

**Study of Vegetation Ecology, Conservation and Management Practices
of Betini Community Forest in Mangalbare Urlabari
of Morang District, East Nepal**



**A thesis Submitted to
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In the Partial Fulfillment of the Requirements for the Degree of
Master of Science in Environmental Science**



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LETTER OF RECOMMENDATION

This is to attest that Ms. *Nirmala Ghimire* has prepared this Master's thesis entitled **“Study of Vegetation Ecology, Conservation and Management Practices of Betini Community Forest, Mangalbare; Uralbari of Morang District, East Nepal”** for partial fulfillment of the requirement for the completion of Master’s Degree in Environmental Science majoring Wildlife Management. She had worked sufficiently well under my supervision and guidance. This Master's degree thesis work embodies her own work and fulfills as per the requirement of Central Department of Environmental Science, Tribhuvan University.

I, therefore, accept and recommend this work for approval.

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DECLARATION

I, Nirmala Ghimire, hereby declare to the Dean of the Tribhuvan University (TU) that this is my original work and all sources of information used are duly acknowledged. This work has not been published or submitted elsewhere for any academic award.

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ABSTRACT

A study on vegetation ecology, conservation and management practice of Betini Community Forest (BCF) was conducted in Urlabari Village Development Committee (VDC) of Morang district of Eastern Nepal. The field work was conducted on the month of January to March in 2011. The major objectives of this research were to study the species diversity of the forest and its status, demand and sustainable supply of the forest product, to identify the management practice of the community forest (CF) and to analyze the socioeconomic aspect of the Community Forest User Groups (CFUGs). The methodologies include both primary and secondary data collection. The primary data were collected by vegetation survey, socioeconomic survey, Focus Group Discussion (FGD), Key Informant Interview (KI) and Interaction with management committee. The secondary data were collected through the internet, report, and other related journals. Vegetation survey was conducted by using random sampling method in 49 quadrates where as socio economic survey was conducted using structured questionnaires of 79 HH through stratified random sampling method. The density and diversity index of the forest indicates that the forest was dense (higher diversity) with dominant species of *Shorea robusta* and the forest was more evenly distributed. The forest was found to be good in terms of high regenerating species. However the demand of forest product does not match with the supply from CF. Resources demand was found to be two times more in fuelwood and 35th times more in fodder than the forest can supply. Large farm households (HH) have fulfilled the deficit of fodder and fuelwood through their own land and have adopted alternative energy resources like biogas. The landless and small farm HH had high pressure on the CF regarding the fuelwood and fodder. The unequal resource distribution compels the locals for illegal extraction of resource from the CF. The forest management practice of the CF was found to be weeding, thinning and new plantation which is entirely depends on their traditional knowledge. Also the forest provided good habitat for the different kind of animals, birds, and maintain biological corridor of elephant.

Key Words: *Community Forest, Forest User Groups, Demand, Sustainable supply, Species Diversity, Biodiversity Conservation, Biological Corridor*

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LIST OF ACRONYMS OR ABBREVIATIONS

BCS	Betini Community Forest
BZ	Buffer Zone
BGP	Biogas plant
CF	Community Forest
CFUGs	Community Forest Users Groups
CNP	Chitwan National Park
CS	Cut Stumps
CSD	Cut Stump Density
DBH	Diameter at Breast Height
DFO	District Forest Officer
DoF	Department of Forest
EDRs	Eastern Development Regions
FGD	Focus Group Discussion
FRSC	Forest Resources and Survey Center
FSSD	Forest Survey and Statistics Division
GIS	Geological Information System
GPS	Global Positioning System
ha	Hectare
HH	Households
HMG/N	His Majesty Government/Nepal
ICIMOD	International Center for Integrated Mountain Development
IVI	Important Value Index
LRMP	Land Resource Management Project
LU	Livestock Unit
MPFSN	Master Plan for Forestry Sector of Nepal
MF	Municipal Forest
PWR	Parsa Wildlife Reserve
NFI	National Forest Inventory
NP	National Park
NTFPs	Non Timber Forest Products
SPSS	Statistical Package for Social Science
TCN	Total Timber Collection of Nepal

TDN	Total Digestive Nutrients
USA	United States of America
US\$	United State Dollar
VDC	Village Development Committee
Yr	Year

CHAPTER I

1. INTRODUCTION

1.1. Background

Community forest also known as "Social" or village forestry is practiced in various combinations of scattered tree, clustered trees in rows monoculture woodlots and in the forms of multiple cropping in both private and communal lands. These multiple land use system aims at designing ecologically sound, economically viable, socially and culturally acceptable and need oriented production of food, animal food, wood, and other production on the same tract of land either simultaneously or sequentially (Rimal, 2005). One of the long-term objectives of community forestry programme was to regularize supply of the people's basic needs for timber, fuelwood, fodder and other forest products (Lamichhane, 2010).

During the 1970s there was a growing recognition that the Department of Forests (DoF), the government body, could not manage the forests alone. A partnership between government and villagers was seen as an essential instrument to ensure sustainability of management and guaranteed access to forest products for villagers. Presently, about 1 million ha of forest are under the control of about 13,000 CFUGs (Gilmour et al 1989; Gilmour and Fisher 1991; Bartlett 1992; Malla 2000 as cited in Acharya K.P, 2005).

In 1970, the CF development programme was introduced the concept of Panchayat Forest and Panchayat Protected Forest to involve local people for the protection and management of forest (Chhetri and Pandey, 1992). In 1988, His Majesty Government/Nepal (HMG/N) prepared a master plan for the development of forestry programme in Nepal. The main strategy was to promote people participation in forest resources development through CFUGs. This programme was supported by many donor agencies such as the Nepal-UK forestry project, the Nepal-Australia forestry project, and World Bank etc (Kanal and Kandel, 2004).

The process of CFUGs formation was very slow in the beginning of community forestry program, which is 778 CFUGs per year were formed in the country before 1995. With the enforcement of the Forest Act (1993) and Forest Regulation (1995), community forestry was provided with the legal basis for its implementation. As a result, the number of CFUGs formed per year has increased to 1,479 until the year 2000 (Kanal and Kandel, 2004).

The experiences and learning of CF are being better documented and disseminated across the world. However, the benefits and impacts of CF are debated around empowerment and/or marginalization of local people. Some practitioners and researchers consider CF as a strong and better medium of empowerment, especially in terms of involving people from community to decide how to use and manage the common property forest resources. It is also seen as the devolution of power to the local people so that they can decide and use their wisdom to manage available resources (Timsina, Undated).

At present forest covers 21 percent of the total area of Nepal (Shrestha, 1998, as cited in Rai, 2003). It is often separated that every country in the world needs a minimum of 25 percent of its total area under forest but National Forest Inventory (NFI) shows 29 percent forest cover and 10.6 percent shrubland in Nepal. Land Resource Management Project (LRMP) shows nearly 27.7 percent forest is dense, 10.3 percent with low density and 24.7 percent shrubs and grazing land (ICIMOD, 1995 as cited in Rai, 2003).

The Master Plan for the Forestry Sector of Nepal (MPFSN) 1988, the Forest Act of 1993, Forest Regulations of 1995, the Operational Guidelines of CF 1995 and the Tenth Five Year Plan (2002-2007) provide the current legal and operational framework of Nepal's Community Forestry. These instruments have legitimized the concept of the CFUGs as an independent, autonomous and self governing institution responsible to protect, manage and use any patch of national forest with a defined forest boundary and user group members. Community Forest Users Groups are to be formed democratically and registered at the District Forest Office (DFO), with a CFUGs constitution, which defines the rights of the users to a particular forest (Pokharel and Nurse, 2004).

1.2. Statement of the problem

There is no research carried out in this CF and very less research has been done in the Terai region of the eastern Nepal. This is the dense Sal forest and found to be good habitat for many species of animal and birds. This CF plays an important role for the movement of elephant from east to west. Vegetative data of the CF, especially in the Terai region, has not been widely explored till now. The forest product has been collected without any scientific basis. Therefore, to explore the vegetative data of eastern Terai CF and assessment of its management system, this research was conducted.

1.3. Research questions

- i) What is the species diversity of the forest, managed by community?
- ii) What is the situation of forest product demand and supply from the CF?
- iii) What is the extraction rate of the forest product and how much the forest can supply?
- iv) What are the management practices?

1.4. Objectives

The broad objective of the research is to assess the vegetation ecology, conservation and management practice of Betini Community Forest (BCF). Whereas the specific objectives of the research are;

1. To identify species diversity of the forest and its status;
2. To identify the demand of forest product and extraction rate from the forest;
3. To assess the sustainable supply of the forest products and identify the management practices of CF and
4. To analyze the socioeconomic aspects of the CFUGs.

1.5. Scope of the study

The present study explores the vegetation ecology of BCF and focuses on species diversity and management practice of BCF. Sustainable annual yield of forest and extraction of the resources also known from this study. The forest resource demand and supply of the resource to the CFUGs has been emerged in this study. The promotion of possible alternative resource like biogas plant was recommended in the study area.

1.6. Overview of the content

"The study of vegetation ecology, conservation and management practices of BCF" includes overall six chapters. The first chapter is introduction which includes the background of the community forestry in Nepal, statement of the problem, research question, objectives, scope, and overview of the content. The second chapter is literature review. This part include finding from different study related with livelihood and community forestry of Nepal. The third chapter is materials and methods of the study. Methodology includes description of study area, research design, data collection methods and result preparation. Study area covers location of the study area, topography and climate, demographic character and information of the CF. The chapter four includes result of the study. Result covers finding from the vegetation analysis, socioeconomic survey, interaction with management committee and FGD. The chapter five includes the discussion of the findings and the last is sixth chapter, includes conclusion and recommendation to the management committee, and user group.

CHAPTER II

2. LITERATURE REVIEW

Many works has conducted in the field of CF in Nepal. Some of them are;

Gawali (1999) conducted the vegetation and soil analysis of regenerating, planting, and natural forest of Kulekhani watershed and found that large number of plant species (33) were present in the natural site and few number of plant species in the planted site (13). Presences of shrub species were remarkable in different sites; only two shrub species were in the completely degraded area whereas the largest numbers of shrub species were in the natural site.

Malla *et al* (2003) studied research on four CFUGs in Nepal focusing on levels of participation, understanding of, and benefit from community forestry activities. Poorer HH are found to benefit significantly less than wealthier HH and in some cases may even be directly disadvantaged by the advent of community forestry in their villages. A major cause of that inequity was found that CFUGs committees are dominated by wealthier HH.

Neupane (2003) studied in the four CF of western hills of Nepal and analyzed the six key factors affecting the ways by which benefits from community forestry are generated and distributed. He found that the poor CFUGs are less benefited from the CF than those of wealthier CFUGs and the member of the DFO. The CF users' committee members are more concerned to the protection of forest rather than the sustainable harvesting, distribution and utilization of the resources. District forest officer and assistant forest officers seem to have got most opportunities to participate in the workshops and extension programs. On the other hand, the forest guards have very little opportunities of exposing themselves to new information and knowledge.

Pokharel and Nurse (2004) showed that in Nepal's community forestry, it is proved that communities are responsible and able to protect, manage and utilized the forest resources sustainably. In fact, in community forestry, poor peoples' access to resources has been reduced, with consequent negative impacts on their livelihoods. Also evidences show that poor HH have not received adequate opportunity for

training package offered in community forestry intervention, poor have also not been given sufficient loan from the CFUGs' fund, and physical infrastructure constructed by CFUGs' fund have also not benefited the poor as compared with the better off members of the same CFUGs.

Acharya (2005) found at least three different kinds of local institutional arrangement exist in CF in Nepal. They range from limited individual ownership to collective and centralized systems. In the collective system, all users have equal recognition and functional participation in running the CFUGs as a collective institution. In the centralized system, only a few selected or elected individuals dominate the scene and take the responsibility of running a centralized cooperative institution by collective action. There is a combination of collective action and individual action pertaining to the same piece of land.

Acharya *et al* (2005) showed the active management practices have influences on structure and composition of forests. There are at least three different types of changes taking places in terms of forest structure and composition. Firstly, the forest types are slowly converting from mixed (Sal mixed) to monoculture (Sal). Secondly, the shrub and tree diversity may gradually decrease. Lastly, the most critical threat was for the shrub species such as climber and thorny species. The active management does not always lead to species reduction; it depends on the kinds of activities undertaken and specific procedures adopted. Forest users' innovative practices of active forest management favor biodiversity conservation.

Bhatta (2005) compared the forest of carbon content in natural forest and CF of Phulchowki watershed. The result showed that most carbon is stored in natural forest as compare to that of CF. The main reason for the high carbon content in natural forest is due to its old age, highly productive areas and less human disturbances.

Joshi *et al* (2006) studied on the CF of two districts namely Kabhrepalanchok and Sindhupalchok and found that CF in two districts has a great potential for contributing to poverty reduction and improving the livelihoods of local people through livelihood improvement processes. In livelihood improvement processes sensitization activities, many more CFUGs are including equity provisions in their plans, particularly in terms

of providing livelihood opportunities to the poor, to women and to disadvantaged groups. Investment of the CFUGs funds for income generation schemes (goat and pig rearing, vegetable growing, etc.) for the poor and allocating patches of CF to women and the poor for forage development.

Bhattarai (2007) studied on vegetation analysis of CF of Salbari, Sanischere VDC in Jhapa, showed that nine trees species are recorded, among them *Shorea robusta* had highest value of density, basal area, and Important Value Index (IVI), which is ecologically successful species in this forest. Lower value of basal area shows that this forest is young and regenerating. Other trees species had comparatively lower value of density, basal area, and IVI due to the regular human interferences. The user groups of CF are protecting only valuable timber plants and other non timber species are utilized annually.

Bhandari and Ubrig (2007) studied on distribution of community forestry benefits among economic group of the users comparing protected area buffer zone with the Department of Forests (DoF) regime in Nepal and found that current distribution practice of community forestry benefit was not equitable and counteracts national forest policy goals and approaches. Users in the buffer zone obtained fewer benefits from CF than that of the DoF regime. Forest user groups in the DoF regime are intended to maximize the product extraction economy and livelihood opportunities through the forest product since they sell surplus products in the market, but, in the buffer zone, the shell of timber and fuelwood was prohibited outside the zone. Poor HH received lesser benefits from CF than the better off HH.

Dhakal (2007) studied on Kolhuwa buffer zone VDC of Chitwan National Park (CNP) and found that the *Shorea robusta* was found to be dominant species. The forest outside the buffer zone has more degraded than the other CF of central and western terai and faces the serious pressure from hill immigrated populations.

Ghimire (2007) showed that the CF had not distributed equal forest resources to all people in the community. There was low success of regenerating species because of the buffer zone CF has been degraded affecting most of the regenerating species. The alien species *Mikania micrantha* poses serious biological threat to 66 forest and

wildlife habitat. The large numbers of extremely poor and socially disadvantaged groups were not socially and economically empowered as envisaged. The deprived groups such as Marginalized, Indigenous groups, Dalit and Janjati were unable to benefit from development activities due to lack of access to information and awareness about the programmes as well as their inability to adopt new practices.

Kandel (2007) studied on the effect of forest certification in Dolkha district and found that certification has brought positive change in forest management systems. However after the forest certification, no positive change have been found so far in employment and income generation for FUGs and does not have economic benefit to FUGs and Non Timber Forest Products (NTFPs) based entrepreneurs.

Paudyal (2007) studied on Piple buffer zone VDC of CNP and found that the CF does not fulfill the HH annual fodder and fuelwood demand. So, peoples were fulfilling their needs through the CNP and other CF.

Shrestha (2007) studied on Buffer Zone (BZ) resources in Chitwan district and found that the *Dalbergia sissoo* was dominant species with highest density, frequency, basal area and highest IVI, due to the plantation. Low success of regenerating species, but good quality in terms of stocking, cut stump and lopping intensity shows the easy extraction of fuelwood and fodder through cutting regenerating species. The CF has been degrading affecting the regenerating species. The annual fuelwood and fodder demand of the HH has higher than the CF can yield. So the peoples were fulfilling their demand through the National Park (NP).

Bhattarai *et al* (2009) studied on creating exclusive rights to the poor groups in CF management in Salyan and found that through the continuous sharing, deliberation and negotiation among the poor and non-poor members of CFUGs, management of CF can be made far more equitable than the usual scenario. The benefit sharing at the local level needs to be improved by better understanding of the social structure of communities, providing a legal framework for community forestry committees, developing criteria and indicators to monitor benefit sharing, and development of effective conflict management mechanisms. Equitable forest product and other benefit

distribution mechanisms can only be achieved if clear provisions in acts and regulation are made, along with better co-ordination among implementing agencies.

Pandey (2009) studied on the BZ resources and socioeconomic perspective of conservation in Tribeni BZ VDC in CNP and found that the annual sustainable supply of the both fuelwood and fodder has less than the annual demand of the user people so the deficit was largely meet through overharvesting of BZ forest. Also the forest was on high stress as the locals were harvesting more than the annual sustainable yield for both forest resources. The complex relationship between residents and protected area was found to be an obstacle to successful conservation of BZ area.

Pokheral (2009) studied on CF on three district of mid hills (Lamjung, Tanahu, and Kaski) and found that CFUGs spent more than one-half of their income on community infrastructures like schools, temples, roads/trail construction, VDC/CFUGs offices and community buildings, extending electricity/mills, water reservoirs/irrigation canals, grants to schools and support for teachers' salary. The CFUGs on an average has spent NRs. 28,142 on community infrastructures annually. They thought investment on school building will help reduce the government burden to expand access to schools in the rural areas.

Sharma (2009) studied on BZ of CNP and showed *Shorea robusta* was found to be dominant tree species with highest important percentage, standing volume, biomass and sustainable fuel wood yield out of total 24 tree species recorded. The buffer zone program in the Nirmalbasti VDC was found to be ecologically good because of improvement in the forest quality. Due to the large forest area (2,440 ha), CF has the capacity to fulfill the demand of fuelwood and timber resource in sustainable manner.

Adhikari (2010) studied on BZ village of Parsa Wildlife Reserve (PWR) and found that supply of fuelwood from the CF was lower than the demand of the entire user HH. So to fulfill their demand they were depended on the India forest. Crop depredation due to wild animals is severe in some areas in close propinquity to reserve forest and India proposed tiger top forest.

Baral *et al* (2010) studied on the above-ground carbon stock in the five major forest types, representing two physiographic regions in four districts Chitwan, Lalitpur, Kavre and Kaski of Nepal and found that the variation in the above-ground carbon stock and rate of carbon sequestration according to forest types and its geographical location. Forests in Terai region had high above-ground carbon stock per hectare compared to hilly region. Carbon sequestration rate of forest was depended on growing nature of the forest stands. Tropical Riverine, Pine and *Alnus nepalensis* forests are important for carbon sequestration in tree biomass in Nepal, as seen from the comparatively higher carbon accumulation rates.

Lamichhane (2010) conducted the consumption pattern of timber and fuelwood in CF of Sindhupalchok district and showed that the demand of the CFUGs on fuelwood was found to be greater than the supply of the products because this CF produces more timber than those of fuelwood. Participation of users in forest management activities was poor because of the lack of time as labor was the main source of income for many users. Therefore, most activities of CF management were carried out on wage basis.

Baral *et al* (2010) showed comparative study on the CF and municipal forest (MF) of Dhulikhel and found 40 vascular plant species of 30 families in the CF but in the MF only 36 species of 25 families. The number of tree species were slightly higher in the MF (14 species of 10 families) than that of the CF (11 species of 8 families), but the higher vascular plant species richness in the CF has been recorded. Silvicultural techniques applied in CF affect forest by altering plant community composition, species richness and distribution, and age class distribution of the trees.

CHAPTER III

3. MATERIAL AND METHODS

3.1. Study area

3.1.1. Location

Nepal is a landlocked country with a total land area of 147,181 km². Roughly rectangular in shape, the land extends approximately 885 km east-west and 145 km at its narrowest to 241 km at its broadest, north-south. The country is bordered by China in the north and by India in the south, west and east (CBS, 2004).

