU/hh) was lower compared to Shrestha (2007) for Kumroj VDC. The average livestock unit per household was higher in big land holding size, followed by large land holding size (Table 5.13). This may be due to large land on which livestock could graze. But distribution of livestock unit based on ethnicity was higher in Damai/Kami group (2.93LSU/hh), followed by Tharu/Damai group (2.36LSU/hh). However, Ghimire (2007) reported 53.76 % and 49.13 % of total LSU with indigenous and Brahmin/Chhettri group in the Bhandara VDC.

In the study area, 92.2 % of households have access to electricity of which 29.68 % use electricity illegally by using long poles with hooks. Ethnic group, Damai/Kami (55.55 %) had no access of electricity. Similarly, 92.2 % use kerosene but DNPWC/PPP (2000) reported that not a single house used kerosene. User of biogas (4.7 %) was higher compared to DNPWC/PPP (2000) in the Dibaynagar VDC. Tharu/Darai households having large and very large farm have access to biogas plant. Total of 7.8 % household have access to LP gas. 23.1 % of Brahmin/Chettri, and 25 % of Gurung/Magar caste/ethnic group have access to LP gas. However, Damai/Kami group have no access to modern energy sources, LPG and Biogas.

6.5 Resource need, access and dependency on park

Average fodder demand per livestock unit in the sampled household was 16344.24kg/LSU/yr, which is very high compared to Jnawali (1994). This may be due to different scale of conversion factor. Based on ethnicity, the green fodder consumption per LSU was higher in Gurung/Magar group followed by Brahamin/Chettri group and least in Damai/Kami group. However, Jnawali (1994) reported that Brahamin/Chettri group need more green fodder than Hill Matawali while Tharu indigeneous group need less. Based on farm holding size, more green fodder was required in small farm holding size followed by medium farm holding size.

Only 56.25 % household use community forest for green fodder, which is very high compared to Joshi (1999), and DNPWC/PPP (2000). Joshi (1999) reported that no collections were made from community forest. As community forest is opened only twice a year, HHs have to depend on their own land for green fodder. Present study showed 93.75 % HH dependent on their own land. Though DNPWC/PPP (2000) reported that no collection were made from National Park, present study showed 7.81% using fodder from National Park which is low compared to Joshi (1999). The people entering into the park for green fodder are from medium and large farm holding size.

The annual fuelwood consumption was 329.65kg/yr/capita, which is higher compared to Joshi (1999) for the whole buffer zone area. However, Edson et al. (1988) reported that per capita consumption of fuelwood in Bachauli was 649kg/yr while Sharma (1991) estimated 579 kg/yr for the people living around the CNP. Only 29.68 % of the sampled households are the user of BZCF as a source of fuelwood which is

similar to DNPWC/PPP (2000) for Dibaynagar VDC. Since BZCF does not provide enough fuelwood, National Park is the major source of fuelwood consumption. Use of resources such as firewood, grazing sites, fodder and other non-timber products have been increasing in Nepal's lowland protected areas (Jnawali1989; Sharma 1991; c.f, Wells & Sharma 1998). About 87.5% of the households collect fuelwood from the National Park, which is very high compare to Joshi (1999) for Dibaynagar VDC. However, DNPWC/PPP (2000) reported that 100% households collect fuelwood from National Park. Users of National Park for fuelwood were from landless to large farm holding size. Fuelwood consumption per household was highest for large farm holding size and lowest in small farm holding size. Sharma (1991) reported that 45% of the people living in neighboring communities use the park illegally as source of fuelwood. Thus, the amount of extraction of natural resources from the Park is heavy and need to be controlled to reduce the negative ecological consequences.

6.6 Depredation by wildlife

Crop and livestock raiding by rhino, bear, tiger and wild pigs are serious threats on communities adjacent to parks (Wells and Sharma 1998). In the study area, more than 65 % of households reported that rhino damage crops either by grazing or by trampling. This was almost equal to Joshi (1999) for the whole buffer zone area. Jnawali (1989) has found rhino as the principal crop raiding animal in the vicinity of CNP. Milton and Benny (1990) conducted a similar study and estimated the mean loss to be 55.8 % of all crops grown in that area. In study area, highest loss by rhino was on paddy followed by maize and Buckwheat that is almost equal to Martin and Vigne (1996). Many of the respondents reported that they have given up planting wheat because wheat is the favorite food of rhino. Intensity of damage was high in area close to the forest.

