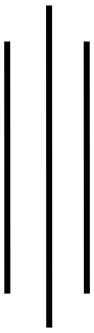
IMPACT OF BHUTANESE REFUGEE SETTLEMENT ON HUMSE-DUMSE COMMUNITY FOREST: A CASE FROM BELDANGI, DAMAK, JHAPA, NEPAL

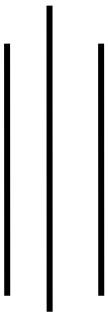


A thesis Submitted to

Central Department of Environmental Science

In the Partial Fulfillment of the Requirements for the Degree of

Master of Science in Environmental Science



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CENTRAL DEPARTMENT OF ENVIRONMENTAL SCIENCE

TRIBHUVAN UNIVERSITY

August, 2012

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LETTER OF RECOMMENDATION

This is to attest that *Ms. Sandhya Subedi* has prepared this Master's thesis entitled **"Impact of Bhutanese Refugee Settlement on Humse-Dumse Community Forest: A case from Beldangi, Damak, Jhapa, Nepal"** for partial fulfillment of the requirements for the completion of Master's Degree in Environmental Science majoring in 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 requierement of Central Department of Environmental Science, Tribhuvan University.

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

…….

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DECLARATION

I, Sandhya Subedi, 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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Approval

This dissertation presented by *Ms. Sandhya Subedi* entitled **"Impact of Bhutanese Refugee Settlement on Humse-Dumse Community Forest: A Case from Beldangi, Damak, Jhapa, Nepal"** has been accepted as a partial fulfillment of the requirement for the final year of the Master degree in Environmental Science.

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ABSTRACT

United Nations High Commissioner for Refugees defines four main reasons for refugees flows: political instability, economic tensions, ethnic conflict, and environmental degradation. Movement of thousands of people and the establishment of refugee camps often has a serious impact on local environment, as well as on the welfare of nearby communities. Nepal has also hosted Bhutanese refugees in the eastern region since 1990. In this context, Humse-Dumse Community Forest was selected to study the impacts of Bhutanese refugee settlements on the forest, as three refugee camps (Beldangi I, Beldangi II and Beldangi III) have been established inside the forest. The reconnaisance survey was conducted during October 2010 and field survey during January 2011. Vegetation analysis and questionnaire survey (to both refugees and Community Forest User Groups) were done by using stratified random samplings. Socio-economic status of the Bhutanese refugees and CFUGs, their resources (fodder and fuelwood) need and access, and their extraction practices are highlighted in the questionnaire survey, and status of forest resources and its supply scenario are highlighted in the vegetation part. The camp settlement inside the CF has reduced the forest area by one fifth. As the refugees had no strong income source, they had no other better alternative (for the fuel resource) than extracting fuelwood from the nearby village, Community Forest and from market. From the CFUGs, landless were more depended on the C.F for both fodder and fuelwood. Annual extraction of both fodder (2896.07 t/yr) and fuelwood (1503.74 t/yr) by the Bhutanese refugees are quite higher than that of CFUGs' (fodder; 1792.53 t/yr and fuelwood; 289.16 t/yr), outstripping the forest's annual sustainable supply (fodder; 152.83 TDN in t/yr and fuelwood; 1087.79 t/yr). Absence of refugee settlement would greatly reduce these extractions so that the C.F resources do not get overharvested. Moreover, the refugees' illegal activities such as slice cutting of trees stems, uprooting of regenerating species and small herb saplings, collecting twigs and broken branches for fuelwood, collecting fodder for their livestock were increasing pressure load for the forest resources. All these activities of the refugees in longer term will definitely decline the forest's sustainability to a very high extent. Therefore, there is an emerging need of strong policy amendment regarding these settlements inside the community forest.

Key words*: Bhutanese refugees, CFUGs, extraction, forest resources, sustainability, vegetation analysis, UNHCR.*

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Sandhya Subedi

August, 2012

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LIST OF ABBREVIATIONS

BZ	Buffer Zone
CF	Community Forest
CFUGs	Community Forest User Groups
CNP	Chitwan National Park
CSD	Cut Stump Density
DAGs	Disadvantaged groups
Dbh	Diameter at breast height
EAP	Environmental Action Plan
ETF	Environmental Task Force
EXCOM	Executive Committee (of UNHCR)
FINNIDA	Finnish International Development Agency
FSRC	Forest Resource and Survey Centre
FSSD	Forest Survey and Statistical Division
FUGs	Forest User Groups
GIS	Geographic Information System
GoN	Government of Nepal
GPS	Global Positioning System
ha	hectare
HDCF	Humse-Dumse Community Forest
HHs	Households
IFMPs	Improved Forest Management Practices
IGAs	Income Generating Activities
INV	Inventory Net Volume
IOM	International Organization for Migration
IVI	Importance Value Index
MPFSN	Master Plan for Forestry Sector, Nepal
NTPFPs	Non Timber Forest Products
PWR	Parsa Wildlife Reserve
TDN	Total Digestible Nutrient
UNHCR	United Nations High Commissioner for Refugees
WFP	World Food Programme

CHAPTER-1

1. INTRODUCTION

1.1 Background

1.1.1 Refugee and Environment

Article 1 of the United Nations Convention Relating to the Status of Refugees (1951), defines refugee as "A person who is outside his/her country of nationality or habitual residence; has a well-founded fear of persecution because of his/her race, religion, nationality, membership in a particular social group or political opinion; and is unable or unwilling to avail himself/herself of the protection of that country, or to return there, for fear of persecution." (UNHCR factsheet, 2011).

According to the United Nations High Commissioner for Refugees (UNHCR), there are four main reasons for refugee flows: political instability, economic tensions, ethnic conflict, and environmental degradation. During such humanitarian crisis, the immediate response is providing assistance and protection to the refugees such as food, shelter, and medicine. The arrival of refugees in any country brings both cost and benefit to the host area (KC and Nagata, 2006). Movement of thousands of people and the establishment of refugee camps can have a serious impact on local ecology, as well as on welfare of nearby communities. The environmental impact of a sudden influx of refugees may create hostility between the local communities and refugees. Where natural resources such as firewood or water are scarce, people compete for access to these resources and this gives birth to the source of conflict between the local communities and the refugees (Lynch, 2002). Environmental issues associated with refugees and returnees are normally the consequence of high concentrations of people, which often build up at a distinct location over a short period of time. In the absence of appropriate mitigating measures, the surrounding environment can quickly become degraded, which can leave a lasting impact. This, in turn, has the potential for other impacts on refugees as well as local populations (UNHCR's Environmental Guidelines, 2005).

Rural populations in developing countries are dependent on their surroundings for water, food, shelter and medicine. Refugee influxes intensify normal 'green' environmental problems - those associated with over-exploitation of rural natural resources due to poverty, rising populations, weak property rights and inappropriate management. The pressure of refugees on the local forest leads to environmental problems such as deforestation, land degradation, and depletion of forest resources (Shepherd, 1995).

The main reason for the negative environmental impacts caused by refugees is their push to get hold of their basic requirements; of which obtaining food, shelter and fuelwood has the greatest negative impacts on the environment and wildlife. Space to live on is also a requirement, with land often cleared to allow for refugee settlements (UNHCR, 2005; Jacobsen, 1997).

1.1.2 Context of Community Forestry in Nepal

In Nepal, populations are dependent on the forest for energy, agriculture, agroforestry (Gautam 1993; as cited in KC and Nagata, 2006), and other social functions such as recreation and celebration of festivals and practicing their customary traditions. The arrival of refugees creates extra pressure on the already scarce resources and leads to scarcity and competition (KC and Nagata, 2006). By the end of 1990, large numbers of refugees from Bhutan arrived in Nepal and lived in ad-hoc encampments in desperate conditions along the banks of the Kankai river in southeastern Nepal. The influx of refugees from Bhutan peaked during the first half of 1992, when up to 1,000 persons arrived daily, with the number of arrivals lessening by 1993. By early 1992, at the request of the GoN, UNHCR launched a major emergency assistance programme together with the World Food Program (WFP) and various non-governmental partners. The refugees were then accommodated in seven campsites on government Forestry Department land in the Terai region of Morang and Jhapa districts (UNHCR factsheet, 2011).

There is a widespread appreciation that community forestry is a successful programme of Nepal in terms of rehabilitating forest condition (Chapagain and Banjade, 2009). Community forestry is the control and sustainable management of

local forest resources, by those who use these resources in multi-dimensional ways for their welfare on an equitable and sustainable basis condition (Maharjan, 1998). The basic concept of community forestry program lies on the participatory approaches for the management of the forest resources through a group of traditional users. The term forest management encompasses both technical and social arrangements involved in the management of forests including protection, utilization and decision-making activities. The ultimate aim of the program is to promote rural development by increasing production efficiency, equity and sustainability of the management system. The program is now successfully promoted for the participatory management of natural resources (Pokharel et.al, 2007).

Since community forests are managed by the local people for the sustainable management of the forest along with the accessible use of the forest products, it is focused on providing resources for meeting the needs of the rural people not for providing shelter to any kind of community. But community forest of Jhapa district, Eastern Nepal have been serving as shelter for Bhutanese refugees from long time before. With the establishment of the refugees camps inside the community forest, the forest resources utilization increases with the increased number of consumers. This generates more pressure on the use of forest products so that the forest may be overexploited exceeding its potential. This problem in long term may create irreversible changes to the resources and the environment, so there arises a need of strong policy amendment for the solution of this serious issue. However, the population is declining due to the third country resettlement. Resettlement as a durable solution began in November 2007 and is continuing successfully with the strong cooperation between the GoN, UNHCR, International Organisation for Migration (IOM) and the resettlement countries. The United States has accepted the largest number followed by Canada, Australia, New Zealand, Norway, Denmark, Netherlands and the United Kingdom.

1.2 Statement of Problem

Community forestry program mostly involves local people to have some success to reverse the trend of deforestation and other type of forest related problems. But, here in case of Humse-Dumse community forest (HDCF), this trend is seen to be followed

up instead of reversing. This is due to the Bhutanese refugee camps established within the forest area.

During refugee camp establishment, many large Sal and other trees were cut down to provide space to accommodate these refugees. This forest area was originally used for agroforestry, grazing, and fuelwood with informal but well-defined usage by the local villagers. Before the arrival of the refugees, the forest management and monitoring of illegal use of forest resources were carried out by the government through its local forester office. The local residents were active users of the forest resources, but were passive in managing and maintaining the forest resource. However, competition from the refugees instilled a desire in the local population to safeguard and protect the dwindling resource against the external threat by creating the Humse-Dumse community forest user group. The people residing in the camps are seen to be heavily dependent on the forest for their daily needs such as timber, fuelwood, grazing area, and fodder for domestic animals. Initially, the construction of refugee camps decreased the total forest area and also required some felling of trees. More significantly, the refugees themselves became active users of the forest resource, which generated extra pressure on the forest and created scarcity of forest resources. The forest is found to be less dense than it used to be before establishment of those camps.

1.3 Research Question

The research questions of the study are:

i) Are there impacts of Bhutanese refugees' settlement on the HDCF?

ii) What are the forest resources' status and its supply demand scenario?

iii) What are the forest resources extraction practices of the Bhutanese refugees and CFUGs?

iv) How to interpret the pressure of the refugees' activities on the forest?

1.4 Objectives

The broad objective is to assess the impact of the Bhutanese refugees' settlement on the community forest.

The specific objectives are:

1) To assess the fuelwood and fodder needs and annual yield of the Bhutanese refugees and CFUGs.
2) To interpret the refugees' pressure on the forest from their settlement and activities.
3) To study the vegetation of the Humse-Dumse Community Forest.
4) To compare the forest resources extraction between the Bhutanese refugees and CFUGs.

1.5 Scope of the Study

The present study focuses the refugees' settlement inside the community forest, their forest resources extraction in comparison with the CFUGs. As their camps are located within the forest, the forest area has not only been decreased but there have arisen several consequences regarding forest resources supply. This study may be helpful in focussing the forest resources' status as well as other overcoming obstacles in the forest resources sustainability.

CHAPTER-2

2. LITERATURE REVIEW

2.1 Impacts of Refugees' Settlements

Allan (1987) studied the impact of Afghan refugees on the vegetation resources of Pakistan's Hindukush-Himalaya. He reported that the impacts varied widely in accordance with the type of environment from which widely different groups originated and the type into which they had been settled. Far-travelled refugees from north of the Hindukush had caused the most extensive degradation; most disturbance had been caused where refugees had been settled into forest land as distinct from sparsely vegetated arid land. The refugees' migration had caused extensive environmental damage, much of it probably irreversible.

Black (1994) examined the effects caused by environmental refugees in the country that receives them and discussed the various impacts: deforestation, land degradation, and water supply and quality and concluded that these problems were solely due to the presence of environmental refugees.

Biswas and Quiroz (1996) studied the environmental impacts of Rwandan refugees on Zaire's forestry sector and other impacts, which were waste disposal, germplasm loss, poaching, changes in land use, and drinking water. The study concluded that the most serious impact was unquestionably the deforestation of the Virunga National Park, which is not only an international treasure in terms of biodiversity but is also a major tropical forest. They suggested that unless the refugees are moved from the park's vicinity, any remedial action taken to ameliorate the environmental impacts on the Virunga National Park is unlikely to be effective.

Jacobsen (1997) argued that the environmental impact of refugees depends on number of factors in the host context, whether refugees were self-settled or residing in organized settlements, was important determinant, playing critical role in offsetting environmental impact. He discussed the various environmental effects of different

types of refugees' settlement and examined the role of the host community in influencing this impact, using researches and other evidences from Africa.

According to Myers (2002), different types of refugees existing in various parts of the world and they address the various environmental and political options of the host country. He reported that some solutions are critically needed to minimize the rate of environmental refugees in the world so that it creates positive hopeful feeling for the local communities.

Bates (2002) attempted to clarify the differences between environmental refugee and other refugees. The origin, intention, and duration of environmental disruptions shape the type of refugees. Environmental refugees may have considerable control over the decision to migrate, varying by the type of environmental disruption, and refugees from disasters and expropriations have limited control over whether environmental changes will produce migration.

Whitaker (2002) argued that the burdens and benefits associated with the refugee (from Rwanda, Burundi and Congo) presence was not distributed evenly among local hosts in Western Tanzania. Some Tanzanians benefited substantially from the presence of refugees and international relief agencies, while others struggled to maintain access to even the most basic resources. The conclusion drawn from the research was that hosts who already had access to resources, education, or power were better poised to benefit from the refugee presence, while those who were already disadvantaged in the local context became even further marginalized.

KC and Nagata (2006) conducted research on refugee impact on collective management of Humse-Dumse community forest resources analyzing the relationship between forest resources, refugees and the host population and examined the past forest condition and management practices and the emerging managing practices due to the threat posed by the presence of the refugees. They concluded that the use of fuelwood by the refugees has been the most critical determinant of the growing resource scarcity and environmental damage and they acted as a trigger for the local population to act more assertively for themselves and be active participants in local protection and management of the forest resources.

Uddin and Khan (2006) in their study on Teknaf Game Reserve (TGR) compared the dependency, livelihood activities and impacts of local people with those of Rohingya refugees on the reserve and found that the Rohingya refugees were comparatively more dependent on the forest and local people and their impacts were influenced by seasonal fluctuations in climate, by the availability of natural resources, and by various environmental, socio-economic and political shocks and stresses.

Young (2007) attempted to examine the broad features of Somalia's harsh physical environment into which several hundreds of thousands of refugees who were residing since six years ago, analyzing the critical environmental concerns: vegetation and erosion on refugee farms, the growing problem of refugee livestock, the destruction of trees, and irrigation practices and salinity on refugee farms. He concluded with an argument to preserve Somalia's environment from careless and destructive exploitation, which was leading towards desertification calling for an in-depth study of the situation.

2.2 UNHCR's Environmental Guidelines

UNHCR's environmental guidelines were published in June 1996, and updated in August 2005.The purpose of these guidelines are :

- To describe the basis for incorporating environmental factors into specific UNHCR guidance/guidelines and programmes.
- To provide more detailed information and the rationale behind the EXCOM policy statement.
- To serve as an awareness raising tool for UNHCR and other agencies involved with refugee and returnee operations.

The guidelines state that an environmental coordinator/focal point and environmental task force (ETF) should be appointed, and an environmental action plan (EAP) written; though only for refugee situations near environmentally sensitive areas where negative impacts are deemed potentially severe. ETFs are often established after the majority of urgent decisions are made; decisions, which affect levels of environmental impacts, like site location.

The guidelines divide refugee situations into three phases:
The *emergency phase* is when refugees first arrive in the host-region, all in urgent need of basic necessities; food, water, shelter and medical care. The provision of fuelwood, adequate sanitation and waste-disposal is also of grave importance here. This is generally the most problematic phase; activities of different agencies have not yet been coordinated properly, and decisions often need to be made quickly, sometimes without all essential information at hand. Actions taken here are of particular importance, as they will profoundly affect the rest of the refugee situation and surrounding environment. UNHCR emphasise the importance of this phase via their 'prevention before cure' strategy.

The *care-and-maintenance phase* is when most refugees have arrived. The cumulative environmental impacts of the refugees have begun to be felt. Actions initiated in this phase protecting the environment are often more thought through, consistent, proactive, and long-term. There is now greater coordination between the agencies on their activities.

The *durable solutions phase* is when the refugee situation is drawing to an end. The refugees are either returning to their home-country, integrating into their host-country, or resettling in a third country. Activities in rehabilitating the environment of the refugee-hosting take centre stage in combination with development projects. Activities include: forest, vegetation, and ecosystem rehabilitation; waste disposal; and general cleaning-up. Lack of action in this stage will diminish the effectiveness of actions taken earlier on in the refugee situation.

Throughout their environmental guidelines, UNHCR emphasizes 'prevention before cure', not because of protecting ecosystems and biodiversity, but mainly for cost effectiveness. It is in most cases cheaper to prevent environmental degradation than to rehabilitate it later. UNHCR does recognize that in some cases prevention is the only option to avoid irreversible impacts like species extinction, whatever the cost. Other aspects that UNHCR emphasize are: an integrated approach throughout all their activities and policies; cost-effectiveness and net benefit maximisation; and participation of local population to increase cooperation and long-term sustainability.

2.3 Community Forest and Livelihood

Maharjan (1998) in his study of Chuliban community forest illustrated the importance of a range of social and economic indicators, in addition to the usual environmental indicators, as a measure of sustainability and argued that if FUGs and community forests are managed properly; they can provide many direct and indirect benefits to the local communities on a sustainable basis. The distribution of the identification, quantification and valuation of the costs and benefits among the different forest users was found to be a particularly critical factor that could lead to the long-term success or failure of the FUG.

Dev et.al. (2003) attempted to assess the livelihood impacts of community forestry based on Forest User Groups (FUGs) in the Middle hills of Nepal, using data from the Koshi hills region in the East and found that impacts were diverse both within and between FUGs, but had been generally positive, in terms of improved levels and security of forest product and benefit flows,various household income generating opportunities, support for community infrastructure and development activities, and improved 'social capital' for collective planning and action.

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

Pokharel et.al (2007) analyzed the evolution of community forestry in Nepal, focusing on how policy, institutions and practical innovations evolved together to create a robust system of community forestry, in the aspects of livelihoods and democracy. The lessons learnt were; the policy amendment and revision of the community forests need to be based on real-life on real-life experiences rather than ad hoc and top-down decision-making and CFUGs can become viable local institutions for sustaining forests and local democracy if they are given complete autonomy.

Chapagain and Banjade (2009), from the results of a survey of 1100 community forest user groups (CFUGs), rapid social analysis of 24 CFUGs and review of existing policies and practices in wider sectors of local development, reported that the organizational scope of CFUGs is not limited to forestry activities but encompasses a wide range of development activities. Their results from Koshi hills give a clear view of how CFUGs' activities have led to increased livelihood opportunities to the local communities in general, and the poor and marginalised groups in particular, which provides clear opportunity for development agencies and policy makers to promote CFUGs as the institutional platform for pro-poor local development.

Gautam (2009) examined the various steps in which community forestry is contributing to sustainable livelihoods, explored the status of equity in community forestry management and observed the nature of dependence of the users on their community forest, based on data collected from seven community managed forests using the International Forestry Resources and Institutions research protocols. The findings suggest that amount of forest products harvested at present is insufficient to meet the users' needs and the current forest products harvesting and distribution systems seem to be unfavorable to the poor households and socially DAGs as the decision making process is generally controlled by elite members of the user groups.