Administratively, Nepal is divided into five development regions and 75 districts. The districts are further divided into VDCs and municipalities, as local units. Currently, there are 3,915 VDCs and 58 municipalities including one metropolitan and four sub metropolitan cities (CBS, 2003).

The study area is Urlabari VDC of Morang District shown in figure 3.1. Morang is one of the eastern Terai districts comprising 65 VDCs and one Sub-metropolitan city, Biratnagar. Morang district is surrounded by Dhankuta in the north, Sunsari in the west, India in the south and Jhapa in the east. Area covered by the district is 1,855 km² and population is 914,799. Geographically the district lies on 87°16' E to 87°41' E longitude and 26°20' N to 26°53' N latitude (<http://www.ddcmorang.gov.np/fckimages/file/Planning%20&%20Programe/DTMP%202010.pdf>).

Urlabari VDC is surrounded by Damak municipality in the east, Pathari VDC in the west, Madhumalla VDC in the north and Rajghat VDC in the south. Area of Urlabari VDC is 30 km². East-west barrier is separated by two rivers, i.e., Mawa in the east and Sanjhora in the west.

Most of the land is covered by rice and jute cultivation, though areas of Sal forest remain along the northern part of the district where the plains meet the hills. A large

amount of the forest was cleared in the last century, and in the process, many settlers migrated to the district from the hills and India (http://en.wikipedia.org/wiki/Morang_District). The Morang plains are one of the most culturally diverse regions in Nepal.

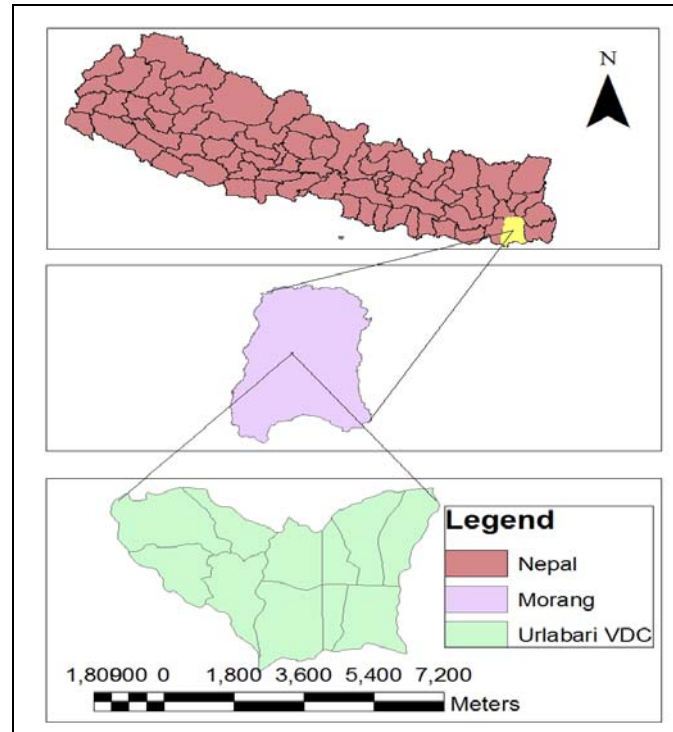


Figure 3. 1: Study area map

3.1.2. Betini community forest

Betini community forest lies in the ward no. 1 and 7 of the Urlabari VDC and ward no. 9 of the Madhumalla VDC of Morang district at about 1500 m north of the East West highway. Betini Community forest covers an area of 547.33 ha. It was handed over to local user groups in 2002. There are 1107 users HH with membership card inside the BCF. The forest user groups comprise of members from ward number 1,4,5,6 and 7 of the Urlabari VDC who are the permanent resident in that area. The FUGs use forest product according to the rule prepared by BCF. Betini Community forest is surrounded by the Manohar CF in the east, Sirjana CF in the west, Dhankheti and Bahra kothi CF in the north and community settlement in the south. It is a dense Sal forest with dominant species of *Shorea robusta* and mixed species like *Lagerstroemia parviflora* Roxb., *Osbeckia stellata* Buch-Ham. Ex D. Don, *Ehretia*

acuminata R. Br. Maina kath, *Dillenia pentagyna*, *Cucumis sativus* L. etc. The medicinal plant includes *Asparagus affici nalis* L., *Alstonia scholaris* (L) R. Br., *Terminalia chebula* Retz., *Terminalia bellirica* (Gaertn.) Roxb., *Emblica officinslis* Gaertn., and *Momordica dioica* Roxb. ex Willd. are not extracted till now.

It provides a good habitat for different kinds of animal and birds, and other creatures. *Elephas maximus*, *Macaca mulatta*, *Canis lupus*, *Felis chaus*, *Sus ccrofa cristatus*, deer, *Lepus ruficaudatus*, *Hystrix indica* and *Urs ursinus* are major wildlife found here. The wetland inside the CF, serves as habitat for different animal and bird species. It was found that the CF plays an important role for the maintenances of elephant corridor. It also provides refuse for the 5 to 6 month to the elephant as a wild animal.

3.1.3. Topography and Climate

The study area has tropical climate with average annual rainfall 1881.1 millimeter (mm), in 2009 and mean temperature 25.2 °C in 2006 (Statistical year book, 2009). The maximum rainfall of district was measured 1812 mm in June, 2005 and similarly, the maximum temperature was recorded 42 °C in summer and 3 °C in winter. The altitude of Morang district ranges from 100 m to 2410 m from mean sea level (<http://www.ddcmorang.gov.np/fckimages/file/Planning%20&%20Programe/DTMP%202010.pdf>).

3.1.4. Demography character of the study area

According to the census 2001, the total population of the Uurlabari VDC was 25742 among them 12695 were male and 13047 were female. The total numbers of HH were 5395 (CBS, 2001).

Betini community forest comprises five wards of Uurlabari VDC namely 1,4,5,6 and 7. The total HH having membership card of the CF were found to be 1107. Among them only 79 HH were sampled using the sample size determination formula.

3.2. Methodology

The methodology of this study includes primary data collection and secondary data collection method. Both the quantitative and qualitative data were collected. Primary data were collected by field survey whereas secondary data were collected through the reviewing of literature like research reports, district profile, VDC profile, journals, papers, and master plans etc.

3.2.1. Research design:

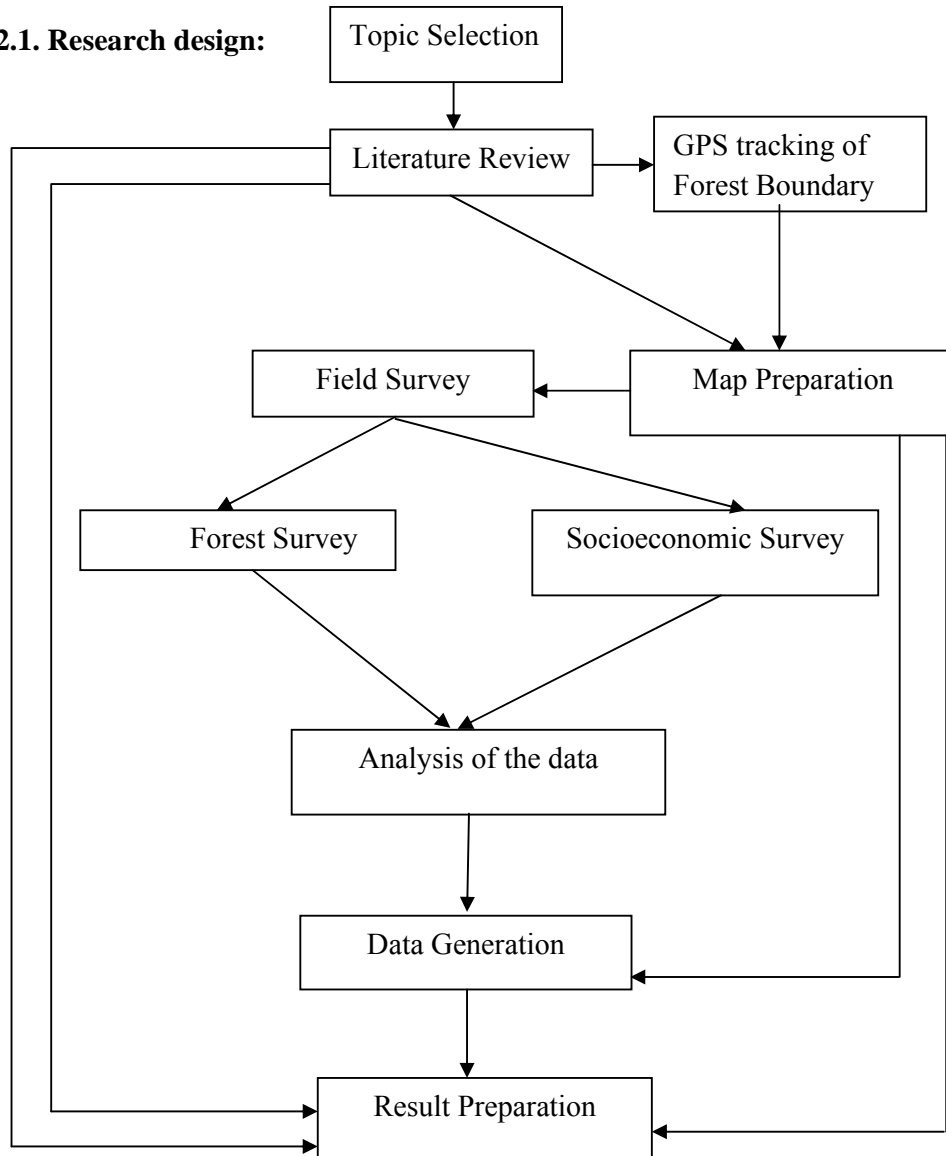


Figure 3. 2: Schematic diagramme of the research design

3.2.2. Data collection method

3.2.2.1. Reconnaissance survey

Reconnaissance survey was conducted during the month of September to October, 2010. During this survey the boundary point of the BCF were taken with the help of Global Positioning System (GPS model: e-trex, Garmin USA) tracking. The forest user's HH were identified with the help of record through management committee based on their land holding category. Through the observation on socio economic status of the user's HH and CF, the questionnaires and checklist were developed shown in annex I.

3.2.2.1.2. Quantitative analysis of vegetation

The detailed field survey was conducted during the month of January to February, 2011. Forest survey was done based on the vegetation sampling in three stages i.e. tree canopy, herbs level and shrubs level. Digital FINNIDA land use map (1992) scaled at 1:25000 was used for vegetation survey by using systematic random sampling methods through Geological Information system (GIS) software. The map of the CF of the study area is shown in figure 3.3.

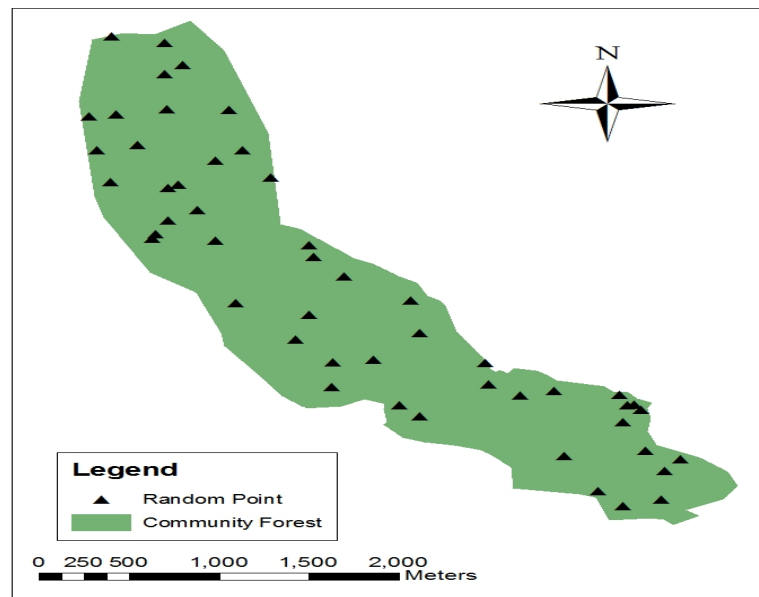


Figure 3.3: Forest map with random point

3.2.3. Plot design

The boundary map of the forest was prepared by using Arc-GIS and generates 50 random points on this map randomly. The latitude and longitude of the random point were saved in a GPS to find out the same point in the forest area. Out of 50 sampling plots, vegetation survey was conducted only in 49 plots. In each sampling point five different nested quadrature plots were laid out. For tree species, 20×20 m² plot sizes was determined, for the shrubs 5×5 m² on the two opposite side of tree plot and for herbs, 1×1 m² quadrature was used in two opposite side of shrub plot (as shown in figure 3.4). All the trees species having diameter at barest height (DBH) greater than 10 cm were taken in the 20×20 m² quadrature. The height of the tree was measured by using clinometers and DBH of the trees was measured by using DBH tape in centimeter. For shrubs, height of the shrub was measured by using normal tape and their individual coverage and total coverage were observed occularly. Also for herb species, number of individual species was counted and their individual cover and total cover were measured occularly. All the trees species and most of the shrubs and herbs species were identified in the field as their local name and for the remaining unidentified species were preserved in herbarium.

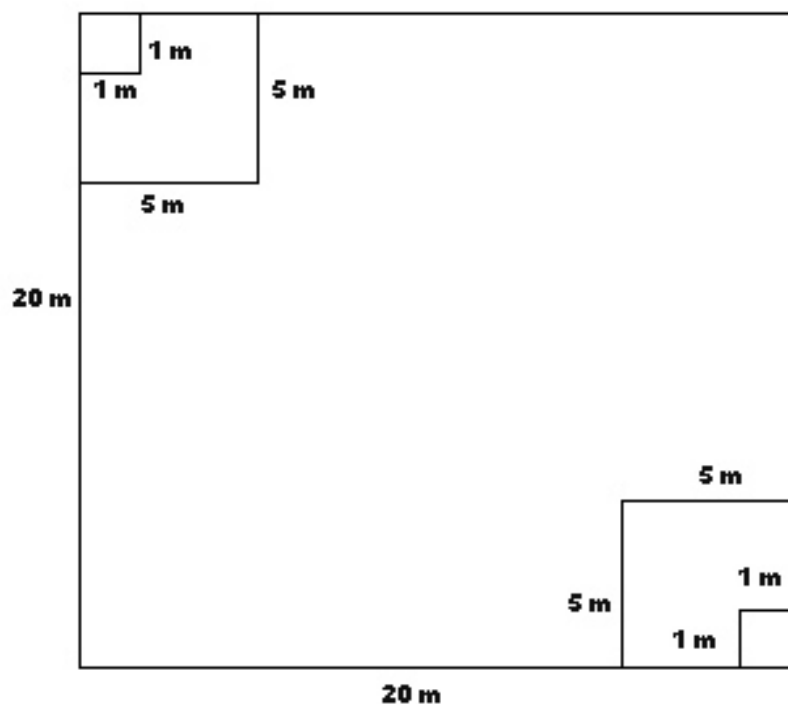


Figure 3. 4: Nested Quadrature plot

3.2.3.1. General parameters

For the calculation of general parameter of the vegetation, the collected data were calculated separately for the tree stratum, shrub stratum and herb stratum. Different structural parameters viz. density, frequency, basal area, IVI, Index of dominance, species richness, Shannon-Wiener diversity index and evenness index, were determined for quantitative analysis using formula given by Kent and Coker (1998) as cited in Dhakal 2007 shown in annex II.

3.2.3.2. Volume and biomass

The calculation system called Inventory Net Volume (INV) developed by the Forest Inventory Section, Ministry of Forest and Soil Conservation; Nepal (HMG 1988) was used for the calculation of volume and biomass of each individual tree. The volume parameters were obtained from the study carried out by Forest Survey and Statistical Division (FSSD 1991) as cited in Annex II.

3.2.3.3. Estimation of Annual and Sustainable Yield

The annual yield and percentage annual yield estimated for Sal forest of EDRs of Nepal prepared by the Master Plan for the Forestry Sector of Nepal (MPFSN, 1988) was applied to estimate the annual yield of the CF, cited in annex II.

3.2.3.4. Cut stump density

To quantify the human pressure, grazing intensity and management practices of the forest, the total number of cut stumps of trees species within 20×20 m² plot with girth size (cm) and height (cm) were taken. Then the girth was categorized in to five classes according to the Silori (2001). These classes are i) < 20 cm, ii) 20-40 cm, iii) 41-60 cm, iv) 61- 80 cm and v) > 80 cm. The density of each girth category was calculated for each species of the CF (Silori, 2000).

3.2.3.5. Lopping intensity

The intensity of cut and lopped trees were assessed under different damage categories. The cutting intensity was assessed in terms of percentage damage done to the

individual tree by counting the number of cut branches of a tree. It was rated in following four categories (i) 1–25% cut – least damage, (ii) 26–50% cut – medium damage, (iii) 51–75% cut – high damage and (iv) >75% cut – very high damage and lopping percentage were also measured inside the 20×20 m² quadrat (Silori, 2000).

3.2.3.6. Forest type

Forest was classified according to the Master's plan for forestry Sector (HMG, 1988), and the forest of Uralbari VDC was found to be mainly Sal forest.

3.2.3.7. Stand size

The following stand sizes classes as used by Forest Inventory Division (FRSC, 1995) were adopted into the study area shown in table 3.1.

Table 3. 1: 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

3.2.3.8. Regeneration of tree Species

For regeneration of tree species, species with number and their height were measured and height classes were made based on Rijal & Meilby (2006). The regenerating species were classified in to four category viz < 3 m, 3 - 6 m, 6 - 9 m and >9 m.

3.2.4. Survey design and sample size determination for social survey

Structured questionnaire surveys were conducted to get the ground level information in the study area. During the field, stratified random sampling method was applied to conduct the structured questionnaire among the 79 HH on the basis of five different landholding categories (as shown in table 3.2).

Table 3. 2: Land holding category

Land Category	Land holding in local unit	Land holding(ha)	Total HH	Sample HH
Land less	0	0	254	18
Small farm	0 K -10 Kattha	0.34-0.68	568	40
Medium farm	10 K-20 Kattha	0.68-1.36	139	10
Large farm	1 B-4 Bigha	1.36-2.72	139	10
Very large	> 4 Bigha	> 2.72	7	1

The sample size (n) in the study area was determined by using the statistical formula (cited in annex II) given by the (Arkin and Colton, 1963, cited in Pandey 2007) at 95% of confidence level.

From the above statistical formula the simple size (n) was found to be 79 HH from the total population of 1107 HH. The questionnaire surveys were conducted to the 18 land less, 40 small farms, 10 medium farms, 10 large farms, and 1 very large farm HH respectively. Stratified random sampling without replacement was done for the equal number of sample size distribution in each land holding categories (as shown in figure 3.5).