Livestock killing by carnivores has become a subject of heated discussion among villagers (Nepal and Weber 1993). In the study area, in between one year, 13 livestocks were killed by wildlife and tiger was found to be major depredator. Around 7% of the rhino population lives outside park boundaries and they, along with other wildlife, damage crop and livestock. This present a real problem for most "Buffer Zone" farmers, who are not compensated by the CNP for this damage (Adhikari et. al.2005). The economic losses due to damage of crops and livestock are being

increasingly realized as serious negative impact of protected area management by the local people.

6.7 Rhino poaching and conservation

Respondents close to forest reported that there is a regular movement of rhino into the village; few respondents said there has been decline in number of rhino movement in the recent years. Main cause of rhino decline is poaching and habitat loss, some of the respondents were unknown about the decline of rhino. Although many households knew about rhino poaching and poacher identity but they were reluctant to talk about the issues. Rhino poaching has noticeably increased in Chitwan since 1984; every settlement is a potential shelter for rhino poachers (Adhikari 2002). Several arrest of rhino poacher has been made from the study area. Up to date, 11 local poachers including Vice president of Kalabanjar BZUC have been arrested from the Dibaynagar VDC; while the President of same BZUC was absconding. Poaching continues because local people living in the buffer zone surrounding National Park are losing more than they gain from Rhino conservation (Adhikari et al. 2005).

6.8 Land use change

Land use map 1992 classified seven type of land in Dibaynagar VDC while DNPWC/PPP (2000) reported only four types of land. The land use change between 1978 and 1992 in Dibaynagar VDC is indicated by 93.51 % and 0.79 % loss of Grassland and agriculture land respectively with a concomitant increase in Water bodies, Forest, Lake/Pond, Built-up area and Orchard. Increase in Water bodies was tremendous in the period of 1978-1992 in the Dibaynagar VDC, which may be because the BZ area lies in the flood plain of the Narayani River. DNPWC/PCP/UNDP (2001) has also reported decrease in grassland while increase in Water bodies in the whole buffer zone area. In between 1978-1992 some parts of Agriculture land and Grassland have converted into forest.

6.9 Vegetation analysis

In the Buffer Zone forest of Dibaynagar VDC, only five tree species were found in the sampling plot of the study area. Rijal (1994) has reported 16 tree species in riverine forest of the CNP. The total number of tree 100.86/ha was less compared to BZCFUG

(2004) and Streade et. al (2002). *Dalbergia sisso* has highest density which is similar to Shrestha (2007) for Kumroj VDC, but higher compared to Rijal (1994).

The invasive species *Mikania micarantha* was also found in the study area which may effect on surrounding vegetations. Succession of invasive *Mikania micarantha* over natural riparian vegetation have increased risk of survival of the endangered rhino that primarily inhabit the riverine environment (Amin et al 2006 c.f Poudel, 2007).

A total of 34 different species were found in herb stratum with a total density of 283275.86/ha. Six regenerating tree species were found in the study area with density of 1889.6/ha, The density per ha of regenerating species was observed highest for *Dalbergia sissoo* followed by *Acacia catechu* and lowest for *Adina cardifolia*, high densities were observed below 1m height which shows less viability of tree species.
In DBH category, pole sized trees were dominant; Large saw timber were absent in the study.
Total density of cut stump was 12.92/ha, *Dalbergia sissoo* being the most cut stump species. Looping intensity was least to medium with very low density (23.28/ha). While looking at the stocking of tree in the study area, forest was poorly stocked to well stocked indicating the degraded condition of Community forest.