CHAPTER-3

3. METHODOLOGY

3.1 Research Design

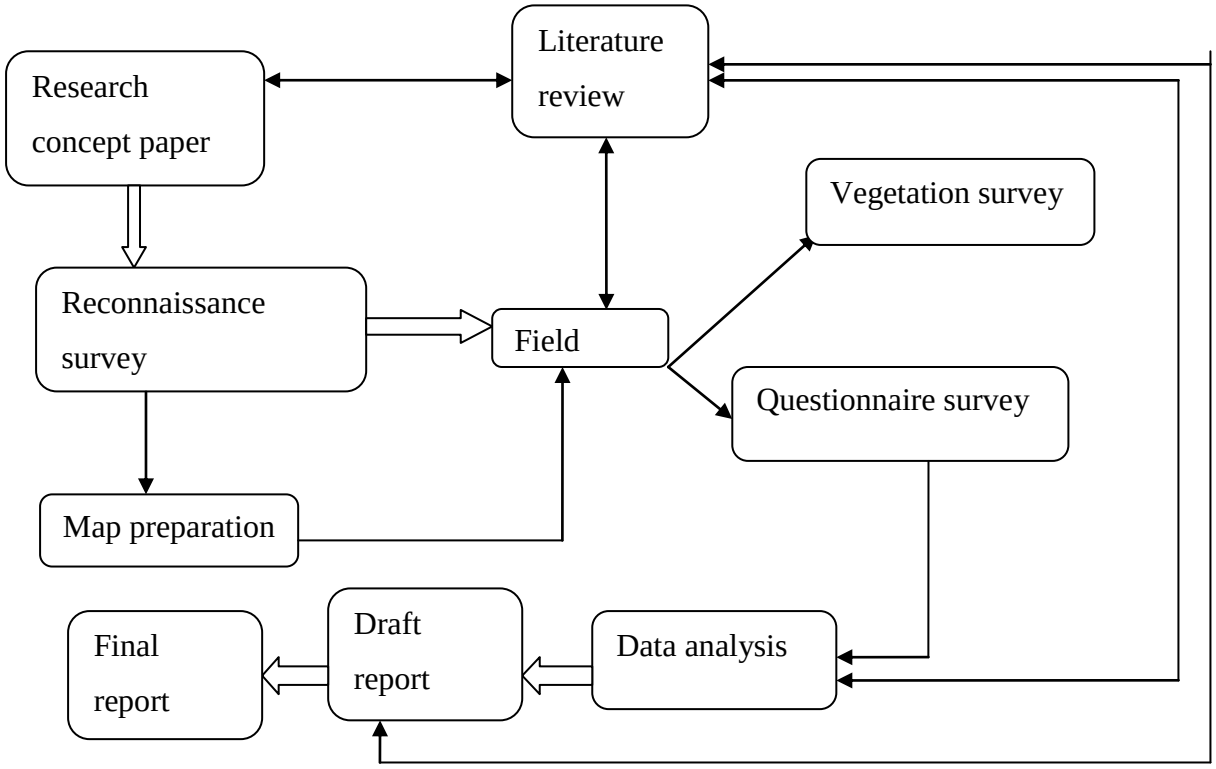


Figure 3.1: Schematic flow diagram of research design

3.2 Data Collection Methods

3.2.1 Reconnaissance Survey

The reconnaissance survey was conducted during October 2010. First, the forest boundary of Humse-Dumse Community Forest was taken with the help of GPS (Garmin e-trex). Then, different activities of the Bhutanese refugees and also of the natives of that area who were the members of the CFUGs, were observed and separate questionnaires were developed for both of them.

3.2.2 Household Socio-Economic Surveys

3.2.2.1 Survey Design and Sample Size

The sample size of the households were determined before going to the field by using the formula adopted by Arkin and Colton (1963) as cited by Poudyal (2000).

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

Where, n = sample size, N= total number of households, Z= confidence level (at 95% level z=1.96), P=estimated population proportion (0.05, this maximize the sample size), d=error limit of 5% (0.05)

The field survey was conducted during January 2011. The sample size of the households calculated for the refugee camps was 72 households (annex IV) using the same formula. The households were selected randomly.

Similarly, the obtained sample size for the CFUGs households was 71 (annex IV). Stratified random sampling was applied for these sampled households based on their land holdings: Landless, Small farm, Medium farm, Big farm and Very Big farm. The sampled households were selected randomly without replacement from the CFUGs members. The information regarding the members, land holdings of the sampled households were gathered from the community forest office. From the list of information obtained on landholding, required number of sample size of each land categories in every ward was selected randomly and survey was conducted. Land holdings of the sampled households were classified as shown in the table 3.1.

Table 3.1: Land holding categories of the households:

Categories	Land holdings (ha)	Land holdings (ha)	Total HHs (No.)	Sampled HHs
Landless	0	0	380	9
Small farm	0-10	0- 0.34	1079	28
Medium farm	10-20	0.34-0.68	341	13
Big farm	20-80	0.68-2.72	494	19
Very big farm	>80	>2.72	55	2

3.2.2.2 Questionnaire Survey

Two types of questionnaire were developed for the Bhutanese refugees and CFUGs of the HDCF (Annex I). The former questionnaire includes two parts: household

information and their resources need and access and the later one consists: household information and community forest management. The sampled refugee households representing from all the three camps (Beldangi I, II and III) were interviewed and filled close ended and open-ended questions in the field.

Similarly, the sampled CFUGs' households representing from ward no.1 to 7 on the basis of land holding categories, were interviewed.

3.2.2.2.1 Farm Size, Crop Production and Livestock Holding

Actual farm size (landholding) of each sampled households was noted in local unit (Kattha and Bigha) and converted into hectare (ha) by using the conversion factors (Annex II). Agriculture production of households was noted in local unit (Mann) and converted into standard unit (Kg). Livestock's of sampled households were counted as the head number and they were converted into the standard unit called livestock unit, by using the conversion factors as given in the annex II.

3.2.2.2.2 Estimation of Annual forest Resources (Fuel wood and Fodder) Need

Annual forest resources use of sampled household and amount of resources from different sources (The community forest, Own land, Market) were noted in local unit (Bhari). The weight of the Bhari was converted into Kilogram (kg) based on the experience of the villagers. Those who could not convert Bhari into kg was calculated based on following equivalents (Nepal and Weber, 1993; as cited in Pandeya 2009).

3.2.3 Vegetation Survey

3.2.3.1 Sample Size

After returning from reconnaissance survey, the boundary map of the forest was prepared by using Arc GIS 9.3 and random points were generated on the Damak municipality map (1992). Then, 60 random sampling plots were generated. The latitude and longitude of these points were pluged in the GPS and in the field, those points were found with the help of GPS and vegetation survey was conducted. In the field, vegetation survey was done in altogether 45 plots because the remaining 15

plots were found within the camp area, i.e., those points were found within the settlement area.

3.2.3.2 Plot Design

Total sample size for the tree stratum was 45, while for the shrub and herb strata, there were 90 for each. Each sampling plot was measured through quadrat method. At each sampling points, altogether five plots were laid out. Tree species (dbh>10 cm) were analyzed within the quadrat size of 20m×20m. Each quadrate of size 20m×20 m comprised of two small sub quadrates of 5m×5m in diagonally opposite corner (NE and SW direction) for shrub stratum (dbh<5 cm) and within 5m×5m, a quadrate of 1m×1m for the study of herb stratum (Figure 3.2). Height, individual coverage and total coverage of the species within the shrub plot and number, individual coverage and total coverage of the species within the herb plot, were measured. Number of cut stump of trees species with height and circumference at top, ocular estimation of lopping percentage of tree species were noted within the 20m×20m plot.

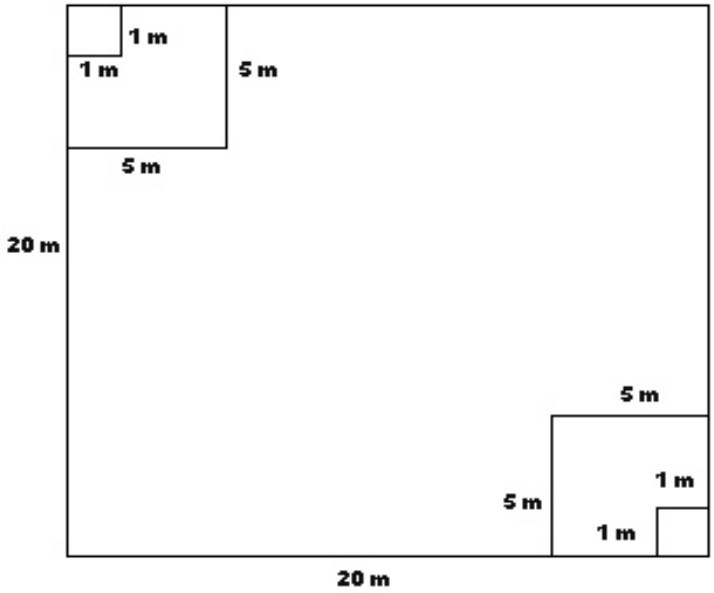


Figure 3.2: Plot Design (Nested quadrate plot)

3.2.3.3 Stand Size

The stand size classification is presented in the table 3.2, based on standards of the Forest Inventory Division (FSRC, 1995).

Table 3.2: Stand size classification

Symbol	Stand size	Dbh (cm)
1	Sapling	<12.5
2	Pole	12.5-25
3	Small Saw Timber	25-50
4	Large Saw Timber	>50

3.2.3.4 General Parameters and Regeneration

Density, Relative Density, Frequency, Relative Frequency, Basal Area, Relative Basal Area and Importance Value Index (IVI) were calculated for tree species. For regeneration of tree species, height classes were used based on Rijal and Meilby, (2006).

3.2.3.5 Tree Volume

The Inventory Net Volume (INV) developed by the Forest Inventory Section, Ministry of Forest and Soil Conservation, Nepal (FSSD, 1991) was used for the calculation of resources of the HDCF. INV was used to estimate the volume of each individual tree, which computes total volume of the whole stems.

3.2.3.6 Biomass of Stems, Branches and Foliage

Stem biomass is obtained by multiplying the stem volume by wood density. Wood density was obtained from the Master Plan for Forestry Sector, Nepal 1988 (GoN, 1988a). For obtaining the biomass of branches (fuelwood) and foliage (fodder), ratio of branch to stem biomass and foliage to stem biomass were applied for various species (GoN, 1988a).

3.2.3.7 Estimation of Annual Yield

The Master Plan for Forestry Sector, Nepal (MPFSN) has estimated the annual yield of different forest types of Terai for the Eastern Development Region. The percent annual yield estimated by Master Plan in similar forest types of Eastern Development Region were applied to estimate the annual yields of the community forest (Given in annex II).

3.2.3.8 Anthropogenic Pressure on the Community Forest

3.2.3.8.1 Cut Stumps

The total number of cut stump of tree species was counted within the tree plots, measuring the girth of each cut stump (cm). The girth size was categorized into five classes according to Silori (2001). These girth classes are: (i) < 20 cm, (ii) 20-40 cm, (iii) 41-60 cm, (iv) 61-80 cm, and (v) > 80 cm. Density of each girth category was calculated for each species of the community forest.

3.2.3.8.2 Lopping Intensity

The lopping intensity was classified based on Silori (2001). The intensity of lopped trees was assessed under different damage categories in each tree plots as in the table 3.3. The lopping 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 into four categories (Silori, 2001).

Table 3.3: Lopping intensity class

Lopping intensity	Scale
Least	1-25% damage
Medium	26-50% damage
High	51-75% damage
Very high	>75% damage

Density in each lopping intensity class was calculated for each species of the community forest.

3.2.4 Data Calculation, Analysis and Interpretation

The collected data from the field were all sorted as per the different categories. The local units obtained from household survey were converted into standard units (Nepal and Weber, 1993). Then those data and also the vegetation data were entered in the data sheet of Microsoft Excel and calculation was proceeded as per standardized formulas. Some data of the household survey were fed into SPSS- 16 (Statistical Package for Social Sciences) and required calculations were made through this program.

CHAPTER-4

4. STUDY AREA

4.1 Geographical Location and Climate

Humse-Dumse Community Forest lies within ward number three and five, Beldangi of Damak Municipality in Jhapa district, Mechi Zone, Eastern Nepal. It lies within the latitude 26°20”-26°50” N and longitude 89°39”-88°12” E at an altitude of 135m from the mean sea level. The geographical setting of the community forest is such that it is bordered by Ilam district in the east and north, Damak municipality’s ward no 5 in the west, and Damak municipality’s ward no 3 and 5 in the south (Second Revised Community Forestry Constiution, 2064). The climate is tropical and subtropical type and the average annual minimum and maximum temperature is 10° C and 35 °C respectively while the average annual precipitation is 1900mm (Damak Municipality Brocheure, 2009).

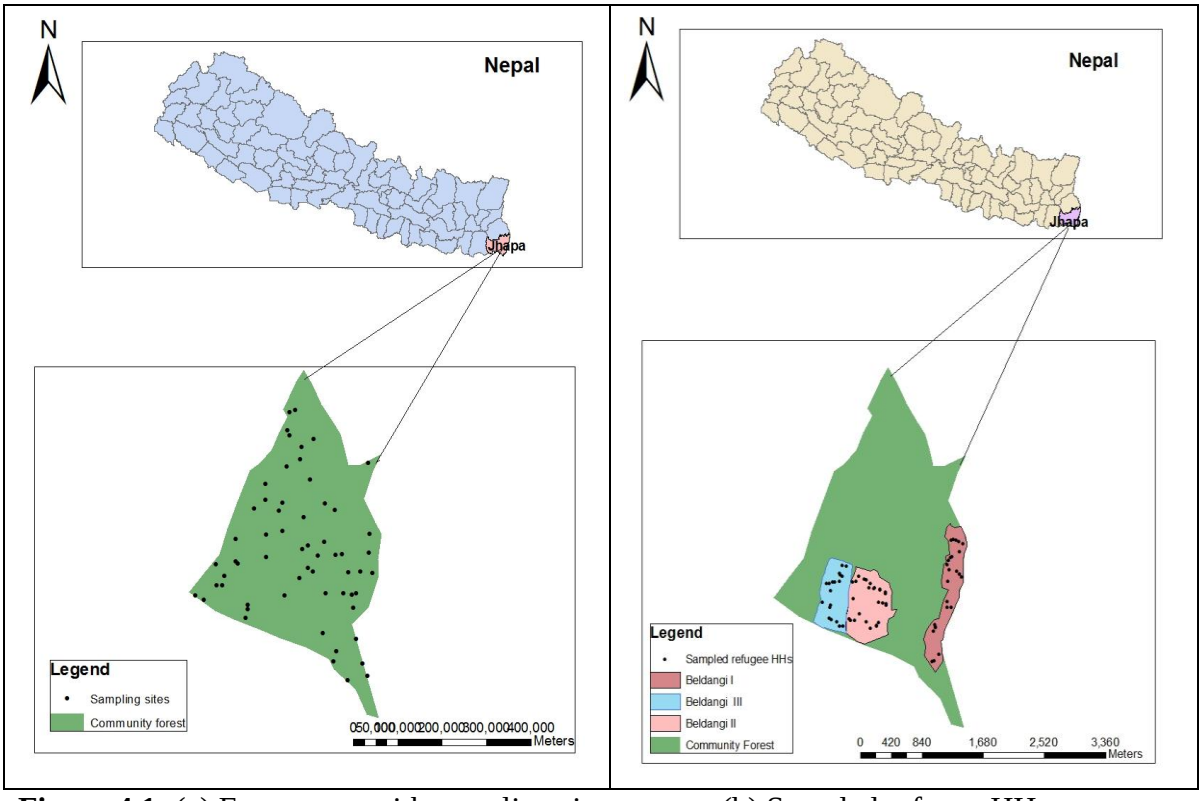


Figure 4.1: (a) Forest map with sampling sites (b) Sampled refugee HHs

4.2 Socio-economic Characteristics of the Study Area

The municipality comprises of 19 wards, of which, ward numbers 1, 2, 3, 4, 5, 6 and 7 were selected for the study as the CFUGs of the HDCF are from these wards. The majority of the ethnic group is Brahmin/Chhetri. The average family size of the area is 6.67/HH and literacy rate is 82.69%. Brahmin/Chhetri are more literate than other groups and also have more access to higher education. Household economy in the study area was mostly based on agriculture system.

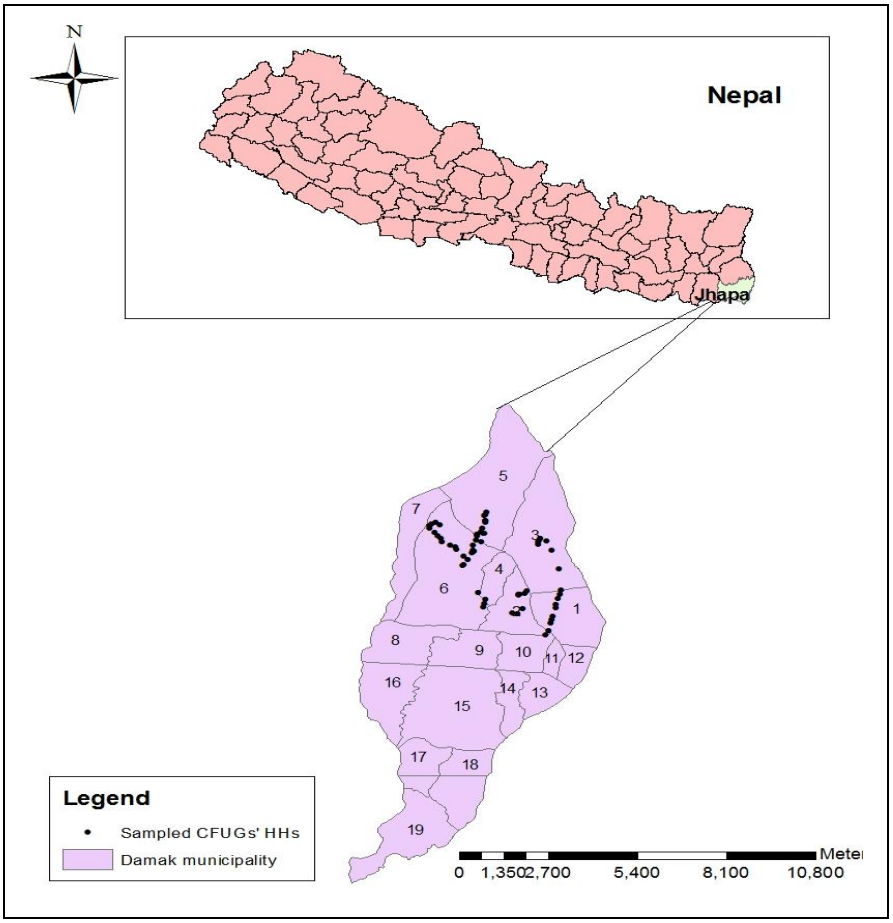


Figure 4.2: Sampled CFUGs' HHs

4.3 Background of the CF

Total area of the community forest is 627.5 ha. The forest area is comprised of grassland, Bhutanese Refugee Camps, Armed Police Force Camp, CF building, nursery and range post as given in the table 4.1.

Table 4.1: Area occupied by several factors within the forest area

Categories	Area (ha)
Open land	50
Bhutanese Refugee Camps	117.5
Armed Police Force Camp	7.5
CF building, nursery and range post	3
Vegetation	449.5
Total forest area	627.5

Source: Second Revised Community Forestry Operational Plan (HDCF), 2064

Of the total area, about 50 ha is open land, Bhutanese refugee camp is in 117.5 ha, Armed Police Force Camp is in 7.5 ha and about 3 ha comprises of CF building, nursery and range post. Historically, the forest was said to be dense natural Sal forest and around 1959 A.D., the forest was fully encroached and most part was destroyed by other migrated settlements (migration from hills to terai). The forest was totally occupied by those settlements around 1974 A.D. The settlement inside the forest was completely removed by then Nepal Government and began plantation of species such as *Dalbergia sisoo, Tectona grandis* and *Acacia catechu* from 1974 to 1978 A.D. Due to the various political changes of 1980 and 1990 of the country, forest again faced several threats such as encroachment, smuggling of NTFPs, timber and other forest products. In addition to this, the government allowed establishment of three Bhutanese refugee camps Beldangi I, Beldangi II and Beldangi II extension of that area in 1992 A.D., besides the local peoples' objection, in 117.5 ha of the forest and from that period, the CF is subjected to decrease in regeneration, growing stock, forest yield, etc. The other problems such as soil erosion, landslides, river cutting, deforestation, and other disasters began to generate with the refugee flow. Considering all these problems, the forest was handed over to the community from the District Forest Office on 22nd March, 1998. The total household members of the community forest are 3150 with population of 18,900. The community forest is divided into five blocks to facilitate the forest management and resources utilization (Second Revised Community Forestry Operational Plan (HDCF), 2064).