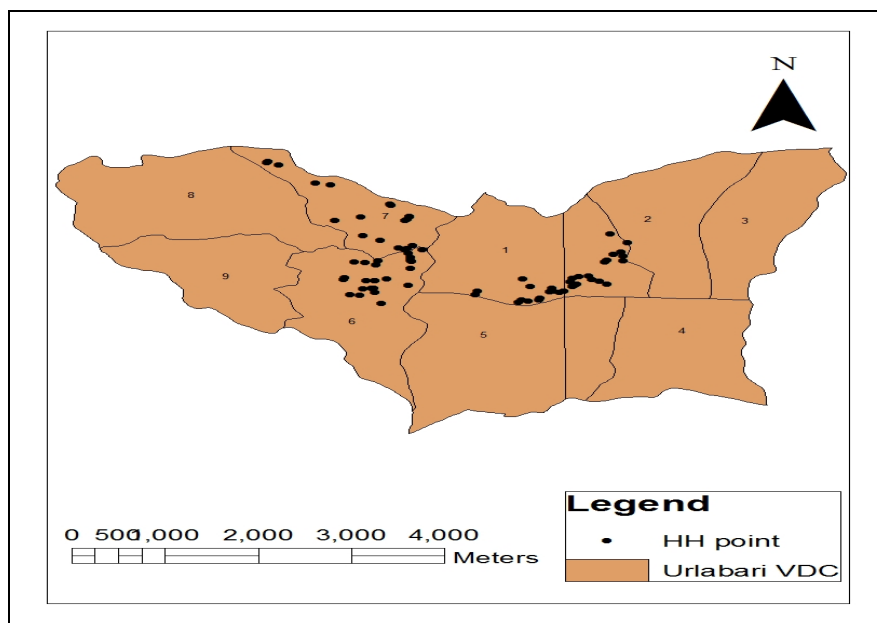


Figure 3. 5: VDC map with HH sampling point

3.2.5. Questionnaire Survey/ Socioeconomic survey

For the conduction of socioeconomic survey 79 house hold were selected through stratified random samplings on the basis of land holding category. Before conducting the formal questionnaire survey, the questionnaire was pre-tested in some household and some modifications were adapted to make more understanding to the respondent and effortless flow of subject matter. Interview was taken from the family head member when possible, or the oldest person of the house. If the family head or the oldest person was no possible, interviews were taken from the other member of the house who is more familiar to the CF.

3.2.5.1. Household information

To know the detailed information of the user's household, question like family size, age, land holding, occupation, and number of live stock and their feeding sources, education, annual crop production, energy used type and yearly income and expenditure were set in the questionnaire. In the questionnaire the questions like harvesting of forest products (fodder and fuel wood collection), fund generating activity, distribution of resources from management committee, forest conservation and management practices, condition of forest as compare to the past were also include. It shows the household dependency level to the CF.

3.2.6. Focus group discussion

In the field two FGD were conducted in the ward no 7 and ward no 4 of the Uurlabari VDC. One focus group discussion was conducted in the village nearby the CF and another was conducted to the village far from the CF. For the conduction of FGD checklist was developed about the historical background of forest, involvement on forest management, consumption and distribution of the resources, allocation of the resources, etc. Focus group discussions were carried out by gathering people who were permanent user's of the CF.

3.2.7. Key Informant Interview

Informal questionnaire and Interviews were conducted to the person in different ward engaging to the CF to get the information about the forest management practices and

distribution of the resources to the poor and wealthier user's HH. The key informants were forest watchers, president, toli commander, Secretariat, etc.

3.2.8. Interaction with forest management committees member

Interaction programme were conducted with the member of the management committee to grab the information on history of the CF, resource allocation system, Silviculture practices, role of women and youth in the forest management practices, most demanded resources, demand supply of forest resources, annual extraction of resources and contribution of CF to the social development.

3.3. Data calculation of the Household

3.3.1. Land holding crop production and livestock holding

Actual land holding of each HH were taken in a local unit during the field and it was converted in to hectare (ha) for the analysis. The farm size conversion factor from the local unit is listed below (table 3.3) Source Dhakal (2007).

Table 3. 3: Farm size conversion factor

Farm size in Kattha and Bigha	Conversion factor
1 Kattha	0.034 ha
1Bigha	0.68 ha

Annual agricultural production like paddy, wheat, maize, lentils, and oil seed of the individual HH were noted in the kg. The livestock holding of the sampled HH were taken in number and types of feeding habitat and they were converted in to the standard unit called Livestock unit, by using the livestock conversion factor. The livestock conversion factor is listed below (table 3.4) Source (Pandey 2007).

Table 3. 4: Livestock conversion factor

Types of Livestock	Conversion factor
Cattle	0.65
Buffalo	0.81
Goat and Ship	0.18

3.3.2. Annual income and expenditure of Household

The income and expenditure of the HH were recorded in the field to know their living standards and dependency on the forest resources. The sources of income of the all HH include agriculture, livestock holding, business, service, foreign remit, wage labor, etc, were directly obtained in monetary value. Income from the livestock and agricultural production were converted in to the monetary value through the local market price. The expenditure sector includes health service, education, food, transportation, and other in terms of monetary value. The net incomes of the HH were obtained by subtracting total expenditure from the total income.

3.3.3. Fuel wood, fodder and need of timber in annual basis and their extraction

The requirement of fuelwood, fodder, and timber of the HH were taken in the local unit (bahri) through assumption and is converted in to the kg by conversion factor. For the collection of fodder the forest is open throughout the year, and for the collection of the fuelwood, twice a day per week up to three month.

3.4. Data calculation and analysis.

For the calculation of the vegetative data Microsoft spread sheet was used and for the analysis of the questionnaire survey data the Statistical Package for Social Sciences (SPSS) was used.

CHAPTER IV

4. RESULT

4.1. Vegetation analysis

4.1.1. Species diversity of community forest

The Shannon diversity index of the trees, shrubs and herbs were found to be 2.61, 2.06, and 2.65 respectively. Similarly, evenness index of tree was found to be higher than the shrubs and herbs. The species richness of shrub 10.81 was found to be highest and index of dominance of shrub 0.10 was found to be higher than the trees and herbs as shown in table 4.1.

Table 4.1: Diversity Index of tree, herbs and shrubs

	Shannon Diversity Index $H = -\sum(n_i/N) \times \ln(n_i/N)$	Evenness Index $e = H/\ln S$	Species richness $R = (S-1)/\ln N$	Index of Dominance $C = \sum(n_i/N)^2$
Tree	2.61	0.73	5.58	0.14
Shrub	2.89	0.63	10.81	0.10
Herb	2.56	0.70	4.92	0.12

4.1.2. Tree Stratum

Community forest of the study area was found to be mainly Sal forest. Total density of the tree species was found to be 265.82 no/ha. Among 36 trees species found in the study area, the density and IVI of the *Shorea robusta* was found to be highest i.e. 89.80 no/ha and 53.81 respectively. The second highest density of *Osbeckia stellata* was found to be 27.041 no/ha, followed by *Ehretia acuminata* of 19.39 no/ha. Total basal area of the CF was found to be 71.76 m². The density, frequency, basal area and IVI of tree species (IVI up to two) are shown in table 4.2. and details were shown in table A of annex III.

Table 4.2: Structural parameter of the species at tree stratum

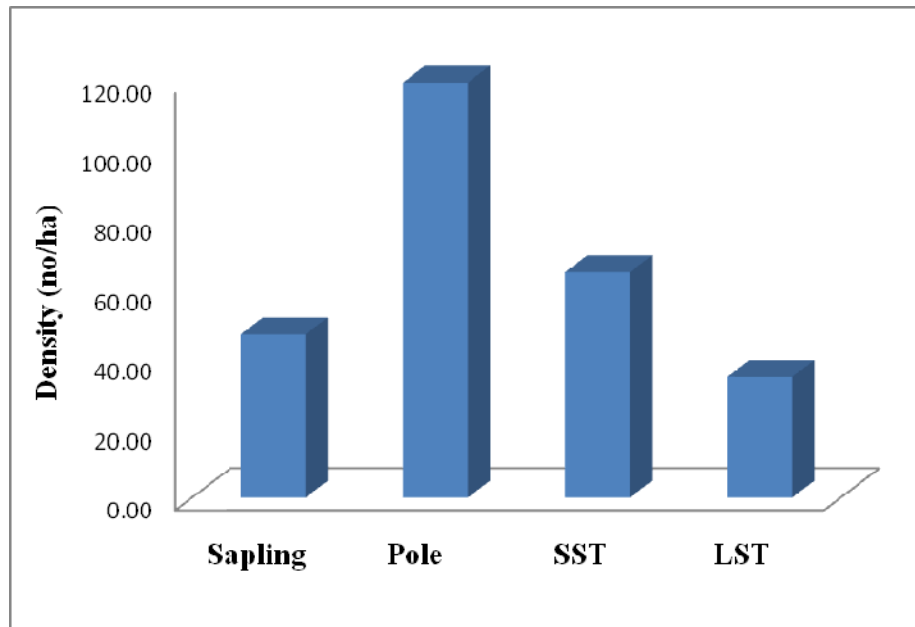
Species	No.	D/ha	RD	F	RF	BA	RBA	IVI
				%	%	(m ² /ha)		
<i>Shorea robusta</i>	176	89.796	33.78	32.65	7.583	8.9369	12.5	53.8
Maina kath*	21	10.714	4.031	24.49	5.687	18.349	25.6	35.3
<i>Osbeckia stellata</i>	53	27.041	10.17	44.9	10.43	2.9656	4.13	24.7
<i>Lagestroemia parviflora</i>	29	14.796	5.566	32.65	7.583	5.2241	7.28	20.4
<i>Ehretia acuminata</i>	38	19.388	7.294	34.69	8.057	3.3825	4.71	20.1
<i>Dillenia pentagyna</i>	31	15.816	5.95	32.65	7.583	4.1474	5.78	19.3
Phalame*	17	8.6735	3.263	26.53	6.161	2.1981	3.06	12.5
Hangrayo*	15	7.6531	2.879	24.49	5.687	1.9552	2.72	11.3
<i>Aesculus indica</i>	4	2.0408	0.768	6.122	1.422	5.7049	7.95	10.1
<i>Dellenia pentagyna</i>	24	12.245	4.607	10.2	2.37	2.2658	3.16	10.1
<i>Biax orellana</i>	15	7.6531	2.879	18.37	4.265	1.6378	2.28	9.43
<i>Aaulia</i> *	19	9.6939	3.647	16.33	3.791	0.9807	1.37	8.8
<i>Garuga pinnata</i>	6	3.0612	1.152	10.2	2.37	2.3991	3.34	6.86
<i>Cucumis sativus</i>	12	6.1224	2.303	14.29	3.318	0.5373	0.75	6.37
<i>Alstonia scholaris</i>	10	5.102	1.919	12.24	2.844	0.7254	1.01	5.77
<i>Cordia dichotoma</i>	5	2.551	0.96	10.2	2.37	1.0717	1.49	4.82
<i>Adina cordifolia</i>	3	1.5306	0.576	6.122	1.422	1.9666	2.74	4.74
<i>Terminallia bellerica</i>	4	2.0408	0.768	8.163	1.896	1.1665	1.63	4.29
<i>Maesa chisia</i>	10	5.102	1.919	8.163	1.896	0.1578	0.22	4.04
<i>Lannea coromandelica</i>	3	1.5306	0.576	6.122	1.422	1.1439	1.59	3.59
<i>Grewia optiva</i>	3	1.5306	0.576	6.122	1.422	0.565	0.79	2.79
Dude Hangrayo*	3	1.5306	0.576	6.122	1.422	0.4775	0.67	2.66
Pipiri*	3	1.5306	0.576	8.163	1.896	0.0344	0.05	2.52
Sadhan*	1	0.5102	0.192	2.041	0.474	1.3273	1.85	2.52
Kaidal*	2	1.0204	0.384	4.082	0.948	0.6479	0.9	2.23
<i>Syzygium cumini</i>	2	1.0204	0.384	4.082	0.948	0.5105	0.71	2.04

* = Local name, D= Density, RD = Relative Density, F = Frequency (%), RF = Relative Frequency (%), BA = Basal Area (m²/ha), RBA = Relative Basal Area, IVI = Important Value Index, ha = Hectare

4.1.2.1. DBH classification of tree

The pole size tree had represented the highest density of 119.39 no/ha (44.91%), whereas large saw timber size trees represent lowest density of 34.69 no/ha (13.05%). The small saw timber size trees had represented the second highest density of 64.80

no/ha (24.38%) followed by sapling with density of 47.94 no/ha (17.66%) as shown in figure 4.1.



SST = Small saw timber, LST = Large saw timber

Figure 4.1: Density of tree according to DBH category

4.1.2.2. Regeneration of tree species

All together 56 regenerating tree species were found with total density of 13333.16 no/ha. The density of seedling was found to be 9579.59 no/ha, where as density of sapling was found to be 3753.06 no/ha. Aaulia had the highest number of regenerating individuals i.e. 1061.735 no/ha. The regenerating species were classified in to five category viz < 1 m, 1 - 3 m, 3 - 6 m, 6 - 9 m and >9 m. The highest density of regenerating species was found to be under the class < 1 m height i.e. 9492.35 no/ha, and lowest density was found to be under the class >9 m shown in figure 4.2.

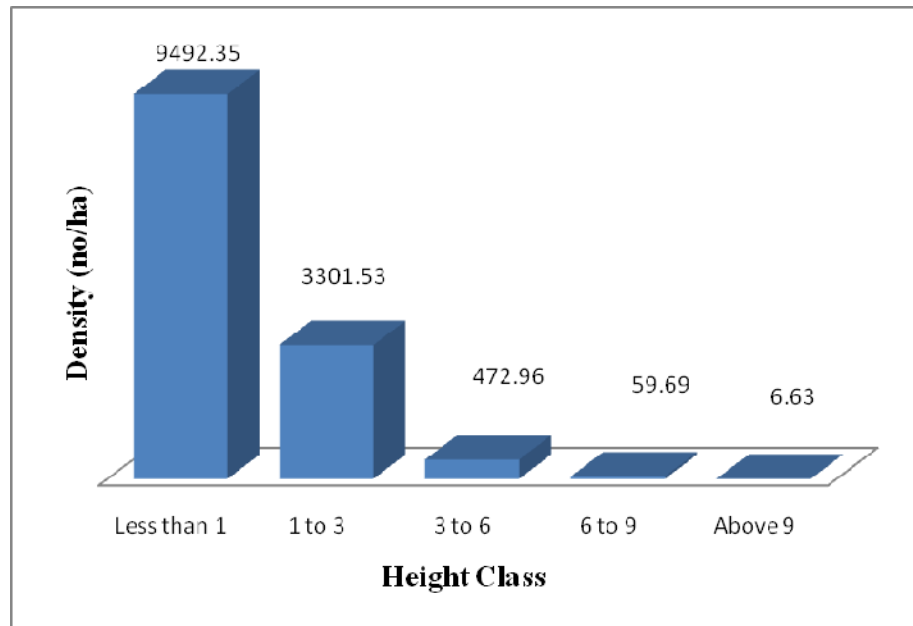


Figure 4.2: Height classification of regenerating species and their density.

4.1.2.3. Tree volume and biomass

The total standing volume of the tree species in the sample plot was found to be 173.26 m³/ha while total biomass was found to be 217.45 t/ha. Maina kath represented the largest standing volume of 61.84 m³/ha (35.48%) and biomass 78.91 t/ha (30.74%), followed by *Lagerstroemia parviflora* 17.94 m³/ha (10.35%) volume and biomass 22.11 t/ha (10.17%), and *Shorea robusta* 15.61 m³/ha (9.01%) volume and biomass 18.53 t/ha (8.52%) and so on. The other species had fewer amounts in terms of volume and biomass. The details of the tree volume and biomass are given in table B of annex III.

4.1.2.4. Annual yield and sustainable supply of forest resources

Total annual yield of the CF was found to be 10.64 t/ha/yr. Community forest can supplied 8.13 t/ha/yr of the fuelwood and 0.45 t/ha/yr foliage in a sustainable way. Maina kath had the highest supply of fuelwood 2.96 (t/ha/yr) and foliage 0.16 t/ha/yr. The details of the annual yield and sustainable supply are given in table C of annex III.

4.1.2.5. Resource demand and Supply from CF

The annual fuelwood demands of the all users HH were found to be 6024.89 t/yr and annual green fodder demands were 6501.90 t/yr. The annual TDN yield of green fodder was found to be 182.58 ton/yr. The annual sustainable yield of fuelwood was found to be 4369.56 t/yr. The demand, supply and deficit of forest resources are shown in table 4.3.

Table 4.3: Forest resources demand and supply

Total forest area (ha)	537.33
Total no of HH	1107.00
Total no of HH using firewood	1107 (100%)
Total no HH using green fodder	827 (75%)
Total amount of green fodder demand (t/yr)	6501.90
Total annual TDN yield of green fodder (t/yr)	182.58
Green fodder deficit (t/yr)	-6319.32
Total amount of fuelwood demand from HH (t/yr)	6024.89
Sustainable fuelwood yield from CF (t/yr)	4369.56
Supply from CF (t/yr)	771.46
Total fuelwood deficit (t/yr)	-5253.43

4.1.2.6. Forest resource extraction and supply

According to the management committee, the average extraction of fuelwood and timber from the CF was 700 t/yr and 158.219 m³/yr. The resources demand was found to be 36500 t/yr (100000 kg/day) of fuelwood and 141.585 m³/yr of timber. The average fuelwood supply from the CF was found to be average 4 quintal (400 kg)/HH/year. The timber supply from CF according to the needs of the user HH was 0.28317 m³/HH/yr. But the entire users HH were not facilitated during the same year. The committee supplies 4-5 quintals fuelwood during several occasions such as marriage ceremony, funeral and such other rituals.

4.1.2.7. Anthropogenic pressure in the forest resources

4.1.2.7.1. Cut stump Density

Out of 49 sampling plots, 29 cut stumps were found in a 38 plots. The total density of cut stump was found to be 129.59 no/ha. Girth size < 20 cm represent the highest density of 102.55 no/ha and the girth size 61 - 80 cm represent the lowest density of 2.04 no/ha (shown in table 4.4). *Shorea robusta* had the highest cut stump density of 38.27 no/ha followed by *Osbeckia stellata* (15.31 no/ha) and *Maesa chisia* (12.76 no/ha). The details of cut stump density are shown in table D and E of annex III.

Table 4.4: Girth Size Classification of stumped tree

Girth class	Density(no/ha)
<20 cm	102.55
20-40 cm	16.84
41-60 cm	4.59
61-80 cm	2.04
> 80 cm	3.57
Total	129.59

4.1.2.7.2. Lopping intensity density

There are all together 12 species were found to be lopped among the 36 species of tree. The total density of the lopped species was found to be 10.71 no/ha. *Aaulia* and *Shorea robusta* had represent the highest density of 2.04 no/ha. The density of lopped trees was maximum in least and minimum in medium class lopping damage shown in figure 4.3 and detailed was shown in table F of annex III.

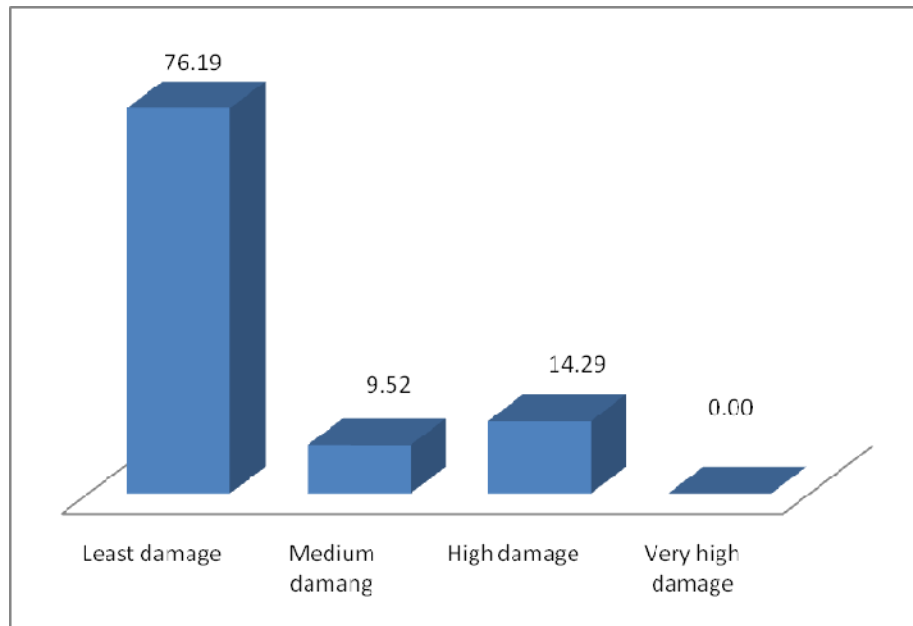


Figure 4.3: Density of lopping intensity.