A total standing volume and total biomass of tree was obtained to be 13.82m^3/ha and 18.11 t/ha respectively. The growing stock volume of *Acacia-Dalbergia* and Terai mixed hardwood forest in the study area was less compared to HMG(1988a). The growing stock of *Acacia-Dalbergia* forest was only 16.23 % and of Terai mixed hardwood forest 1.27 % compared to volume estimated by HMG (1988a). It has estimated that growing stock for *Acacia-Dalbergia* forest and Terai mixed hardwood forest of Terai of Central Development Region was 76.69m^3/ha and 107.74m^3/ha respectively. The biomass of *Acacia-Dalbergia* forest and Terai mixed hardwood forest was only 12.56% and 1.01% respectively compared to biomass estimated by HMG (1988a). The biomass for *Acacia-Dalbergia* forest and Terai mixed hardwood forest of Terai of Central development Region are 132.13 ton/ha and 148.87 ton/ha respectively.

Chapter 7

CONCLUSION AND RECOMMENDATION

7.1 Conclusion

Household's socioeconomic status in Dibaynagar buffer zone VDC primarily depends on subsistence agriculture system. Majority of the households faced food deficiency. The insufficiency of fuel wood and fodder in the BZCF has forced people, both landless and big farm holders to enter the National park. Until and unless local people are provided with a means to meet their resource needs, the goal on reducing pressure on park for fodder and fuelwood cannot be achieved. Crop damage by rhino and livestock depredation by wildlife were serious threats to the well being of the buffer zone residents.

Although, many of the respondents had positive attitude towards the rhino conservation, they were unknown about activities done by BZCF and park for the conservation of the rhino. Several rhino poachers, including BZUC members, have been arrested by park authorities from the Dibaynagar VDC.

7.2 Recommendation

Increase Conservation awareness of people through special awareness programs targeting the local population.

Subsidy for alternative energy should be promoted to reduce pressure on park.

Compensation to local people should be effectively implemented.

Establishment of APU at community level could minimize the poaching.

Integration of fuelwood and fodder component in community forest programme could help to solve the problem of low availability of forest resources.

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ANNEXES

Annex1 Occupation based on Land Holding Size

Occupation	Land Holding Size				
	Landless	Small	Medium	Big	Large
Agriculture	-	4	22	38	10
House Work	1	5	6	9	6
House Work+Business	-	-	2	-	-
Agriculture+House Work	-	6	28	48	16
Service	-	3	9	16	5
Agriculture+Service	-	-	1	1	1
Unskilled	3	4	-	-	-
Business	-	1	2	4	2
Agriculture+Business	-		1	1	1
Remittence	-	5	12	20	7
Total	4	28	83	137	48

Annex 2 Education status based on Ethnicity

Ethnicity	Educational Status				
	Literate				
	General	Lower Class	High School	College	Illiterate
Brahamin/Chettri	8	18	29	15	8
Gurung/Magar	3	17	20	3	8
Tharu/Darai	18	80	128	27	37
Damai/Kami	6	25	13	4	10
Total	35	140	190	49	63

Annex 3 Educational Status based on Land Holding Size

Land holding Size	General	Lower Class	High School	College	Illiterate
Land less	1	3	-	-	2
Small	-	20	12	-	7
Medium	11	47	45	11	20
Big	18	55	106	27	25
Large	5	15	27	11	9
Total	35	140	190	49	63

Annex 4 Distribution of livestock on the basis of Ethnicity

Ethnicity	Buffalo	Cow	Goat /Sheep
Brahamin / Chettri	18(11*)	16(7)	32(9)
Gurung/Magar	6(3)	12(4)	13(3)
Tharu/Darai	46(22)	39(18)	99(23)
Damai/Kami	14(7)	14(6)	33(6)
Total	84(43)	81(35)	177(41)

*The number in parenthesis indicate the number of households having livestock

Annex 5 Total Livestock unit based on the Ethnicity

Ethnicity	No of HH	Mean LSU	Total LSU
Brahamin/Chettri	13	2.37	30.78
Gurung/Magar	8	1.78	14.28
Tharu/Darai	34	2.36	80.43
Damai/Kami	9	2.93	26.38
Total	64	2.37	151.87