CHAPTER-5

5. RESULTS

5.1 Socio-economic Characteristics of Bhutanese Refugees

5.1.1 General Characteristics of the Respondents

The general characteristics of the respondents based on sex, caste/ethnic group, age group, occupation, education and family structure is given in annex III, table 8. More than 50% of the respondents were female. Based on caste or ethnic group, most of the respondents were Rai/Subba/Magar/Tamang/Gurung/Sherpa (52.78%), followed by Brahmin/Chettri (41.67%) and Dalits and Sanyasi (2.78%) each. Most of the respondents were from age group 15-59 yrs. Most of the respondents (43.06%) were jobless and remaining had adopted occupations such as wage labouring (16.67%), pig farming (11.11%), weaving threads (9.72%), weaving hats (5.56%) and respondents engaged in service, business (shop) were very less. Majority of the respondents had lower class education (38.89%), followed by general literate (33.33%), illiterate (22.22%) and respondents with higher class education were only 5.56%. More than 50% of them had joint family (Annex III, table 8).

5.1.2 Households' Income Source

Most of the households' source of income was wage labour (29.17%) in the Beldangi itself but most were towards Damak Bazaar (Table 5.1). 12.50% had no income; they were solely depended on the aids provided to them. Households engaged in pig farming and weaving threads were equal in percentage (11% each). Occupations like weaving hats, service, and shop were very less in number. There were five households, which were totally depended upon the money sent by their family members from abroad (third country resettlement).

Table 5.1: Refugee households' sources of income

Income source	Frequency	Percent
Weaving hats	5	6.94
No occupation	9	12.50
Wage labour	21	29.17
Pig farming	8	11.11
Weaving threads	8	11.11
Service (in Beldangi itself and Damak Bazaar)	6	8.33
Wage labour+ Weaving threads	3	4.17
Shop	3	4.17
Wage labour+ Pig farming	3	4.17
Remittance	5	6.94
Social worker inside the camp	1	1.39
Total	**72**	**100**

5.1.3 Refugees' Third Country Resettlement Process

Third country resettlement has begun since November 2007. During the study period, of the total sampled households, 61.1% of the households had already started processing for the resettlement. From the 72 sampled HHs, 75 refugees had already been migrated to other countries.

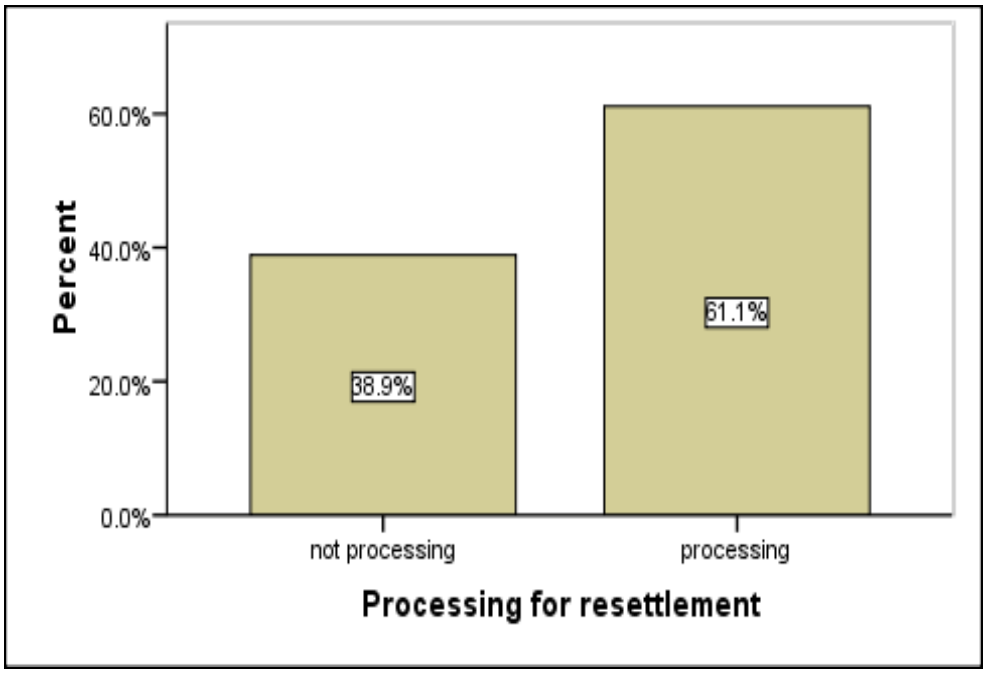


Figure 5.1: Refugee populations processing for resettlement to third country

5.1.4 Fuel Resources

Lutheran World Federation (LWF) has been looking after the various sectors of refugees' livelihood through different types of aids; health, sanitation, fuel resources, etc. It provides briquettes and kerosene on monthly basis for each household. LWF provides 30 kg briquettes per month for household having family size five and more and 25 kg to households having family size less than five. As the fuel resources provided is not enough for them, they had other alternatives such as coal, fuel wood, solar cooker and bhusechulo. Majority of households (70.8%) was using firewood as an alternative source. Along with other alternatives, fuel wood was also used (Table 5.2).

Table 5.2: Alternative sources of fuel wood of the refugees

Alternative source	No. of HHs	Percent
Fuelwood	51	70.83
Coal	1	1.39
Fuelwood+coal	4	5.56
Solar cooker	1	1.39
Fuelwood+solar cooker	11	15.28
Fuelwood+Bhusechulo	2	2.78
Briquettes buying from others inside the camp itself	2	2.78
Total	**72**	**100**

5.1.5 Forest Utilization by the Refugees

Observations and results obtained from questionnaire exposed the refugees' activities of extracting forest resources for their daily use, although the refugees were provided with daily necessities such as vegetables, rice, and tea for food, and briquettes for cooking and kerosene as lighting fuel.

The refugees were hesitant to reveal their forest activities and the forest resources they utilized. They had fuel wood as the best alternative for the briquettes. Though most of them had reports of buying fuel wood from the nearby village (villages across the Ratuwa river) and from market, not much extraction from the forest, the observation of most of the huts and forest area during the survey revealed their activities such as slice cutting of trees stems, uprooting of regenerating species and small herb saplings, collecting twigs and broken branches for fuelwood. As a whole,

they were found engaging in activities such as collection of fuelwood, small timber-quality wood for furniture and tools.

5.1.5.1 Fodder Need and Sources of the Refugees

The refugees were not allowed to rear livestock inside the camp. Some were engaged in pig farming by taking land on lease in Beldangi Bazaar. Only 13.89% of the households reared livestock and all they had goats. The total fodder need of the livestock-holding household of the refugee camp was 43.2 t/yr and average household need was 4.32 t/yr. Of the households, that need fodder, 77.8% of them had their fodder access from community forest. The average extraction of fodder per household from the forest was 4.43 t/yr higher than their total average need.

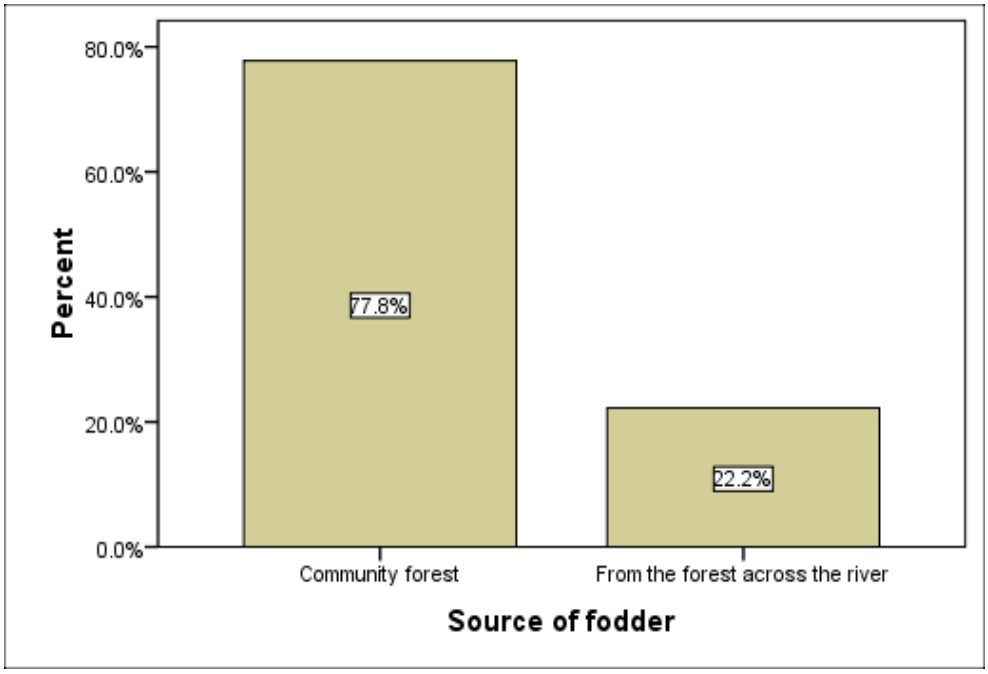


Figure 5.2: Fodder access of the Bhutanese refugees

5.1.5.2 Fuelwood Need and Sources of the Refugees

Almost all of the refugee households (94.44 %) had no alternatives except firewood, whether they were from community forest or nearby village or market. The total firewood need of the camp people was 76.6 t/yr and average household need was 1.13 t/yr. The total fuel wood extracted from the community forest was 18.42 t/yr and average household extraction from the community forest was 1.03 t/yr.

The fuelwood sources for the Bhutanese refugees were buying from nearby village, market, and collecting from community forest. Majority of the households (49.3%) used to buy fuelwood brought from the nearby villages across the Ratuwa river; Bukuwa, Peltimari and Chula Chuli. Households buying from market and collecting from the community forest were equal in percentage (21.7%).

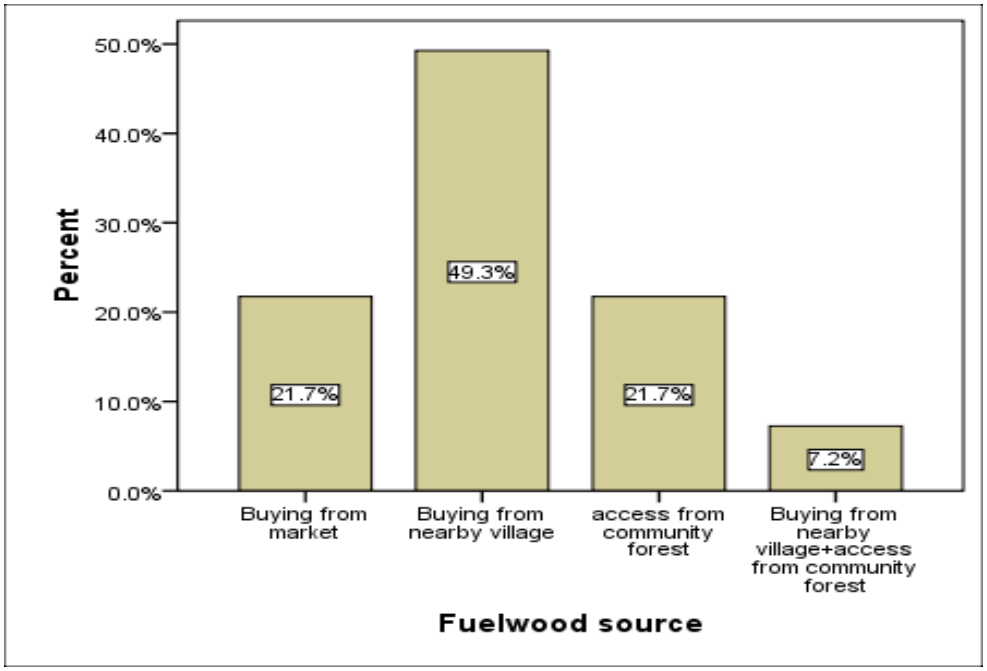


Figure 5.3: Fuelwood sources of the Bhutanese refugees

5.1.6 Bhutanese Refugees' Perception on Benefits from Forest

Majority of the refugee households (73.6%) accepted that they did not have any kind of benefit from the community forest. 11.1% of the households agreed that they get firewood from the forest and 5.6% believed that forest is their fodder source for their livestock. Very least (2.8%) responded that there was environmental benefit of having the forest.

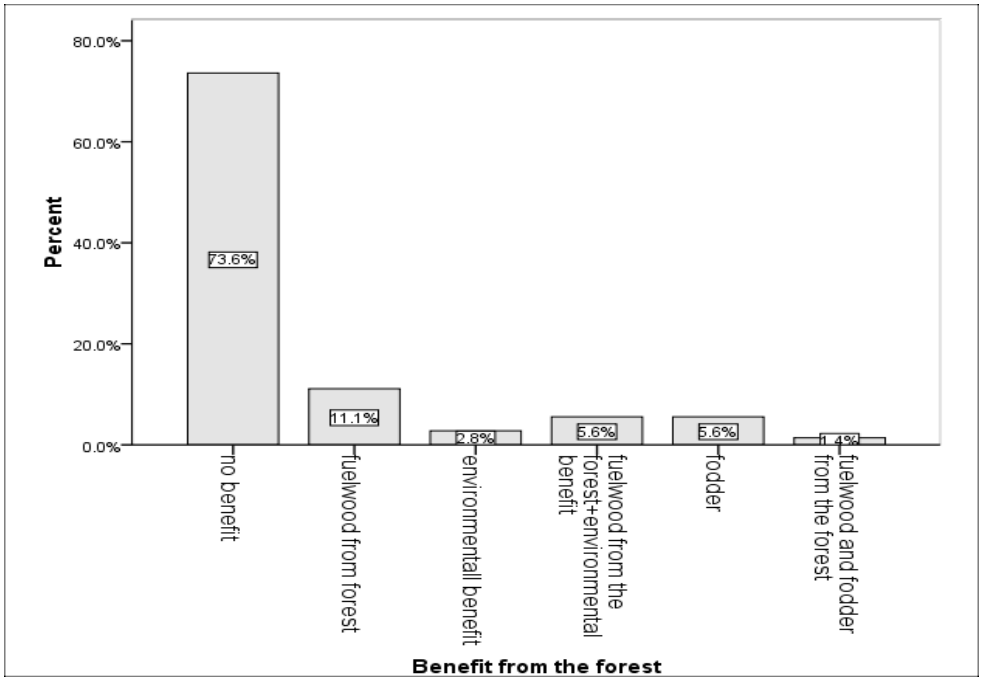


Figure 5.4: Bhutanese refugees' perception on their benefits from forest

5.2 Socio-economic Characteristics of the CFUGs

5.2.1 General Characteristics of the Respondents

The general characteristics of the respondents based on sex, caste/ethnic group, occupation, education and family structure is presented in the annex III, table 9. More than 50% of the respondents were male. Based on caste or ethnic group, most of the respondents were Brahmin/Chettri (59.15%) followed by Rai/Limbu/Subba/Magar/Newar (18.31%), Indigenous group (Dhimal/Rajbansi) (12.68%) and least in context of Dalits. Most of the respondents were from age group 15-59 yrs. Major occupation of the respondents was agriculture followed by unskilled wage labour, service, some were only house workers and some did nothing. Majority of the respondents were general literate (39.44%) followed by illiterate (23.94%) and 19.72% of them had studied upto S.L.C. More than half had joint family and there were more respondents having small farm and big farm (Annex III, table 9).

5.2.2 Age Structure

The total population of sample households of the CFUGs was 474; out of this 231 were male and 243 female with 7.5 average family sizes. Of the total population, majorities (69.62 %) were from working group and others were from dependent population group (Table 5.3). The dependent population both old and young age were distributed in 12.66 % and 17.72% of sampled household respectively.

Table 5.3: Distribution of male and female in the CFUGs' HHs

Age	Male	Female	Total	%
<15yrs	42	42	84	17.72
15-59yrs	159	171	330	69.62
60 yrs and above	30	30	60	12.66
Total	231	243	474	100

5.2.3 Occupation

The occupations adopted by the sampled CFUGs households were agriculture, unskilled wage labour, service, business, foreign job and skilled wage labour as shown in the table 5.4. 73.24% of the sampled households were engaged in agriculture, 29.58% in business, 26.76% in service, 25.35% in foreign job, 15.49% in unskilled wage labour and 12.68% in skilled wage labour.

Table 5.4: Distribution of CFUGs' population by occupation

Occupation	Population	HH	% of HH
Agriculture	102	52	73.24
Unskilled wage labour	16	11	15.49
Service	21	19	26.76
Business	22	21	29.58
Foreign job/remittance	25	18	25.35
Skilled wage labour	9	9	12.68

5.2.4 Education

Educational status the sampled CFUGs' households is shown in the table 5.5. Illiterate and general literate populations were represented in 16.93% and 22.44% respectively of the sampled households. Population with education under SLC and up to SLC was represented from 15.75% and 18.50% of the households respectively. The high school and college/university level population was represented in 11.02% and 15.35%.

Table 5.5: Distribution of CFUGs' household population by educational status

Education	Population	% Population	HH Number	% of HH
Illiterate	77	17.26	43	60.56
General literate	115	25.78	57	80.28
Under SLC	74	16.59	40	56.34
Upto SLC	72	16.14	47	66.20
Higher Class	46	10.31	28	39.44
College/University	62	13.90	39	54.93

Literacy rate was very high in Brahmin/Chettri group than other groups (Table 5.6). Access to higher education was also high in this group.

Table 5.6: Educational status of the CFUGs based on ethnicity

	Educational status						
Ethnicity	**Illiterate**	**Literate**	**Under SLC**	**Upto SLC**	**Higher class**	**College/ University**	**Total**
Brahmin/Chettri	40	64	42	46	39	49	280
Rai/Magar/ Limbu/Subba/Newar	12	18	10	15	5	9	69
Dalit	8	12	13	4	1	3	41
Dhimal/ Rajbansi(Indigenous)	17	21	9	7	1	-	55
Total	77	115	74	72	46	61	445

5.2.5 Farm Size, Crop Production, Livestock Holding and Income as Per Land Holding

The farm size of the of the CFUGs household varied from landless to 3.604 ha with average household farm size of 0.68 ha. Livestock unit, biogas installations and net income tend to increase with bigger farm size. But this trend didn't follow for fuel wood consumption as shown in the table 5.7. Average fuelwood consumption is high for landless households (1.58 t/yr), followed by medium farm (0.87 t/yr), small farm (0.79 t/yr), very big farm (0.6 t/yr) and big farm (0.40 t/yr). Households with very big farm size had high average fodder consumption.

Table 5.7: Household characteristics of the CFUGs based on land holding (ha)

Variables	Landless(9)*	Small farm(28)	Medium farm(13)	Big farm(19)	Very big farm(2)	Average
Average family size	7	6	6	7.5	11	6.67
Actual land owned (ha)	0	0.11	0.58	1.63	3.37	0.68
Livestock unit (LSU)	0.85	1.23	1.44	2.71	4.16	1.7
Fuelwood consumption(t/yr)	1.58	0.79	0.87	0.40	0.60	0.94
Fodder consumption(t/yr)	10.22	5.83	7.93	10.71	16.5	8.38
Biogas installation(%)	0	7.14	23.08	63.16	100	-
Net income(US$)	-274.72	-235.13	-38.46	418.42	493.75	-8.71

*Number in parenthesis indicates sampled HHs per land class category.

5.2.6 Crop Production Status as Per Landholding

As per crop production, 100 percent of the landless had food deficit followed by small farm and medium farm sized households. And 100 percent of the very big farm sized households had surplus food production followed by big farm and medium farm sized housheols (Table 5.8).

Table 5.8: Crop production status of the CFUGs' HHs per landholding

Land class	Deficit (%)	Balanced (%)	Surplus (%)
Landless	100	0	0
Small farm	71.43	28.57	0
Medium farm	15.38	53.85	30.77
Big farm	0	15.79	84.21
Very big farm	0	0	100

5.2.7 Household Livestock Feeding of the CFUGs

Of the sampled households, 87.32% rear livestock; major cow, buffalo and goat. Of them, 75.4% had stall-feeding, 16% leave their livestock for grazing and 23% are involved in both activities. The households were not allowed to graze their livestock inside the forest. Livestock were grazed around their surrounding area (village, own land, etc.).

