

# CHAPTER I

## INTRODUCTION

### 1.1 General Background of the Study

Nepal is a mountainous country in Asia, and occupies only 0.03% of the total land surface of the earth. The country is well known for its natural beauty and unique cultural heritage. Nepal has varied climatic conditions from the hot Gangetic plain to the world's highest peak. The country is also very rich in biodiversity. With land area of 143 000 km<sup>2</sup>, the country is endowed with more than 6000 species of flowering plants including 61 bamboo species. Bamboo is important and extensively used in Nepal, however greater knowledge of the various bamboo species and their botanical identification is inadequate. Bamboo is common throughout Nepal, however the intricacies of bamboo cultivation, harvesting and application are not widely understood or propagated. Many other species remain yet undiscovered, mostly in less accessible parts of the country.

Bamboo is a versatile, strong, renewable and environmentally friendly material. It is a member of the grass family, Gramineae, and is the fastest growing woody plant on earth. Most bamboo species produce mature fibre in 3 years, faster than any tree species. Some bamboos grow up to 1 meter a day, with many reaching culm lengths of 25 metres or more. Bamboo is referred to as "arborescent grass" because some species grow to nearly 100 feet tall. Bamboo can be grown quickly and easily, and can be sustainably harvested in 3 to 5 year cycles. It is able to grow on marginal and degraded land, on steep slopes and river banks. It adapts to most climatic conditions and soil types, acting as a soil stabilizer, an effective carbon sink and helps to counter the greenhouse effect.

Although bamboo is classified in the grass family, it has its own very distinct characteristics. They are aptly named the “Elder Brother of Grasses” because of their large size relative to the rest of the grass family. Other names that bamboo is known by are “Poor Man’s Timber” and “Green Gold of the 21st Century”.

Bamboo has been intimately associated with Nepali people since ancient times. Bamboo is an important component of the rural farming system, as it plays a critical role in rural economy and helps sustain the livelihood of many rural households that include socially and economically disadvantaged groups. It is extremely difficult to imagine the rural economy without bamboo (Das2001, 2002a and b)

## **1.2 Statement of the Problem**

Forests are the largest natural resource of Nepal in terms of land area coverage and an expanding human population is exerting pressure on forests. People depend on the forest for firewood, timber, and fodder for livestock and other non timber forest products as well as cattle grazing. As a result of this pressure, forest areas are decreasing and losing their productivity. Out of the total land area in the country, forest area accounted for 38% in 1978/79 whereas that area has decreased now to 29 %. The shrub area (degraded forest) increased during the same period from 4.7 percent to 10.6 percent. This is mainly due to the uncontrolled felling of trees for meeting fuel wood and timber requirements and the need to increase agricultural land. Agricultural areas increased from 235,900 hectares in 1980 to 296,800 hectares in 1999 and have since remained constant. This increment was mainly due to encroachment on forest areas. Forest also have been destroyed for infrastructural development such as roads, irrigation dams and canals, electricity transmission lines, schools, public places, institutional buildings and so on. More

than 12,000 hectares of forest have been used for such infrastructure development (DOF 1999)

As well as decreasing forest areas, deforestation has also caused severe ecological impacts. It has changed the soil characteristics resulting in reduction soil's water holding capacity, porosity, permeability and infiltration and accelerated the surface runoff. The most obvious impacts of deforestation is soil erosion, loss of top soil, silting up of river and lake beds, floods, mass wasting, destruction of roads, bridges, canals, croplands and loss of property and human life.

High population growth rate in Nepal has resulted in the conversion of forest land to agricultural land, as well as creating a demand-supply gap of forest products. Increasing poverty in the rural areas in Nepal has a direct impact on environmental degradation and biodiversity loss. Alleviation of poverty in rural areas therefore has sizable environmental implications (hagon1996) with almost 38% (Tenth five year plan) of the population in Nepal still living below the national poverty line. The current state of the vast majority of Nepal's rural population, with their sole dependence on forest products to meet their daily needs of food, fuel wood, fodder and fiber, is simply not sustainable.

Wood has become scarce, causing degradation of land and forests; it has now become imperative to look for alternative or substitute materials as well as improving land and forest management. Cultivating bamboo is a solution that can meet these human needs in a sustainable way.

Bamboo has not, as yet, been considered an important resource and existing bamboo resources are mostly contained in natural forests. It has not been cultivated professionally yet or been promoted as a commercial product. It has been used in making household utensils in rural areas, fencing and firewood and

for making handicrafts but an expanded market has not been pursued. Most people have not been educated on preservative treatment to increase its durability and its broad application in housing, bioengineering, maintaining environment and industrial use.

Therefore, this study will focus on the following research questions

- ) Why bamboo is not considered a vital resource in the minds of most people?
- ) What types of benefits have rural people received from bamboo?
- ) What traditional knowledge do local people have on resource management, cultivating bamboo and bamboo handicrafts?
- ) How has bamboo played a role in rural economy and maintaining the environment?
- ) How has the local socio-political institution taken initiative to promote professional bamboo farming and a wider bamboo market ?

### **1.3 Objectives of the Study**

This study will mainly focus on the socio-economic impact and cultural acceptability of Bamboo in rural livelihood. It will explore the environmental and ecological impacts of Bamboo in its local surroundings. It will also explore the traditional art of using bamboo, traditional methods and practices adopted on bamboo plantation and the sensitivity and awareness of people on sustainable resource management. It will also study the possibility of professional bamboo farming and widening the potential market for bamboo and bamboo products.

The Main objectives are

- I. To analyze the socio-economic, ecological and cultural impact of bamboo in rural livelihood
- II. To identify the existing practices in bamboo cultivation, and the management and marketing of bamboo products
- III. To promote integrated Bamboo farming professionally and commercialization of bamboo products
- IV. To identify the existing bamboo based micro enterprise and promote their products in various level of market.