4.1.3. Shrub Stratum

There are all total 98 species of shrubs were found within the 98 plots of shrubs stratum. The total density of the shrub species was 35457.14 no/ha. Among these species highest density was found to be 8171.43 no/ha of *Clerodendrum viscosum* and second highest density was found to be 5016.33 no/ha of *Maesa chisia* followed by 4024.49 no/ha of Jungeli kada. Similarly highest frequency was found to be 88.78 of *Clerodendrum viscosum* and second highest frequency was found to be 86.73 of *Maesa chisia* followed by 76.53 of *Swertia nervosa*. The highest cover was found to be 1893 of *Maesa chisia* followed by 1695 of *Swertia nervosa* and 1438.50 of *Clerodendrum viscosum*. The highest IVI was found to be 44.40 of *Clerodendrum viscosum* and then 40.40 of *Maesa chisia* followed by 30.12 of *Swertia nervosa*. The density, frequency, relative cover and IVI of shrub species (IVI up to two) are shown in table 4.5 and details were shown in table G of annex III.

Table 4.5: Structural Parameter at Shrub Stratum

Species	Total	D/ha	R.D	F	R.F	T C	RTC	IVI
			(%)		(%)		(%)	
Bhatti*	2002	8171.43	23.05	88.78	6.63	1438.50	14.73	44.40
<i>Maesa chisia</i>	1229	5016.33	14.15	86.73	6.47	1893	19.39	40.01
<i>Swertia nervosa</i>	612	2497.96	7.05	76.53	5.71	1695	17.36	30.12
Junjeli kada*	986	4024.49	11.35	48.98	3.66	444.50	4.55	19.56
<i>Nyctanthes arbor</i>	484	1975.51	5.57	61.22	4.57	439.50	4.50	14.64
Hangrayo*	243	991.84	2.80	60.20	4.49	359.00	3.68	10.97
Masinapate*	322	1314.29	3.71	58.16	4.34	274.50	2.81	10.86
<i>Sambucus hookeri</i>	259	1057.14	2.98	56.12	4.19	306.00	3.13	10.30
Kali ghas*	245	1000.00	2.82	47.96	3.58	270.00	2.76	9.16
Khasre galeni*	204	832.65	2.35	59.18	4.42	200.50	2.05	8.82
Aaulia*	259	1057.14	2.98	33.67	2.51	244.00	2.50	7.99
<i>Ehretia acuminata</i>	165	673.47	1.90	57.14	4.27	137.00	1.40	7.57
<i>Osbeckia stellata</i>	149	608.16	1.72	48.98	3.66	200.00	2.05	7.42
<i>Bridelia retusa</i>	156	636.73	1.80	43.88	3.27	148.50	1.52	6.59
<i>Shorea robusta</i>	187	763.27	2.15	30.61	2.28	99.00	1.01	5.45
<i>Biax orellana</i>	80	326.53	0.92	36.73	2.74	59.00	0.60	4.27
<i>Syzygium cumini</i>	87	355.10	1.00	35.71	2.67	53.00	0.54	4.21
Pipiri*	69	281.63	0.79	34.69	2.59	68.00	0.70	4.08
Phalame*	91	371.43	1.05	24.49	1.83	101.50	1.04	3.91
<i>Lagestroemia parviflora</i>	67	273.47	0.77	27.55	2.06	78.50	0.80	3.63
<i>Cassia fistula</i>	33	134.69	0.38	21.43	1.60	132.50	1.36	3.34
Breea arvensis	44	179.59	0.51	17.35	1.29	113.00	1.16	2.96

* = Local name, D= Density, RD = Relative Density, F = Frequency (%), RF = Relative Frequency (%), BA = Basal Area (m²/ha), RBA = Relative Basal Area, IVI = Important Value Index, ha = Hectare

4.1.4. Herbs Stratum

All together 41 species of herbs were found within the 98 plots of herbs stratum. The total density was found to be 231428.57 no/ha. Among them highest density of herbs was found to be 147.49 no/ha of *Dryopteris filix-mas*. and second highest density was found to be 85.71 no/ha of *Dryopteris cochleata* followed by 74.49 no/h of *Digitaria* spp. The highest IVI of herbs was found to be 56.17 of *Dryopteris filix-mas* and second highest value was found to be 47.84 of *Dryopteris cochleata* followed by 38.70 of *Tetrastigma serrulatum*. The density, frequency, total cover and IVI of the

herb species (IVI up to one) are given in table 4.6 and details were shown in table H of annex III.

Table 4.6: Structural Parameter at Herb Stratum

Species	Total	D/ha	RD	F	RF	TC	RTC	IVI
				%	%		%	
<i>Dryopteris spp.</i>	578	58979.59	25.49	39.8	11.02	1782	19.67	56.17
<i>Dryopteris cochleata</i>	336	34285.71	14.81	44.9	12.43	1866	20.6	47.84
<i>Digitaria spp.</i>	292	29795.92	12.87	59.2	16.38	995	10.98	40.24
<i>Tetrastigma serrulatum</i>	231	23571.43	10.19	48	13.28	1381	15.24	38.7
<i>Piper longum</i>	123	12551.02	5.42	33.7	9.322	791	8.731	23.48
<i>Equisetum arvanse</i>	103	10510.20	4.54	18.4	5.085	429	4.735	14.36
Aalu jhar*	90	9183.67	3.97	8.16	2.26	217	2.395	8.623
Khasre lahara*	14	1428.57	0.62	11.2	3.107	212	2.34	6.065
<i>Cyperus rotundus</i>	31	3163.27	1.37	12.2	3.39	102	1.126	5.883
Aangare jhar*	29	2959.18	1.28	9.18	2.542	146.5	1.617	5.438
<i>Imperata cylindrical</i>	77	7857.14	3.40	4.08	1.13	27	0.298	4.823
Gittha lahara*	35	3571.43	1.54	7.14	1.977	100	1.104	4.624
<i>Cissus repens</i>	16	1632.65	0.71	7.14	1.977	93	1.026	3.709
Kanaso*	53	5408.16	2.34	3.06	0.847	37	0.408	3.593
Kharane*	9	918.37	0.40	4.08	1.13	171.5	1.893	3.42
<i>Marsdenia roylei</i>	25	2551.02	1.10	6.12	1.695	40	0.442	3.239
<i>Ageratum conyzoides</i>	41	4183.67	1.81	3.06	0.847	45	0.497	3.152
Speices B*	40	4081.63	1.76	1.02	0.282	80	0.883	2.929
<i>Oxalis corniculata</i>	25	2551.02	1.10	4.08	1.13	25.5	0.281	2.514
Mashi jhar*	6	612.24	0.26	3.06	0.847	102	1.126	2.238
Kure jhar*	10	1020.41	0.44	5.1	1.412	16	0.177	2.03
Aakhate jhar*	8	816.33	0.35	1.02	0.282	100	1.104	1.739
<i>Cynodon spp.</i>	24	2448.98	1.06	2.04	0.565	10	0.11	1.734

* = Local name, D= Density, RD = Relative Density, F = Frequency (%), RF = Relative Frequency (%), BA = Basal Area (m²/ha), RBA = Relative Basal Area, IVI = Important Value Index, ha = Hectare

4.2. Forest management practice

4.2.1. Types of forest management practices

Plantation, weeding, thinning, and clear cutting were the management practices applied in the CF. According to management committee, in previous 1 to 2 years, about 70% of women were participated in forest protection, above 50% women were

participated in weeding, and about 30% women were participated in new plantation in open area. Only about 15% of youth were participated in different activity of forest management because of most of youth were attracted by foreign job and engage in other job. From the total respondents, 77.2% of the respondents were participated in different activities of CF management, 55% HH were participated in the weeding and thinning activity, 15% HH were participated in new plantation, weeding and thinning activity. Only 6% HH were participated in the plantation in open place as shown in table 4.7.

Table 4.7: Forest management practice

Forest management practice	HH	Percentage (%)
Plantation	5	6.33
Clear cutting	6	7.59
Weeding	2	2.53
Weeding + thinning	44	55.70
Plantation + weeding + thinning	12	15.19
Clear cutting + weeding + thinning	10	12.66
Total	79	100.00

During the survey, 87.34% of the respondents had said that there is no facility to economically poor HH, 74.68% of the respondent had said that there is no public audit, 82.28% of the respondents opinioned for no facility to share views in decision making processes and 81.01% of the respondents were not happy with consumption and distribution pattern of the forest resources. The following table 4.8 shows the respondents views in different aspect.

Table 4.8: Respondents views on different aspects

Respondents View	Yes (%)	No (%)
Facility to economically poor HH regarding resource ability	12.66	87.34
Public Audit	25.32	74.68
Facility to share views in decision making processes	17.72	82.28
Happy with consumption and distribution pattern	18.99	81.01

4.2.2. Purpose of forest management

Among the 79 sampled HH 35% of the respondents argued that forest management practice was mainly for good timber and regeneration, 12% of the respondents argued forest management practice was mainly for good timber and for plantation and only 3% (shown in figure 4.9) respondents argued forest management practice was for plantation.

Table 4.9: Purpose of forest management practices

Purpose of forest management	HH	Percentage
Good timber	10	12.66
Regeneration	8	10.13
Plantation	3	3.80
Good timber + supply fuel wood + supply fodder +regeneration	7	8.86
Good timber + regeneration + plantation	8	10.13
Good timber + plantation	10	12.66
Good timber + regeneration	28	35.44
Supply fodder + regeneration + plantation	5	6.33
Total	79	100.00

4.2.3. Condition of forest

Most of the respondents (65.6%) said that the condition of forest in terms of resource availability and forest quality was found to be satisfactory, 5.1% respondents said the forest was very good and the remaining 30.4% of respondents said that forest was very bad. The present condition of forest in terms of resource availability and quality of forest are shown in figure 4.4.

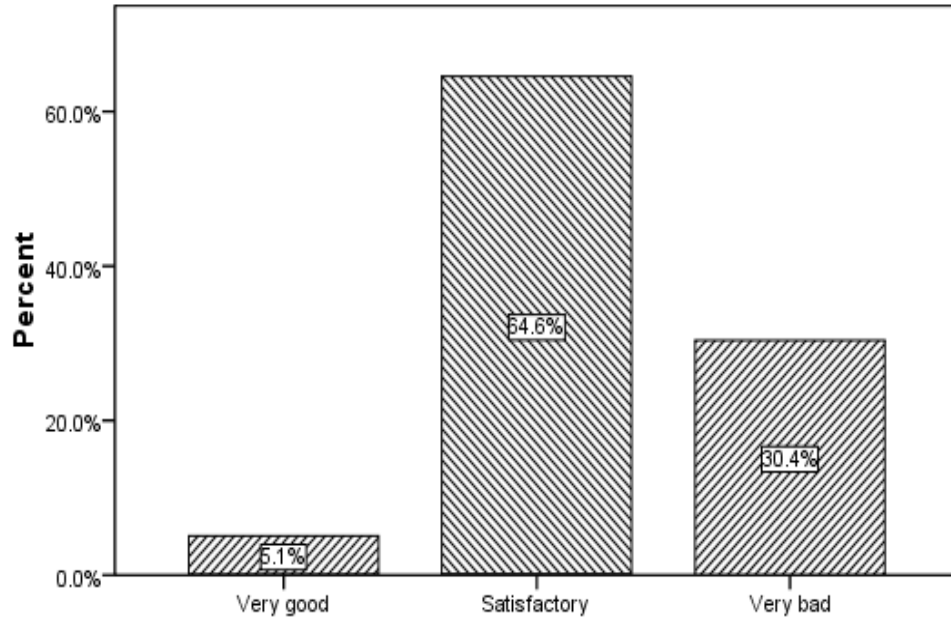


Figure 4.4: Condition of forest in terms of resource availability and quality of forest

4.2.4. Fund generation and spend

Fund generating activity of the CF includes selling of resources (fuelwood and timber), renew of membership card, different punishment fee, new membership card (fee), from animal breed, different donor agency, and donation from government etc. Investment of forest capital includes forest management and protection, cutting and transportation of tree, social infrastructure development (road, culvert, electricity and education), salary of staff, help to disaster victim, help to chronic diseased member, management of animal breed and miscellaneous expenses.

4.2.5. Households perception in fund generation and spend

Most of the sampled HH 81% knew about the fund generating activities of the forest which include selling of forest products, fee from membership and penalty for illegal activity (given in the table 4.10).

Table 4.10: Fund generating activities

Fund generating activities	%
Selling of forest product	1.27
penalty from illegal activity	1.27
Interest from bank	1.27
Forest product + fee from membership + penalty from illegal activity	81.01
Forest product + fee from membership + penalty from illegal activity + interest from bank	3.80
Selling of forest product + fee from membership	11.39

Among the respondents, 20% reported that the forest fund was used for construction of road and culvert and 53% of them accepted that they were unknown about the fund expenditure sector (given in the table 4.11).

Table 4.11: forest fund spend

Forest fund spend	%
Unknown	53.16
Construction of road and culvert	20.25
Forest protection and management	5.06
Construction of road and culvert + education	8.86
Construction of road and culvert + education + investment for IGA/ Skill development+ forest protection and management + salary of board member	3.8
Construction of road and culvert + salary of board member	2.53
Construction of road and culvert + forest protection and management	33

4.2.6. Wildlife depredation issue

Wildlife which frequently comes to the adjacent village includes elephant, wild pig, and monkey. Out of 79 HH, 71 HH had no problems of the wildlife and 5 HH (6.33%) had faced crop damage due to wildlife especially elephant and wild pig.

4.2.7. Respondent perception towards the CF

Respondent's perception on protection, quality of forest, firewood collection time and benefit of forest, shows that most of the respondents had positive response but regarding firewood collection time, they had negative response. Of them 55.70% of respondents had positive response in forest protection, 53.16% had positive response in quality of forest, 41.77% had positive response in benefit and 49.37% had negative response in firewood collection time as shown in the table 4.12.

Table 4.12: Respondent perception towards the CF

Attitude towards the community forest	Positive (%)	Negative (%)	Neutral (%)
Protection	55.70	29.11	15.19
Quality of forest	53.16	26.58	20.25
Firewood collection time	15.19	49.39	35.44
Benefit	41.77	20.25	37.97

4.2.8. Problems in CF

Sampled HH reported nine different problems at the CF. Regarding the problems in CF, the main problems were unequal distribution of resources (89.87%), untransparency of fund management (87.34%) given in the table 4.13. Similarly, other problems were unavailability of resources from the management committee (86.08%), decrease in wildlife population in the CF (75.95%), negligence of lower class peoples' problems (56.96%), smuggling (40.51%), CF far from community (36.71%), illegal firewood collection (34.18%) and so on.

Table 4.13: Problem identified by the respondent

Problem in CF	Frequency	%
Unequal distribution of resources	71	89.87
Untransparency of fund management	69	87.34
Unavailability of resources from committee	68	86.08
CF far from community	29	36.71
Illegal firewood collection	27	34.18
Decrease in wildlife population	60	75.95
Crop damage from wildlife	8	10.13
Smuggling	32	40.51
Negligence of lower class peoples' problems	45	56.96
Unknown	6	7.59

4.2.9. Solutions to the problem

The major suggestions for the better CF management were equal distribution of resources (92.41%) followed by strict rules and regulations (91.14%), transparency in fund management (87.34%), regular distribution of resources (86.08%), provision for poor household (58.23%), plantation on bare area and control on illegal resource collection (43.04%) and so on as given in the table 4.14.

Table 4.14: Solution to the problem of CF

Solution to the problem	Response frequency	%
Equal distribution of resources	73	92.41
Transparency in fund management	69	87.34
Regular distribution of resources	68	86.08
Provision for poor household	46	58.23
Plantation of fodder tree and grasses	25	31.65
Control on illegal resource collection	34	43.04
Launch IGA/ skill development programme	21	26.58
Strict rules and regulation	72	91.14
plantation on bare area	34	43.04
No idea	5	6.33

IGA = Income Generating Activity

4.2.10. Wellbeing ranking of the user group

Fuelwood and timber were supplied with free of cost to the economically and mentally poorer HH (disabled HH) while other HH had to pay the investment cost of resource extraction.

4.2.11. Income generating activity

During 2007 to 2009, 0.068 ha of land/HH was provided to about 30 economically poorer HH of the slum area for the community vegetable farming. All the necessary resources like fertilizer, irrigation, experts, seed and equipment were available without cost to those HH. This programme was terminated after two years. The reasons behind the termination were peoples' growing interest towards foreign job and engage in other employment. The biggest achievement of this programme was the HH who were completely dependent upon the forest for sustaining livelihood, became independent after the IGA.

4.2.12. Wildlife issue

From the interaction with management committee and key informant interview it was found that in the CF 4 to 6 elephant has been staying during the six month within a year. Also during the vegetation survey we saw one elephant in the sampling area. Although the forest provides good habitat for the wild animal but there has been decreasing of wild life year by year.

4.2.13. Minuting

From the management committee, minuting of different year were taken and their frequency response were count by different topic in which the minuting has been done. It shows that the minuting has been done an approximately same trend from the beginning of the committee formation. The different activities on minuting are shown in table 4.15.

Table 4.15: Minuting of different year.

	Frequency								
	206	206	206	206	206	206	206	206	206
Issues	0	1	2	3	4	5	6	7	
Management Issue	29	24	25	24	17	15	33	10	
Fund Management	13	3	6	11	5	12	9	3	
Forest protection	9	7	5	5	12	7	14	9	
Implementation Issue	2	2	1	1	-	-	-	-	
Forest harvest and supply of resources to the users group	20	11	4	3	8	9	-	5	
Fund expenditure in social development	1	2	5	2	5	1	3	-	

4.3. Socio economic analysis

4.3.1. General character of the respondent

The general characteristics of the respondents were presented on the basis of sex and age, educational status and caste/ethnicity, occupation and family structure. The total populations of the sampled HH were found to be 574. The most of the respondents were female 46 (52.8%) and rests of them are male 33 (41.8%).

Ethnicity of the people in the study area was found to be heterogeneity. Majority of the respondents were Brahmin and Chhetri representing 59.5%. Janjati represents 16.5%, Indigenous represents 15.2%, Dalit represents 6.3% and other caste represents 2.5%. As per occupation of the respondents 55.69% of the respondents had agriculture as major occupation, 20.25% of the respondents were busy in unskilled wage labour, 12.7% respondents had a business, 5.1% respondents had service and 3.8% were student.

Most of the respondents 32.9% in sample HH were general literate, and 31.6% of the respondents were illiterate. Only 1.3% respondents had Master's degree education, 2.5% had Bachelor's degree and 24.1% had up to SLC.

Among the land holding category of the 79 HH, it was found that most of the respondents had small farm i.e. 53.2%, landless represent 16.5%, middle farm represent 17.7% and large farm represent 12.7%. The detail information's are shown in table 4.16.

Table 4.16: General characteristic of the respondent

Category		No of respondent	%
By Sex	Male	33	41.77
	Female	46	58.23
By Ethnic Group	Bhramin/Chettry	47	59.49
	Janjati	13	16.46
	Indigenous	12	15.19
	Dalit	5	6.33
	Other	2	2.53
By Occupation	Agriculture	44	55.69
	Service	4	5.06
	Unskilled Wage labour	16	20.25
	Business	10	12.66
	Student	3	3.80
	Ag+ S	2	2.54
By Education	Illiterate	25	31.65
	General Literate	26	32.91
	Up to SLC	19	24.05
	Intermediate	6	7.59
	Bachelor	2	2.53
	Masters	1	1.27
By Farm size	Land less	13	16.46
	Small farm	42	53.16
	Medium farm	14	17.72
	Large farm	10	12.66

%= Percentage, Janjati = Tamang/Rai/Limbu/Shrestha/Magar, Indigenous = Dhimal/Urab/Maghi, Other = Giri/Puri

4.3.2. Population

Among the 79 sampled HH, 51(64.56%) HH were found to be joint and 28(35.44%) HH were nuclear. The total populations of sampled HH were found to be 574 of which male represented 49.13% and female 50.87%. Following table 4.17 shows the detail characters of the sampled HH.