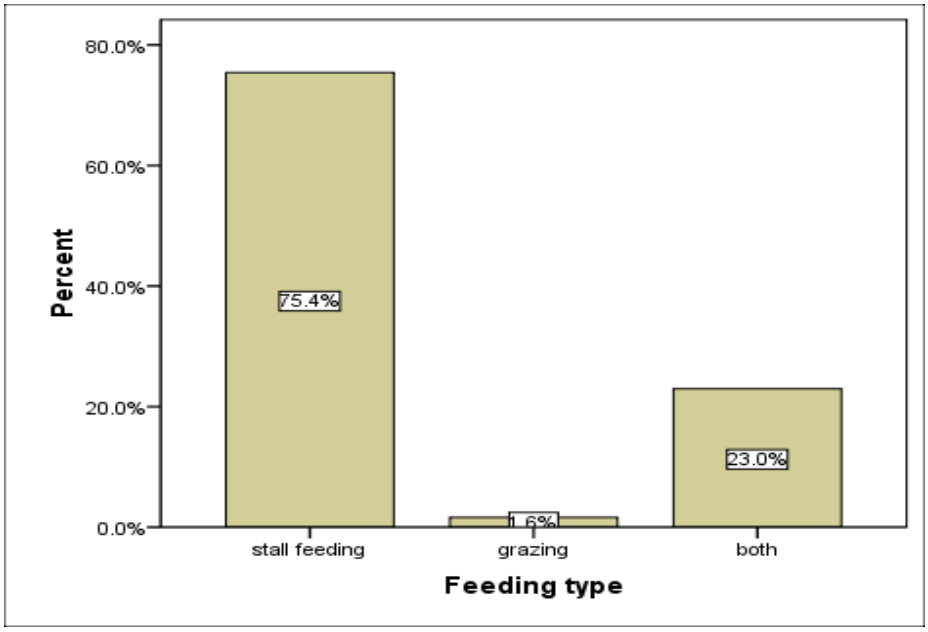


Figure 5.5: Livestock feeding of CFUGs' households

5.2.8 Household Energy Use

Kerosene, electricity, liquefied petroleum gas (LPG), solar-cooker, biogas, fuel wood and bhusechulo were used as energy sources in the sampled households (Table 5.9). All the households had access to electricity, with mean use of 305.56 unit per year, but 12 households (16.9%) were using illegally, i.e., by hooking directly from main line without permit.. Those households were mostly landless (58.33%) and small farm size holders (41.67%). 60 households (84.51%) were using fuel wood with mean use of 0.94 t/yr, 52 households (73.24%) were using kerosene with mean use of 20.12 litre per year, 25 households (35.21%) were using LPG with mean cylinder use 6.32 per year, 26.76% of the households were using bio-gas and 4.23% were using solar cooker.

Kerosene was used only for lighting, LPG for cooking purposes only while electricity was used for several purposes; lighting, cooking and for running electronic devices.

Table 5.9: CFUGs' household energy consumption

Energy used	Number of HH	%
Kerosene	51	71.83
Electricity	71	100
LPG	25	35.21
Solar cooker	3	4.23
Bio-gas	19	26.76
Fuel wood	60	84.51
Bhusechulo	4	5.63

The household distribution of energy use types varied with the household farm size (Table 5.10). LPG users were more from medium farm (53.85%), small farm (32.14%) and big farm holders (42.11%). Bio-gas users were maximum from big farm (63.16%) and very big farm holders (100%) from their group. Landless had no ability to afford biogas installation and small farm holders having biogas plant were least (7.14%).

Table 5.10: CFUGs' household energy use based on farm size

Energy source	Landless	Small farm	Medium farm	Big farm	Very big farm
Kerosene	6(66.67)*	22(78.57)	9(69.23)	12(63.16)	2(100)
Electricity	9(100)	28(100)	13(100)	19(100)	2(100)
LPG	1(11.11)	9(32.14)	7(53.85)	8(42.11)	0
Solar cooker	3(33.33)	0	0	0	0
Bio-gas	0	2(7.14)	3(23.08)	12(63.16)	2(100)
Bhusechulo	1(11.11)	2(7.14)	1(7.69)	0	0
Fuelwood	9(100)	25(89.29)	12(92.31)	12(63.16)	2(100)

*Number in parenthesis denotes percentage within respective land class

5.2.9 Resources (Fodder and Fuelwood) Need and Access of the CFUGs

Total annual fodder and fuel wood need of the sampled households were 594.7 tons and 56.39 tons respectively with average annual need per household 9.91 tons and 0.94 tons respectively. Fodder needs were fulfilled mostly from their own land (71.30%) and surrounding area (19.60%) and less than 10% from community forest. Fuel wood need were fulfilled by buying from market or elsewhere (79.45%) and 15.43% from community forest (Table 5.11). The households were not allowed to collect fire wood from the forest, there was no any time separated for collection, they had to buy fire wood from the forest, about once or twice in a year. The community forest provides either one or two quintals of firewood per year on occasions like marriage ceremony, funeral and other rituals.

Table 5.11: Fodder and fuelwood need and access of the CFUGs

Sources	Fodder(t/yr)	Fodder %	Fuel wood(t/yr)	Fuel wood %
Community forest	54.1	9.10	8.7	15.43
Own land	424.05	71.30	2.89	5.13
Surrounding area	116.55	19.60	-	-
Buying from market or elsewhere	-	-	44.80	79.45
Total	**594.7**	**100**	**56.39**	**100**

Landless were more dependent on community forest followed by medium farm households but with reference to the household need, except landless households, all others fulfill their fodder need from their own land (Table 5.12). The landless fulfill their fodder demand from their surrounding area. The landless households who collect the fodder from their own land indicate ailani land, others' land, and those lands were not of their own. Very big farm holders do not depend on community forest for the fodder, they solely collect from their own land. Average annual fodder need is found to be highest for very big farm holders (16.5 t/yr), followed by big farm (10.71 t/yr), landless (10.22 t/yr), medium farm (7.93 t/yr) and small farm (5.83 t/yr) holders.

Table 5.12: CFUGs' annual fodder need based on farm size

Landholding	Fodder need(t/yr)	CF(t/yr)	Own land(t/yr)	Surrounding area(t/yr)
Landless	10.22	1.2(11.74)*	2.22(21.72)	6.8(66.54)
Small farm	5.83	0.68(11.76)	3.17(54.37)	1.98(33.96)
Medium farm	7.93	1.05(13.24)	6.88(86.76)	0(0)
Big farm	10.71	0.56(5.23)	10.15(94.77)	0(0)
Very big farm	16.5	0(0)	16.5(100)	0(0)

*Number in parenthesis represents percentage of fodder fulfilled from the CF

Landless were more users of fuel wood from the community forest but with respect to each need, all of them fulfill their most need from market (Table 5.13). Very big farm holders solely fulfill from the market only. Average annual fuel wood need is high in case of landless households (1.58 t/yr) followed by medium farm holders (0.87 t/yr), small farm (0.79 t/yr), big farm (0.40 t/yr) and at last very big farm holders (0.60 t/yr).

Table 5.13: CFUGs' annual fuelwood need based on farm size

Landholding	Fuel wood need(t/yr)	CF(t/yr)	Own land(t/yr)	Buying from market or elsewhere(t/yr)
Landless	1.58	0.17(10.76)*	0(0)	1.41(89.24)
Small farm	0.79	0.10(12.66)	0.012(1.52)	0.68(86.08)
Medium farm	0.87	0.16(18.39)	0(0)	0.71(81.61)
Big farm	0.40	0.11(27.5)	0.13(32.5)	0.18(45)
Very big farm	0.60	0(0)	0(0)	0.6(100)

*Number in parenthesis indicates percentage.

5.2.10 Community Forest and CFUGs

5.2.10.1 Resources Used by CFUGs From Community Forest

Resources available from the forest were fuel wood, fodder and timber. Of the sampled households, 38% of were fuel wood users from the forest, 26.8% use no any forest resource, 15.5% use both fuel wood and fodder, 11.3% use fodder and timber using households were very less (2.8%).

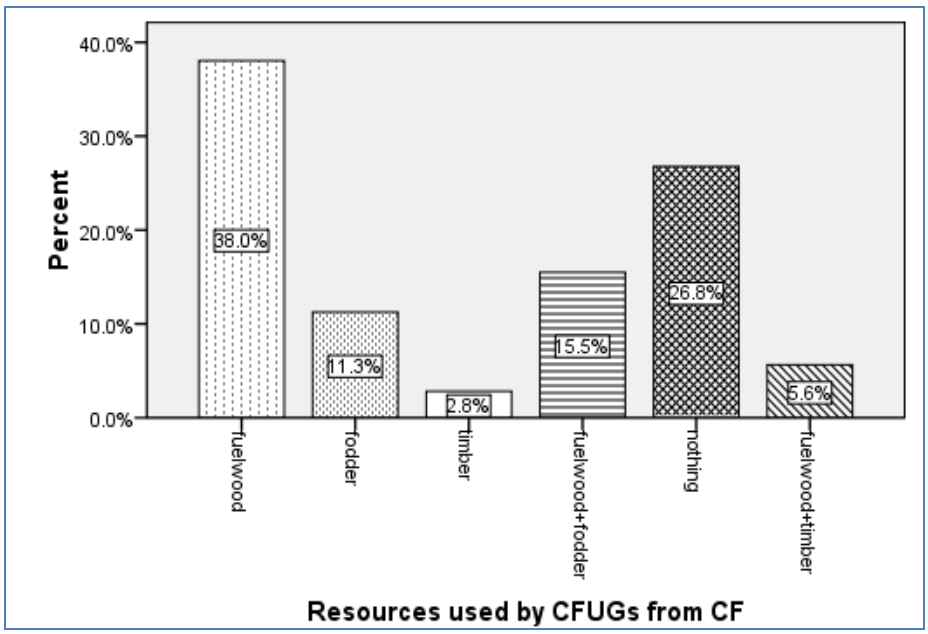


Figure 5.6: Resources used by CFUGs from CF

5.2.10.2 Peoples' Perception on Reduction of Problems of Resources and Forest Condition Improvement After the CF Handover

Almost all of the households believed that their problems regarding collection of forest resources had not been reduced after the CF handover. They agreed that they

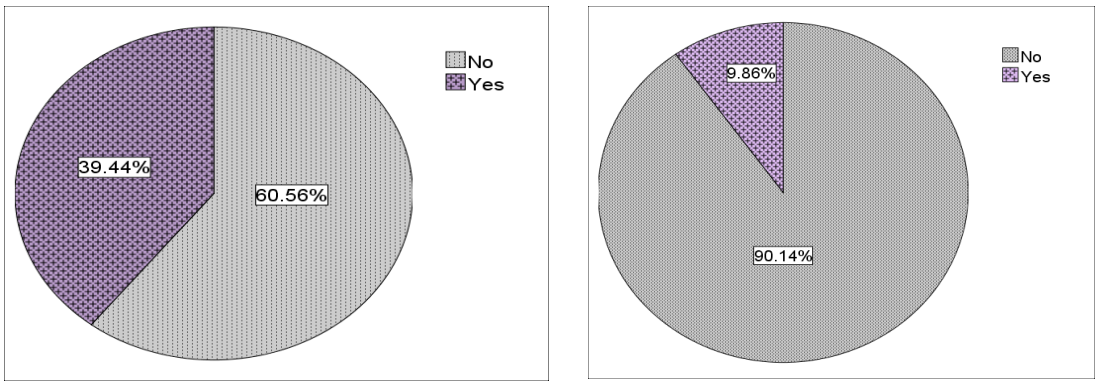
were deprived of utilizing the forest resources they needed. About forest condition, 67.61% of them accepted that, the condition of forest is depleting since after the CF handover (Table 5.14). They blamed board committee for this reason.

Table 5.14: Peoples' perception regarding forest condition and reduction of their problems

Reduction of problem of resources after CF handover	Number	Percent	Forest condition after CF handover	Number	Percent
Agree	10	14.08	Improved	16	22.54
Disagree	61	85.92	About same	7	9.86
			Depleting	48	67.61

5.2.10.3 People's Knowledge Regarding Block Division, Improved Forest Management Practices (IFMPs), CF Constitution, and Operational Plan

Most of the households had no idea of block division of the forest. 60.6% of the households did not know whether there is block division of their forest or not. Those who knew about the block division, they answered that there was prevalence of IFMPs in their forest and almost none of the sampled households (90.1%) had any information/knowledge about their CF constitution and operational plan (Figure 5.7).



(a) (b)

Figure 5.7: Peoples' knowledge regarding (a) block division and (b) CF constitution and operational plan

5.2.10.4 Fund Generating Provisions in the Forest

While gathering information regarding fund generation of the community forest, 80.3% of the households accepted that, the fund is mostly created from the fee collected from membership and punishment charge from illegal activity (tree felling, smuggling, etc.). The forest did not receive much support from the prevalent

organizations such as UNHCR, Caritas (working for Bhutanese refugees). Very less (1.4%) households believed that these organizations donate for the fund.

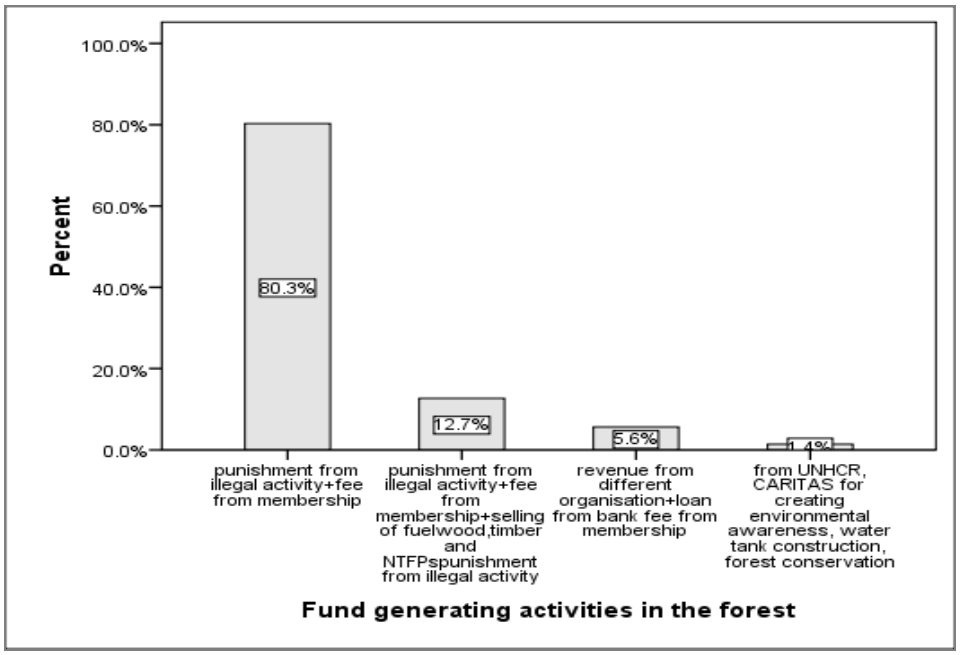


Figure 5.8: Fund generating provisions in the CF

5.2.10.5 Expenditure Sectors of the CF Fund

Nearly 30% of the households believed that the forest fund was mostly spent on support for road construction, biogas installation and school support. Other sectors for fund expenditure were forest development, community building, and drinking water supply, for the forest watcher and least accepted that the fund did not support for disadvantaged peoples' IGAs (Table 5.15). 18.31% of the households responded that the fund was spent nowhere in the past years.

Table 5.15: CF fund expenditure category

Fund expenditure sector	Frequency	Percent (%)
Spend nowhere	13	18.31
Forest development+school support	6	8.45
Forest guard+school support+temple support+community building	11	15.49
Road construction+forest development+Biogas installation support+school support	21	29.58
Biogas installation support+drinking water supply+school support+community building+temple support	10	14.08
IGAs+forest development and school support+forest watcher+temple support+community building	10	14.08

Equal percentage of the households (33.80%) insisted that the FUG's fund should be spent for fulfilling community needs and it should give top priority to the disadvantaged groups' income generating activities (IGAs) or low interest loan to them from the FUG fund as given in the table 5.16. They suggested that the extra fund could also be distributed to them as loan based on their needs.

Table 5.16: Peoples' suggestion for fund expenditure

Suggestion for fund spending	Frequency	Percent
Distribute to the members as loan as per their need+ give priority to the DAGs' IGAs	24	33.80
Spend on forest development activities+ give priority to the DAGs' IGAs	23	32.39
Spend on community needs+ give priority to the DAGs' IGAs	24	33.80
Total	71	100.00

5.2.10.6 Income Generating Activities and Trainings Organized for the User Members

Almost all the households, 95.77% and 97.18% responded that there were no any IGAs and trainings organized for FUG, respectively (Table 5.17). Some years back, there were some sort of IGAs for the poor and disadvantaged people but during the study period, there were no any kinds of activities/trainings for the user members.

Table 5.17: IGAs and training for FUGs

Activities	Yes	No
Income Generating Activities	3(4.23)	68(95.77)
Training organized for FUG	2(2.82)	69(97.18)

5.2.10.7 Suggestions for Decision Making for the Committee

More than 50% of the households suggested that in the decision making process in the meetings conducted (Table 5.18).

Table 5.18: Peoples' suggestions for decision making for committee

Suggestions for decision making in CFUG	**Frequency**	**Percent**
Distribution of forest products+use of FUG fund in different community development activities	44	61.97
Distribution of forest products+ use of FUG fund in different community development activities+forest management activities	26	36.62
Any change in operational plan forest management activities	1	1.41

5.2.10.8 Peoples' Perception Regarding Forest Resources Used by Bhutanese Refugees

Of the sampled households, 97.2% of them accepted the fact that the Bhutanese refugees were continuously using the forest resources though they were totally prohibited to do that. 76.1% of the households blamed that the forest condition was in a depleting phase because of the activities of the refugees (deforestation, conversion to farmland and smuggling of timber) leading to decrease in availability of forest resources for CFUGs.

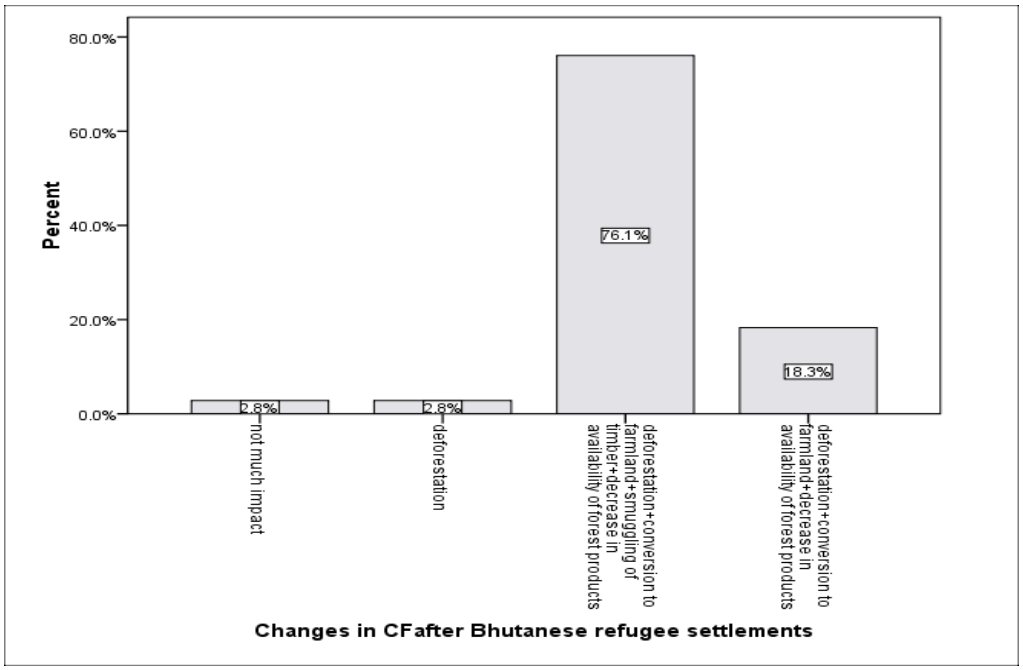


Figure 5.9: CFUGs' perception regarding forest resources used by Bhutanese refugees

5.3 Vegetation Analysis

5.3.1 Tree Species

Out of 45 sample plots, 41 plots had tree species. There were 22 tree species with total density of 183.33 no/ha, of which *Shorea robusta* Gaertn. and *Dalbergia sisoo* O. Roxb. share the same value with highest density of 54.44no/ha as shown in the table 5.19. Next was of *Tectona grandis* L.f with 28.89 no/ha followed by *Myrsine semiserrata* Wall with 10.56 no/ha. The highest frequency and basal area was observed in *D. sisoo* (64.44) followed by *S. robusta* (24.44). The Importance Value

Index (IVI) was also high for *D. sisoo* (100.81) followed by *S. robusta* (65.31) and *T. grandis* (41.22) (Table 5.19).