#### **1.4 Rationale of the Study**

Report of the Brundtland Commission defined sustainable development as “meeting the needs of the present without compromising the ability of future generations to meet their own needs”(WCED,1987). The concept of sustainability originated in the context of harvesting and managing renewable resources in such a way as not to damage future supplies. Most supporters of sustainability take it to mean the maintenance of the existence of ecological conditions necessary to support human life at a specific level of human well being through future generations. In essence, sustainability has its roots in the notion of ecological sustainability.

Bamboo is a fast growing plant and a renewable resource; it can mature in 2.5 to 3 years, whereas timber takes 20 to 25 years to mature. Bamboo can provide ecological security through conservation of forests by timber substitution, efficient carbon sequestration, and by serving as an alternative materials to non-biodegradable & high energy consuming materials like metals and plastics. Bamboo can also address sustainable food security by the implementation of

bamboo based agro-forestry system, which maintains soil fertility of adjoining agricultural lands.

Bamboo based handicrafts and enterprise can create employment for the number of people. The use of bamboo as a building material can replace current timber use as well as provide cultivation, harvesting and fabrication livelihoods. Integrated bamboo agro forestry with timber, vegetables, fruits and the cash crops is a better option for wasteland management, sustainable supply of resource and income generation for rural people.

Bamboo is distributed all over the country, east to west and north, however the Southern and Eastern part of the country is richer in bamboo resource than the other parts. The South-Eastern Jhapa District is the main area where there is an abundance of bamboo resource, both in forest form as well as cultivated. Bamboos from Ilam and Panchthar is collected and exported to other parts of the country. Khudanabari, Shantinagar, Bahundangi, Bhudhabare and Arjundhara are the main areas of Bamboo resources. Some remarkable practices on plantation of bamboo on riverside to control the flood disaster has been successfully implemented in these areas. This work has been done through Disaster Management committee (DMC), there are 23 DMCs under which Bamboo has been planted in riverside and wasteland. Commercial plantation of Bamboo in private land has also been initiated. Forest Users groups (CFUGs) have also started planted Bamboo along with other trees.

Bhorleni Bamboo Plantation Group has initiated a pioneering work in re-greening wasteland by integrated bamboo farming; this is an example of participatory resource management and proper sharing of the benefits

## **1.5 Organization of the Thesis report**

This Thesis report “*Integrated Bamboo Farming (A case study of Bhorleni bamboo plantation group of Jhoda vlillage, Khudanabari VDC, Jhapa)* is divided in to eleven chapters. The first four chapters are Introduction, Literature Review, Methodology and Setting of the study area. Chapter five describes about the livelihood and socioeconomic aspects of the Integrated bamboo farming in the study area. Chapter six and seven is related with management and Cultivation of the IBF while Chapter eight describes about various methods of preservative treatments to increase the durability of bamboo. Chapter nine explains about the Industrial application of bamboo and ten describes on trade system and market price of the bamboo. Finally, there is section of Summery, Conclusion and Recommendation in Chapter 11.

# **CHAPTER II**

## **LITERATURE REVIEW**

### **2.1 Theoretical review**

Ecology as a science blossomed in the twentieth century, but was mostly restricted to the study to the study plants and animals other than man. However in the late 1930's Steward, who was a pioneer anthropologist, made important contributions through his method of Cultural Ecology. Cultural Ecology recognizes that the environment and culture are not separate spheres but are involved in "dialectic interplay or what is called feedback or reciprocal causality (Hardesty 1977:8, Kaplan and Manners, 1972:79). Similarly, Conklin and Frake made a series of thought provoking papers on Human Ecology that were published in the mid 1950's. They suggested that ecologically oriented ethnographers would do well to combine traditional techniques from cultural and biological ecology with others designed to more systematically to explore native conceptions of their environments (Ibid).

Ecological models have become a popular approach in anthropology to describe a subsistence economy and to determine what constraints or limiting factors operate in a particular system. If the ecological model is comprehensive, then it enables the researcher to examine the interrelation of environment and economy. An environment of subsistence economy includes elements of both the physical environment and the cultural environment. The physical environment (a biotic) accounts for such things as climate, soil, water, vegetation, forest, and fauna and so on. The cultural environment (anthropic) includes such things as local technology cultural attitudes and beliefs, social organizations and external elements that impinge on or are exploited by the society (institutional) such as government, markets, outside markets, outside traders, and employment



opportunities. The constraints operating in the choice of a particular economic strategy lie not only in the physical and biological environment but also in the economic and cultural systems within which decision are being made. Considering both environmental and cultural settings allow the researcher/analyst to see which constraints are important and how these will affect economic decision making.

## **2.2 Bamboo Resources in Nepal**

Out of the 75 districts of Nepal, 73 are known to have one or more species of bamboo and due to prevalence of more humid climatic conditions; the eastern half of the country has a higher biodiversity than the western half. It is estimated that the total growing stock of bamboo in Nepal is around 15 million cubic meters with an approximate biomass value of 1060 M. tons. The total coverage of the area is estimated to be around 63,000 ha out of which 60% is estimated to be in natural forests. Annual production of bamboo culm is estimated at 3.01 million out of which 2.64 is internally consumed and around 0.64 m. culms are exported to India. On average, each household consumes about 46 stems/year. Around 102 M. tons of bamboo shoot is estimated to be annually produced in Nepal, all of which consumed locally. It is estimated that there are around 81 processors and 509 trading firms in Nepal directly employing over 1500 people.(*Joshi B. &Amatyas.,2005*)

**Table 1 Estimated hectare of bamboo stand in the natural forests of Nepal**

<b>S.N</b>	<b>Region</b>	<b>Estimated Area (Ha)</b>
01	Eastern development region	23,565
02	Central Development region	17,453
03	Western Development region	11,528
04	Mid west & far west Dev.region	11,528
	<b>Total Area</b>	<b>62,891</b>