Table 4.17: General character of the sampled HH

HH characteristics		HH	%
Family structure	Nuclear	28	35.44
	Joint	51	64.56
		Population	%
HH sex ratio	Male	282	49.13
	Female	292	50.87

4.3.3. Occupation

Except land less, agriculture was the major occupation adapted by the sampled HH. People from small farm, medium farm and large farm were engaged in agriculture, as a major source of occupation. Unskilled wage labour (UWL) was mainly found in landless HH are shown in table 4.18.

Table 4.18: Occupation of the people in sampled HH

Household Occupation	Landless HH (Popln %)	Small farm HH (Popln %)	Medium farm HH (Popln %)	Large farm HH (Popln %)	Total HH
Agriculture	-	34 (26.13)	14 (45.97)	9 (39.77)	57
UWL	12 (48)	17 (14.29)	-	-	29
Service	4 (9.33)	12 (5.57)	5 (8.41)	5 (11.36)	26
Business	4 (14.67)	15 (9.41)	3 (5.61)	3 (9.09)	25
Remit	5 (12)	23 (9.76)	7 (8.41)	3 (10.23)	38
Student	6 (13.33)	38 (33.45)	14 (31.78)	10 (29.55)	68
Skilled Wage Labour	1 (2.67)	4 (1.39)	-	-	5

% = Population Percentage

4.3.4. Education level of sampled population

Of the sampled HH, 48 HH were Bhramin/Chhetri of them 24.55% had education up to School Leaving Certificate (SLC), 8.91% had certificate level, 4.36% had Bachelor and 0.91% had graduates. But the in case of Janjati, indigenous and Dalit only 6.91%, 4.18% and 2.36% had education up to SLC respectively. They had no education after SLC which are shown in table 4.19.

Table 4.19: Education of the population of sampled HH as per ethnicity

Ethnic group	HH	I	G.L	up to SLC	Int	B	M
		(%)	(%)	(%)	(%)	(%)	(%)
Brahmin/Chhetri	48	6.36	16.91	24.55	8.91	4.36	0.91
Janjati	12	2.73	4.00	6.91	0.91	0.55	-
Indigenous	12	2.36	5.09	4.18	0.91	-	-
Dalit	5	2.18	2.55	2.36	0.91	-	-
Other	2	0.55	0.91	0.91	-	-	-

I= Illiterate, G.L = General Literate, Int = Intermediate, B = Bachelor, M = Masters

Janjati = Tamang/Rai/Limbu/Shrestha/Magar, Indigenous = Dhimal/Urab/Maghi,

Other = Giri/Puri, % = Population percentage.

4.3.5. General characteristics of HH by farm size

Based on the land holding category of the HH, the average family size, farm size, total crop production, average livestock unit, fodder consumption were higher in medium and large farm HH than small farm and landless HH. Most of the HH 74.68% had self tenant, 12.66% of HH had aailani land, 7.59% of HH had given tenant to other and 5.06% HH had taken tenant from other. The general characteristics of the HH by farm size are shown in table 4.20.

Table 4.20: General Characteristics of HH by farmland size

Variable	Category of the farmland			
	Landless	Small	Medium	Large
Households	13	42	14	10
Average family size	6.31	6.93	7.86	9.1
Total farm size (ha)	0.38	4.54	7.68	10.61
Total not registered land(ha)	0.38	0.58	-	0.27
Total registered land(ha)	-	3.143	6.358	6.086
Total crop production (kg/yr)	400	23855	26639	36404
Average livestock unit (LU/farm size)	0.82	1.64	1.87	2.31
Average fodder demand(t/yr/	6.91	6.2	9.39	11.5
Average fuel wood demand(t/yr)	4.29	5.19	7.79	4.69
Total annual Income (\$)/HH	680.76	1117.46	1716.21	2191.03

\$1 = 78 NRs (9th Feb, 2012, Kantipur daily)

4.3.6. Food crop production and food security

The average crop production of the sampled HH were found to be 1105.04 kg/yr. Production from the agricultural land showed that, 40 HH (50.63%) had always food deficit, 5 HH (6.33%) had food sufficient up to 3 month, 4 HH (5.06%) had food sufficient up to 3 to 6 month, 9 HH (11.39%) had food sufficient up to 6 to 9 month. All total 73.4% HH had food deficit throughout the year, 12.7% HH had food balance throughout the year and remaining 13.9% HH had food surplus as shown in table 4.21.

Table 4.21: Food sufficiency month

Food Sufficient Month	HH	%
Always deficit	40	50.63
Up to 3 month	5	6.33
3 to 6 month	4	5.06
6 to 9 month	9	11.39
12 month	10	12.66
Surplus	11	13.92

Out of 79 sampled HH almost all lands less HH had food deficit throughout the year. Similarly, 88.10% HH of the small farm, 42.86% HH of the medium farm and 20% HH of the big farm had food deficit throughout the year. Also 7.14% HH of the small farm, 35.71% HH of the medium farm, and 20% HH of the large farm had food balance and 4.76% HH of the small farm, 21.43% HH of the medium farm and 60% HH of the large farm had food surplus throughout the year as shown in table 4.22.

Table 4.22: Land holding with crop status

Land holding	Crop status		
	Deficit (HH %)	Balance (HH %)	Surplus (HH %)
Land less	100	-	-
Small farm	88.10	7.14	4.76
Medium farm	42.86	35.71	21.43
Large farm	20	20	60

Most of the landless and small farm HH fulfills their food deficit from unskilled wage labour, business, service and foreign remittance. Medium farm and large farm HH fulfills their food deficit through service, business and remittance.

4.3.7. Livestock holdings and forest resource demand

The major livestock's in sampled HH were cattle, buffalo and goat. Numbers of different livestock were synthesized in single unit called Livestock Unit (LU). The total livestock units of sampled HH were found to be 102.31 and average livestock unit was found to be 1.73/HH.

4.3.8. Feeding type and fodder accessibility

Households with livestock's were dependent on the CF and their own land for fodder and grazing. Among the 59 livestock having HH, 81.4% does stall feeding, 10.2% HH does grazing in CF and 8.5% HH does both stall feeding and grazing as shown in table 4.23.

Table 4.23: Feeding type

Feeding type	HH%
Stall feeding	81.4
Grazing	10.2
Both	8.5

For the fulfillment of the fodder demand, 27% HH were dependent on the forest, 60.9% HH were dependent on own land and 12.1% were on the both CF and own land as shown in table 4.24.

Table 4.24: Fodder accessibility

Fodder accessibility	HH%
Forest	27
Own land	60.9
Both	12.1

4.3.9. Energy consumption and expenditure in energy

Energy usage of the sampled HH includes kerosene, electricity, Liquefied Petroleum Gas (LPG), biogas, and battery. The energy usage of the land less and small farm HH had less than the medium farm and large farm HH. Household used electricity for lightening, cooking and for running device etc. Kerosene was mainly used for lightening purpose, LPG was mainly for cooking, battery was for lightening, and running device and BGP was mainly for cooking. The different categories of energy consumption of sampled HH are shown in table 4.25.

Table 4.25: Energy consumption

Energy use category	Landless HH (%)	Small farm HH (%)	Medium farm HH (%)	Large farm HH (%)
Kerosene Usage	92.31	76.19	85.71	90
Electricity Usage	53.85	90.48	100	100
LPG Usage	23.08	54.76	71.43	70
Battery usage	23.08	14.29	7.14	20
BGP usage			21.43	20

LPG = Liquefied Petroleum Gas, BGP = Biogas Plant

The large farm HH had spent greater amount and landless HH had spent lesser amount (shown in table 4.26) in energy consumption sectors.

Table 4.26: Expenditure in energy consumption

Land holding	Average annual expenditure in energy(US \$)
Landless	61.64
Small farm	74.78
Medium farm	84.79
Large farm	113.52

\$1 = 78 NRs (9th Feb, 2012, Kantipur daily)

CHAPTER V

5. DISCUSSION

5.1. Vegetation analysis

The Shannon diversity index of shrub (2.89) was higher than the trees (2.61) and herbs (2.56). The species richness of shrubs (10.81) was higher than the trees (5.58) and herbs (4.92). The evenness index of trees (0.73) was higher than the herbs (0.70) and Shrubs (0.63). The index of dominance of trees (0.14) was higher than the herbs (0.12) and shrubs (0.10). The Shannon diversity index of trees was found to be 2.61 higher than the Ghimire (2007) of 1.51, Thapa (2010) of 0.708, Dhakal (2007) of 1.08168, Adhikari (2010) of 1.009 which shows the higher diversity of tree, shrub and herb in the CF. The evenness index of the tree, shrub and herb was found to be greater than 0.5 which indicates the species were more evenly distributed.

The total density of the tree species was 265.82 no/ha. The highest density was found to be 89.80 no/ha (frequency 32.65%) of *Shorea robusta* (dominant species) followed by *Osbeckia stellata* with 27.04 no/ha and highest frequency 44.90%. This study showed higher density of *shorea robusta* as well as overall density as compared to the study carried out by Dhakal 2007 of *Shorea robusta* 45.83 no/ha with total density 46.66 no/ha, Thapa 2010 of *Shorea robusta* 110.8 no/ha with total density 197 no/ha, Adhikari 2010 of *Shorea robusta* 75 no/ha with total density 260 no/ha and Pandey 2009 of *Shorea robusta* 82.50 no/ha with total density 328.33 no/ha. This shows that the CF of Uralbari VDC was dense and improved than the BZ forest of CNP and PWR.

Total basal area of the CF was found to be 71.76 m². The highest relative basal area for the Maina kath was found to be 25.57% followed by *Shorea robusta* 12.5% and *Lagerstroemia parviflora* 7.28%. The present study showed higher basal area as compared to the basal area of 20.16 m² Pandey (2009), 9.32 m² of Dhakal (2007), 15.99 m² of Ghimire (2006), 28.77 m² of Adhikari (2011), 5.47 m² of Shrestha (2007) and 12.41 m² off Thapa (2010). The lower value of basal area indicates that the forest

is young and regenerating (Bhattarai, 2007). The higher value of basal area of this forest shows that this forest was old and matured than the mentioned other.

Important Value Index provides a quantitative basis for the classification of community (Adhikari, 2010). Among them, the highest IVI found to be 53.81 for the *Shorea robusta*, showing the highest dominancy over other species followed by Maina kath of 35.3. This indicates that these species are ecologically important to maintain existing ecosystem (Pandey, 2009).

The total annual yield was found to be 10.64 t/ha/yr, greater than the 8.66 t/ha /yr of the HMG (1988). The total standing volume and biomass of the tree species were found to be 173.26 m³/ha and 217.45 t/ha respectively. The obtained value is higher than the average volume and biomass of Sal forest in Terai of EDR of 124.32 m³/ha and 176.97 t/ha (HMG/N 1988). This shows that the total standing volume and biomass of the present study was higher and store enough volume and biomass.

The annual sustainable fuelwood yield was found to be 8.13 t/yr/ha. This value is higher than the sustainable annual wood supply from EDR natural forest of 2.6 t/yr/ha (HMG/N, 1988). The annual sustainable yield of green fodder was found to be and 182.58 TDN in t/yr. This value is lower than the value of 272 t/yr of EDR and higher than the 8 TDN in t/yr of Terai forest of EDR (HMG/N, 1988). This may be due to the small forest area of the present study as compared to the large forest area of EDR.

Form the socio economic survey, the total fuelwood demand of the user group of BCF was found to be 6024.89 t/yr. The supply of fuelwood to the user groups from the CF was 771.46 t/yr. The sustainable yield of fuelwood from the CF was found to be 4369.56 t/yr. The total green fodder demand was found to be 6501.90 t/ha. The demand of green fodder of the user groups was much higher than the supply from the CF. The deficits of fuelwood and green fodder were found to be -5253.43 t/yr and -6319.32 t/yr respectively.

The CF does not fulfill the resource demand of the user HH. The HH were fulfilling their demand of fuelwood and fodder from their own agricultural land and from

alternative energy resources. This may be due to the smaller area of forest; it had not the capacity to fulfill the demand of fuelwood and fodder.

While looking at DBH category, pole sized trees had represented the highest density 119.39 no/ha and the small saw timber represented second highest density 64.80 no/ha. Saplings and large saw timber had represented less as compared to the pole sized and small saw timber. The dominance of pole and small saw timber sized trees in the forest indicates that forest is still in its seral stage (Adhikari 2010).

Among the 49 plots, 29 cut stumps species were found to be in a 38 plots. The total cut stump density of the species was found to be 131.63 no/ha. *Shorea robusta* was the most common cut stump (38.27 no/ha) species among other species followed by *Osbeckia stellata* (15.31 no/ha) and *Maesa chisia* (12.76 no/ha). During the vegetation survey, the old cut stumps were found to be greater than the newly one, While the density of lopping intensity was found to be 10.71 no/ha. The least damage density was found to be 8.16 no/ha. This shows that there might be control of cutting of branches and tree after the formation of management committee.

The total density of the shrub species was found to be 35457.14 no/ha. This value is higher than the 32786.67 no/ha of Dhakal (2007), 28,826.67 no/ha of Pandey (2009), 19,046 no/ha of Sharma (2009), 7840 no/ha Adhikari (2010) and lower than the 106428.6 no/ha of Shrestha (2007). Seasonal variance is the prominent factors for fluctuation of density of shrubs and herbs. Grazing of cattle also lowers the density of shrubs in the study area. Among these species highest density was found to be 8171.43 no/ha of *Clerodendrum viscosum* and second highest density was found to be 5016.33 no/ha of *Maesa chisia* followed by 4024.49 no/ha of Jungeli kada. The dominant species were *Clerodendrum viscosum* (IVI 44.40) and *Maesa chisia* (IVI 30.12).

All together there were 56 regenerating species (including seedling and sapling) were found with density 13333.16 no/ha. This value is higher than 2751.16/ha (DBH <12.5 cm, and trees within shrub and herb plots) of Shrestha (2007) and 13,060 no/ha of Pandey (2009), and lower than 30573.33 no/ha of Dhakal (2007). As height classification of species, < 1m class represents the highest density of 9492.34 no/ha.

This exact reverse J-shaped curve shows the sustainable regeneration i.e. this forest had well for regeneration (Sharma, 2009). According to the CF inventory guideline 2061, CF having density greater than 7000 no/ha of regenerating species shows this CF is good in terms of regenerating species.

The total density of herbs was found to be 2, 31,428.57 no/ha. The density of the present study is higher than that of the 1, 25,571 no/ha of Sharma (2009), 179,000 no/ha of Pandey (2009), 57,333.33 no/ha of Dhakal (2007), 62150 no/ha of Shrestha (2007), 104333.33 no/ha of Adhikari (2010) and 1, 38,000 no/ha of Thapa (2010). The dominant species of herbs was found to be *Dryopteris filix-mas* (IVI 56.17) and then *Dryopteris cochleata* (IVI 47.84).

Inside the CF there is a wetland which serves as a good habitat for the different kind of mammal, birds and large animal. Different kinds of medicinal plant have not been extracted till now. This forest maintains the biological corridor for the elephant. So for the protection of animal, birds and other medicinal plant, CF itself enough for providing good habitat to the animal and birds.

5.2. Livelihood and forest use

Majority of the HH were depends up on the forest for the fuelwood and fodder resources. Large farm and HH may have sufficient crop production land and substantial number of cattle. Household with big farm required more green fodder as they had comparatively large number of livestock than those of small farm HH. They graze their cattle on their own land and supply fodder from private land so haven't too much pressure on the forest resources.

Medium farm HH commonly have land holdings and cattle, but only modest private tree resources and grazing land. They tend to be dependent on the forest resources for grazing of their cattle. Small farm HH were more dependent on fuelwood as they had less access to biogas, electricity, kerosene and LPG. The HH near the CF had almost depended up on grazing their livestock to the forest throughout the year.

landless HH were depend on non-land based activities such as laboring, artisanal work, NTFPs collection, and selling of forest product in market for their daily basis. To pursue these livelihoods they have specific needs from the forest distinct from the other land holding HH; such as fuelwood and medicinal plants collection and sale, collection of NTFPs like leaf of Sal, vegetable. Landless were not able to offer the alternative approach on energy consumption pattern and heavily depends on the forest resources as they had also livestock and lack of land on grazing.

5.3. Management issue

Plantation, weeding, thinning and clear cutting were the forest management practices done in the CF. The sampled HH were participated in the different activity of CF management. Female mostly participated in the forest management and protection. Participation of youth in the forest management and protection was found to be very low as compare to women. The main purpose of forest management was for good timber and regeneration.

In general it is considered that high participation is an indicator of positive perception/attitude towards the program and success and failure of any program depend very much on the perception/ attitude of the beneficiaries (Rayamajhi, 1994 as cited in Upadhaya 2009).

The respondents were not happy with consumption and distribution pattern of forest resources, because they said there were not facility to economically poor HH and no facility to share views in decision making process. But according to the management committee, there was facility to the economically and mentally poor people to the resources. This may be due to the research does not cover all the land less and poorer HH, it is limited to some land less HH.

The forest fund was spends in the CF management and social development. Most of the respondent had no idea about the forest fund spend. Only fewer respondents had known the fund was spend on the construction of road and culvert. The respondents had positive attitude towards the forest protection, quality of forest, and benefit of the forest and negative attitude towards the firewood collection time. This is because

forest was open only two days per week within three month. So HH had not collected enough fire wood.

There was no issue of the wildlife depredation but had issue of depletion wildlife population. The reasons behind the depletion of wildlife population were weak law and legislation, foolish society, not having defense equipment and DFO had not responsibility only had formality. There were some problems in the management committee of the CF. Unequal distribution of the forest resources, lack of transparency in the CF fund management and unavailable of the resource from the committee regularly were the main problems pointed by the respondent. The other problems include not concern poor problems, illegal collection of firewood and smuggling.

The suggestions of the respondent for the better CF management include equal distribution of the resources, strict rules and regulations, transparency in the fund management, regular distribution of the resources, provision for poor HH, plantation on bare area, launch IGA/ skill development programme and plantation of fodder tree and grasses.

Minuting of different year showed that at the beginning of the CF formation, minuting was focus on the draft preparation of constitution, tol committee formation, and distribution of the membership card. While looking the minuting scenario of the CF, there has been decreasing on issue of minuting. This might be due to, at the beginning CF has seems to be very active so minuting on different issue were conducted but the trend has been decreasing which seems passive towards the minuting. Minuting always focused on the management issue rather than the forest management and protection, social development and resource distribution to the user groups.

5.4. Socio economic analysis

Urlabari VDC has an assemblage of various groups of people following different religions and adopting different occupation for their survival. Majority of the residence in the study area was found to be Bhramin and Chhetri followed by Janjati and Indigenous people include Dhimal, Maghi and Urab.

The average family size of the sampled HH was found to be 7 which was higher than the 5.6/HH of national average and 5.3/HH of Nepal Living Standards Survey (NLSS) 2003-2004. This may be due to the higher joint type family of sampled HH. Education level showed that Brahmin and Chhetri had higher percentage of education above SLC. This may be due to the better economic condition. Indigenous and Dalit had not attained above certificate level education. This may be due to the low economic condition.

Except landless, agriculture is the primary livelihood activity, based on the ownership of less farmland. Most of the HH had self tenant to grow the food production. Most of the land less had Aailani land (not registered). The big farm HH may supplement farming with income from business and service employment. Landless and small farm HH may take other tenant for sustaining their life .Almost all sampled HH (land less and small farm) had food deficit throughout the year. They fulfill the food deficit through wage labour, service, business and foreign remittance. Only the big farm HH had food surplus throughout the year. The land is more suitable for agricultural productivity, but unplanned urbanization and increasing number of settlement are gradually reducing the productive fertile land.

Fuelwood was the major source for cooking of food and animal food. There were fewer shares of kerosene, LPG and electricity as a alternative resource as compare to fuelwood. Bio gas having HH were found to be very less so most HH had depend up on the fuelwood for cooking. Landless HH spend less money in alternative energy source as compare to small farm, medium farm and large farm HH.