Annex 6 Source of fuel wood

Fuel wood access	Land holding Size				
	Land less	Small	Medium	Big	Large
Parks	-	3(50*)	9(39.13)	6(22.22)	2(28.57)
Community forest	-	1(16.66)	1(4.34)	1(3.7)	-
Buy	-	1(16.66)	2(8.7)	-	1(14.28)
Parks + community forest	1	-	4(17.39)	6(22.22)	-
Community forest + own land	-	-	-	1(3.7)	-
Park+Ownland+Buy	-	-	1(4.34)	-	2(28.57)
Park+Buy	-	-	3(13.04)	7(25.92)	1(14.28)
Park+Ownland	-	-		1(3.7)	-
River+Ownland+Park	-	-	1(4.34)		-
Park+River	-	1(16.66)	2(8.7)	2(7.4)	-
Park+Community forest+Buy+River	-	-	-	1(3.7)	-
Park+Community forest+Ownland	-	-	-	2(7.4)	1(14.28)

*The number in parenthesis indicate percentage

Annex 7 Type of resources use from BZCF based on Land holding size

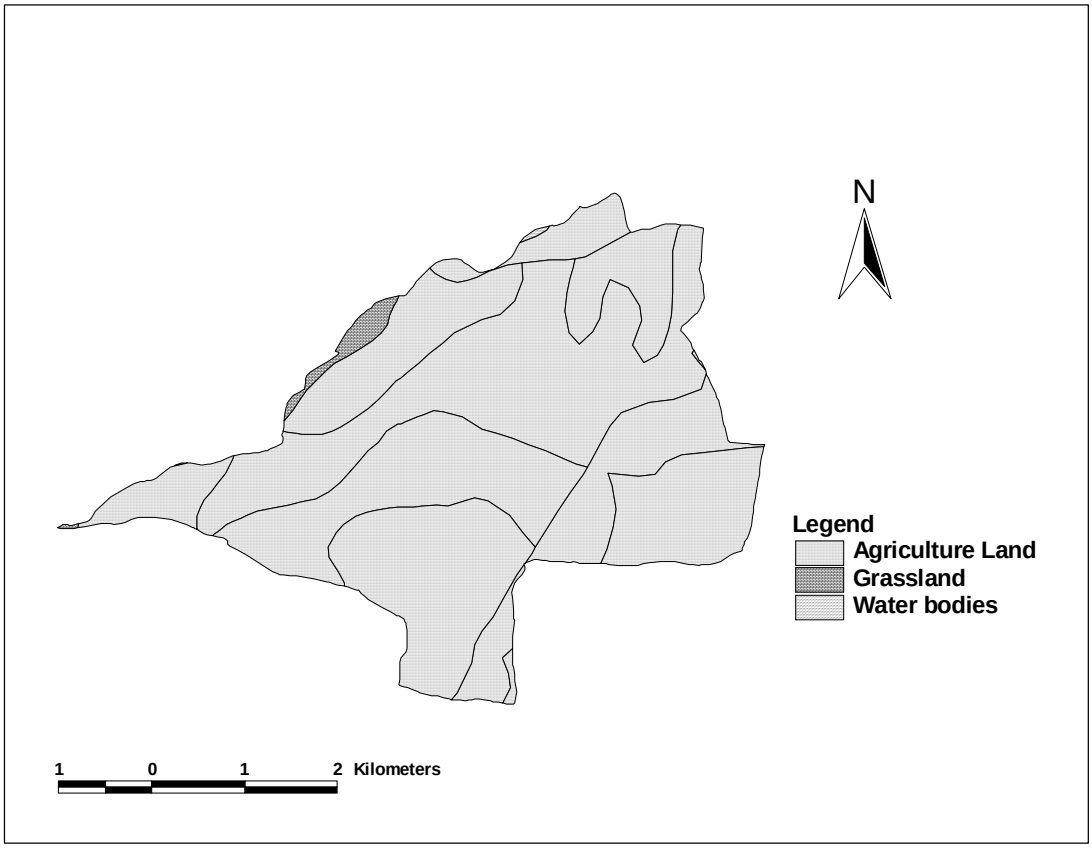
Land holding size	Resources bring from BZCF					
	Non user of BZCF	Khar	Fuel wood	Fodder+Khar	Khar+Fuel wood	Fodder+Khar +Fuel wood
Land less	-	-	-	-	1	-
Small	2	1	-	2	-	1
Medium	6	1	-	11	-	5
Big	6	5	1	4	-	11
Large	5	1	-	-	-	1
Total	19	8	1	18	1	18