*Source: Joshi R.B & Amatya S.M, Bamboo and Rotton Development in Nepal, 2005*

**Table 2 Estimated Growing Stock of Bamboo Resources in Nepal**

<b>S.N</b>	<b>Region</b>	<b>Estimated Area (Ha)</b>	<b>Est. Biomass (M.tones)</b>
01	Eastern development region	6,104	407.5
02	Central Development region	6,363	424.2
03	Western Development region	2,065	137.7
04	Mid west & far west Dev.region	1,372	91.9
	<b>Total Area</b>	<b>15,904</b>	<b>1,061.3</b>

*Source: Joshi R.B & Amatya S.M, Bamboo and Rotton Development in Nepal, 2005*

**Table 3 Estimated production, consumption, and percent sold of bamboo stems**

<b>Region</b>	<b>Production (million stems)</b>	<b>Estimated Consumption per household/year</b>	<b>In-country Consumption (million stems)</b>	<b>Export (million stems)</b>
<b>Eastern</b>	1.22	42	0.98	0.24
<b>Central</b>	1.23	60	1.10	0.23
<b>Central</b>	0.29	52	0.29	
<b>Far-western</b>	0.27	28	0.27	
	3.01	45.5	2.64	0.46

*Source: Joshi R.B & Amatya S.M, Bamboo and Rotton Development in Nepal, 2005*

### **2.3 Role of Bamboo in Ecology**

Rapid industrialization, human population growth, urbanization and globalization have an adverse effect on the existing environment. This is accentuated by the fact that there is already heavy pressure on the forest. People depend the forest for firewood, timber, and fodder for livestock and other non-timber forest product as well as cattle grazing. Forest have also been destroyed for infrastructural development such as roads irrigation, dams and canal, electricity transmission line, school and institutional building and so on. Deforestation does not only decrease forest area but also has an adverse impact on ecology. It changes the soil characteristics, resulting in the reduction of soil holding capacity, porosity, permeability and infiltration and the acceleration of surface runoff of rainwater. The most obvious impact of deforestation is soil erosion, loss of fertile top soil, silting up of river and lakebeds, floods, mass wasting and destruction of roads, bridges, canals and other infrastructure. ( Lekhak D. & Lekhak B.2005). Bamboo can provide ecological sustainability through conservation of forests through

timber substitution, efficient carbon sequestration, and providing alternate materials to non-biodegradable and high-energy consuming materials like metals and plastics. ( Karki M.,Sherchan G.,Karki J. 1998).

Bamboo is the fastest growing plant. It produces greater biomass and 30% more oxygen than a hardwood forest on the same area, while improving watersheds, preventing erosion, restoring soil, providing sweet edible shoots and removing toxins from contaminated soil. Bamboo can be used to produce structural beams, flooring, wall paneling, fencing and many more sustainable by-products of environmental restoration. Bamboo timber can be harvested every year after 3 years, compared to 30 to 50 years for trees. With a 10 to 30% annual increase in biomass versus 2-5% for trees, bamboo can yield 20 times more timber than trees on the same area. Bamboo can be selectively harvested annually and regenerates itself without replanting. Bamboo generates 30% more oxygen than trees. It helps reduce carbon dioxide gases blamed for global warming. Some bamboo sequesters up to 12 tons of carbon dioxide per hectare acting as a natural air filter and oxygen generator. Bamboo is a natural water control barrier. Because of its wide spread root system and large canopy, bamboo greatly reduces rain run off, prevents massive soil erosion and keeps twice as much water in the watershed. Bamboo also helps mitigate water pollution due to its high nitrogen consumption, making it a solution for restoring soil with excess nutrients. Excess nutrients commonly occur in locations such as wastewater disposal sites from manufacturing, livestock farming and sewage treatment. Bamboo can restore degraded lands. It is a pioneering plant and can be grown in soil damaged by overgrazing and

Poor agriculture. Proper harvesting does not kill the bamboo plant, so topsoil is held in place. Because of its dense litter on the forest floor it feeds topsoil, restoring healthy agricultural lands for generations to come.  
<http://www.bamboocentral.org/whybamboo.html#top>

## **2.4 Role of Bamboo in Bioengineering**

Deforestation in mountain slopes, unmanaged grazing, unsustainable agricultural practices, environmentally unfriendly ways of mining and stone quarrying have been major causes of the disasters like mass wasting, landslide in the hilly areas and flooding in the plains. Landslides and floods are considered natural disasters, however since 1960s unsustainable human activities have contributed to sharp rises in flood deaths and damages. Landslide and flood frequency and intensity are increased by the replacement of the water-absorbing vegetation areas and wetlands with highways and parking areas that causes rapid runoff of rainwater (Lekhak D. & Lekhak B. 2005). Bamboo is known as the natural soil binder and it is a very useful plant for bioengineering purposes. Its net-like root system creates an effective mechanism for watershed protection stitching the soil together along fragile riverbanks, deforested areas and in areas prone to earthquakes and mud slides. Because of their wide-spreading root system, uniquely shaped leaves, and dense litter on the forest floor, the sum of stem flow rate and canopy intercept of bamboo is 25%. This means that bamboo greatly reduces rain runoff, preventing massive soil erosion and keeping up to twice as much water in the watershed <http://www.bamboocentral.org/whybamboo.html#top>.

Bamboo is a pioneering plant and can be grown in soil damaged by overgrazing and poor agricultural techniques. In South-East Nepal, bamboo has been planted in the roadside of hilly areas to reinforce the soil and control the landslide whereas in the plains it has been planted in riversides and wasteland to control flooding. In Jhapa District, the Disaster Management Committee (DMC) has taken the initiative to plant bamboo in riverbanks in collaboration with the District Soil Conservation Office and the Local NGOs. (Progress report DISCO, 2063)