CHAPTER VI

6. CONCLUSION AND RECOMMENDATION

6.1. Conclusion

- The density and diversity index of BCF indicates that the forest was dense (higher diversity) with dominant species of *Shorea robusta* and the forest was more evenly distributed. The forest was found to be good in terms of high regenerating species with dominant species of *Shorea robusta*.
- The annual fuelwood demand of the all users HH were found to be 6024.89 t/yr and annual green fodder demands were 6501.90 t/yr.
- The average extraction of fuel wood and timber from the management committee was found to be 700 t/yr and 158.219 m³/yr respectively.
- The CF can supply 182.58 t/yr TDN of fodder and 4369.56 t/yr of fuelwood in a sustainable way.
- Resources demand was found to be two times more in fuelwood and 35th times more in fodder than the forest can supply.
- The average fuel wood supply from the management committee was found to be average 4 quintal (400kg)/HH/year. The average timber supply according to the needs of the user HH was 0.28317 m³/HH/yr, but not all users HH get during the year.
- The intensity of weeding, thinning and new plantation entirely depended on traditional knowledge.
- The resource (fuel wood, fodder and timber) available from the CF were not sufficient for the local people and thus they depend on private lands and alternative energy resources.
- This CF maintains the biological corridor of elephant, hence to protect biodiversity conservation.
- Land less and small farms HH have high pressure on the CF as compare large farm and middle farm HH.

6.2. Recommendation

6.2.1. To the Management Committee

- 1) Uurlabari VDC is potential site for biogas installation since the most of HH reared livestock. For the installation of BGP, CF should provide subsidy to the HH having livestock's and promote other alternative energy promotion program to the HH without livestock. This scheme would reduce over dependency on forest and would enhance conservation of biodiversity.
- 2) To mitigate fodder demand, the unproductive herds of livestock should be replaced by the high yielding hybrids so that the number of animals and grazing pressure on the community forest will be reduced.
- 3) Income generating activity/skill development programme target to the landless and small farm HH to change the behavior of locals for their economic improvement.
- 4) Strong rules and regulations should be adapted to control the poaching and hunting of the wildlife.
- 5) Large scale research including the entire user households should be requiring.

6.2.2. To the CFUGs

- 1) For the land holding HH, fodder trees should be planted to their farm land that reduces the overharvesting and grazing pressure on the CF.
- 2) For the landless HH, alternative energy resources like briquette, solar cooker, improve cooking stoves should be adopted.

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ANNEX I

FIELD QUESTIONNAIRE

S.N:
Latitude:
Longitude:

General information of the respondent

Respondent—MaleCaste/Ethnic
group/Clan..... Natal village/VDC-Ward/District.....

Respondent—FemaleCaste/Ethnic
group/Clan..... Natal village/VDC-Ward/District.....

Current Address (Village/VDC/Ward).....Household No
(001 to 999).....

Name of Data Collector(s).....Dates:

First/Second visit..(1).....(2).....

Household information (beginning with the oldest person)

Individual ID (Full Name)	Relation to Respondent	Sex	Age	Marital Status	Occupations			Education*
					I	II	III	See Note

Relation: R= Respondent, Hu= Husband, Wi= Wife, Br= Brother, Si= Sister, Fa= Father, Mo= Mother, So= Son, Da= Daughter (Use Combinations of these for other relations).

Marital Status: NM= Never Married, CM= Currently Married, Wid= Widowed, Sep= Separated, Div= Divorced

Education*: Specify as Illiterate, Literate (for those who can read and write only) and Class/Level/Degree (if applicable)

B. HOUSEHOLD ECONOMY

1. Types of Land?

- Own:Bigha..... Katha..... Dhur
- Shared Tenant:Bigha..... Katha..... Dhur
- Aailani:Bigha..... Katha..... Dhur
- If other.....

2. Types of Crop and Annual Production (in Kg) form agriculture land.

Types of crop	Annual production (kg)	Annual consumption	Income
Paddy			
Maize			
Wheat			
Mustard			
Potato			
Lentil			
Commercial			
Others(specify)			
Total			

3. How much Food sufficiency from agriculture Production?

- (a) 3 months, (b) 6 months, (c) 9 months, (d) 12 months (e) surplus

4. How can you manage for the deficit period?

- a) Bye (b) burrow, (c) Barter (d) wage labor (e) Other

5. What are the other or secondary sources of income?

- (a) Livestock holding, (b) Business, (c) Wages, (d) Teaching,
(e) (Foreign or remittance, (f) Service, (g) others....

6. Types of Livestock Holding.

Types of Animal	Number			Feeding type		
	Young	Sub adult	Adult	Stall feeding	Grazing	Both
Cow						
Buffalo						
Goat						
Pig						
Poultry						
Any others						

7. Amount of fodder consumption per day and from where?
 (a) Fodder From Community Forest.....Bhari
 (b) From own land.....Bhari
8. Amount of fuel wood Consumption per day?
 (a).....Bhari
9. How much fuel wood is taken from forest per month?
 (a).....Bhari
10. Does these community forests provide any facility to the economically poor household regarding the resources accessibility?
 a) Yes, (b) No
11. What kinds of resources is extracted from the forest
 a) Fuel wood, b) Fodder, c) NTFPs d) Other
12. Does the community forest fulfill yours daily needs?
 a) Yes (b) No
13. Type of fuel wood use for different Purpose.

Uses	Consumption(<i>bhari</i> /month)	Man days (monthly)
Cooking food		
Preparation of animal food		
Preparation of alcohol		
Heating home and water		
Others		

14. Total annual expenses of different Category.

Category	Expenses(Per Year)
Health	
Education	
Food	
Transportation	
Other	

15. Alternative energy Resource consumption

Fill the information of energy consumption (Record use for the each month, liter of kerosene, number of cylinder for gas, number of batteries)

Source	Quantity/month	Purpose	Remarks
Electricity			
Kerosene			
Solar			
Lp gas			
Battery			
Bio gas			
Other...			

C. QUESTIONNAIRE ABOUT THE COMMUNITY FOREST MANAGEMENT

18. What is the position of your in the community Forest?

- (a) Board member/position (b) General member

19. Are you involved for the forest management activities?

- a) Yes (b) No

If yes, how often time...

20. What is the Present condition of forest in terms of resources availability and quality of forest in compare to past?

- a) Very good, b) Good, c) Satisfied, d) Very bad

22. Which type of forest management practice (silviculture) is done?

- a) Enrichment felling, b) Clear cutting
c) Weeding, d) Pruning e) Thinning

23. What is the purpose of forest management practice?

- a) For good timber b) To supply fuel wood c) To supply fodder
d) For regeneration e) others

24. Do you know, what are the fund generating activities of your community forest?

- a) Selling of NTFP , fuel wood, timber b) Fee from membership
c) Punishment fee from illegal activity
d) Revenue from different organization e) Interest from bank

25. Do you know at which activity that fund is spent?

- a) Yes
- b) No

If yes,

- (a) For construction of road and culvert
- (b) For development of education
- (c) Investment for IGA/ skill development
- (d) Others

26. Does the management committee do the public audit of Account?

- (a) Yes
- (b) No

27. What were the problems faced in the past and present in this forest?

- a) Unequal distribution of resources
- b) Wild life depredation
- c) Untranspirancy
- d) Other.....

28. What are the probable solutions for this problem?

.....
.....

29. Does this community forestry provide facility to share your view in decision making process of management committee?

- (a) Yes
- (b) No

30. Are you happy with distribution and consumption of available resources from your community forest? Any problem....

If yes.....

31. Do you face any wild life depredation issue?

- a) Yes
- b) No

If yes, which of the following types, and from which animal?

- a) Crop damage
- b) Live stock killed
- c) Human resource Damage
- d) Other

32. What kind of the compensation is available from the community forestry?

.....
.....

33. Attitude towards community forest
- a) Quality of forest (+ve, -ve, Neutral), b) Collection time (+ve, -ve, Neutral)
 - c) Protection (+ve, -ve, Neutral), d) Benefit (+ve, -ve, Neutral)

D. CHECKLIST FOR THE MANAGEMENT COMMITTEE

1. The historical background of this forest.
2. Type of forest management practices or Silviculture and aim of management practice.
 - a) Weeding b) clear felling c) pruning d) Enrichment filling
3. Role/ participation of female in forest management practices.
4. Role /participation of youth in forest management practices.
5. Entry of users group in the community forestry.
6. Types of resources available for member.
7. Demand and supply of Timber, fuel wood, and Fodder by user group per year.

Year	Resources Demand/year			Resources Supply/year		
	Timber	Fuel wood	Fodder	Timber	Fuel wood	Fodder

8. Most demanded resources from your community forest.
9. Extraction of forest resources (or not) that are needed to the user’s household.
10. Type of timber, fuel wood, NTFPs supply outside the community and name of the taking organization.
11. Fund generating activities of community forestry.
12. Investment of the forest capital.
13. Wellbeing ranking of the user group.
14. Timing of the product distribution and name of the product.
15. Allow to entry of livestock to the community forest for grazing

ANNEX II

FORMULA

SAMPLE SIZE DETERMINATION

$$\text{Sample size } n = \frac{NZ^2.P(1-P)}{[Nd^2 + Z^2.P(1-P)]}$$

Where,

n= sample size

N=Total no of Households

Z= Confidence interval (at 95% level and z= 1.96)

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

d= error limit of 5% and value is 0.05

GENERAL PARAMETER

$$\text{Density (No/ha)} = \frac{\text{Total no of Individual Species} \times 10000}{\text{Size of plot} \times \text{Total no of plot Sampled}}$$

$$\text{Relative Density, RD (\%)} = \frac{\text{Density of Individual Species} \times 100}{\text{Total density of all Species}}$$

$$\text{Frequency (\%)} = \frac{\text{Total no. of plots in which species occurred}}{\text{Total no. of plots sampled}} \times 100$$

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

Importance Value Index (IVI) = Σ (RD+ RF+ RC) for Herbs and Shrubs Stratum

Importance Value Index (IVI) = Σ (RD+ RF+RBA) for Tree Stratum

Where, RD= Relative Density, RF= Relative Frequency, RC= Relative Cover

RBA= Relative Basal Area

$$\text{Basal Area} = \frac{\Pi d^2}{4}$$

Where, d = diameter of a tree at breast height (1.37m)

$$\text{Relative Basal Area (RBA) (\%)} = \frac{\text{Basal Area of a species} \times 100}{\text{TBA of all species}}$$

$$\text{Index of Dominance (c)} = \sum (ni/N)^2$$

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

$$\text{Shannon-Wiener index of diversity (H)} = - \sum (ni/N) \times \log (ni/N)$$

Where ni = No. of individual species,
 N = Total no. of individual species

$$\text{Species richness (R)} = (S-1)/\log N$$

Where, S = no. of species; N = Total no. of individual species

$$\text{Evenness index (E)} = H/\log S$$

Where, H = Shannon-Wiener index of diversity and S = no. of species.

VOLUME AND BIOMASS

$$\ln(V) = a+b*\ln(d)+ c*\ln(h)$$

$$V = e^{a+b\ln(d) + c\ln(h)}$$

Where,

\ln (=loge) refers the logarithmic value

V = Total Stem Volume with Bark

d = Diameter at breast height

h = Total Height

a , b and c are 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, 1990).

Stem Biomass = Stem Volume \times Wood Density [where wood density was obtained from Forestry sector Master Plan, 1988 (HMG, 1988)].

Branch Biomass = Stem Biomass \times Ratio of Branch to Stem Biomass [Where Branch to Stem Biomass ratio was obtained from Forestry sector Master Plan, 1988 (HMG, 1988)].

Foliage Biomass = Stem Biomass \times Ratio of Leaf to Stem Biomass [Where Leaf to Stem Biomass ratio was obtained from Forestry sector Master Plan, 1988 (HMG, 1988)].

ANNUAL AND SUSTAINABLE YIELD

Stem Annual Yield = Stem Biomass × Percent yield

Branch Annual Yield = Branch Biomass × Percent yield

Foliage Annual Yield = Leaf Biomass × Percent yield

Where, Percent Yield is obtained from Forestry sector Master Plan, 1988 (HMG, 1988), as shown below, for the Sal Forest of Eastern Development Region.

Growing Stock and Annual Yield (tons/ha) in the natural forest of Terai Regions of Eastern Development Region, Nepal are given below.

Forest type	Forest Biomass			Annual yield			Percentage Yield		
	Stem	Branch	Foliage	Stem	Branch	Foliage	Stem	Branch	Foliage
Sal forest	4713.1	1854.7	316.4	230.5	90.7	15.5	4.89	4.89	4.9

Table: Forest Biomass and Annual Yield of Sal forest.

Sustainable fire wood yield = 85% of sustainable stem supply + sustainable branch supply.

Where,

Sustainable Stem Supply = 90% of Stem Annual Yield

Sustainable Branch Supply = 90% of Branch Annual Yield

Sustainable Foliage Supply = 90% of Foliage Annual Yield*

*: This method was not used as the yield from leaf biomass can only be used as fodder if the tree is fodder species

Fodder yield from Buffer Zone forest was calculated on the basis of Total Digestible Nutrient (TDN) yields for various categories of land as follows (HMG, 1988)

Table: TDN yield as per land category

Land Category	TDN Yield (t/ha/yr)
Hardwood Forest, grazing	0.34
Conifer Forest, grazing	0.1
Mixed Forest, grazing	0.15-0.2
Forest Plantation/Hand Cutting	1.44
Shrub/Burnt Forest Grazing	0.77
Waste Land/Over Grazed land, grazing	0.24
Flat Land, grazing	0.58

ANNEX III

TABLE OF RESULT

Table A: Structural parameter of the species at Tree stratum

S.N.	Species	No.	D/ha	RD	F	RF	BA	RBA	IVI
					%	%	(m ² /ha)		
1	<i>Shorea robusta</i>	176	89.796	33.78	32.65	7.583	8.9369	12.5	53.8
2	Maina kath*	21	10.714	4.031	24.49	5.687	18.349	25.6	35.3
3	<i>Osbeckia stellata</i>	53	27.041	10.17	44.9	10.43	2.9656	4.13	24.7
4	<i>Lagestroemia parviflora</i>	29	14.796	5.566	32.65	7.583	5.2241	7.28	20.4
5	<i>Ehretia acuminata</i>	38	19.388	7.294	34.69	8.057	3.3825	4.71	20.1
6	<i>Dillenia pentagyna</i>	31	15.816	5.95	32.65	7.583	4.1474	5.78	19.3
7	Phalame*	17	8.6735	3.263	26.53	6.161	2.1981	3.06	12.5
8	Hangrayo*	15	7.6531	2.879	24.49	5.687	1.9552	2.72	11.3
9	<i>Aesculus indica</i>	4	2.0408	0.768	6.122	1.422	5.7049	7.95	10.1
10	<i>Dellenia pentagyna</i>	24	12.245	4.607	10.2	2.37	2.2658	3.16	10.1
11	<i>Biax orelana</i>	15	7.6531	2.879	18.37	4.265	1.6378	2.28	9.43
12	<i>Aaulia</i> *	19	9.6939	3.647	16.33	3.791	0.9807	1.37	8.8
13	<i>Garuga pinnata</i>	6	3.0612	1.152	10.2	2.37	2.3991	3.34	6.86
14	<i>Cucumis sativus</i>	12	6.1224	2.303	14.29	3.318	0.5373	0.75	6.37
15	<i>Alstonia scholaris</i>	10	5.102	1.919	12.24	2.844	0.7254	1.01	5.77
16	<i>Cordia dichotoma</i>	5	2.551	0.96	10.2	2.37	1.0717	1.49	4.82
17	<i>Adina cordifolia</i>	3	1.5306	0.576	6.122	1.422	1.9666	2.74	4.74
18	<i>Terminallia bellerica</i>	4	2.0408	0.768	8.163	1.896	1.1665	1.63	4.29
19	<i>Maesa chisia</i>	10	5.102	1.919	8.163	1.896	0.1578	0.22	4.04

Contd....

20	<i>Lannea coromandelica</i>	3	1.5306	0.576	6.122	1.422	1.1439	1.59	3.59
21	<i>Grewia optiva</i>	3	1.5306	0.576	6.122	1.422	0.565	0.79	2.79
22	<i>Dude Hangrayo*</i>	3	1.5306	0.576	6.122	1.422	0.4775	0.67	2.66
23	<i>Pipiri*</i>	3	1.5306	0.576	8.163	1.896	0.0344	0.05	2.52
24	<i>Sadhan*</i>	1	0.5102	0.192	2.041	0.474	1.3273	1.85	2.52
25	<i>Kaidal*</i>	2	1.0204	0.384	4.082	0.948	0.6479	0.9	2.23
26	<i>Syzygium cumini</i>	2	1.0204	0.384	4.082	0.948	0.5105	0.71	2.04
27	<i>Eugenia operculata</i>	1	0.5102	0.192	2.041	0.474	0.6793	0.95	1.61
28	<i>Delbergia sisoo</i>	2	1.0204	0.384	2.041	0.474	0.1178	0.16	1.02
29	<i>Anthocephalus chinensis</i>	1	0.5102	0.192	2.041	0.474	0.1662	0.23	0.9
30	<i>Cassia fistula</i>	2	1.0204	0.384	2.041	0.474	0.0265	0.04	0.89
31	<i>Albizia rulibrissin</i>	1	0.5102	0.192	2.041	0.474	0.0908	0.13	0.79
32	<i>Semicarpus anacardium</i>	1	0.5102	0.192	2.041	0.474	0.0814	0.11	0.78
33	<i>Schleichera oleosa</i>	1	0.5102	0.192	2.041	0.474	0.0471	0.07	0.73
34	<i>Careya arborea</i>	1	0.5102	0.192	2.041	0.474	0.0314	0.04	0.71
35	<i>Caryota urens</i>	1	0.5102	0.192	2.041	0.474	0.0201	0.03	0.69
36	<i>Bridelia retusa</i>	1	0.5102	0.192	2.041	0.474	0.0201	0.03	0.69
	<i>Total</i>	521	265.82	100	430.6	100	71.76	100	300

* = Local name, D= Density, RD = Relative Density, F = Frequency (%), RF = Relative Frequency (%), BA = Basal Area (m²/ha), RBA = Relative Basal Area, IVI = Important Value Index, ha = Hectare

Table B: Volume and Biomass of tree species

S.N.	Species	Standing Volume (m ³ /ha)	Biomass (%)	Stem Biomass (t/ha)	Branch Biomass (t/ha)	Foliage Biomass (t/ha)	Total Biomass (t/ha)	Biomass (%)
1	Maina kath*	61.48	35.48	1.04	0.32	0.07	1.43	0.66
2	<i>Lagestroemia parviflora</i>	17.94	10.35	4.10	1.26	0.28	5.60	2.57
3	<i>Shorea robusta</i>	15.61	9.01	0.01	0.00	0.00	0.02	0.01
4	<i>Aesculus indica</i>	11.13	6.42	3.46	1.36	0.23	5.05	2.32
5	<i>Dillenia pentagyna</i>	8.69	5.02	0.13	0.05	0.01	0.19	0.09
6	<i>Garuga pinnata</i>	6.31	3.64	0.12	0.01	0.01	0.14	0.07
7	Phalame*	4.95	2.86	1.48	0.57	0.10	2.15	0.99
8	<i>Osbeckia stellata</i>	4.67	2.70	15.25	5.84	1.02	22.11	10.17
9	<i>Dellenia pentagyna</i>	4.65	2.69	1.05	0.36	0.07	1.48	0.68
10	<i>Ehretia acuminata</i>	4.01	2.32	5.54	2.18	0.37	8.09	3.72
11	<i>Adina cordifolia</i>	3.94	2.28	0.33	0.22	0.00	0.55	0.25
12	<i>Terminallia bellerica</i>	3.94	2.27	3.52	1.27	0.24	5.04	2.32
13	Sadhan*	3.71	2.14	1.06	0.42	0.07	1.54	0.71
14	Hangrayo*	3.38	1.95	0.02	0.00	0.00	0.02	0.01
15	<i>Lannea coromandelica</i>	3.25	1.87	2.85	1.12	0.19	4.17	1.92
16	<i>Biax orelana</i>	2.96	1.71	2.96	1.12	0.20	4.28	1.97
17	<i>Cordia dichotoma</i>	1.69	0.97	0.45	0.18	0.03	0.66	0.30
18	<i>Grewia optiva</i>	1.50	0.87	0.45	0.17	0.03	0.65	0.30
19	Kaidal*	1.47	0.85	1.29	0.51	0.09	1.89	0.87
20	Dude Hangrayo*	1.20	0.70	2.64	1.04	0.18	3.86	1.78

Cont.....