Annex 8 Household Perception on the condition of BZCF

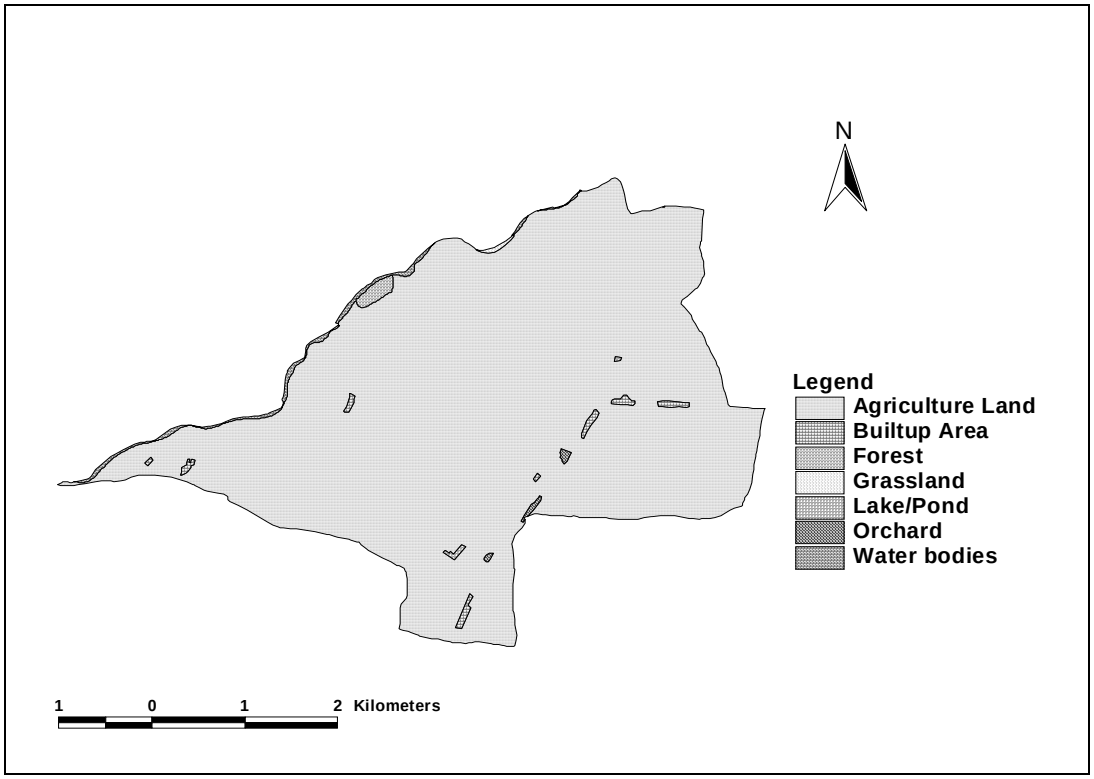
Household Perception	Present	Past
No Response	14(21.88*)	14(21.88)
Poor	9(14.06)	18(28.13)
Satisfactory	11(17.19)	18(28.13)
Good	24(37.50)	7(10.94)
Very Good	4(6.25)	1(1.56)
Don't know	2(3.13)	6(9.38)

*The number in parenthesis indicate percentage

Annex 9 Land use map of Dibaynagar VDC 1978



Annex 10 Land use map of Dibaynagar VDC 1992



Annex 11 DBH Classification of trees in the study area (no/ha)

DBH Classification	No/ha	%
Sapling	15.52	15.38
Poles	56.90	56.41
Small Saw Timber	28.45	28.21
Large Saw Timber	-	-

Annex 12 DBH class of each species (no/ha)