Table 5.19: Importance Value Index of tree species

Species	Number	D/ha	RD(%)	F(%)	RF(%)	BA(m2/ha)	RBA	IVI
Dalbergia sisoo O. Roxb.	98	54.44	29.70	64.44	33.72	7.26	37.39	100.81
Shorea robusta Garrtn.	98	54.44	29.70	24.44	12.79	4.43	22.83	65.31
Tectona grandis L. f	52	28.89	15.76	13.33	6.98	3.59	18.49	41.22
Adina cordifolia (Wild. Ex Roxb.) Benth & Hook. f.ex Brandis.	6	3.33	1.82	11.11	5.81	1.34	6.91	14.55
Myrsine semiserrata Wall.	19	10.56	5.76	11.11	5.81	0.52	2.70	14.28
Ehretia acuminata R.Br.	10	5.56	3.03	13.33	6.98	0.16	0.81	10.82
Eucalyptus citriodora Hook.	10	5.56	3.03	8.89	4.65	0.17	0.88	8.56
Cassia fistula L.	10	5.56	3.03	6.67	3.49	0.15	0.77	7.29
Dalbergia latifolia Roxb.	6	3.33	1.82	4.44	2.33	0.11	0.58	4.72
Albizia julibrissin Durazz.	4	2.22	1.21	4.44	2.33	0.22	1.16	4.70
Trifala*	1	0.56	0.30	2.22	1.16	0.42	2.19	3.65
Syzygium cumini (L.) Skeels	1	0.56	0.30	2.22	1.16	0.42	2.16	3.62
Cucumis sativus L.	3	1.67	0.91	4.44	2.33	0.03	0.16	3.39
Garuga pinnata Roxb.	1	0.56	0.30	2.22	1.16	0.30	1.56	3.02
Terminalia myriocarpa Heurck & Muell-Agr.	4	2.22	1.21	2.22	1.16	0.04	0.22	2.59
Bombax ceiba L.	1	0.56	0.30	2.22	1.16	0.09	0.44	1.91
Anthocephalus chinensis (Lam.) A. Rich. ex Walp.	1	0.56	0.30	2.22	1.16	0.06	0.32	1.78
Zanthoxylum oxyphyllum Edgew.	1	0.56	0.30	2.22	1.16	0.02	0.10	1.57
Albizia spp.	1	0.56	0.30	2.22	1.16	0.02	0.10	1.56
Ficus lacor Buch-Ham.	1	0.56	0.30	2.22	1.16	0.02	0.09	1.56
Oroxylum indicum (L.) Kurz	1	0.56	0.30	2.22	1.16	0.02	0.09	1.56
Albizia spp.	1	0.56	0.30	2.22	1.16	0.01	0.07	1.54
Total	**330**	**183.33**	**100**	**191.11**	**100**	**19.41**	**100**	**300**

* local name, D=Density, RD=Relative density, F=Frequency, RF=Relative frequency, BA=Basal area, RBA=Relative Basal area, IVI=Importance Value Index

5.3.2 Shrub Species

Out of 90 shrub plots, 81 plots only had shrub species. There were 54 shrub species with total density of 1644.44 no/ha, of which *Clerodendrum viscosum* Vent. had the highest density of 8391.11 no/ha, followed by Auliya (2031.11 no/ha), *S. robusta* (1964.44 no/ha) and *Swertia nervosa* (G.Don) C.B. Clarke (1333.33 no/ha), *Ehretia acuminata* R.Br. (453.33 no/ha), *D. sisoo* (342.22 no/ha), *Lantana camara* L. (297.78 no/ha) *and Syzygium cumini* (L.) Skeels (226.67 no/ha). Similarly, the frequency of occurrence was also high for *C. viscosum* (65.56%) followed by *S. nervosa* (61.11%),

E. acuminata (32.22%), *L. camara* (30%), *S. robusta* (27.78%) *and* Auliya (26.67%). The IVI was also high for *C. viscosum* (99.81) followed by *S. nervosa* (46.03) (Annex III, table 1). Some of the major shrub species with descending order of IVI are given in the table 5.20.

Table 5.20: IVI of some of the major shrub species

Species	Number	D/ha	RD(%)	F(%)	RF(%)	C(%)	RC(%)	IVI
Clerodendrum viscosum Vent.	1888	8391.11	50.41	65.56	15.25	2719.00	34.15	99.81
Swertia nervosa (G.Don) C.B. Clarke	300	1333.33	8.01	61.11	14.21	1895.00	23.80	46.03
Auliya*	457	2031.11	12.20	26.67	6.20	511.00	6.42	24.82
Shorea robusta Garrtn.	442	1964.44	11.80	27.78	6.46	345.00	4.33	22.60
Lantana camara L.	67	297.78	1.79	30.00	6.98	556.00	6.98	15.75
Dalbergia sisoo O. Roxb.	77	342.22	2.06	20.00	4.65	646.50	8.12	14.83
Ehretia acuminata R.Br.	102	453.33	2.72	32.22	7.49	290.00	3.64	13.86
Syzygium cumini (L.) Skeels	51	226.67	1.36	12.22	2.84	55.05	0.69	4.90
Myrsine semiserrata Wall.	41	182.22	1.09	11.11	2.58	75.00	0.94	4.62
Cassia fistula L.	26	115.56	0.69	13.33	3.10	49.00	0.62	4.41
Osbeckia stellata Buch.-Ham. ex D. Don	18	80.00	0.48	10.00	2.33	54.50	0.68	3.49
Cucumis sativus L.	19	84.44	0.51	10.00	2.33	22.50	0.28	3.12

*local name

5.3.3 Herb Species

Out of 90 plots, 84 plots had herb species. There were 56 herb species with a total density of 602666.67 no/ha. Highest density was of *Cynodon dactylon* L. with 75666.67 no/ha followed by Chepti ghas (65333.33no/ha), *Imperata cylindrical* (L.) P. Beav. (65222.22no/ha), *Ageratum conyzoides* L. (59222.22no/ha) and so on. The highest frequency of occurrence was of *Digitaria* spp. (46.67%) followed by *Tetrastigma serrulatum* (Roxb.) Planch. (44.44%) (Annex III, table 2).

5.3.4 Diversity Index

Diversity index was calculated for trees, shrubs and herbs plot (Table 5.19). Evenness index and Shannon diversity index were high for herbs (0.74 and 2.98 respectively), and index of dominance and species richness were high for shrubs (0.29 and 6.44 respectively).

Table 5.21: Diversity indices of tree, shrub and herb

Parameters	Tree	Shrub	Herb
Evenness Index (e)	0.64	0.48	0.74
Index of Dominance (C)	0.21	0.29	0.07
Shannon Diversity Index (H)	1.97	1.9	2.98
Species richness (R)	3.62	6.44	6.4

5.3.5 DBH Class of Trees

Poles were found highest in number in the study area (43.64%) followed by small saw timber (25.76%). Timber yielding trees were least in number (5.15%) and that of saplings was 25.45% as shown in the figure 5.10.

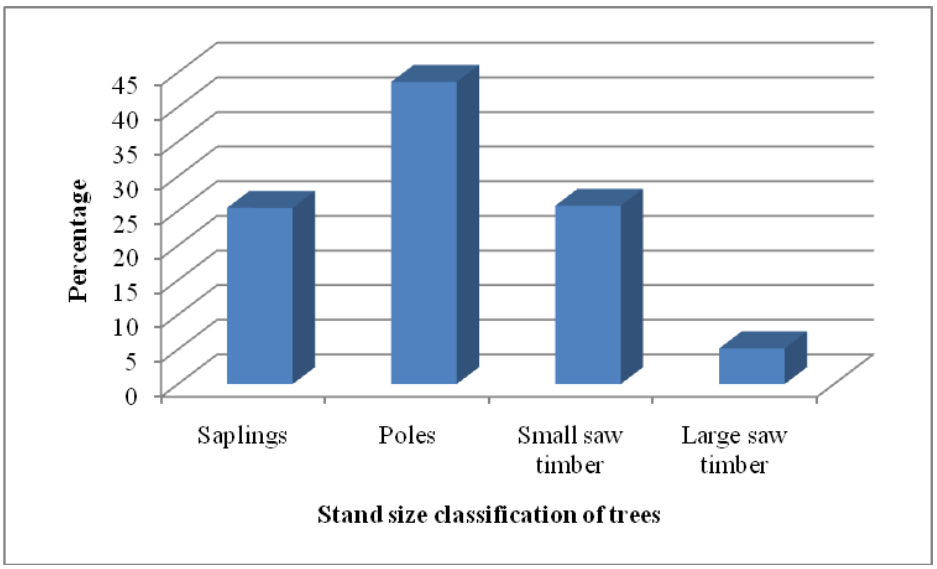


Figure 5.10: Stand size classification of trees

In sapling and pole categories, *Shorea robusta* dominated over other species while in small saw timber (SST) and large saw timber (LST), *Dalbergia sisoo* was the highest in density (Table 5.21).

Table 5.22: Dbh Class tree species

Species	Saplings	Poles	SST	LST
Shorea robusta Gaertn.	15.00	31.67	5.56	2.22
Dalbergia sisoo O. Roxb.	10.00	13.33	28.33	2.78
Ehretia acuminata R.Br.	3.89	1.11	0.56	-
Albizia spp.	0.00	1.11	-	-
Ficus lacor Buch-Ham.	0.00	0.56	-	-
Myrsine semiserrata Wall.	3.89	5.56	1.11	-
Adina cordifolia (Wild. Ex Roxb.) Benth & Hook. f.ex Brandis.	1.11	1.11	-	1.11
Cucumis sativus L.	1.67	0.00	-	-
Eucalyptus citriodora Hook.	1.11	4.44	-	-
Terminalia myriocarpa Heurck & Muell-Agr.	1.67	0.56	-	-
Cassia fistula L.	2.22	3.33	-	-
Dalbergia latifolia Roxb.	1.11	2.22	-	-
Albizia julibrissin Durazz.	0.00	1.67	0.56	-
Tectona grandis L. f	5.00	12.22	-	1.67
Zanthoxylum oxyphyllum Edgew.	-	0.56	-	-
Oroxylum indicum (L.) Kurz	-	0.56	-	-
Anthocephalus chinensis (Lam.) A. Rich. ex Walp.	-	-	0.56	-
Bombax ceiba L.	-	-	0.56	-
Garuga pinnata Roxb.	-	-	-	0.56
Syzygium cumini (L.) Skeels	-	-	-	0.56
Trifala*	-	-	-	-

*local name

5.3.6 Regeneration

For regeneration, all the trees within tree plots having Dbh <10 cm and trees within shrub and herb plots were taken into account. Total number of regenerating species were 40 with total density of 6160 no/ha (Annex III, table 3). Of them, Auliya had the highest density of 2031.11 no/ha followed by *Shorea robusta* (1997.61 no/ha). Density is seen decreasing with increasing height class. The tree species with <1m height was considered seedlings while tree species with >1m height was considered saplings. Seedlings density was found to be higher (5057.78 no/ha) (Annex III, table 4) than those of saplings (1102.22 no/ha.) (Annex III, table 5), i.e., seedlings covered 82.11% and that of saplings was 17.89%.

5.3.7 Tree Volume and Biomass

The total tree volume of the study area was found to be 49.88 m^3/ha. *Dalbergia sisoo* had occupied more than 50% of the total volume followed by *Tectona grandis* (20.743%). Total biomass was found to be 62.68 no/ha and highest was of *D. sisoo* (54.873%) followed by *T. grandis* (20.545%). Other species had fewer amounts in terms of volume and biomass (Annex III, table 6).

5.3.8 Sustainable Yield from the Community Forest

Annual yield from the Humse-Dumse community forest was 3.07 t/ha/yr, of which 54.88% was from *Dalbergia sisoo* only and 20.56% was from *Tectona grandis*. Sustainable fuel wood yield from the forest was found to be 2.42 t/ha/yr of which 56.642% was from *D. sisoo* and 19.882% was from *T. grandis* (Annex III, table 7).

5.3.9 Annual Fodder Yield from the Forest

Table 5.23: Annual green fodder yield (TDN in tons/yr)

Landuse category	TDN yield factor	Area (ha)	Annual TDN yield (t/yr)
Hardwood forest	0.34	627.5*	152.83

*50 ha Open land, 117.5 ha Bhutanese refugee camp, 3 ha Community Forest Office Building, nursery and range post and 7.5 ha Armed Police Force Base Camp.

5.3.10 Supply and Deficit of Resources in the Forest

The estimation of supply and demand resources situation of the community forest is shown in the table 5.24. Both the fuel wood and fodder demand were very high as compared to the sustainable supply from the forest. Fodder and fuel wood extraction were very high in case of Bhutanese refugees. The deficit fuel wood and fodder amount was 705.11 t/yr and 4535.77 t/yr respectively.

Table 5.24: Resources supply and deficit in the study area

Total forest area	627.5 ha*
Total estimated no. of CF member HHs using FW	1985.14
Total estimated no. of refugees' HHs using FW	5569.13
Total demand of FW** from CF member HHs (t/yr)	1866.03
Total demand of FW from refugees' HHs (t/yr)	6293.17
Total estimated no. of CF member HHs using FW from the CF	1521.89
Total estimated no. of refugees' HHs using FW from the CF	1474.25
Total estimated FW extraction by the CF member HHs from the CF (t/yr)	289.16
Total estimated FW extraction by the refugees' HHs from the CF (t/yr)	1503.74
Sustainable FW yield from the CF (t/yr)	1087.79
Deficit FW (tons/yr)	**-705.11**
Total estimated no. of CF member HHs using fodder	1985.14
Total estimated no. of refugees' HHs using fodder	819.09
Total demand of fodder from CF member HHs (t/yr)	19672.74
Total demand of fodder from refugees' HHs (t/yr)	3538.47
Total estimated no. of CF member HHs using Fodder from the CF	694.78
Total estimated no. of refugees' HHs using Fodder from the CF	655.22
Total estimated fodder extraction by the CF member HHs from the CF (t/yr)	1792.53
Total estimated fodder extraction by the refugees' HHs from the CF (t/yr)	2896.07
Sustainable Green Fodder Yield from the CF (TDN in t/yr)	152.83
Deficit fodder (tons/yr)	**-4535.77**

* 50 ha open land 117.5 ha Refugee settlements, 7.5 ha Armed Police Force base camp, 3 ha CF office building, Nursery and Range post.

**= Fuel wood

5.3.11 Cut Stumps

A total of 30 cut stumps of 11 species were recorded in 16 plots out of 45 plots in the study area. *Dalbergia sisoo* had the highest cut stump density (CSD; 3.89 no/ha), followed by *Ehretia acuminata* (3.33 no/ha), *Cassia fistula* L. (2.22 no/ha) and *Shorea robusta* (2.22 no/ha) as given in the table 5.25. When CSD was compared to live tree density (LTD), it was found that *Oroxylum indicum* (L.) Kurz had 100% CSD to LTD, followed by *Cucumis sativus* L. (66.67%) and *E. acuminata* (60%). Altogether, 10.17% of live trees had been cut to remain stumps.

Table 5.25: Cut stump denstiy

Species	No.	<20cm	20-40cm	Total cut stump density(no/ha)	Live tree density(no/ha)	%of cut stump with live tree density
Dalbergia sisoo Roxb.	7	2.78	1.11	3.89	53.33	7.29
Ehretia acuminata R.Br.	6	3.33	-	3.33	5.56	60
Cassia fistula L.	4	1.67	0.56	2.22	5.56	40
Shorea robusta Garrtn.	4	1.67	0.56	2.22	54.44	4.08
Tectona grandis L. f	3	1.67	-	1.67	28.89	5.77
Cucumis sativus L.	2	1.11	-	1.11	1.67	66.67
Myrsine semiserrata Wall.	1	0.56	-	0.56	10.56	5.26
Dalbergia latifolia Roxb.	1	0.56	-	0.56	3.33	16.67
Thaksi*	1	0.56	-	0.56	-	-
Oroxylum indicum (L.) Kurz	1	0.56	-	0.56	0.56	100
Total	**30**	**14.44**	**2.22**	**16.66**	**163.89**	**10.17**

*local name

5.3.12 Lopping

Altogether, 172 out of 330 trees (52.12%) of nine species were found to be lopped from minimum to severe intensity. The density of lopped trees were maximum for *Dalbergia sisoo* (31.11 no/ha), followed by *Shorea robusta* (30.56 no/ha). Density was found highest (36.11 no/ha) for the high damage category. The total density of lopped trees was recorded as 95.56 no/ha as shown in the table 5.26.

Table 5.26: Lopping intensity of tree species

Species	Lopping intensity class				
	Least	Medium	High	Very high	Total density(no/ha)
Dalbergia sisoo	11.11	-	5.56	14.44	31.11
Shorea rousta	2.78	12.22	15.56	-	30.56
Tectona grandis	3.89	-	10.00	5.56	19.44
Cassia fistula	-	1.67	-	2.78	4.44
Myrsine semiserrata	-	-	2.78	-	2.78
Ehretia acuminata	-	-	1.11	1.67	2.78
Adina cordifolia	0.56	-	1.11	0.56	2.22
Terminalia myriocarpa	-	0.56	-	1.11	1.67
Cucumis sativus	-	-	-	0.56	0.56
Total	**18.33**	**14.44**	**36.11**	**26.67**	**95.56**

CHAPTER-6

6. DISCUSSION

6.1 Socio-economic Analysis

6.1.1 Bhutanese Refugees

The average family size of the refugee HHs is 6.14/HH more than the national (5.6/HH) and district (5.03/HH) averages (Statistical Year Book of Nepal, 2009). More than 50% of the refugees' households were from Rai/Subba/ Magar/Tamang/Gurung/Sherpa group. The refugees were mostly depended on the various aids provided by the donor organizations, to run their livelihood. Many of them had no jobs and others had adopted wage laboring as their occupation to meet their family needs. Partly of them were engaged in weaving threads, pig farming and depended on their relatives who had already been migrated to foreign countries. The refugees of the camps did not have any strong source of income and so their overall dependency was on the aids provided to them. As they are being driven away by the sophisticated life style of the abroad countries, third country settlement process was observed to be in fast phase and more than 60% of the households had started processing for the migration.

6.1.2 CFUGs

The average family size of the CFUGs' HHs is 6.67/HH, which is higher as compared to national average (5.6/HH) and district average (5.03/HH) (Statistical Year Book of Nepal, 2009). Variation in the family size may be due to traditional systems, educational status, land class and ethnicity. Households having very big farm size had highest average family size (11/HH) and small and medium farm sized HHs had equal average family size of 6/HH.

Household economy in the study area is mostly based on the agriculture system. Agriculture is the main occupation and source of livelihood for the people in the study area. 73.24% of the sampled HHs were involved in agriculture for their livelihood.

More than 50% of the HHs were from Brahmin and Chhetri family and HHs of Dalit groups were least (9.86%) which shows there is dominancy of higher ethnic caste (Brahmin/Chhetri) in the area. Economically active population was dominant with 69.62%. Average literacy rate of the study area is 82.69%, which is higher than the Damak municipality's average (76.93%) (District profile, CBS). Literacy rate is very high (85.71%) in Brahmin/Chettri group than other groups. Access to higher education is also high in this group.

Regarding crop production status, small farm households seem to have more deficits of crops than others do. From the analysis of results based on the household land holding, very big farm sized households had higher overall fodder demand followed by big farm and landless as they had higher livestock unit. Landless and small farm households were more dependent on fuel wood as they have less access to biogas and liquefied petroleum gas.

6.2 Vegetation Strata and Species Diversity

The total density of tree species was 183.33 no/ha. *Shorea robusta* Gaertn. and *Dalbergia sisoo* O. Roxb. are the dominant species within the study area with density of 54.44 no/ha each (Annex III, table a). However, frequency and basal area of the study area were higher for *Dalbergia sisoo*, 64.44% and 37.39% respectively and that of *Shorea robusta* were 24.44% and 22.83% respectively. Highest IVI of the study area was recorded for *Dalbergia sisoo* (100.81) followed by *Shorea robusta* (65.31) (Annex III). Dhakal (2007) in his study of Kolhuwa Buffer Zone VDC of Chitwan National Park, found the density of *Shorea robusta* (dominant species) to be 45.83 no/ha. Pandeya (2009) reported the density of dominant *Shorea robusta* as 82.50 no/ha of Tribeni buffer zone VDC of CNP. Thapa (2010) in the study of Subarnapur Buffer Zone VDC of Parsa Wildlife Reserve, reported the highest density of *Shorea robusta* as 111 no/ha followed by *Dalbergia sisoo* with 34 no/ha. Though the HDCF site was Sal forest, after its handover to the community, the management committee has given emphasis to the *Dalbergia sisoo, Tectona grandis* and other species plantation in all the available areas. So, the HDCF has been transformed actually as plantation forest. So, all the values are found highest for *Dalbergia sisoo*. Moreover, the natural forest in the total forest area is only about 30 ha and that of plantation

forest is 419.5 ha (Second Revised Community Forestry Operational Plan (HDCF), 2064).

Altogether 54 shrub species were found in the study area with density of 1644.44no/ha. Highest density was of *Clerodendrum viscosum* Vent. (8391.11no/ha), followed by Auliya (2031.11no/ha) and *Shorea robusta* (1964.44no/ha) (Annex III, table b). Pandeya (2009) reported the density of shrub species in the Tribeni Buffer Zone VDC of CNP to be 28826.67no/ha. While Dhakal (2007) in his study of Kolhuwa BZ forest of CNP, found 32786.67no/ha. Adhikari (2010) in her study of Nirmalbasti BZ forest of PWR, found the shrub density to be 7840no/ha. Compared to these data of forest of Central terai, the shrub density of the study area is relatively very less. The reasons may be due to frequent human behavior inside the forest as the camps are located within the forest and other settlements are also nearby. Moreover, most of the forest area is plantation area and natural forest area is very limited.