## **2.5 Role of Bamboo in rural livelihood**

Bamboo has not been planted commercially much yet in Nepal, though it has been an essential part of rural livelihood. Household daily using items like baskets (*Doko, Dalo*), mats for storing grains (*Bhakari*), *Nanglo* (mat used for screening grains), *Namlo* (rope used to carry luggage on people's back), *Damlo* (rope used to tie the cattle's neck) are made from bamboo. Dry bamboo is also widely used as firewood for cooking and its leaves for cattle fodder. Bamboo is used for gates and fencing off land as well as in shelters for rafters, pillars and purlins. People earn money in various ways from bamboo, some people earn by selling the bamboo culms, some by selling the handicrafts of bamboo in the market and some by selling young bamboo shoots for food. Baskets have a good market within rural areas as well as in urban areas. Handicrafts made from bamboo have good market within the country as well as in export markets. Bamboo shoots are a popular food item as they are tasty as well as being nutritious. People in the South-East of Nepal have more income from the bamboo because of the abundant existing bamboo resource well as a larger market with nearby Bhutanese refugee camps requiring bamboo for temporary huts. The earnings from the selling of bamboo as well as bamboo items has allowed people of rural areas to meet their daily needs.(Karki M., Sherchan G., Karki J. 1998)

## **2.6 Role of bamboo in Eco technology**

Eco technology offers specific technological solutions for sustainable development. It implies the blending of traditional wisdom and environmentally friendly technologies with frontier technologies such as biotechnology, information technology, renewable energy technology, information technology new materials or space technology. Eco technology is not merely a technology, but also defines the process of strengthening the codes practices and guidelines with in the framework of sustainable development. For a technology to be classified as an

eco technology has to be environmentally friendly, scale natural and gender neutral, ([www.biodiversityinternational.org/publications](http://www.biodiversityinternational.org/publications)) so bamboo based technology specially in housing classifies as eco technology.

## **2.7 Role of bamboo in Agro forestry**

Agro forestry is the integration of woody plants with other enterprises such as crop or livestock production. The idea behind agro forestry is to derive both economic and ecological benefits, two key goals of sustainable agriculture.

Bamboo plays a crucial role in almost all terrestrial ecosystems and provides a range of products and services to rural and urban people. As natural vegetation is cleared for agriculture and other types of development, the benefits that bamboo provides are best sustained by integrating bamboo into agriculturally productive landscapes — a practice known as agro forestry.

Farmers have practiced agro forestry for years. Agro forestry focuses on the wide range of working trees grown on farms and in rural landscapes. Among these are fertilizer trees for land regeneration, soil health and food security; fruit trees for nutrition; fodder trees that improve smallholder livestock production; timber and fuel wood trees for shelter and energy; medicinal trees to combat disease; and trees that produce gums, resins or latex products. Many of these trees are multipurpose, providing a range of benefits. (*Diver S.2001*)

**Table 4 Uses of bamboo in agro forestry**

<b>S.N</b>	<b>Agro forestry Function- Primary Use</b>	<b>Agro forestry Products Value-Added</b>
01	Inter cropping	Timber
02	Riparian vegetation filter	Craft wood
03	Constructed wetlands	Fiber crop
04	Living screens	Livestock forage
05	Permaculture	Bamboo shoots

*Source: Diver S.2001, Bamboo : A Multipurpose Agro forestry plant*



## **CHAPTER III**

### **METHODOLOGY**

#### **3.1 Rationale of the Selection of Study Area**

Jhapa is rich district in bamboo resources, which is a main bamboo collecting as well as trading point. Bamboo and bamboo-based products from the Ilam, Panchthar and other parts of the district are collected and sent to different parts of the country as well as to India. There are several applications of bamboo that are put into use in Jhapa, for example disaster management, housing materials, landscaping, fodder and firewood and so on. Jhoda Village of Khudanabari VDC of Jhapa is purposively selected as a study area after reconnaissance survey, as it is model place of the integrated bamboo farming. Jhoda village was selected taking consideration the following items:

- ) Historical background of the village was determined. People who had migrated from hill areas after being cleared of forest by the land and timber mafia settled the land.
- ) Bhorleni Bamboo Plantation Group was established as a solution settling the confrontation being taken place between District forest office and villagers for a long time.
- ) The villagers worked together to manage the community bamboo as well as share the benefits equally among the group members and also provide a certain percentage to local government and use a certain percentage for the extension of the plantation.

) Researcher himself is working in the related field specially promoting bamboo as environmental friendly construction materials for housing as well as cultivation and nursery management since 2006.

### **3.2 Research design**

Both descriptive as well as exploratory types of research design were applied in the research study. It is hoped that the descriptive research design was able to describe all aspects of integrated bamboo farming systems. Using this method the researcher was able to assess the availability of resources, its applications, existing management systems, current and potential trading situation, and its impact on rural livelihood, as well as local environment and sustainability. It also systematically describes the method of propagation and the potential of commercial bamboo farming. Exploratory method was applied to obtain the information on market price, market channel, place and quantity of trading as well as current trade practices. It was also helpful in finding out the information on household uses, cultural value, local indigenous methods of cultivation, resource management and sharing of benefits within the community.

### **3.3 Nature and Sources of data**

#### **3.3.1 Primary sources of data**

Primary data were collected by field observations, informal interviews, semi-structured questionnaires, rapid vegetative analysis and group discussion with bamboo plantation groups, FUG members, Disaster Management Committees, Local traders, local craftsman, women saving groups, farmers, NGO, DFO and DSCO staff involved in cultivation and management of bamboo. Checklists and questionnaires were developed before going to the field. In addition, some PRA tools and techniques were also used to collect information such as season of

plantation harvesting of the bamboo as well as vegetables and cash crops planted along with the bamboo etc. Information regarding scientific methods of propagations of bamboo, industrial processing and application and treatment of bamboo were obtained by visiting Wood Science Technology, Bangalore, IPIRTI(Indian Plywood industry Research and Training Institute) Bangalore, CBTC (Can and Bamboo Technology Centre) Assam, India.

### **3.3.2 Secondary Source of data**

Secondary data constituted another source of data collected for the study. Primarily, secondary data was obtained from VDC profiles and records, meeting minutes and records of the Bhorleni Bamboo Plantation Group, district profile, records of DFO and DSCO, literatures related to ethno botany, agro forestry, bamboo cultivations and bamboo species available in Nepal. Information available in the Department of Forest Research and Survey were also used. Information was also collected by visiting various websites.