S.N.	Species	Standing Volume (m3/ha)	Biomass (%)	Stem Biomass (t/ha)	Branch Biomass (t/ha)	Foliage Biomass (t/ha)	Total Biomass (t/ha)	Biomass (%)
21	<i>Alstonia scholaris</i>	1.19	0.69	0.90	0.29	0.06	1.24	0.57
22	<i>Aaulia*</i>	1.19	0.69	0.02	0.00	0.00	0.02	0.01
23	<i>Eugenia operculata</i>	1.15	0.66	0.06	0.01	0.00	0.07	0.03
24	<i>Cucumis sativus</i>	1.02	0.59	1.01	0.40	0.07	1.47	0.68
25	<i>Syzygium cumini</i>	0.52	0.30	9.77	3.87	0.65	14.29	6.57
26	<i>Anthocephalus chinensis</i>	0.51	0.30	53.98	21.31	3.62	78.91	36.29
27	<i>Delbergia sisoo</i>	0.42	0.24	0.23	0.09	0.02	0.33	0.15
28	<i>Albizzia rulibrissin</i>	0.26	0.15	4.35	1.63	0.29	6.27	2.88
29	<i>Semicarpus anacardium</i>	0.15	0.09	0.05	0.01	0.00	0.06	0.03
30	<i>Maesa chisia</i>	0.14	0.08	7.63	2.88	0.51	11.02	5.07
31	<i>Schleichera oleosa</i>	0.07	0.04	0.04	0.00	0.00	0.05	0.02
32	Pipiri*	0.06	0.03	3.26	1.29	0.22	4.77	2.19
33	<i>Cassia fistula</i>	0.05	0.03	13.74	3.89	0.90	18.53	8.52
34	<i>Careya arborea</i>	0.02	0.01	1.32	0.52	0.09	1.92	0.88
35	<i>Bridelia retusa</i>	0.02	0.01	2.59	0.96	0.18	3.73	1.71
36	<i>Caryota urens</i>	0.01	0.01	4.09	1.47	0.28	5.83	2.68
	Total	173.26	100.00	150.79	56.60	10.09	217.45	100.00

* = Local name, t/ha = Ton/hectare

Table C: Annual yield and sustainable yield of the forest product

S.N.	Species	Stem Annual Yield (t/ha/yr)	Branch Annual Yield (t/ha/yr)	Foliage Annual Yield (t/ha/yr)	Total Annual Yield	Sustainable Stem Supply (t/ha/yr)	Sustainable Branch Supply (t/ha/yr)	Sustainable Foliage Supply (t/ha/yr)	Sustainable Fuel wood Yield (t/ha/yr)
1	Aaulia*	0.05	0.02	0.0035	0.07	0.05	0.01	0.0031	0.05
2	<i>Osbeckia stellata</i>	0.20	0.06	0.0136	0.28	0.18	0.06	0.0123	0.21
3	<i>Caryota urens</i>	0.00	0.00	0.0000	0.00	0.00	0.00	0.0000	0.00
4	<i>Terminallia bellerica</i>	0.17	0.07	0.0114	0.25	0.15	0.06	0.0103	0.19
5	<i>Semicarpus anacardium</i>	0.01	0.00	0.0004	0.01	0.01	0.00	0.0004	0.01
6	<i>Maesa chisia</i>	0.01	0.00	0.0004	0.01	0.01	0.00	0.0004	0.01
7	<i>Cordia dichotoma</i>	0.07	0.03	0.0049	0.11	0.07	0.03	0.0044	0.08
8	<i>Lagestroemia parviflora</i>	0.75	0.29	0.0502	1.08	0.67	0.26	0.0452	0.83
9	<i>Alstonia scholaris</i>	0.05	0.02	0.0035	0.07	0.05	0.02	0.0031	0.06
10	<i>Garuga pinnata</i>	0.27	0.11	0.0182	0.40	0.24	0.10	0.0164	0.30
11	<i>Delbergia sisoo</i>	0.02	0.01	0.0002	0.03	0.01	0.01	0.0001	0.02
12	<i>Ehretia acuminata</i>	0.17	0.06	0.0117	0.25	0.16	0.06	0.0105	0.19
13	Dude Hangrayo*	0.05	0.02	0.0035	0.08	0.05	0.02	0.0031	0.06
14	<i>Bridelia retusa</i>	0.00	0.00	0.0001	0.00	0.00	0.00	0.0000	0.00
15	<i>Lannea coromandelica</i>	0.14	0.05	0.0094	0.20	0.13	0.05	0.0084	0.16
16	Hangrayo*	0.14	0.05	0.0098	0.21	0.13	0.05	0.0088	0.16

Cont.....

17	<i>Syzygium cumini</i>	0.02	0.01	0.0015	0.03	0.02	0.01	0.0013	0.02
18	<i>Anthocephalus chinensis</i>	0.02	0.01	0.0015	0.03	0.02	0.01	0.0014	0.02
19	<i>Flacourtia indica</i>	0.06	0.02	0.0043	0.09	0.06	0.02	0.0038	0.07
20	<i>Adina cordifolia</i>	0.13	0.05	0.0087	0.19	0.12	0.05	0.0078	0.14
21	<i>Cucumis sativus</i>	0.04	0.01	0.0030	0.06	0.04	0.01	0.0027	0.05
22	<i>Careya arborea</i>	0.00	0.00	0.0001	0.00	0.00	0.00	0.0001	0.00
23	<i>Schleichera oleosa</i>	0.00	0.00	0.0002	0.00	0.00	0.00	0.0002	0.00
24	<i>Eugenia operculata</i>	0.05	0.02	0.0033	0.07	0.04	0.02	0.0030	0.06
25	<i>Aesculus indica</i>	0.48	0.19	0.0321	0.70	0.43	0.17	0.0289	0.54
26	Maina kath*	2.64	1.04	0.1773	3.86	2.38	0.94	0.1595	2.96
27	<i>Albizzia rulibrissin</i>	0.01	0.00	0.0008	0.02	0.01	0.00	0.0007	0.01
28	Phalame*	0.21	0.08	0.0144	0.31	0.19	0.07	0.0129	0.23
29	Pipiri*	0.00	0.00	0.0002	0.00	0.00	0.00	0.0001	0.00
30	<i>Dillenia pentagyna</i>	0.37	0.14	0.0252	0.54	0.34	0.13	0.0227	0.41
31	<i>Cassia fistula</i>	0.00	0.00	0.0001	0.00	0.00	0.00	0.0001	0.00
32	Sadhan*	0.16	0.06	0.0107	0.23	0.14	0.06	0.0096	0.18
33	<i>Shorea robusta</i>	0.67	0.19	0.0443	0.91	0.60	0.17	0.0399	0.69
34	<i>Grewia optiva</i>	0.06	0.03	0.0043	0.09	0.06	0.02	0.0039	0.07
35	<i>Biax orelana</i>	0.13	0.05	0.0086	0.18	0.11	0.04	0.0077	0.14
36	<i>Dellenia pentagyna</i>	0.20	0.07	0.0135	0.29	0.18	0.06	0.0121	0.22
	Total	7.37	2.77	0.49	10.64	6.64	2.49	0.45	8.13

* = Local name, t/ha = Tone/ha

Table D: Cut stumps density of species according to their girth size

S.N.	Species	< 20	20-40	41-60	61-80	> 80	Total
1	<i>Shorea robusta</i>	32.65	2.55	0.51	0.51	2.04	38.27
2	<i>Osbeckia stellata</i>	12.76	2.04	0.51			15.31
3	<i>Maesa chisia</i>	11.73		0.51	0.51		12.76
4	Hangrayo*	5.10	2.04			0.51	7.65
5	<i>Cassia fistula</i>	7.14		0.51			7.65
6	<i>Ehretia acuminata</i>	4.08	1.02		0.51		5.61
7	<i>Dillenia pentagyna</i>	4.08	1.53				5.61
8	<i>Biax orelana</i>	4.08	1.02				5.10
9	<i>Lagestroemia parviflora</i>	2.55	1.02	0.51		0.51	4.59
10	Aaulia*	2.55	1.02			0.51	4.08
11	Phalame*	3.57		0.51			4.08
12	<i>Cucumis sativus</i>	1.53	1.02				2.55
13	Maina kath*	2.04	0.51				2.55
14	<i>Dalbergia latifolia</i>	1.02	1.53				2.55
15	<i>Alstonia scholaris</i>	0.51	1.02				1.53
16	<i>Garuga pinnata</i>	1.02		0.51			1.53
17	<i>Bridelia retusa</i>	1.02					1.02
18	<i>Pterospermum acerifolium</i>	1.02					1.02
19	<i>Syzygium cumini</i>	1.02					1.02
20	Sadhan*		0.51	0.51			1.02
21	Bansuntola*	0.51					0.51
22	<i>Michelia champaca</i>				0.51		0.51
23	Ghorla*	0.51					0.51
24	<i>Adina cordifolia</i>	0.51					0.51
25	<i>Albizia rulibrissin</i>	0.51					0.51
26	Pipiri*	0.51					0.51
27	<i>Dellenia pentagyna</i>			0.51			0.51
28	<i>Toona ciliata</i>	0.51					0.51
	Total	102.55	16.84	4.59	2.04	3.57	129.59

* = Local name

Table E: Percentage of cut stump density with live stock density

S.N.	Species	CSD	LTD	% of Cut stump
		(no/ha)	(no/ha)	with LTD
1	<i>Aaulia*</i>	4.08	9.69	42.11
2	<i>Osbeckia stellata</i>	15.31	27.04	56.60
3	Bansuntola*	0.51	-	-
4	<i>Maesa chisia</i>	12.76	5.10	250.00
5	<i>Lagerstroemia parviflora</i>	4.59	14.80	31.03
6	<i>Alstonia scholaris</i>	1.53	5.10	30.00
7	<i>Michelia champaca</i>	0.51	-	-
8	<i>Garuga pinnata</i>	1.53	3.06	50.00
9	<i>Ehretia acuminata</i>	5.61	19.39	28.95
10	<i>Bridelia retusa</i>	1.02	0.51	200.00
11	Ghorla*	0.51	-	-
12	Hangrayo*	7.65	7.65	100.00
13	<i>Pterospermum acerifolium</i>	1.02	-	-
14	<i>Syzygium cumini</i>	1.02	1.02	100.00
15	<i>Adina cordifolia</i>	0.51	1.53	33.33
16	<i>Cucumis sativus</i>	2.55	6.12	41.67
17	Maina kath*	2.55	10.71	23.81
18	<i>Albizzia ruliobrissin</i>	0.51	0.51	100.00
19	Phalame*	4.08	8.67	47.06
20	Pipiri*	0.51	1.53	33.33
21	<i>Dillenia pentagyna</i>	5.61	15.82	35.48
22	<i>Cassia fistula</i>	7.65	1.02	750.00
23	<i>Dalbergia latifolia</i>	2.55	-	-
24	<i>Shorea robusta</i>	38.27	89.80	42.61
25	<i>Biax orelana</i>	5.10	7.65	66.67
26	Sadhan*	1.02	0.51	200.00
27	<i>Dellenia pentagyna</i>	0.51	12.24	4.17
28	<i>Toona ciliata</i>	0.51	-	-
	Total	129.59	249.49	51.94

* = Local name, CST= Cut Stump Density, LTD = Live Tree Density, no/ha= Number/hectare

Table F: Density of lopping intensity according to their class

S.N.	Species	Least damage	Medium damage	High damage	Very high damage	Total
		(1-25%)	(26-50%)	(51-75%)	(>75%)	
1	<i>Osbeckia stellata</i>	2.04				2.04
2	<i>Lagerstroemia parviflora</i>	0.51		0.51		1.02
3	<i>Dalbergia sisoo</i>	0.51				0.51
4	<i>Ehretia acuminata</i>	1.02	0.51			1.53
5	<i>Hangrayo*</i>	0.51				0.51
6	<i>Schleichera oleosa</i>			0.51		0.51
7	<i>Aesculus indica</i>	0.51				0.51
8	Maina kath*	0.51				0.51
9	<i>Dillenia pentagyna</i>			0.51		0.51
10	<i>Cassia fistula</i>		0.51			0.51
11	<i>Shorea robusta</i>	2.04				2.04
12	<i>Biax orelana</i>	0.51				0.51
	Total	8.16	1.02	1.53		10.71

* = Local name

Table G: Structural parameter of the species at Shrub stratum

S.N.	Species	Total	D/ha	R.D (%)	F	R.F (%)	T C	RTC (%)	IVI
1	Bhatti*	2002	8171.43	23.05	88.78	6.63	1438.50	14.73	44.40
2	<i>Maesa chisia</i>	1229	5016.33	14.15	86.73	6.47	1893	19.39	40.01
3	<i>Swertia nervosa</i>	612	2497.96	7.05	76.53	5.71	1695	17.36	30.12
4	Junjeli kada*	986	4024.49	11.35	48.98	3.66	444.50	4.55	19.56
5	<i>Nyctanthes arbor</i>	484	1975.51	5.57	61.22	4.57	439.50	4.50	14.64
6	Hangrayo*	243	991.84	2.80	60.20	4.49	359.00	3.68	10.97
7	Masinapate*	322	1314.29	3.71	58.16	4.34	274.50	2.81	10.86
8	<i>Sambucus hookeri</i>	259	1057.14	2.98	56.12	4.19	306.00	3.13	10.30
9	Kali ghas*	245	1000.00	2.82	47.96	3.58	270.00	2.76	9.16
10	Khasre galeni*	204	832.65	2.35	59.18	4.42	200.50	2.05	8.82
11	Aaulia*	259	1057.14	2.98	33.67	2.51	244.00	2.50	7.99
12	<i>Ehretia acuminata</i>	165	673.47	1.90	57.14	4.27	137.00	1.40	7.57
13	<i>Osbeckia stellata</i>	149	608.16	1.72	48.98	3.66	200.00	2.05	7.42
14	<i>Bridelia retusa</i>	156	636.73	1.80	43.88	3.27	148.50	1.52	6.59
15	<i>Shorea robusta</i>	187	763.27	2.15	30.61	2.28	99.00	1.01	5.45
16	<i>Biax orehana</i>	80	326.53	0.92	36.73	2.74	59.00	0.60	4.27
17	<i>Syzygium cumini</i>	87	355.10	1.00	35.71	2.67	53.00	0.54	4.21
18	Pipiri*	69	281.63	0.79	34.69	2.59	68.00	0.70	4.08
19	Phalame*	91	371.43	1.05	24.49	1.83	101.50	1.04	3.91
20	<i>Lagetroemia parviflora</i>	67	273.47	0.77	27.55	2.06	78.50	0.80	3.63
21	<i>Cassia fistula</i>	33	134.69	0.38	21.43	1.60	132.50	1.36	3.34

Cont...

S.N.	Species	Total	D/ha	R.D (%)	F	R.F (%)	T C	RTC (%)	IVI
22	<i>Breca arvensis</i>	44	179.59	0.51	17.35	1.29	113.00	1.16	2.96
23	<i>Bauhinia vahlii</i>	60	244.90	0.69	7.14	0.53	139.50	1.43	2.65
24	<i>Melastoma melabathricum</i>	40	163.27	0.46	10.20	0.76	139.00	1.42	2.65
25	<i>Cucumis sativus</i>	46	187.76	0.53	19.39	1.45	38.50	0.39	2.37
26	<i>Ficus racemosa</i>	86	351.02	0.99	9.18	0.69	39.50	0.40	2.08
27	<i>Dillenia pentagyna</i>	27	110.20	0.31	16.33	1.22	50.50	0.52	2.05
28	<i>Lannea coromandelica</i>	28	114.29	0.32	13.27	0.99	69.50	0.71	2.02
29	Morange*	32	130.61	0.37	9.18	0.69	65.00	0.67	1.72
30	Lahare pipiri*	19	77.55	0.22	12.24	0.91	29.50	0.30	1.43
31	<i>Dellenia pentagyna</i>	15	61.22	0.17	13.27	0.99	11.00	0.11	1.28
32	<i>Antidesma bunius</i>	15	61.22	0.17	12.24	0.91	11.00	0.11	1.20
33	<i>Strychnos potatorum</i>	25	102.04	0.29	8.16	0.61	24.00	0.25	1.14
34	Dudehangrayo*	19	77.55	0.22	9.18	0.69	22.00	0.23	1.13
35	Species A*	36	146.94	0.41	6.12	0.46	17.00	0.17	1.05
36	Guiyelo*	28	114.29	0.32	2.04	0.15	45.00	0.46	0.94
37	<i>Grewia optiva</i>	14	57.14	0.16	4.08	0.30	33.00	0.34	0.80
38	maina kath*	9	36.73	0.10	7.14	0.53	16.00	0.16	0.80
39	<i>Garuga pinnata</i>	9	36.73	0.10	8.16	0.61	7.50	0.08	0.79
40	<i>Pterospermum acerifolium</i>	10	40.82	0.12	7.14	0.53	9.50	0.10	0.75
41	Khasre pate*	22	89.80	0.25	3.06	0.23	21.00	0.22	0.70
42	<i>Rosa brunoii</i>	6	24.49	0.07	6.12	0.46	5.50	0.06	0.58
43	<i>Solanum anguivi</i>	3	12.24	0.03	3.06	0.23	21.00	0.22	0.48
44	Damphar*	2	8.16	0.02	1.02	0.08	35.50	0.36	0.46

Cont....