Altogether 56 herb species were encountered with total density of 602666.67no/ha where *Cynodon dactylon* had the highest density of 75666.67no/ha. The ground vegetation of the study area is found to be in quite good condition and moreover, the density of herbs is higher in the areas with lower canopy coverage (less woody species) because they get better light condition, higher nutrient availability and lower degree of competition (Pandeya 2009). Moreover, the highest density of *C. dactylon* reveals that the forest is in disturbed condition as it is most common in trampled areas and other disturbed areas (Mudau, 2006).

Species evenness is the distribution of individuals among the species (Sigdel 2008). Ground vegetation had higher values in terms of evenness index and Shannon diversity index that shows that the ground vegetation is evenly distributed. Species diversity is the combination of species richness and species evenness. Species richness is the reflection of diversity index and shrubs had higher values in terms of species richness and index of dominance.

6.3 Forest Condition, Regeneration and Anthropogenic Interference

There were 40 regenerating species with total density of 6160 no/ha which is about 33 times greater than tree density. Among them, major regenerating species were Auliya, *Shorea robusta*, *Dalbergia sisoo* and *Ehretia acuminata*. It likely indicates the favorable micro climatic condition, nutrient availability and adequate light resulting higher regeneration of these species unlike other species. Seedlings density is found to be higher than the value (>5000 no/ha) given by the CF Inventory Guidelines which indicates that the regeneration condition is good while looking at the saplings density, it lies between 800-2000 no/ha, which indicates the regeneration condition is just satisfactory only.

While looking at height categories, more than 80% is under one meter height and the density is seen decreasing as the height class increases. This may be due to the harvesting trends of locals and refugees mostly on shrubs and saplings of trees as fodder and fuel wood.

While looking at dbh category, pole sized trees were dominant of which *Shorea robusta* had the maximum number than other species. There was not much good presentation of Large saw timber in the study area. *Dalbergia sisoo* had the higher number of small saw timber and large saw timber.

The total cut stump density of the study area was found to be 17.22 no/ha. *Dalbergia sisoo* was the most preferred species having high cut stump density of 3.89 no/ha, followed by *Ehretia acuminata* (3.33 no/ha), *Cassia fistula* and *Shorea robusta* of 2.22 no/ha each. Sharma (2009) recorded total cut stump density of 52 no/ha with highest of *Shorea robusta* (18 no/ha) in the study of Nirmalbasti BZ forest of CNP. While Thapa (2010) in the study of Subarnapur BZ forest of PWR found the total cut stump density as 55 no/ha with highest of *Shorea robusta* (39 no/ha). Poudyal (2007) recorded the total cut stump density to be 107.69 no/ha in the study of Piple BZ forest of CNP. Compared to these study of various forests of Central terai, the cut stump density of the present study area is less. But lopping intensity in the study area was found higher. The total density of lopping damage to trees was 95.56 no/ha. *Dalbergia sisoo*, *Shorea robusta* and *Tectona grandis* were the most common species

lopped among others. Lopping damage scale was highest for very high damage. Households' fodder and fuel wood need may have to be fulfilled by this. Moreover, because of the camp settlements inside the forest, there is easy extraction of fuel wood and fodder, so the lopping intensity is more than 50% of the trees recorded though the cut stump density is not much high.

The total standing volume and total biomass was found to be 49.88 m^3/ha and 62.68 t/ha respectively. Both these values of volume and biomass were lower than the average volume and biomass estimated by MPFSN (1988) for Terai Sal Forest, Eastern Development Region, which is 124.32 m^3/ha and 176.97 t/ha respectively which shows less dense and bad forest condition. *Dalbergia sisoo* had occupied the maximum volume (26.030 m^3/ha) and biomass (34.394 t/ha) and followed by *Tectona grandis* (10.346 m^3/ha 12.878 t/ha respectively).

Similarly, the average of total annual yield and sustainable fuelwood supply as reported by MPFSN (1988) for Terai Sal Forest of Eastern Development Region: 8.66 t/ha/yr and 6.3 t/ha/yr respectively, were higher than that of the study area (3.07 t/ha/yr and 2.42 t/ha/yr respectively).

6.4 Comparison of Resources Extraction and Their Dependency on HDCF Between CFUG and Bhutanese Refugees

The average annual need of fodder per household was found to be 9.91 t/yr. This need varies as per the land size of the households. Very big farm sized households had higher demand followed by big farm and landless as they had higher livestock unit. Community forest dependency for fodder is seen higher in landless households. Big farm and very big farm sized households are quite distant from the forest and they have their own land and the surrounding areas as other better alternatives. Similarly, the average annual need of fuel wood per household was found to be 0.94 T/yr. The average annual need is seen higher in landless households and they are also more user of the community forest. The data suggests that 15.43% and 9.1% of their fuel wood and green fodder need is supplied by the forest. Remaining need is fulfilled from market. Very big farm holders solely fulfill from the market only.

The CF does not have any certain period for allowing their access to the forest. It sells fuel wood to the user groups (1-2 quintals) once or sometimes twice in a year as per the occasion such as rituals, marriage ceremony and death cases, etc. Though the demand of the resources (both fuel wood and fodder) are high for both the user groups and the refugees, they do not solely fulfill their demand from the forest. They had other access also such as buying from markets, collecting from surrounding areas, buying from other villages, etc. They are given briquettes by LWF as fuel resource. As the fuel resources are not enough to run their livelihood, they have fuel wood as the better alternative. Although they fulfill most of the fuel wood need from other sources, their extraction from the forest is much higher than those of the CFUGs (Fuel wood; 1503.74 t/yr, i.e., 83.87% of the total extraction and fodder; 2896.07 t/yr which is 61.77% of the total extraction). Even though, the HDCF is managed by its CF user groups, they are remained far behind as active users and the Bhutanese refugees are more forward in resources utilization generating extra pressure on the forest.

6.5 Community Forest Management

The majority of the households admit that the forest condition is depleting since the handover. They had complaints against the forest management committee who were not able to provide enough benefits to them and there was unequal distribution. The forest was divided into five blocks but more than 60% of the households had no any information about the block division. Though IFMPs was prevalent (but was not properly practiced) but most of the households were unknown about this.

For the forest management, most funds are generated from punishment fee from illegal activity and fee collected from the membership. They suggested that the fund generated should be spent for fulfilling community needs providing low interest loan giving priority to the disadvantaged groups. There were no any IGAs or some other kinds of training organized by the management committee for the CFUGs. They emphasized distribution of forest products and use of the fund in community development activities as their suggestions in decision-making process of the management committee. The members have strict complains against the refugees' illegal use of the forest products which is accelerating the forest degradation because

of their activities which are deforestation, smuggling of timber and conversion to farmland.

6.6 Impact of Refugees on the Community Forest

The use of fuelwood and fodder by the refugees has been the most critical determinant of the forest degrading condition. As their settlements have occupied 117.5 ha of the forest area, it is obvious to have their impacts on the forest because the settlement area had already displaced the existing vegetation and decreased the forest area. Moreover, their settlements with no boundary on the forest area are posing continuous threats to the forest resources. Though their most firewood source was from nearby village, their extraction from the forest was creating much pressure. The average fuelwood extraction of the refugees from the community forest is 5.2 times higher than those of CF members whereas average fodder extraction was 1.6 times higher. However, the refugees had not reported about their much dependency upon the forest products, their activities during the survey such as slice cutting of trees stems, uprooting of regenerating species and small herb saplings, collecting twigs and broken branches for fuelwood, collecting fodder for their livestock (goats) (though they were not allowed to raise livestock), reveal that they are frequent and daily users of the forest resources than the CFUGs. KC and Nagata in their study of the same area also found refugees' activities accelerating resources scarcity and environmental damage to the forest, which resembles the same problem as that of the present study. Smaller and dispersed refugee camps have less impact on the environment than large and concentrated settlements (Jacobsen 1997 as cited in KC & Nagata 2006). Although, camp settlements have become smaller and less compact because of third country resettlement; their impacts on the forest area have not been reduced.

CHAPTER-7

7. CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

The influx of Bhutanese refugees in HDCF has serious consequences for the existing local forest resources. After the establishments of the camps, not only demand of forest resources (fuelwood and fodder) have been increased but the forest cover area is also decreased by one-fifth, posing threats and reducing the sustainability of the forest.

Though the forest was originally natural sal forest, due to its encounter with various deforestation phases in the earlier periods, it was handover to the community, which accelerated the ongoing afforestation program with more emphasis on *Dalbergia sisoo, Tectona grandis*, *Acacia catechu*, in all the available areas. Therefore, *Dalbergia sisoo* resulted as dominant species.

Both refugees and CFUGs are benefitted by the forest resources but the overall demand of fuelwood and fodder do not match the forest sustainable supply. As a result, the forest is facing degrading condition affecting most of the regenerating species. The number of HHs using fuel wood and fodder from the CF is higher for CFUGs than that for the refugees but the extraction is very higher in case of the refugees indicating their more impact on the forest resources. Because of the camp settlements, one-fifth of the forest cover area has already been reduced and become worthless. In addition to this, the fuelwood and fodder extraction of the refugees is 5.2 times and 1.6 times higher than those of the CFUGs.

The sustainable fuelwood supply of the CF is much deficit only due to the refugees' mere presence. In case of their absence in the forest, the sustainable supply would have been surplus as the extraction of the CFUGs is much less than the forest sustainable yield.

7.2 Recommendations

7.2.1 Recommendations for the Government and Aid Agencies

- The community forest and refugee camps cannot co-exist scot-free. Therefore, the best way may be removing the refugees from the CF and its vicinity.
- Both the Nepal Government and the aid/relief agencies need to be aware that both the urgency of their relief measures and proper environmental planning need to proceed side by side to ensure that there are no long-term adverse impacts to the local environment.
- The findings of the study suggest that, in future, before hosting refugees, the host country and the relief agencies must give higher priority and better planning of the camps' site locations to reduce the level and intensity of environmental impacts and conflict with the local communities.

7.2.2 Recommendations for the CF Management Committee

- The forest management committee need to seriously decide about the fencing of the vegetation area with a well-built boundary and secret inspection of the refugee activities should be made stronger.
- Improving the attitude of the refugees towards the local environment is also a prerequisite for the sustainability of the forest environment.

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ANNEX I

QUESTIONNAIRE FOR THE BHUTANESE REFUGEES

SN:
Latitude:
Longitude:

A. General information of the respondent

1. Name:-
2. Sex:

   a) Male b) Female c) Third Gender
3. Age: .....
4. Caste/Ethnic group:

   a) Brahmin b) Chettri c) Dalit d) Other
5. Camp:

   a) Beldangi I b) Beldangi II c) Beldangi III
6. Sector:

   a)A b) B c) C d)D e)E f)F g)G h)H
7. Family System:

   a) Single b) Joint

8. Occupation

   a) Wage labor

   b) Pig farming

   c) Weaving hats

   d) Weaving threads

   e) Others

B. Household Information

9. Total family size: …… a) Male ……. b) Female ……..

10. Family income source: a) Wage labor b) Pig farming c) Weaving hats d) Weaving threads e) Others

11. Processing for third country resettlement: a) Yes b) No

If yes, how many members have been out migrated? ……..

C. Resource need and access

12. What do you use as fuel for cooking purpose?

a) Firewood b) LPG c) Briquettes d) Kerosene

13. If briquettes are used, how much is provided by the donor organization?

a) 20-25 kg b) 25-30 kg

14. If kerosene is used, how much is provided?

a) 1 litre b) 3 litres c) 5 litres

15. Are the briquettes and kerosene provided to you enough for your whole family?

a) Yes b) No

16. Have you been using the same fuel source from the earlier times?

a) Yes b) No

If no, then what did you use as fuel for cooking purpose and up to when, did you use that?

17. What is another alternative for briquettes in case they are not enough?

a) Firewood b) Any other source

18. If you use firewood, from where do you get them?

19. How much firewood (bhari) do you buy per month?

a) 2-5 bhari b) 5-7 bhari (1 bhari = ?? KG)

20. Do you raise livestock?

a) Yes b) No

Types of livestock raised: a) Cow b) Buffalo c) Goat d) Pig

If yes, from where do you bring fodder for your animals?

21. Is there any benefit from this forest in your opinion?

a) Yes b) No

If yes, what type of benefits are you receiving?

QUESTIONNAIRE FOR THE FOREST USER GROUPS

SN:
Latitude:
Longitude:

A. General information of respondent

8. Name:-
9. Sex: a) Male b) Female
10. Age…….
11. Ward No: .....
12. Family System: a) Single b) Joint
13. Level of Education
    a) Illiterate b) Literate c) Up to SLC d) Up to Intermediate
    e) Graduation and Above

B. Household information (beginning with the oldest person)

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

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)

8. Do you have land assets? a) Yes b) No

8.1. If yes, then what types of land do you have? a) Khet b) Baari c) Any other

8.2 Farm size

Ownership	Area		
	Bigha	Kattha	Dhur
Own			
Shared			

8.3 Crops grown in the farm and their annual yield

Crop Type		Area			Production		Consumption (Kg)	Surplus (Kg)	Deficit (Kg)	Deficit Period (Month)
		Bigha	Kattha	Dhur	Man	Kg				
Food Crop	Wheat									
	Paddy									
	Maize									
Pulses										
Cash crop	Vegetables									
	Oil seeds									

8.4 How will you manage for the deficit months?

a) Buy b) Borrow c) Barter d) Wage labor e) Others..... (Specify)

8.5 If surplus what do you do with the surplus crops?

a) Store b) Sale c) Others..... (Specify)

9. Primary source of income.....

10. Secondary sources

a) Business b) Teaching c) Wages d) Foreign job e) Shop f) Contract e) Service

f) Forest resources

C. Livestock type and holdings

11. How many of the following livestock do you have and how are you managing them?

Types of Animals	Number			Stall Feeding	Grazing in			Both
	Young	Adult	Old-aged		C.F	P.L	In both	
Buffalo								
Cow/Ox								
Goat								
Pig								

D. Resources need and access

Season/ Month	Fodder			Fuelwood		
	Species	Quantity	Access	Species	Quantity	Access

E. Energy consumption and its purposes (Record use for the each month, Litre for Kerosene, No. of Cylinder for Gas,etc.)

Source	Quantity	Purpose	Remarks
Kerosene			
Solar			
LP Gas			
Bio-gas			
Electricity			
Other			

13. If you have biogas installation, did you receive any support from any institution for its installation?

a)Yes b) No

If yes, please specify the institution and its contribution: .....
.....

.....

Number of livestock needed to operate biogas plant:

Livestock	Numbers	Fodder requirement

F. Community forestry

14. Are you or your household members in the FUG?
a) Yes b) No
15. Have you/your household members sometimes been in the management committee?
a) Yes b) No
If yes, what is the position?
a) Chairman b) Secretary c) Treasurer d) General member
16. Do you participate in the FUG's regular assembly?
a) Yes b) No
If yes, how often? a) Always b) Most of the time c) Some time d) Rarely

17. What type of resources are you getting from the community forest?
a) Fodder b) Fuel wood c) Timber d) All these e) Others (specify)
18. Resource allocation and accessibility system
18.1 On what basis are the forest resources allocated to the members?
a) Emphasizing on economic status b) Per household (size of the family) c) Per user group d) Per individual e) Others
If answer is the first one, please give details.
.....

18.2 Time opened to collect forest products:

Sources collected	Timing of collection	Quantity

19. Do you think the grass, fodder and fuel wood problem has been reduced after the community forest?

a) Yes b) No

20. Is there block division for the forest management?

a) Yes b) No

If yes, how many blocks and on what basis it has been divided?

21. Is there application of improved forest management practices, i.e. silviculture?

a) Yes b) No

22. Do you know about existence of any fund generating provisions in your forest?

a) Yes b) No

If yes, please specify: .....

23. Do you know where the FUG fund spent in previous years?

a) Forest development b) Forest watcher c) School support d) Temple support e) Community building f) IGAs g) Road construction h) Bio-gas installation i) All above

24. Is there any provision of giving loan from FUG fund to disadvantaged people specially to carry out the IGAs?

a) Yes b) No

If yes, what activities are being carried out from these soft loans? Please specify.....

25. What do you think the FUG should spend/use its income or fund?

a) Equally distribute to all the users b) Spend on forest development activities c) Give loan on high interest rate d) Spend on community needs e) Give priority to the disadvantaged people's IGAs

26. Are there any Income Generating Activities in your FUG?

a) Yes b) No

If yes, how these IGA are implanted?

a) Individual household b) Interested group (poor, disadvantaged, etc.) c) FUG collectively

27. Were there any kind of training organized for FUG and did you participate?

a) Yes b) No

If yes, what was the training about?

a) Forest management b) Skill development c) IGA related d) Others specific

28. How do you categorize the training/skill development to you daily work, occupation and employment?

a) Very helpful b) Helpful c) Normal d) Not helpful

29. Is there active participation of women in the forest management committee?

a) Yes b) No

30. Are there any networks/enterprises to buy and process the forest products and IGA products?

a) Yes b) No

31. Do you know your CF constitution and operational plan?

a) Yes b) No

32. Have you noticed any improvement in the forest condition of your CF after the handover?

a) Improved b) About same c) Depleting

33. What changes have you observed in your CF after the settlement of the Bhutanese refugees?

a) Deforestation b) Conversion to farmland c) Smuggling of timber d) Decrease in availability of forest products e) Others

34. In your perception, do these refugees use the forest resources?

a) Yes b) No

36. What aspect would you like to add in the decision making of the FUG?

a) Distribution of the forest products b) Change in the operational plan c) Forest management activities d) Use of FUG fund in different community development activities e) Others (specify)

ANNEX II

Formulae

Table: Farm size conversion factor

Farm size in bigha and kattha	Conversion factor
1 kattha	0.034 ha
1 bigha (20 kattha)	0.68 ha

Table: Unit conversion for forest resources

Particulars	Local unit (bhari)	Standard unit (kg)
Fuelwood	1 bhari	40
Fodder	1 bhari	50

Source: Nepal and Weber (1993)

Table: Livestock unit conversion

Livestock	Livestock unit value
Cattle	0.65
Goat and sheep	0.18
Buffalo	0.81

Vegetation Analysis

$$\text{Density/ha} = \frac{\text{No. of individuals of species}}{\text{Size of the plot} \times \text{Total no. of plots sampled}} \times 10000$$

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

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

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

$$\text{Relative coverage, RC (\%)} = \frac{\text{Individual coverage of a species}}{\text{Total coverage of all the species}} \times 100$$

(Individual and total coverage was obtained from ocular estimation)

Importance Value Index (IVI) = Σ(RD+RF+RC)

Basal Area (BA) = $\frac{\Pi d^2}{4}$ [d= diameter of a tree at breast height (1.37m)]

Relative Basal Area, RBA (%) = $\frac{\text{Basal area of a species}}{\text{Total basal area of all the species}} \times 100$

Index of dominance, $c = \Sigma (n_i/N)^2$ [n_i = importance value for each species]
[N= total of importance values]

Shannon index of diversity (H) = $- \Sigma (n_i/N) \times \log (n_i/N)$

Species richness (d1) = $\frac{S-1}{\log N}$ where, S= No. of species and N= No. of individuals

Evenness index (e) = $\frac{H}{\log s}$ where, H= Shannon index of diversity
S= No. of species

Biomass and volume:

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

Where, Ln refers to natural logarithmic value

V = total stem volume with bark (m^3/ha)

d = Diameter at breast height (m)

h = Total height (m)

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

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

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

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

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 a), as shown below, for the Sal Forest.

Table: Growing Stock and Annual Yield (tons/ha) in the natural forest of Terai Regions of Eastern Development Region, Nepal (Source: HMG, 1988a)

Forest	Forest Biomass			Annual Yield			Percent Yield		
	Stem	Branch	Foliage	Stem	Branch	Foliage	Stem	Branch	Foliage
Sal	4713.1	1854.7	316.4	230.5	90.7	15.5	4.89	4.89	4.90

Sustainable Fuelwood 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 the community forest was calculated on the basis of Total Digestible Nutrient (TDN) yields for various categories of land in Master Plan for Forestry Sector of Nepal (GN, 1988 b).