### **3.4 Universe and Sampling**

The Bhorleni Bamboo plantation group of Jhoda was purposively selected. Bhorleni bamboo plantation group is the universe of this study population comprised of 180 households. Out of 180 households 35% (63 households) sampling intensity was maintained. In this research study each household is one sampling unit. Beyond the sampling area some of the farmers CFUGs having cultivation of bamboo on their private lands and forests were also visited. Likewise, to obtain the market price and information systems, some bamboo traders of Shantinagar, Bahundangi, Jayapur, Bhudhabare, Dhaijan, Lakhanpur and Ilam were also visited and interviewed by the researcher.

## **3.5 Data collection and techniques**

### **3.5.1 Rapid vegetative analysis (RVA)**

Ecological information of locally available bamboo species, intercropped plants and condition of the planted area were obtained by this method.

### **3.5.2 Informal Interviews**

Villagers, Members of the Bamboo Plantation groups, local craftsmen, traders, farmers, Micro finance groups, Village Bank groups, Staff of Bamboo Enterprise for Habitat, DMC members, staff of DFO and DSCO were informally interviewed to obtain the information on their activities and involvements in Bamboo plantation, management and application. Information on challenges faced in plantation, marketing and management were also acquired through these interviews.

### **3.5.3 Group discussion and Informal interaction**

Group discussion and interactions were made at different places and times. The Researcher participated in bamboo plantation group meetings as well as planning and review workshops. This tool was used to explore information on seasons of collection cultivation and harvesting of bamboo and types and seasons of intercrop plantation, preference ranking, traditional uses of bamboo, indigenous management system, seasonal calendar etc.

### **3.5.4 Field Observation**

The Bamboo plantation area was visited to acquire information on types of bamboo species, types of vegetables, cash crops, fruits and other timber plants

planted along with the bamboo. Researcher also visited some bamboo nurseries, wastelands and riversides to observe the use of bamboo for flood control. The Researcher also visited in CBTC Assam, IPIRTI, Bangalore and institute of wood science technology in India to observe processing and industrial application of bamboo, nursery management and chemical treatment to increase the durability of bamboo.

### **3.5.5 Semi-structure questionnaires**

Semi-structured Questionnaires were developed and used to obtain ecological, economical, social and environment impact of integrating bamboo in the life of local people. It was also used to obtain information on yearly income, expenditure, land holding, education, occupation, culture, market, cultivation, management as well as the involvement of local people in different activities related with bamboo.

### **3.5.6 Case studies**

Various case studies have been developed to share the broader practices applied to integrated Bamboo farming by local people, uses of bamboo in bioengineering and housing.

### **3.5.7 Historical studies**

Historical studies were also carried out to explore how the forest was cleared in the past and occupied by the migrated people, conflict between the local people and district forest office authorities and conflict management practices carried out to protect the degraded land.

### **3.6 Data processing and Analysis**

All the data collected from the numerous sources are analyzed in the subsequent chapters using various methods of analysis. The collected data was processed and statistically analyzed to make them clear and scientific. The data entry was done in Microsoft Excel. Cross tabulation, percentage distribution and frequency tables were the main tools to analyze the data. In order to make it easy to understand the results of the study, charts and figures are also presented in some cases.

### **3.7 Limitation of the Study**

Like other research work, this study was also not entirely free from constraints. This study was done in Jhoda Village of Jhapa focusing on integrated bamboo farming with the primary objective being the partial fulfillment of the Master's degree requirement of anthropology. However only Borleni Bamboo plantation area was selected for the study with limited time, budget and manpower. The respondents do not keep the actual records in written documents of the daily activities, hence the data obtained from interviewing were subject to their memory. As Bamboo is a new topic chosen for the study, it was difficult to get enough written and published literature.

# **CHAPTER-IV**

## **THE SETTING**

### **4.1 Introduction of Jhapa district**

Jhapa district lies between 26°2' to 26°5' N latitude and 87°39' to 88°12' longitude and is located in the far eastern Terai region of Nepal. This district is surrounded by west Bengal, India in the east, Bihar, India in the south, Morang district in the west and Ilam district in the North. The altitude of this district varies from 50 m to 500 m. The lowest place is called Kechana and the longest bridge, Kankai, of Nepal lies in Jhapa. The total area covered by the district is 1,606 sq.km. A total of 63.37% of the area is covered by cultivated land and 12.43% is covered by forest. Jhapa district is divided into three Municipalities, 47 VDC's and 7 parliament regions.(DDC Profile 2061)

#### **4.1.1 Geographical setting**

Northern part of the district is called Bhabar and the soil is made up of deposited sandy soil brought by the river. A total of 50% of the area is covered by the Bhabar region. The southern part of the district is Terai region which has occupied the 50% of the total area. Soil of the southern part is fertile and the rivers Mechi, Kankai, Ratua, Biring, Ninda and Mawa are the main rivers that flow through this area. The Mechi river makes up the eastern boarder and the Mawa River the western boarder. The waters of these rivers irrigate all the cultivated land of the district and all of these rivers originate in Ilam and Panchthar.