S.N.	Species	Total	D/ha	R.D (%)	F	R.F (%)	T C	RTC (%)	IVI
45	Kure jhar*	5	20.41	0.06	4.08	0.30	8.00	0.08	0.44
46	Unknown kada vako*	4	16.33	0.05	3.06	0.23	6.00	0.06	0.34
47	Siraule*	5	20.41	0.06	3.06	0.23	4.00	0.04	0.33
48	<i>Ficus hispida</i>	4	16.33	0.05	3.06	0.23	5.00	0.05	0.33
49	<i>Albizia rulibrissin</i>	3	12.24	0.03	3.06	0.23	5.00	0.05	0.31
50	Unidentified*	8	32.65	0.09	2.04	0.15	6.50	0.07	0.31
51	Maldhido*	5	20.41	0.06	3.06	0.23	2.00	0.02	0.31
52	<i>Vibumum cotinifolium</i>	9	36.73	0.10	2.04	0.15	4.50	0.05	0.30
53	<i>Terminallia bellerica</i>	3	12.24	0.03	3.06	0.23	3.00	0.03	0.29
54	Kanaso lahara*	7	28.57	0.08	2.04	0.15	5.50	0.06	0.29
55	<i>Anthocephalus chinensis</i>	3	12.24	0.03	3.06	0.23	2.10	0.02	0.28
56	<i>Cereya arborea</i>	3	12.24	0.03	3.06	0.23	2.00	0.02	0.28
57	Boksi kada*	2	8.16	0.02	2.04	0.15	10.00	0.10	0.28
58	kade rukh*	3	12.24	0.03	3.06	0.23	1.00	0.01	0.27
59	<i>Indigkofera pulchella</i>	5	20.41	0.06	2.04	0.15	5.50	0.06	0.27
60	ghorlaapate*	11	44.90	0.13	1.02	0.08	4.50	0.05	0.25
61	<i>Phyllanthus emblica</i>	6	24.49	0.07	2.04	0.15	2.40	0.02	0.25
62	Badkaule*	2	8.16	0.02	2.04	0.15	6.50	0.07	0.24
63	Bansuntola*	4	16.33	0.05	2.04	0.15	4.00	0.04	0.24
64	<i>Adina cordifolia</i>	2	8.16	0.02	2.04	0.15	6.00	0.06	0.24
65	<i>Bomabx ceiba</i>	2	8.16	0.02	2.04	0.15	5.50	0.06	0.23
66	<i>Ageratum conyzoides</i>	2	8.16	0.02	2.04	0.15	4.00	0.04	0.22
67	kuraune*	6	24.49	0.07	1.02	0.08	6.50	0.07	0.21

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S.N.	Species	Total	D/ha	R.D (%)	F	R.F (%)	T C	RTC (%)	IVI
68	<i>Careya arborea</i>	2	8.16	0.02	2.04	0.15	3.50	0.04	0.21
69	<i>Comus oblonga</i>	3	12.24	0.03	2.04	0.15	1.00	0.01	0.20
70	kali Jhar*	3	12.24	0.03	2.04	0.15	1.00	0.01	0.20
71	<i>Magnifera sylvatica</i>	2	8.16	0.02	2.04	0.15	2.00	0.02	0.20
72	Darim pate*	2	8.16	0.02	2.04	0.15	1.00	0.01	0.19
73	<i>Semicarpus anacardium</i>	2	8.16	0.02	2.04	0.15	1.00	0.01	0.19
74	Dhode galeni*	3	12.24	0.03	1.02	0.08	3.00	0.03	0.14
75	kaidal*	3	12.24	0.03	1.02	0.08	2.50	0.03	0.14
76	kalo Aakhle*	2	8.16	0.02	1.02	0.08	3.00	0.03	0.13
77	<i>Litsea monopelata</i>	2	8.16	0.02	1.02	0.08	3.00	0.03	0.13
78	Hade khasreto*	3	12.24	0.03	1.02	0.08	1.00	0.01	0.12
79	Adiya ghas*	2	8.16	0.02	1.02	0.08	2.00	0.02	0.12
80	Khasre lahara*	2	8.16	0.02	1.02	0.08	2.00	0.02	0.12
81	<i>Cordia dichotoma</i>	1	4.08	0.01	1.02	0.08	3.00	0.03	0.12
82	<i>Dalbergia latifolia</i>	2	8.16	0.02	1.02	0.08	1.50	0.02	0.11
83	Akhate*	2	8.16	0.02	1.02	0.08	1.00	0.01	0.11
84	<i>Psidium guajava</i>	2	8.16	0.02	1.02	0.08	1.00	0.01	0.11
85	Thulo suntole*	2	8.16	0.02	1.02	0.08	1.00	0.01	0.11
86	Ban tejpat*	1	4.08	0.01	1.02	0.08	2.00	0.02	0.11
87	Kalu pate jhar*	1	4.08	0.01	1.02	0.08	2.00	0.02	0.11
88	khasre ghas*	1	4.08	0.01	1.02	0.08	2.00	0.02	0.11
89	Besare*	2	8.16	0.02	1.02	0.08	0.50	0.01	0.10
90	<i>Celtis australis</i>	2	8.16	0.02	1.02	0.08	0.50	0.01	0.10

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S.N.	Species	Total	D/ha	R.D (%)	F	R.F (%)	T C	RTC (%)	IVI
91	<i>Alstonia scholaris</i>	1	4.08	0.01	1.02	0.08	1.00	0.01	0.10
92	<i>Caryota urens</i>	1	4.08	0.01	1.02	0.08	1.00	0.01	0.10
93	Kade jhar*	1	4.08	0.01	1.02	0.08	1.00	0.01	0.10
94	Katus*	1	4.08	0.01	1.02	0.08	1.00	0.01	0.10
95	tuni*	1	4.08	0.01	1.02	0.08	1.00	0.01	0.10
96	Bel*	1	4.08	0.01	1.02	0.08	0.50	0.01	0.09
97	pane ghas*	1	4.08	0.01	1.02	0.08	0.50	0.01	0.09
98	Sano suntole*	1	4.08	0.01	1.02	0.08	0.50	0.01	0.09
	Total	8687	35457.14	100	1340	100	9765	100	300

= Local name, D= Density, RD = Relative Density, F = Frequency (%), RF = Relative Frequency (%), TC = Total Cover, RTC = Relative Total Cover, IVI = Important Value Index, ha = Hectare

Table H: Structural parameter at Herb Stratum

S.N.	Species	Total	D/ha	RD	F (%)	RF (%)	TC	RTC (%)	IVI
1	<i>Dryopteris spp.</i>	578	58979.59	25.49	39.80	11.02	1782	19.67	56.17
2	<i>Dryopteris cochleata</i>	336	34285.71	14.81	44.90	12.43	1866	20.60	47.84
3	<i>Digitaria spp.</i>	292	29795.92	12.87	59.18	16.38	995	10.98	40.24
4	<i>Tetrastigma serrulatum</i>	231	23571.43	10.19	47.96	13.28	1381	15.24	38.70
5	<i>Piper longum</i>	123	12551.02	5.42	33.67	9.32	791	8.73	23.48
6	<i>Equisetum arvanse</i>	103	10510.20	4.54	18.37	5.08	429	4.74	14.36
7	Aalu jhar*	90	9183.67	3.97	8.16	2.26	217	2.40	8.62
8	Khasre lahara*	14	1428.57	0.62	11.22	3.11	212	2.34	6.06
9	<i>Cyperus rotundus</i>	31	3163.27	1.37	12.24	3.39	102	1.13	5.88
10	Aangare jhar*	29	2959.18	1.28	9.18	2.54	146.5	1.62	5.44
11	<i>Imperata cylindrical</i>	77	7857.14	3.40	4.08	1.13	27	0.30	4.82
12	Gittha lahara*	35	3571.43	1.54	7.14	1.98	100	1.10	4.62
13	<i>Cissus repens</i>	16	1632.65	0.71	7.14	1.98	93	1.03	3.71
14	Kanaso*	53	5408.16	2.34	3.06	0.85	37	0.41	3.59
15	Kharane*	9	918.37	0.40	4.08	1.13	171.5	1.89	3.42
16	<i>Marsdenia roylei</i>	25	2551.02	1.10	6.12	1.69	40	0.44	3.24
17	<i>Ageratum conyzoides</i>	41	4183.67	1.81	3.06	0.85	45	0.50	3.15
18	Speices B*	40	4081.63	1.76	1.02	0.28	80	0.88	2.93
19	<i>Oxalis corniculata</i>	25	2551.02	1.10	4.08	1.13	25.5	0.28	2.51
20	Mashi jhar*	6	612.24	0.26	3.06	0.85	102	1.13	2.24
21	Kure jhar*	10	1020.41	0.44	5.10	1.41	16	0.18	2.03
22	Aakhate jhar*	8	816.33	0.35	1.02	0.28	100	1.10	1.74

Cont....

S.N.	Species	Total	D/ha	RD	F (%)	RF (%)	TC	RTC (%)	IVI
23	<i>Cynodon spp.</i>	24	2448.98	1.06	2.04	0.56	10	0.11	1.73
24	Chulese jhar*	8	816.33	0.35	1.02	0.28	85	0.94	1.57
25	<i>Cynodon dactylon</i>	13	1326.53	0.57	3.06	0.85	9.5	0.10	1.53
26	<i>Centella asiatica</i>	10	1020.41	0.44	2.04	0.56	45	0.50	1.50
27	Kali jhar*	7	714.29	0.31	3.06	0.85	15	0.17	1.32
28	<i>Leucas cephalotes</i>	7	714.29	0.31	2.04	0.56	8	0.09	0.96
29	Tile jhar*	2	204.08	0.09	1.02	0.28	40	0.44	0.81
30	<i>Ohloglossum vulgatum</i>	3	306.12	0.13	2.04	0.56	6	0.07	0.76
31	Speices A*	3	306.12	0.13	2.04	0.56	6	0.07	0.76
32	<i>Euphorbia hirta</i>	3	306.12	0.13	2.04	0.56	5	0.06	0.75
33	Silame jhar*	6	612.24	0.26	1.02	0.28	9	0.10	0.65
34	<i>Mimmosa pudica</i>	3	306.12	0.13	1.02	0.28	20	0.22	0.64
35	Pani amala*	2	204.08	0.09	1.02	0.28	20	0.22	0.59
36	<i>Phyllodium pulchellum</i>	1	102.04	0.04	1.02	0.28	10	0.11	0.44
37	<i>Commenlina benghalensis</i>	2	204.08	0.09	1.02	0.28	3	0.03	0.40
38	<i>Dioscorea bulbifera</i>	1	102.04	0.04	1.02	0.28	5	0.06	0.38
39	Pade jhar*	1	102.04	0.04	1.02	0.28	5	0.06	0.38
40	Total	2268	231428.57	100	361.2	100	9060	100	300

* = Local name, D= Density, RD = Relative Density, F = Frequency (%), RF = Relative Frequency (%), TC = Total Cover, RTC = Relative Total Cover, IVI = Important Value Index, ha = Hectare

Table I: Dominant Species according to the quadrate

Quadrate	Longitude	Latitude	Dominant Species
1	87° 34' 52.5" E	26° 43' 15.1" N	<i>Shorea robusta</i>
2	87° 35' 5.4" E	26° 42' 54.1" N	<i>Lagerstroemia parviflora</i>
3	87° 34' 53.0" E	26° 42' 54.4" N	Phalame
4	87° 34' 56.2" E	26° 43' 8.0" N	<i>Osbeckia stellata</i>
5	87° 34' 52.5" E	26° 43' 5.2" N	Maina kath
6	87° 34' 37.3" E	26° 42' 52.2" N	Khirra
7	87° 34' 38.9" E	26° 42' 41.5" N	<i>Alstonia scholaris</i>
8	87° 34' 42.7" E	26° 42' 52.7" N	<i>Osbeckia stellata</i>
9	87° 34' 46.9" E	26° 42' 43.1" N	<i>Dillenia pentagyna</i>
10	87° 34' 41.6" E	26° 42' 31.6" N	<i>Ehretia acuminata</i>
11	87° 35' 8.0" E	26° 42' 41.4" N	<i>Schleichera oleosa</i>
12	87° 34' 55.1" E	26° 42' 30.7" N	<i>Osbeckia stellata</i>
13	87° 34' 59.0" E	26° 42' 22.8" N	<i>Osbeckia stellata</i>
14	87° 34' 53.1" E	26° 42' 29.7" N	<i>Ehretia acuminata</i>
15	87° 35' 2.6" E	26° 42' 38.2" N	<i>Garuga pinnata</i>
16	87° 35' 13.7" E	26° 42' 32.8" N	<i>Dillenia pentagyna</i>
17	87° 34' 53.0" E	26° 42' 19.6" N	Phalame
18	87° 35' 21.2" E	26° 42' 11.7" N	<i>Biax orelana</i>
19	87° 35' 2.5" E	26° 42' 13.3" N	<i>Ehretia acuminata</i>
20	87° 35' 22.2" E	26° 42' 8.1" N	Hangrayo
21	87° 34' 50.4" E	26° 42' 15.3" N	<i>Dillenia pentagyna</i>
22	87° 34' 49.7" E	26° 42' 13.9" N	Maina kath
23	87° 35' 28.1" E	26° 42' 1.9" N	<i>Osbeckia stellata</i>
24	87° 35' 41.4" E	26° 41' 54.5" N	<i>Biax orelana</i>
25	87° 35' 6.5" E	26° 41' 53.8" N	Maina kath
26	87° 35' 21.0" E	26° 41' 50.0" N	<i>Aesculus indica</i>
27	87° 35' 18.4" E	26° 41' 42.4" N	Bhatti
28	87° 35' 43.2" E	26° 41' 44.3" N	Jungeli kada
29	87° 35' 56.3" E	26° 41' 34.9" N	<i>Dillenia pentagyna</i>
30	87° 35' 33.9" E	26° 41' 36.0" N	<i>Dillenia pentagyna</i>
31	87° 35' 25.7" E	26° 41' 35.2" N	<i>Shorea robusta</i>
32	87° 35' 25.6" E	26° 41' 27.5" N	<i>Shorea robusta</i>
33	87° 35' 56.8" E	26° 41' 28.1" N	<i>Swertia nervosa</i>
34	87° 36' 10.1" E	26° 41' 26.0" N	<i>Shorea robusta</i>
35	87° 34' 42.0" E	26° 43' 17.1" N	<i>Dillenia pentagyna</i>
36	87° 36' 3.2" E	26° 41' 24.7" N	<i>Shorea robusta</i>
37	87° 36' 23.1" E	26° 41' 24.8" N	Pithari
38	87° 36' 26.1" E	26° 41' 21.7" N	<i>Eugenia operculata</i>

Cont....

39	87° 36' 24.7" E	26° 41' 21.6" N	Dude hangrayo
40	87° 36' 27.4" E	26° 41' 20.1" N	<i>Sambucus hookeri</i>
41	87° 35' 43.1" E	26° 41' 18.3" N	<i>Shorea robusta</i>
42	87° 35' 39.1" E	26° 41' 21.8" N	<i>Shorea robusta</i>
43	87° 36' 23.7" E	26° 41' 16.2" N	<i>Shorea robusta</i>
44	87° 36' 28.3" E	26° 41' 7.4" N	<i>Shorea robusta</i>
45	87° 36' 12.0" E	26° 41' 5.8" N	<i>Shorea robusta</i>
46	87° 36' 35.1" E	26° 41' 4.7" N	<i>Sambucus hookeri</i>
47	87° 36' 32.0" E	26° 41' 1.1" N	<i>Shorea robusta</i>
48	87° 36' 18.6" E	26° 40' 54.7" N	<i>Shorea robusta</i>
49	87° 36' 23.7" E	26° 40' 50.2" N	<i>Delbergia sisoo</i>

Table J: Name of the respondent and interviewed date

S. N.	Name of the Respondent	Interviewed Date	S. N.	Name of the Respondent	Interviewed Date
1	Ambika B.K.	6/04/2011	41	Kedar Chauwan	7/04/2011
2	Ananda Dahal	30/03/2011	42	Keshab Dhimal	30/03/2011
3	Anju Rai	6/04/2011	43	Kunta Raya	6/04/2011
4	Bashudev Ghimire	6/04/2011	44	Laxmi Dahal	4/04/2011
5	Bhakta maya Puri	10/04/2011	45	Laxmi Majhi	28/03/2011
6	Bhuwan Dhakal	30/03/2011	46	Laxmimaya Sunchuri	6/04/2011
7	Bidhyapati Guragain	6/04/2011	47	Madan Rai	4/04/2011
8	Bishnu Katwal	6/04/2011	48	Mala Guragain	8/04/2011
9	Bishnu limbu	29/03/2011	49	Mamta ojha	29/03/2011
10	Bishnumaya Khadka	10/04/2011	50	Man bd. B.K.	5/04/2011
11	Bishnumaya Sitaula	5/04/2011	51	Man kumar Thapa	3/04/2011
12	Chandra Bhandari	7/04/2011	52	Manju pandey	7/04/2011
13	Chandra pd. Gautam	8/04/2011	53	Manmaya Magar	7/04/2011
14	Chandrakala Urab	7/04/2011	54	Mina Kafle	7/04/2011
15	Dakshya mani Nepal	7/04/2011	55	Minlal Giri	29/03/2011
16	Dambar Bhattarai	30/03/2011	56	Nirmala Budathoki	3/04/2011
17	Deepak lama	8/04/2011	57	Phulmaya Dhimal	4/04/2011
18	Devimaya Khadka	7/04/2011	58	Pujan pokheral	28/03/2011
19	Dilmaya Thapa	30/03/2011	59	Purna B. Sapkota	6/04/2011
20	Ekanath pokheral	5/04/2011	60	Puspa Adhikari	30/03/2011
21	Farida Ghimire	6/04/2011	61	Radha Dhimal	7/04/2011
22	Gaj B. B.K.	6/04/2011	62	Ram B. Dhungana	4/04/2011
23	Gita Basnet	29/03/2011	63	Rama Dahal	7/04/2011
24	Gita Karki	8/04/2011	64	Rama Ghimire	3/04/2011
25	Gita Sapkota	8/04/2011	65	Ramu Tamang	28/03/2011
26	Givan Dhimal	29/03/2011	66	Renuka Dhimal	8/04/2011
27	Goma Ghimire	7/04/2011	67	Santosh K. Neupane	30/03/2011
28	Harimaya Basnet	8/04/2011	68	Sarita Khadka	4/04/2011
29	Harimaya Khatiwada	7/04/2011	69	Shankarlal Urab	7/04/2011
30	Hemanta Khatiwada	7/04/2011	70	Shanti Dhimal	4/04/2011
31	Indira Dahal	7/04/2011	71	Shantiram Sapkota	8/04/2011
32	Indira Dahal	4/04/2011	72	Sher B. Dhimal	3/04/2011
33	Indra maya thapa	28/03/2011	73	Sita Dangi	28/03/2011
34	Januka Dahal	5/04/2011	74	Suresh Limbu	30/03/2011
35	Januka Thapa	7/04/2011	75	Susma Rai	7/04/2011
36	Januka Wasti	8/04/2011	76	Tanka pd. Neupane	6/04/2011
37	Jhabru Urab	3/04/2011	77	Tara Shrestha	28/03/2011
38	Kallu Urab	4/04/2011	78	Tikaram Magar	6/04/2011
39	Kalpana Shrestha	8/04/2011	79	Tulsa Ojha	7/04/2011
40	Kamala Rai	28/03/2011			

Table K: Name of the Key Informant and Interviewed date

S.N.	Name of the Key Informant Interview	Interviewed Date
1	Bhim Rai	6/04/2011
2	Krishna Dahal	8/04/2011
3	Dev mani Neupane	7/04/2011
4	Madan Rai	9/04/2011
5	Arjun Dhakal	9/04/2011

Table L: Interaction with Management Committee and Focus Group Discussion

२००७/१८/११

Interaction with Management Committee

S.N.	Name	position	signature	Ward No-
1	कुमल प्र. दाहाल	अध्यक्ष		6
2	देवमणी श्रेष्ठ	कार्यवाही		6
3	गोपाल श्रेष्ठ	सदस्य		
4	श्रीम राई	सचिव		
5	नर के श्रेष्ठ	सदस्य		
6	पार्वती कुशाल	उपाध्यक्ष		6
7	दिल माया श्रेष्ठ	सदस्य		
8	एड के वि. को	सदस्य		वार्ड नं. ९
9	मदुल राई	कमान्डर (हस्तगत)		6
10	नेमल राई	उपनिष्ठा		" ३
11	शुभाषि कार्की	"		" ९
12	काली के श्रेष्ठ	उपनिष्ठा सदस्य		वार्ड नं. १
13	शुभेन्द्र श्रेष्ठ	"		७
14	कमला कुमारी राई	समीति सदस्य		कमलाकुमारी
15	हर्ष के तिमथी	"		१
	दिकारी म पूर	वन विभाग		दिकारी म ७

Ward No: 7

FOCUS Group Discussion

Date: २००७/१२

S.No	Name	Address	Signature
1)	गंगा कुमारी	७	
2)	श्रीमती श्रेष्ठ	७	
3)	विष्णुमाया आंघोरी	७	
4)	श्रीमती श्रेष्ठ	७	
5)	श्रीमती श्रेष्ठ	७	
6)	श्रीमती श्रेष्ठ	७	
7)	अम्बिका श्रेष्ठ	७	
8)	कुमारी कुमारी	७	
9)	पद्म कुमारी श्रेष्ठ	७	
10)	नेमली अम्बिका	७	
11)	इन्दिरा श्रेष्ठ	७	
12)	निर्मला कार्की	७	

ANNEX IV
PHOTOGRAPHS



Measuring circumference of cut stumps



Measuring base of the tree



Measuring DBH of tree



Taking height of herbs



Interaction with Management Committee



FGD with user group



Key informant interview



Questionnaire survey