Table: Fodder Yield from various land categories (HMG, 1988 b)

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 1: Importance Value index (IVI) of shrub stratum

Species	Number	D/ha	RD(%)	F(%)	RF(%)	C(%)	RC(%)	IVI
Clerodendrum viscosum Vent.	1888	8391.11	50.41	65.56	15.25	2719.00	34.15	99.81
Swertia nervosa (G.Don) C.B. Clarke	300	1333.33	8.01	61.11	14.21	1895.00	23.80	46.03
Auliya*	457	2031.11	12.20	26.67	6.20	511.00	6.42	24.82
Shorea robusta Garrtn.	442	1964.44	11.80	27.78	6.46	345.00	4.33	22.60
Lantana camara L.	67	297.78	1.79	30.00	6.98	556.00	6.98	15.75
Dalbergia sisoo O. Roxb.	77	342.22	2.06	20.00	4.65	646.50	8.12	14.83
Ehretia acuminata R.Br.	102	453.33	2.72	32.22	7.49	290.00	3.64	13.86
Syzygium cumini (L.) Skeels	51	226.67	1.36	12.22	2.84	55.05	0.69	4.90
Myrsine semiserrata Wall.	41	182.22	1.09	11.11	2.58	75.00	0.94	4.62
Cassia fistula L.	26	115.56	0.69	13.33	3.10	49.00	0.62	4.41
Osbeckia stellata Buch.-Ham. ex D. Don	18	80.00	0.48	10.00	2.33	54.50	0.68	3.49
Cucumis sativus L.	19	84.44	0.51	10.00	2.33	22.50	0.28	3.12
Bandre*	34	151.11	0.91	5.56	1.29	39.00	0.49	2.69
Lagerstroemia parviflora Roxb.	19	84.44	0.51	7.78	1.81	25.90	0.33	2.64
Eucalyptus citriodora Hook.	3	13.33	0.08	2.22	0.52	160.00	2.01	2.61
Pipiri*	10	44.44	0.27	8.89	2.07	16.55	0.21	2.54
Dhokre	28	124.44	0.75	1.11	0.26	100.00	1.26	2.26
Ficus hispida L.	9	40.00	0.24	7.78	1.81	13.50	0.17	2.22
Adina cordifolia (Wild. Ex Roxb.) Benth & Hook. f.ex Brandis.	14	62.22	0.37	5.56	1.29	38.00	0.48	2.14
Pilea symmeria Wedd.	11	48.89	0.29	2.22	0.52	75.00	0.94	1.75
Sambucus hookeri Rehder.	8	35.56	0.21	4.44	1.03	35.00	0.44	1.69
Masina paate*	13	57.78	0.35	4.44	1.03	13.00	0.16	1.54
Albizia spp.	11	48.89	0.29	4.44	1.03	11.00	0.14	1.47

Rosa brunoii Lindl.	4	17.78	0.11	2.22	0.52	63.00	0.79	1.41
Dillenia pentagyna Roxb.	8	35.56	0.21	4.44	1.03	13.05	0.16	1.41
Psidium guajava L.	10	44.44	0.27	4.44	1.03	8.50	0.11	1.41
Mallotus philippensis(Lam.)Muell.-Arg.	12	53.33	0.32	3.33	0.78	13.00	0.16	1.26
Nyctanthes arbor-tristis L.	4	17.78	0.11	4.44	1.03	4.05	0.05	1.19
Dalbergia latifolia Roxb.	12	53.33	0.32	3.33	0.78	5.00	0.06	1.16
Tectona grandis L. f	3	13.33	0.08	3.33	0.78	6.00	0.08	0.93
Bidens biternata (Lour.)Merr.& Sherff	5	22.22	0.13	2.22	0.52	7.00	0.09	0.74
Gmenlina arborea Roxb.	3	13.33	0.08	1.11	0.26	25.00	0.31	0.65
Woodfordia fructicosa (L.) Kurz	2	8.89	0.05	2.22	0.52	4.00	0.05	0.62
Solanum anguivi Lam.	2	8.89	0.05	2.22	0.52	2.00	0.03	0.60
Citrus limon (L.) Burn f.	7	31.11	0.19	1.11	0.26	10.00	0.13	0.57
Aegle marmelos (L.) Corr.	5	22.22	0.13	1.11	0.26	5.00	0.06	0.45
Triumfetta pilosa Roth.	1	4.44	0.03	1.11	0.26	10.00	0.13	0.41
Putali lahara*	1	4.44	0.03	1.11	0.26	10.00	0.13	0.41
Bombax ceiba L.	1	4.44	0.03	1.11	0.26	6.00	0.08	0.36
Zizyphus mauritiana Lam.	1	4.44	0.03	1.11	0.26	5.00	0.06	0.35
Putali kath*	1	4.44	0.03	1.11	0.26	5.00	0.06	0.35
Lyonia ovalifolia (Wall.) Drude	2	8.89	0.05	1.11	0.26	0.85	0.01	0.32
Terminalia bellirica (Gaertn.) Roxb.	2	8.89	0.05	1.11	0.26	0.50	0.01	0.32
Kharane*	1	4.44	0.03	1.11	0.26	2.00	0.03	0.31
Maidal kada*	1	4.44	0.03	1.11	0.26	2.00	0.03	0.31
Bauhinia purpurea L.	1	4.44	0.03	1.11	0.26	2.00	0.03	0.31
Antidesma bunius (L.) Spreng.	1	4.44	0.03	1.11	0.26	1.00	0.01	0.30
Sapindus mukorossi Gaertn.	1	4.44	0.03	1.11	0.26	1.00	0.01	0.30
Litsea monopelata (Roxb.) Pers.	1	4.44	0.03	1.11	0.26	1.00	0.01	0.30
Cochlospermum religiosum (L.) Alston	1	4.44	0.03	1.11	0.26	1.00	0.01	0.30

Portulaca oleracea L.	1	4.44	0.03	1.11	0.26	1.00	0.01	0.30
Syzygium cumini (L.) Skeels	1	4.44	0.03	1.11	0.26	1.00	0.01	0.30
Artocarpus lakoocha Wall.	1	4.44	0.03	1.11	0.26	0.50	0.01	0.29
Persea odoratissima (Nees) Kosterm.	1	4.44	0.03	1.11	0.26	0.05	0.00	0.29
Total	**3745**	**16644.44**	**100.00**	**430.00**	**100.00**	**7961.00**	**100.00**	**300.00**

*local name

Table 2: Importance Value index (IVI) of herb stratum

Species	Number	D/ha	RD(%)	F(%)	RF(%)	C(%)	RC(%)	IVI
Chepti ghas*	588	65333.33	10.84	37.78	7.85	1820	21.97	40.66
Tetrastigma serrulatum (Roxb.) Planch.	362	40222.22	6.67	44.44	9.24	958	11.57	27.48
Cynodon dactylon L.	681	75666.67	12.56	34.44	7.16	635	7.67	27.38
Digitaria spp.	503	55888.89	9.27	46.67	9.70	629	7.59	26.57
Imperata cylindrical (L.) P.Beav	587	65222.22	10.82	17.78	3.70	781	9.43	23.95
Ageratum conyzoides L.	533	59222.22	9.83	37.78	7.85	393.50	4.75	22.43
Oxalis corniculata L.	422	46888.89	7.78	18.89	3.93	415	5.01	16.72
Hedyotis scandens Roxb.	217	24111.11	4	26.67	5.54	404.50	4.88	14.43
Piper longum L.	90	10000	1.66	16.67	3.46	610.75	7.37	12.50
Centella asiatica (L.) Urban.	155	17222.22	2.86	16.67	3.46	155	1.87	8.19
Mimosa pudica L.	111	12333.33	2.05	20	4.16	78.50	0.95	7.15
Aalu jhar*	117	13000	2.16	14.44	3.00	163	1.97	7.13
Bidens biternata (Lour.)Merr.& Sherff	116	12888.89	2.14	15.56	3.23	71	0.86	6.23
Dryopteris spp.	59	6555.56	1.09	7.78	1.62	241	2.91	5.61
Angaare*	104	11555.56	1.92	12.22	2.54	64.75	0.78	5.24
Cynodon spp.	62	6888.89	1.14	6.67	1.39	71	0.86	3.39
Cyperus rotundus L.	81	9000	1.49	4.44	0.92	47	0.57	2.98
Equisetum arvanse L.	27	3000	0.50	8.89	1.85	38	0.46	2.80
Silaame jhar*	36	4000	0.66	4.44	0.92	95	1.15	2.73
Hypericum uralum Buch-Ham.ex.D.Don	21	2333.33	0.39	8.89	1.85	35.50	0.43	2.66
Cynodon spp.	61	6777.78	1.12	4.44	0.92	33	0.40	2.45
Saccharum spontaneum L.	71	7888.89	1.31	1.11	0.23	50	0.60	2.14
Drymaria diandra Blume.	36	4000	0.66	4.44	0.92	43	0.52	2.11
Melochia corchorifolia L.	32	3555.56	0.59	3.33	0.69	30.50	0.37	1.65
Euphorbia hirta L.	21	2333.33	0.39	3.33	0.69	41	0.49	1.57

Dryopteris spp.	5	555.56	0.09	3.33	0.69	60.50	0.73	1.52
Hymenopogon parasiticus Wall.	14	1555.56	0.26	5.56	1.15	7	0.08	1.50
Dryopteris cochleata (D.Don) C. Chr	9	1000	0.17	4.44	0.92	32	0.39	1.48
Biblyate*	14	1555.56	0.26	4.44	0.92	23.25	0.28	1.46
Digitaria ciliaris (Retz.) Koeler	59	6555.56	1.09	1.11	0.23	10	0.12	1.44
Stephania glandulifera Miers.	12	1333.33	0.22	4.44	0.92	11	0.13	1.28
Digitaria spp.	21	2333.33	0.39	2.22	0.46	18	0.22	1.07
Runche jhar*	13	1444.44	0.24	3.33	0.69	9.25	0.11	1.04
Tite ghas*	23	2555.56	0.42	2.22	0.46	11	0.13	1.02
Piper chaba Hunter	22	2444.44	0.41	2.22	0.46	11	0.13	1
Eleusine indica (L.) Gaertn	7	777.78	0.13	1.11	0.23	50	0.60	0.96
Bhirgeni*	22	2444.44	0.41	2.22	0.46	5.50	0.07	0.93
Commenlina benghalensis L.	17	1888.89	0.31	2.22	0.46	6	0.07	0.85
Parochetus cummunis Buch-Ham.ex.D.Don	7	777.78	0.13	2.22	0.46	15	0.18	0.77
Lahare pipiri*	1	111.11	0.02	1.11	0.23	40	0.48	0.73
Thaade jhar*	5	555.56	0.09	2.22	0.46	12	0.14	0.70
Cyperus iria L.	16	1777.78	0.29	1.11	0.23	10	0.12	0.65
Digitaria spp.	17	1888.89	0.31	1.11	0.23	5	0.06	0.60
Adenostemma lavenia (L.) Kuntz.	5	555.56	0.09	2.22	0.46	2	0.02	0.58
Dhotisaro*	2	222.22	0.04	2.22	0.46	5.50	0.07	0.57
Lahare dude*	8	888.89	0.15	1.11	0.23	2	0.02	0.40
Gnaphalium polycaulon Pers.	6	666.67	0.11	1.11	0.23	5	0.06	0.40
Digitaria spp.	4	444.44	0.07	1.11	0.23	8	0.10	0.40
Bujhadi jhar*	4	444.44	0.07	1.11	0.23	5	0.06	0.37
Lwang fuli jhar*	3	333.33	0.06	1.11	0.23	5	0.06	0.35
Polygonum hydropiper (L.) Spach.	3	333.33	0.06	1.11	0.23	4	0.05	0.33
Eupatorium adenophorum Spreng.	4	444.44	0.07	1.11	0.23	2	0.02	0.33

Chyapchyape*	3	333.33	0.06	1.11	0.23	2	0.02	0.31
Batul paate kuro*	2	222.22	0.04	1.11	0.23	1	0.01	0.28
Fimbristylis miliacea (L.) Vahl	2	222.22	0.04	1.11	0.23	1	0.01	0.28
Ankhete*	1	111.11	0.02	1.11	0.23	0.50	0.01	0.26
Total	**5424**	**602666.67**	**100**	**481.11**	**100**	**8283.50**	**100**	**300**

*local name

Table 3: Regeneration of tree species in shrub plots

Species	<1m	1-3m	3-5m	>5m	Total density (No/ha)
Auliya*	1986.67	44.44	-	-	2031.11
Shorea robusta Gaertn.	1813.33	147.06	15.56	21.67	1997.61
Ehretia acuminata R.Br.	320.00	133.39	8.33	2.78	464.50
Dalbergia sisoo O. Roxb.	53.33	280.00	22.22	12.78	368.33
Syzygium cumini (L.) Skeels	217.78	8.89	-	-	226.67
Myrsine semiserrata Wall.	111.11	71.11	2.22	4.44	188.89
Cassia fistula L.	48.89	66.67	0.56	1.11	117.22
Cucumis sativus L.	26.67	53.33	5.00	1.11	86.11
Lagerstroemia parviflora Roxb.	71.11	13.33	1.11	-	85.56
Osbeckia stellata Buch.-Ham. ex D. Don	17.78	40.00	22.22	-	80.00
Adina cordifolia (Wild. Ex Roxb.) Benth & Hook. f.ex Brandis.	53.33	8.89	2.22	1.11	65.56
Dalbergia latifolia Roxb.	53.33	-	-	0.56	53.89
Mallotus philippensis(Lam.)Muell.-Arg.	53.33	-	-	-	53.33
Albizia spp.	35.56	8.89	4.44	0.56	49.44
Pipiri*	31.11	13.33	1.11	-	45.56
Psidium guajava L.	44.44	-	-	-	44.44
Dillenia pentagyna Roxb.	35.56	-	-	-	35.56
Citrus limon (L.) Burn.f	31.11	-	-	-	31.11
Aegle marmelos (L.) Corr.	13.33	8.89	-	-	22.22
Tectona grandis L. f	8.89	-	-	10.56	19.44
Eucalyptus citriodora Hook.		13.33	1.67	3.89	18.89
Gmenlina arborea Roxb.	4.44	4.44	-	-	8.89
Terminalia bellirica (Gaertn.) Roxb.	4.44	-	0.56	-	5.00
Bombax ceiba L.	-	4.56	-	-	4.56
Antidesma bunius (L.) Spreng.	-	4.44	-	-	4.44
Artocarpus lakoocha Wall.	4.44	-		-	4.44
Zizyphus mauritiana Lam.	-	4.44	-	-	4.44
Persea odoratissima (Nees) Kosterm.	4.44	-	-	-	4.44
Cochlospermum religiosum (L.) Alston	4.44	-	-	-	4.44
Litsea monopelata (Roxb.) Pers.	-	4.44	-	-	4.44
Maidal kaada*	-	4.44	-	-	4.44
Syzygium cumini (L.) Skeels	4.44	-	-	-	4.44
Putali kaath*	-	4.44	-	-	4.44
Sapindus mukorossi Gaertn.	4.44	-	-	-	4.44
Bauhinia purpurea L.	-	4.44	-	-	4.44
Terminalia myriocarpa Heurck & Muell-Agr.	-	-	0.56	3.33	3.89
Zanthoxylum oxyphyllum Edgew.	-	-	1.11	0.56	1.67
Hangrayo*	-	-	-	0.56	0.56
Ficus hispida L.	-	-	0.56	-	0.56
Acacia catechu	-	-	-	0.56	0.56
Total	**5057.78**	**947.23**	**89.44**	**65.56**	**6160.00**

*local name

Table 4: Regeneration of seedlings

Species	Density (no/ha)
Auliya*	1986.67
Shorea robusta Gaertn.	1813.33
Ehretia acuminata R.Br.	320.00
Dalbergia sisoo O. Roxb.	53.33
Syzygium cumini (L.) Skeels	217.78
Myrsine semiserrata Wall.	111.11
Cassia fistula L.	48.89
Cucumis sativus L.	26.67
Lagerstroemia parviflora Roxb.	71.11
Osbeckia stellata Buch.-Ham. ex D. Don	17.78
Adina cordifolia (Wild. Ex Roxb.) Benth & Hook. f.ex Brandis.	53.33
Dalbergia latifolia Roxb.	53.33
Mallotus philippensis(Lam.)Muell.-Arg.	53.33
Albizia spp.	35.56
Pipiri*	31.11
Psidium guajava L.	44.44
Dillenia pentagyna Roxb.	35.56
Citrus limon (L.) Burn.f	31.11
Aegle marmelos (L.) Corr.	13.33
Tectona grandis L. f	8.89
Gmenlina arborea Roxb.	4.44
Terminalia bellirica (Gaertn.) Roxb.	4.44
Artocarpus lakoocha Wall.	4.44
Persea odoratissima (Nees) Kosterm.	4.44
Cochlospermum religiosum (L.) Alston	4.44
Syzygium cumini (L.) Skeels	4.44
Sapindus mukorossi Gaertn.	4.44
Total	**5057.78**

*local name

Table 5: Regeneration of saplings

Species	Density
Auliya*	44.44
Shorea robusta Gaertn.	184.28
Ehretia acuminata R.Br.	144.50
Dalbergia sisoo O. Roxb.	315
Syzygium cumini (L.) Skeels	8.89
Myrsine semiserrata Wall.	77.78
Cassia fistula L.	68.33
Cucumis sativus L.	59.44
Lagerstroemia parviflora Roxb.	14.44
Osbeckia stellata Buch.-Ham. ex D. Don	62.22

Adina cordifolia (Wild. Ex Roxb.) Benth & Hook. f.ex Brandis.	12.22
Dalbergia latifolia Roxb.	0.56
Albizia spp.	13.89
Pipiri*	14.44
Aegle marmelos (L.) Corr.	8.89
Tectona grandis L. f	10.56
Eucalyptus citriodora Hook.	18.89
Gmenlina arborea Roxb.	4.44
Terminalia bellirica (Gaertn.) Roxb.	0.56
Bombax ceiba L.	4.56
Antidesma bunius (L.) Spreng.	4.44
Zizyphus mauritiana Lam.	4.44
Litsea monopelata (Roxb.) Pers.	4.44
Maidal kaada*	4.44
Putali kaath*	4.44
Bauhinia purpurea L.	4.44
Terminalia myriocarpa Heurck & Muell-Agr.	3.89
Zanthoxylum oxyphyllum Edgew.	1.67
Hangrayo*	0.56
Ficus hispida L.	0.56
Acacia catechu	0.56
Total	**1102.22**

*local name

Table 6: Volume and biomass of tree species

Species	Standing volume(m3/ha)	% volume	Stem biomass(t/ha)	Branch biomass(t/ha)	Foliage biomass(t/ha)	Total biomass(t/ha)	% Biomass
Dalbergia sisoo O. Roxb.	26.030	52.188	20.303	13.887	0.203	34.394	54.873
Tectona grandis L. f	10.346	20.743	9.084	3.178	0.616	12.878	20.545
Shorea robusta Garrtn.	5.875	11.780	5.170	1.311	0.338	6.819	10.880
Adina cordifolia (Wild. Ex Roxb.) Benth & Hook. f.ex Brandis.	2.328	4.669	1.560	0.562	0.105	2.227	3.553
Myrsine semiserrata Wall.	0.992	1.988	0.871	0.233	0.060	1.163	1.855
Trifala*	0.843	1.689	0.740	0.293	0.050	1.082	1.727
Garuga pinnata Roxb.	0.712	1.428	0.625	0.248	0.042	0.915	1.459
Syzygium cumini (L.) Skeels	0.624	1.251	0.548	0.217	0.037	0.802	1.279
Albizia julibrissin Durazz.	0.529	1.061	0.465	0.141	0.032	0.638	1.017
Eucalyptus citriodora Hook.	0.365	0.731	0.320	0.036	0.022	0.379	0.604
Bombax ceiba L.	0.284	0.570	0.250	0.095	0.017	0.362	0.577
Dalbergia latifolia Roxb.	0.259	0.519	0.227	0.026	0.016	0.269	0.429
Cassia fistula L.	0.228	0.457	0.200	0.023	0.014	0.237	0.377
Ehretia acuminata R.Br.	0.185	0.372	0.163	0.037	0.011	0.212	0.337
Anthocephalus chinensis (Lam.) A. Rich. ex Walp.	0.080	0.160	0.070	0.027	0.005	0.102	0.162
Terminalia myriocarpa Heurck & Muell-Agr.	0.052	0.105	0.046	0.005	0.003	0.054	0.086
Albizia spp.	0.035	0.070	0.031	0.003	0.002	0.036	0.058
Albizia spp.	0.030	0.061	0.027	0.003	0.002	0.032	0.050
Oroxylum indicum (L.) Kurz	0.027	0.053	0.023	0.003	0.002	0.028	0.044
Cucumis sativus L.	0.026	0.053	0.023	0.003	0.002	0.027	0.043
Ficus lacor Buch-Ham.	0.017	0.034	0.015	0.002	0.001	0.017	0.028
Zanthoxylum oxyphyllum Edgew.	0.009	0.018	0.008	0.001	0.001	0.009	0.015
Total	**49.88**	**100.00**	**40.77**	**20.33**	**1.58**	**62.68**	**100.00**