# Map of Jhapa Indicating Khudanabari VDC



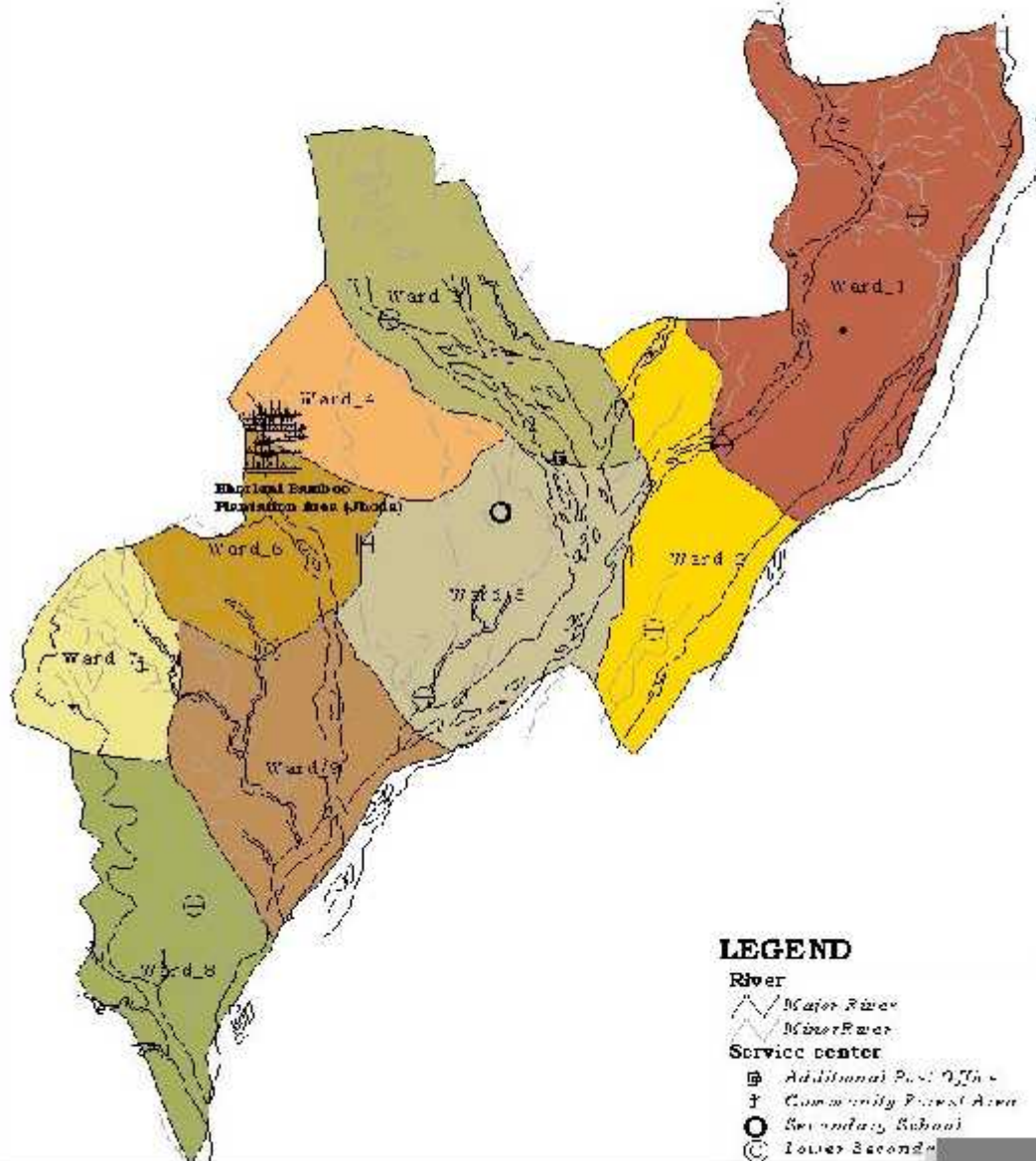
Source: Topo Map, Esri/Mapbox & © 2018 Mapbox

Prepared by: Design and Map: DDC, (DTRC), Jhapa

Map.1 Map of Jhapa district showing Khudanabari V.D.C



# Map of Khudunabari VDC With Study Area



Map 2: Map of Khudunabari V.D.C indicating the study area

### **4.1.2 Biodiversity**

Jhapa is rich in its biodiversity with various species of flora and fauna. The district is characterized with tropical and subtropical vegetation types. Sal tree (*shorea rubosta*) is the major species which occupies 84% of the forest area, Simal, Khayar, Tuni, Maleto, Sisso, Siris, Chilaune, Bhud dhairo, Satisal, kadm, Tik and Karma are the other species along with Sal tree. Mal Bans (*bambusa nutans*), Bhalu bans (*dendrocalamus giganteus*). Choyabans (*bambusa subsp.*) are the major bamboo species found in Jhapa. Rudhilo, Bel, Amala, Harro, Barro, Pipla, Abijalo, Titepati, Rajbrikchhya, Paniamala, Barmeli Dhaniya, Kurilo, Bayar, Hadchur, Taruwa, Kamaru, Bako, Gurjo are the main medicinal plants. Chital, Dumsi, Thatari, Malsapro, Bandel, Khurkhure, Jackle, Money, Bandhade, Chituwa, Patebagh, Salak, Boasso and Jarayo are the main animals found in Jhapa. Mayur, Luenche, Dhukur, Suga, Maina, Koili, huttityau, Eagle, are the main birds found in Jhapa.

### **4.1.3 Climate and weather**

Climate of Jhapa is tropical and subtropical and seasons can be divided in to three categories. The first is hot and rainy season which prevails from June to September; the second is post monsoon season from October to January. In the beginning, the weather is characterized by warm and moist, followed by cool and cold. The third season is pre monsoon season extending from February to May which is dry and hot. During summer season temperature reaches 38° c to 42°c during winter season it goes down up to 15°c to 5°c. Due to the monsoon wind from the Bay of Bengal rain falls up to 200 cm during winter season.

**Table 5 The recorded temperature of Jhapa on January to December 2004 is as follows**

Date/Month		Temperature in °c		Rainfall (mm)
		Maximum	Minimum	
2004	January	23.0	8.8	20.4
2004	February	27.5	11.3	0.00
2004	March	31.7	17.6	10.2
2004	April	31.4	20.5	93.2
2004	May	32.8	22.7	245.3
2004	June	33.3	23.7	308.7
2004	July	31.6	24.1	903.0
2004	August	34.2	24.9	327.1
2004	September	33.2	23.3	412.7
2004	October	31.9	18.7	130.7
2004	November	30.6	13.0	0.00
2004	December	27.4	11.3	0.00

*Source: DDC profile 2061*

#### **4.1.4 Population, households and population density**

According to the census of 2058, total population of Jhapa district is 6, 88,109. Out of total population the population of male is 3,41,675 (49.65%) and the population of female is 3,46,434(50.35%). Total number of household is 1,37,301 and the average family size is 5.01. Population density of the district is 428/Km square. Population growth rate is 1.48, which is less than National population growth rate 2.24. (*Source: profile 2061*)

#### 4.1.4.1 Caste and Ethnicity

Jhapa is multi caste district with diverse ethnicity .There are altogether 99 castes in Jhapa district Bramin, Chhetri, Rajbanshi, Limbu and Rai are in majority according to their population.