Species	Sapling	Poles	Small Saw Timber
Acacia catechu	0.86	2.59	1.72
Bombax ceiba	3.45	6.03	2.59
Dalbergia sissoo	9.48	37.93	22.41
Litsea monopetala	1.72	6.9	-
Trewia nudiflora	-	3.45	1.72

Annex 13 DBH class of each species (no/ha) at 5cm interval

	DBH class						
Species	10-15	16-20	21-25	26-30	31-35	36-40	41-45
Acacia catechu	0.86	0.86	1.72	1.72	-	-	-
Bombax ceiba	5.17	1.72	2.59	0.86	1.72	-	-
Dalbergia sissoo	17.24	17.24	12.93	6.03	8.62	6.03	1.72
Litsea monopetala	5.17	2.59	0.86	-	-	-	-
Trewia nudiflora	-	2.59	0.86	1.72	-	-	-

Annex 14 Height class regeneration species

Height class (m)	Density (no/ha)	Relative density
<1	1282.76	67.88
1-2	393.1	20.8
2-3	96.55	5.11
3-4	48.28	2.55
4-5	6.9	0.37
>5	62.07	3.28
Total	1889.66	

Annex 15 List of Plant species

Species	Family
Abel moselus spp.	Malvacea
Accacia catechu	Leguminosae
Adina cordifolia	Rubiaceae
Ageratum sp.	Compositae
Amele pate*	
Arisaema spp.	Araceae
Asparagus racemoscus	Liliaceae
Boehmeria rofundifolia	Udificaceae
Bombax ceiba	Bombacaceae
Callicarpa macrophylla	Vebernaceae
Chrysopogan aciculatus	Gramineae
Clerodendron spp.	Verbenaceae
Clerodendron viscosum	Verbenaceae
Colebrookea oppositifolia	Labiatae
Commelina sp	Commelinaceae
Cucurbitaceae	*Cucurbitaceae*
Cynodon dactylon	Gramineae
Dalbergia sissoo	Leguminosae
Desmodium sp	Leguminosae
Digitaria setigeria	Gramineae
Dioscorea spp.	Dioscoreaceal

Dryopteris cochleata	Aspidiaceae
Elephantopus Scaber	Compositae
Equisetum diffusum	Equisetaceae
Eupatorium adenophorum	Compositae
Euphorbia hirta	Euphorbiaceae
Ficus sp.	Euphorbiaceae
Flemingia macrophylla	Leguminosae
Ganostegia oppositifolia	Urticaceae
Gonostegia hirta	Urticaceae
Gurmi *	
Imperata cylindrica	Gramineae
Ipomoea quamoclit	Convolvulaceae
latre ghar *	
leea aspera	Leeceae
Litsea monopetala	Lauraceae
Marsdenia roylei	Asclepiadaceae
Micania micarantha	Compositae
Mimosa pudica	Leguminosae
Muraya koenigii	Rutaccaeae
Oplismenus burmanii	Poaceae
Paduwa jhar *	
passiflora spp.	Passifloraceae
Phragmaties karka	Gramineae
Physolis spp.	Solanacea
Pogostemon benghalensis	Labiatae
polygonum spp.	Polygonaceae
Premma integrifolia	Verbenaceae
Pteris sp.	Pteridaceae
Saccharum spontaneum	Gramineae
Solanum erianthum	Solanaceae
Solanum capsicoidis	Solanaceae
Solanum xanthocarpum	Solanaceae
Tetrastigma serrulatum	Vitaceae
Trewia nudiflora	Euphorbiaceae
Trifolium sp.	Leguminosae
Unyu *	
Urena sp.	Pteridaceae
Zizipus mauritiana	Rhannaceae

*Local name

Annex 16 Fodder yield from various land categories (Source: HMG, 1988 b)

Land Category	TDN yield(t/ha/yr)
Hardwood forest, grazing	0.34
Mixed forest, grazing	0.15-0.20
Forest plantation, grazing	1.44
Shrub/burnt forest, grazing	0.77
Waste land/overgrazed land, grazing	0.24
Flat land, grazing	0.58
Alpine meadows, grazing 5 months	1.54

Annex 17 Household Questionnaire Survey

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?

.....