Table 7: Annual yield and sustainable supply from the forest

Species	Stem annual yield (t/ha/yr)	Branch annual yield (t/ha/yr)	Foliage annual yield (t/ha/yr)	Total annual yield (t/ha/yr)	Sustainable fuelwood yield (t/ha/yr)	% sustainable fuelwood yield
Dalbergia sisoo O. Roxb.	0.993	0.679	0.010	1.682	1.371	56.642
Tectona grandis L. f	0.444	0.155	0.030	0.630	0.480	19.822
Shorea robusta Garrtn.	0.253	0.064	0.017	0.333	0.251	10.376
Adina cordifolia (Wild. Ex Roxb.) Benth & Hook. f.ex Brandis.	0.076	0.027	0.005	0.109	0.083	3.434
Myrsine semiserrata Wall.	0.043	0.011	0.003	0.057	0.043	1.769
Trifala*	0.036	0.014	0.002	0.053	0.041	1.676
Garuga pinnata Roxb.	0.031	0.012	0.002	0.045	0.034	1.417
Syzygium cumini (L.) Skeels	0.027	0.011	0.002	0.039	0.030	1.242
Albizia julibrissin Durazz.	0.023	0.007	0.002	0.031	0.024	0.975
Eucalyptus citriodora Hook.	0.016	0.002	0.001	0.019	0.014	0.561
Bombax ceiba L.	0.012	0.005	0.001	0.018	0.014	0.559
Dalbergia latifolia Roxb.	0.011	0.001	0.001	0.013	0.010	0.399
Cassia fistula L.	0.010	0.001	0.001	0.012	0.008	0.351
Ehretia acuminata R.Br.	0.008	0.002	0.001	0.010	0.008	0.320
Anthocephalus chinensis (Lam.) A. Rich. ex Walp.	0.003	0.001	0.000	0.005	0.004	0.157
Terminalia myriocarpa Heurck & Muell-Agr.	0.002	0.000	0.000	0.003	0.002	0.080
Albizia spp.	0.001	0.000	0.000	0.002	0.001	0.054
Albizia spp.	0.001	0.000	0.000	0.002	0.001	0.047
Totala*	0.001	0.000	0.000	0.001	0.001	0.041
Cucumis sativus L.	0.001	0.000	0.000	0.001	0.001	0.040
Ficus lacor Buch-Ham.	0.001	0.000	0.000	0.001	0.001	0.026
Zanthoxylum oxyphyllum Edgew.	0.000	0.000	0.000	0.000	0.000	0.014
Total	**1.99**	**0.99**	**0.08**	**3.07**	**2.42**	**100.00**

Table 8: General characteristics of the Bhutanese refugee respondents

Categories		Number	Percent
By sex	Male	24	33.33
	Female	48	66.67
By caste/ethnic group	Brahmin/Chettri	30	41.67
	Rai/Subba/Magar/Tamang/Gurung/Sherpa	38	52.78
	Dalits	2	2.78
	Sanyasi	2	2.78
By age group	15-59yrs	60	83.33
	60 yrs or above	12	16.67
By occupation	Weaving hats	4	5.56
	Jobless	31	43.06
	Wage labour	12	16.67
	Pig farming	8	11.11
	Weaving threads	7	9.72
	Service	3	4.17
	Shop	3	4.17
	Weaving hats+ weaving threads	3	4.17
	Social worker inside the camp	1	1.39
By education	Illiterate	16	22.22
	General literate	24	33.33
	Lower class education	28	38.89
	Higher Class education	4	5.56
By family structure	Nuclear	30	41.67
	Joint	42	58.33

Table 9: General characteristics of the CFUGs respondents

Categories		Number	Percent
By sex	Male	47	66.20
	Female	24	33.80
By caste/ethnic group	Brahmin/Chettri	42	59.15
	Rai/Limbu/Subba/Magar/Newar	13	18.31
	Dalit(Darji/Biswakarma)	7	9.86
	Indigenous(Dhimal/Rajbansi)	9	12.68
By age group	15-59 yrs	56	78.87

	60 or above	15	21.13
By occupation	Nothing	7	9.86
	Agriculture	38	53.52
	Housework	7	9.86
	Service	4	5.63
	Unskilled wage labour	11	15.49
	Business	1	1.41
	Agriculture+Service	2	2.82
	Agriculture+Business	1	1.41
By education	Illiterate	17	23.94
	General literate	28	39.44
	Upto SLC	14	19.72
	Under SLC	3	4.23
	Intermediate level	4	5.63
	Bachelor level	3	4.23
	Masters level	2	2.82
By family structure	Nuclear	33	46.48
	Joint	38	53.52
By farm size	Landless	9	12.68
	Small farm	28	39.44
	Medium farm	13	18.31
	Big farm	19	26.76
	Very big farm	2	2.82

ANNEX IV

Table 1: GPS location of quadrates with dominant species

Quadrate	GPS Location		Dominant species
	Longitude	Latitude	
1	87°41'21.0"	26°44'22.8"	*Dalbergia sisoo* O. Roxb. *Eucalyptus citriodora* Hook.
2	87°41'23.8"	26°44'23.8"	No trees found
3	87°41'19.8"	26°44'15.1"	*Eucalyptus citriodora* Hook.
4	87°41'20.9"	26°44'12.7"	*Terminalia myriocarpa* Heurck & Muell-Agr.
5	87°41'33.0"	26°44'11.3"	*Tectona grandis* L. f
6	87°41'26.9"	26°44'7.8"	*Adina cordifolia* (Wild. Ex Roxb.) Benth & Hook. f.ex Brandis.
7	87°41'26.2"	26°44'2.4"	*Tectona grandis* L. f
8	87°41'19.3"	26°43'59.3"	*Adina cordifolia* (Wild. Ex Roxb.) Benth & Hook. f.ex Brandis. *Ehretia acuminata* R.Br.
9	87°41'31.1"	26°43'53.5"	*Shorea robusta* Garrtn.
10	87°41'8.7"	26°43'51.7"	*Dalbergia sisoo* O. Roxb.
11	87°41'8.7"	26°43'44.7"	*Shorea robusta* Garrtn.
12	87°41'17.1"	26°43'43.3"	*Shorea robusta* Garrtn.
13	87°41'43.4"	26°43'40.3"	*Dalbergia sisoo* O. Roxb. *Bombax ceiba* L.
14	87°41'38.5"	26°43'43.0"	*Dalbergia sisoo* O. Roxb.
15	87°41'27.8"	26°43'37.1"	*Shorea robusta* Garrtn.
16	87°41'2.9"	26°43'41.0"	*Dalbergia sisoo* O. Roxb.
17	87°41'15.4"	26°43'40.0"	*Shorea robusta* Garrtn.
18	87°40'54.0"	26°43'27.6"	*Dalbergia sisoo* O. Roxb.
19	87°41'8.9"	26°43'29.6"	*Dalbergia sisoo* O. Roxb.
20	87°41'17.0"	26°43'31.0"	*Shorea robusta* Garrtn.
21	87°41'37.8"	26°43'26.5"	*Ehretia acuminata* R.Br.
22	87°41'43.5"	26°43'20.5"	*Dalbergia sisoo* O. Roxb.
23	87°41'46.6"	26°43'20.8"	No trees found
24	87°41'27.0"	26°43'23.3"	*Dalbergia sisoo* O. Roxb.
25	87°41'29.6"	26°43'24.8"	*Dalbergia sisoo* O. Roxb.
26	87°41'34.7"	26°43'20.4"	*Ehretia acuminata* R.Br.
27	87°40'55.0"	26°43'17.0"	*Tectona grandis* L. f
28	87°40'53.8"	26°43'17.8"	*Dalbergia sisoo* O. Roxb.
29	87°41'9.1"	26°43'19.8"	*Dalbergia sisoo* O. Roxb.
30	87°40'44.0"	26°43'16.8"	*Dalbergia sisoo* O. Roxb.
31	87°41'29.7"	26°43'14.9"	*Dalbergia sisoo* O. Roxb. *Syzygium cumini* (L.) Skeels
32	87°41'49.7"	26°43'13.1"	Trifala
33	87°40'44.2"	26°43'7.7"	*Dalbergia sisoo* O. Roxb.

34	87°40'48.2"	26°43'11.7"	*Dalbergia sisoo* O. Roxb.
35	87°40'46.9"	26°43'7.4"	*Dalbergia sisoo* O. Roxb.
36	87°41'53.7"	26°43'3.6"	*Dalbergia sisoo* O. Roxb.
37	87°41'38.3"	26°43'3.9"	No trees found
38	87°41'47.5"	26°43'3.8"	*Dalbergia sisoo* O. Roxb.
39	87°41'51.3"	26°43'3.0"	*Dalbergia sisoo* O. Roxb.
40	87°41'52.3"	26°42'57.4"	*Dalbergia sisoo* O. Roxb.
41	87°40'37.8"	26°43'1.2"	*Dalbergia sisoo* O. Roxb.
42	87°41'37.0"	26°42'46.5"	*Dalbergia sisoo* O. Roxb.
43	87°41'43.6"	26°42'38.4"	*Dalbergia sisoo* O. Roxb.
44	87°41'56.5"	26°42'32.9"	*Dalbergia sisoo* O. Roxb.
45	87°41'59.0"	26°42'27.7"	*Dalbergia sisoo* O. Roxb.

Table 2: Respondents from Bhutanese refugees

Identity	Respondents	Sex	Age	Date	Address		
					Location	Sector	Hut number
1	Yammaya Subba	Female	49	24-03-2011	Beldangi II	I4	7
2	Sanmaya Subba	Female	60	24-03-2011	Beldangi II	E3	54-55
3	Bal Bahadur Rai	Male	38	24-03-2011	Beldangi II	G1	9
4	Mandari Maya Dahal	Female	45	24-03-2011	Beldangi II	G3	25
5	Tikaram Rai	Male	50	24-03-2011	Beldangi II	G2	22
6	Bagi Maya Wagle	Female	38	24-03-2011	Beldangi II	H1	44
7	Laal Maya Bista	Female	44	24-03-2011	Beldangi II	H3	61
8	Man Bahadur Khadka	Male	77	24-03-2011	Beldangi II	I1	89
9	Nar Maya Bhattarai	Female	30	24-03-2011	Beldangi II	D3	2
10	Jit Bahadur Kunwar	Male	47	24-03-2011	Beldangi II	D4	35
11	Hari Maya Rai	Female	48	24-03-2011	Beldangi II	A2	72-73
12	Saadika Subedi	Female	26	25-03-2011	Beldangi II	A3	59
13	Bhim Kumari Magar	Female	30	25-03-2011	Beldangi II	B4	43
14	Purna Maya Thapa	Female	55	25-03-2011	Beldangi II	C3	43
15	Padam Maya Rai	Female	46	25-03-2011	Beldangi II	E2	41
16	Bir Bahadur Magar	Male	47	25-03-2011	Beldangi II	F1	1
17	Jamuna Sanyasi	Female	28	25-03-2011	Beldangi II	I2	103-104
18	Panchu Maya Rai	Female	61	25-03-2011	Beldangi II	H2	37
19	Aaiti Maya Rai	Female	36	25-03-2011	Beldangi II	F2	103-104
20	Indrakala Ghimire	Female	28	25-03-2011	Beldangi II	D2	108

21	Man Maya Kafle	Female	55	25-03-2011	Beldangi II	C2	48
22	Dambar Singh Rai	Male	55	25-03-2011	Beldangi II	C1	101
23	Kamala Bhujel	Female	32	25-03-2011	Beldangi II	B3	45
24	Bhim Kumari Khadka	Female	28	25-03-2011	Beldangi II	A4	27
25	Laxmi Regmi	Female	22	25-03-2011	Beldangi II	E1	125
26	Man Maya Rai	Female	45	25-03-2011	Beldangi III	B4	22
27	Kausila Magar	Female	60	25-03-2011	Beldangi III	D3	22
28	Dhanmaya Acharya	Female	53	26-03-2011	Beldangi III	D4	65
29	Rita Magar	Female	45	26-03-2011	Beldangi III	B1	79
30	Ganesh Bahadur Lungeli	Male	47	26-03-2011	Beldangi III	C1	51
31	Man Maya Gurung	Female	69	26-03-2011	Beldangi III	C2	14
32	Saha Bahadur Rai	Male	69	26-03-2011	Beldangi III	B2	7
33	Bhupal Chettri	Male	33	26-03-2011	Beldangi III	A3	58
34	Durgalaxmi Rai	Female	41	26-03-2011	Beldangi III	C3	46
35	Dal Bahadur Thapa	Female	61	26-03-2011	Beldangi III	E4	5
36	Pabitra Bishwakarma	Female	45	26-03-2011	Beldangi III	E1	53-54
37	Pabi Maya Poude	Female	60	26-03-2011	Beldangi III	E3	78
38	Kul Bahadur Sanyasi	Male	63	26-03-2011	Beldangi III	B3	30
39	Dhanmaya Bista	Female	43	26-03-2011	Beldangi III	A4	64
40	Chandra Thapa	Female	40	26-03-2011	Beldangi III	B2	30
41	Chalimaya Acharya	Female	40	26-03-2011	Beldangi III	E3	27
42	Ran Kumar Bista	Male	61	26-03-2011	Beldangi III	D1	10
43	Kuberlal Adhikari	Male	45	26-03-2011	Beldangi III	D4	62
44	Nar Maya Adhikari	Female	22	26-03-2011	Beldangi I	G1	97
45	Biman Singh Tamang	Male	52	26-03-2011	Beldangi I	G3	365
46	Kedar Nath Thapa	Male	31	26-03-2011	Beldangi I	G2	154-`155

47	Phul Maya Magar	Female	53	26-03-2011	Beldangi I	G2	205
48	Ambar Maya Rai	Female	50	26-03-2011	Beldangi I	G2	250
49	Pabi Maya Rai	Female	44	26-03-2011	Beldangi I	G3	288
50	Dil Maya Sherpa	Female	45	27-03-2011	Beldangi I	D3	179
51	Dhan Kumari Rai	Male	31	27-03-2011	Beldangi I	F1	73-74
52	Tika Maya Ghale	Female	57	27-03-2011	Beldangi I	F2	165-166
53	Nari Maya Aale	Female	32	27-03-2011	Beldangi I	F3	261
54	Kul Bahadur Magar	Male	37	27-03-2011	Beldangi I	E1	42
55	Rama Dawadi	Female	35	27-03-2011	Beldangi I	E2	141
56	Man Maya Limbu	Female	40	27-03-2011	Beldangi I	E2	178
57	Gyan Bahadur Mainali	Male	50	27-03-2011	Beldangi I	D2	109
58	Bir Bahadur Rai	Male	66	27-03-2011	Beldangi I	D1	77
59	Dil Maya Magar	Female	46	27-03-2011	Beldangi I	C4	379-380
60	Khadga Bahadur Lungeli	Male	43	27-03-2011	Beldangi I	C2	193
61	Rupa Maya Magar	Female	47	27-03-2011	Beldangi I	C3	279
62	Suk Raj Rai	Male	28	27-03-2011	Beldangi I	A1	69
63	Lal Bahadur Tamang	Male	45	27-03-2011	Beldangi I	A2	185
64	Prem Bahadur Gurung	Male	76	27-03-2011	Beldangi I	A3	461
65	Padam Rai	Male	32	27-03-2011	Beldangi I	B2	185-186
66	Sanmati Rai	Female	53	27-03-2011	Beldangi I	B2	176
67	Sam Maya Magar	Female	50	27-03-2011	Beldangi I	B3	280
68	Nanda Rijal	Male	36	27-03-2011	Beldangi I	B4	375
69	San Bahadur Magar	Male	56	27-03-2011	Beldangi I	E2	35
70	Gali Maya Tamang	Female	32	27-03-2011	Beldangi I	C4	75
71	Ganga Maya Magar	Female	27	27-03-2011	Beldangi I	B1	94
72	Bhim Kumari Ghimire	Female	39	27-03-2011	Beldangi I	F4	365

Table 3: Respondents from Community Forest User Groups (CFUGs)

Identity	Respondents	Sex	Age	Date	Ward number
1	Rudra Hari Dhungana	Male	45	27-02-2011	2
2	Padam Bhadur Shrestha	Male	55	27-02-2011	6
3	Govinda Bogati	Male	42	27-02-2011	4
4	Nayaryan Shrestha	Male	80	27-02-2011	7

5	Bhimala Bogati	Female	35	27-02-2011	1
6	Krishan Karki	Male	40	27-02-2011	5
7	Raghunath Mahato	Male	41	27-02-2011	2
8	Prakash Neupane	Male	25	27-02-2011	1
9	Chunamani Silwal	Male	49	27-02-2011	7
10	Tej Kumari Pante	Female	46	27-02-2011	6
11	Amrita Silwal	Female	35	27-02-2011	7
12	Mitra Karki	Male	26	27-02-2011	7
13	Den Bahadur Basnet	Male	37	27-02-2011	6
14	Tika Kalariya	Male	70	28-02-2011	7
15	Bashudev Bandari	Male	53	28-02-2011	6
16	Lal Bahadur Basnet	Male	45	28-02-2011	2
17	Kedar Thapa	Male	52	28-02-2011	2
18	Kedar Bahadur Basnet	Male	47	28-02-2011	6
19	Kalika Chaudary	Female	21	28-02-2011	6
20	Indra Bahadur Dhakal	Male	38	28-02-2011	5
21	Bhshara Chaudari	Male	28	28-02-2011	6
22	Phulwa Chaudary	Male	38	28-02-2011	7
23	Uma Mahato	Female	20	28-02-2011	7
24	Thing Bhadur Gurung	Male	20	28-02-2011	7
25	Dhani Ram Chaudary	Male	35	28-02-2011	6
26	Phul Kumari Chetri	Female	32	28-02-2011	5
27	Sita Ram Chaudary	Male	23	28-02-2011	6
28	Charupia Mahato	Female	40	28-02-2011	6
29	Rewati Upreti	Female	31	02-03-2011	5
30	Jogia Mahato	Male	79	02-03-2011	5
31	Arjun Tiwari	Male	45	02-03-2011	5
32	Shir Pd. Lataula	Male	45	02-03-2011	2
33	Santa Kumari Pariyar	Female	40	02-03-2011	5
34	Hem Bahadur Upreti	Male	33	02-03-2011	5
35	Ram Chaudary	Male	46	02-03-2011	5
36	Megh Nath Kharel	Male	63	02-03-2011	6

37	Tej Prasad Bartaula	Male	48	02-03-2011	5
38	Laxman Ale Magar	Male	43	02-03-2011	5
39	Mohan Chaudary	Male	23	02-03-2011	6
40	Sarswoti Chaudary	Female	29	02-03-2011	7
41	Krishana Chaudary	Male	16	02-03-2011	7
42	Shiva Kanta Sedai	Male	43	02-03-2011	6
43	Shyam Regmi	Male	40	02-03-2011	6
44	Ganesh Prasad Bartula	Male	56	02-03-2011	4
45	Karna Bartaula	Male	65	03-03-2011	3
46	Sharki Mahato	Male	50	03-03-2011	4
47	Bikram Chaudary	Male	55	03-03-2011	5
48	Meena Chaudary	Female	25	03-03-2011	7
49	Pushpa Raj Chaudary	Male	18	03-03-2011	7
50	Manoj Chaudary	Male	24	03-03-2011	7
51	Pudka Chaudary	Male	67	03-03-2011	2
52	Sujani Chaudary	Female	72	03-03-2011	2
53	Kamala Darai	Female	35	03-03-2011	2
54	Raju Chadaary	Male	24	03-03-2011	1
55	Kanun Chaudary	Male	36	03-03-2011	1
56	Krishan Chaudary	Male	44	03-03-2011	1
57	Bifala Chaudary	Male	35	03-03-2011	1
58	Kari Ram Mahato	Male	53	03-03-2011	1
59	Deepak Chaudary	Male	19	04-03-2011	1
60	Kari Ram Chaudary	Male	21	04-03-2011	1
61	Bhishu Chaudary	Female	30	04-03-2011	1
62	Indra Raj Chaudary	Male	44	04-03-2011	3
63	Madev Raymaji	Male	38	04-03-2011	3
64	Hari Bhadaru Dhungana	Male	66	04-03-2011	3
65	Dalle Darai	Male	46	04-03-2011	3
66	Jamun Mahato	Male	50	04-03-2011	3
67	Bishnu Maya Thapa	Female	54	04-03-2011	3
68	Sub Bahadur Tamang	Male	35	04-03-2011	3

69	Deepak Lohani	Male	41	04-03-2011	3
70	Phum Bdr. Bogari	Male	50	04-03-2011	4
71	Dharsharth Chaudary	Male	24	04-03-2011	4

ANNEX V

Reasearcher measuring dbh of tree

Researcher measuring cut stump

Researcher using clinometer for tree height

Interviewing with CFUGs' respondent

Interviewing with Bhutanese refugee respondent

Briquettes provided by LWF to the refugees

Refugee raising livestock

Slice cutting of trees near refugee camp