**Table 6 Population of Jhapa according to Ethnicity**

Category	Male	Female	Total population	Percentage
Chetri/Bramin	125,929	129,223	255,152	40.30
Ethnic &Indigenous	130,826	132,077	262,903	41.53
Dalit	22,818	23,184	46,002	7.27
Others	35,054	33,931	68,985	10.90
<b>Total</b>	<b>314,627</b>	<b>318,415</b>	<b>633,042</b>	<b>100.00</b>

Source: DDC profile 2061

#### 4.1.4.2 Religion

In Jhapa district dominant is Hindu (79.37%) follow followed by Kirat (9.02%)

**Table 7 Population according to religion**

S.N	Religion	Total Population	Percentage
1	Hindu	502,451	79.37
2	Buddhist	31,648	5.32
3	Muslims	19,367	3.01
4	Kirat	57,939	9.02
5	Jain	298	0.01
6	Christian	4,824	0.76
7	Sikh	1,658	0.26
8	Bahai	37	0.005
9	Other	14,820	2.34

Source: DDC profile, Census 2001

## **4.2 Study Area: Jhoda**

### **4.2.1 Geographic Setting**

Jhoda is the key study area of the research, which includes ward no: 4 and 6 of the Khudanabari VDC. The Jhoda village is surrounded by forest in the west, Subba pahini in the east, graveled road in the south and Ilam district in the North. The Altitude of the study area is about 350 metre and lies in the Bhabar zone. The meaning of the Jhoda is an established human residence after clearing the forest. Jhoda once was a forested area, however the land timber mafia and land mafia cleared the forest and later people migrated from Panchthar and Taplejung and occupied the open land and settled there. Jhoda is 20 km far from the district headquarter (Chandragari) and 8km far from the Birtamode, one of business markets of Jhapa.

#### **4.2.1.2 Climate and weather**

Jhoda village is located at the base of Churiya range in between the junction of Terai and Hill, so there is a slight difference in the climate of overall Jhapa and Jhoda. The area expands in subtropical region and the maximum intensity of the rainfall occurs between late June and early September and has a higher rainfall than other parts of Jhapa. Maximum temperature of the Jhoda goes up to 35°C in summer and minimum goes down to 14°C to 5°C in winter.

#### **4.2.1.3 Vegetation**

Vegetation of the Jhoda is characterized by tropical forest, predominantly made up of Sal (*Shorea robusta*). Other plants are planted bamboo (*Bambusa*)

along with hard nut trees, Sisoo (*Dalbergia sisoo*) Simal (*Bombax ceiba*), Chilaune (*Schima wallichii*), Tejpatta (*Cinnamomum tamala*) and others.

#### **4.2.2 Socio-economic setting**

##### **4.2.2.1 Population**

##### **4.2.2.1.1 Sample Households, density and Household sizes**

Total population of the Jhoda village is 1,069 with 556 male and 513 female residing in 180 households (source: V.D.C profile). Most of the family initially live together in joint families but as the family grows if as the sons marry they generally choose to live separately once they have children.

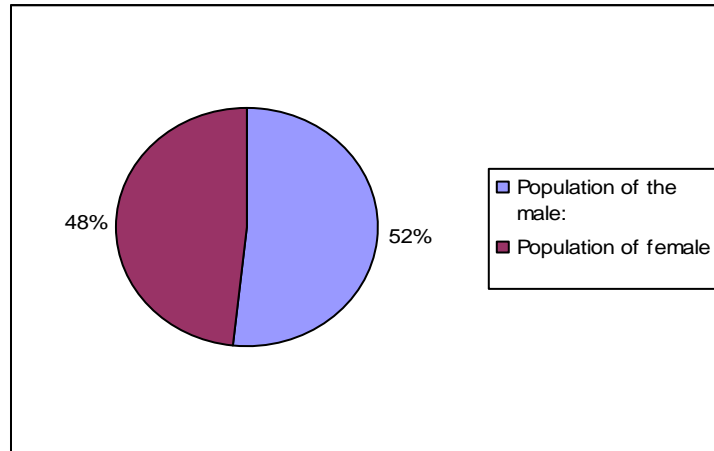
The total population of Sampled Household (SHH) is 374 out of the total population, the number of males is 193 and number of females is 181. The average family size of the respondent household is 5.94 which is a little above the national average family size 5.45.

**Table 8 Distribution of sex of SHH**

<b>S.N</b>	<b>Sex</b>	<b>Frequency</b>	<b>Percentage</b>
01	Male	193	52%
02	Female	181	48%
03	Total	374	100%

*Source (field survey, September 2008)*

**Figure 1: Population of Sample Households (SHH)**

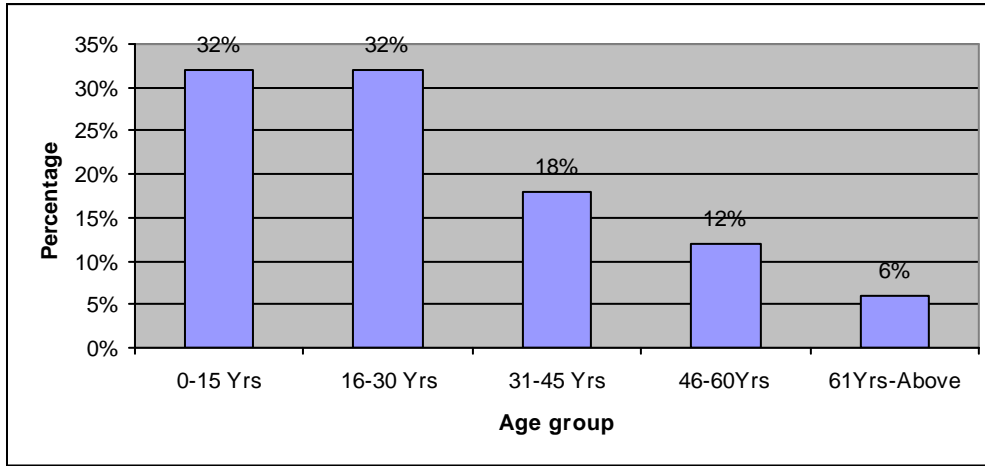


*Source: September 2008*

#### **4.2.2.1.2 Distribution of population according to Age group**

The total population of the respondent's household was categorized into five groups according to their age group. These five groups were 0-15 yrs, 16-30 yrs, 31-30 yrs, 46-60yrs and 60 above. The majority age group was 0-15 and 16-30, both groups composed 32% of the population. The age group of 31-45 years was found to be 18% , and the age group of 46-60 was found 12% and finally the Above 61 years Age group was found to be 6%.

**Figure 2: Population of SHH According to Age group**



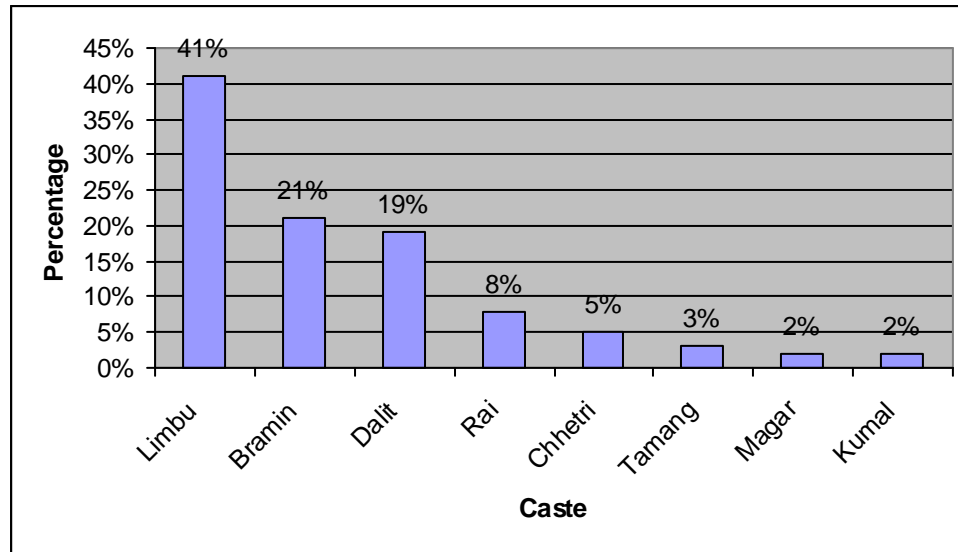
*Source: field survey September 2008*

#### **4.2.2.2 Caste and Ethnicity**

The study area consists of diversity in ethnicity although there is majority of population is Limbu occupied by 41% followed by Bramin, Dalit, Rai and Chetri. There is only few percent of Tamang, Magar and kumal. Occupational caste like kami, Damai, Sarki are categorized into Dalit. Figure 3 presents the presents the percentage of caste distribution of the SHH.



**Figure 3: Caste and Ethnicity of SHH**

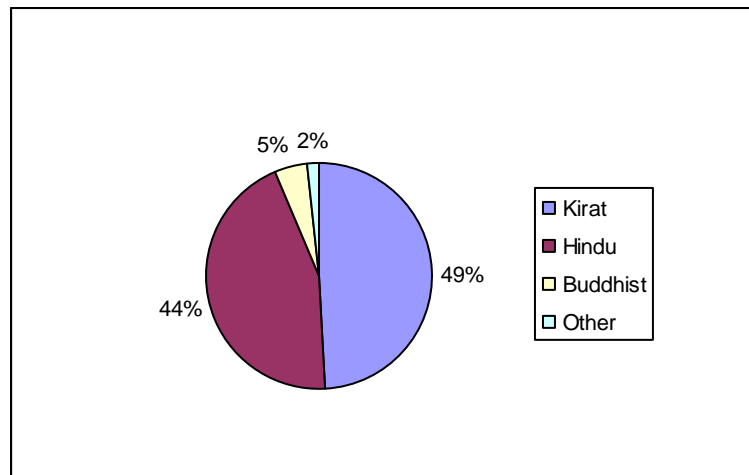


*Source: Field Survey September 2008*

#### **4.2.2.3 Religion**

In the study area mainly three kind of religion are found followed by the SHH families, Kirat, Hindu and Buddhist. Both Limbu and Rai follow the same religion, Kirat, whereas Brahmin, Chhetri and Dalits are allied to Hindu. Tamnag and Magars were found to be Buddhist.

**Figure 4 : Religion of the SHHs**



#### 4.2.2.4 Cultural features of the village

Majority of people living in Jhoda are Limbu, 41% and Rai, 8%, the remaining populations are Brahmins, Chhetris, Dalits, Tamang and Magar. Brahmin, Chhetri and Dalits who belongs to Hindu religion normally have Hindu culture, celebrates Dashain and Tihar as primary festivals whereas Tamang and magar Follow the Buddhist culture and celebrate Buddha Jayanti.

Limbus and Rais have their own culture, *Chasotangnam* (Nwagi Puja) is the main festival of the Limbu, which is also called *Umauli*. This festival is celebrated during the time of storing new crops inside the house. In this occasion they worship several of their Gods (*Thakurani Maharani, Ban Budheni and Lati Budheni*) asking them for blessing for the coming year. *Maghe Sakranti, Srawane Sakranti and Chaite Dashain* are the other primary festivals of Limbus.

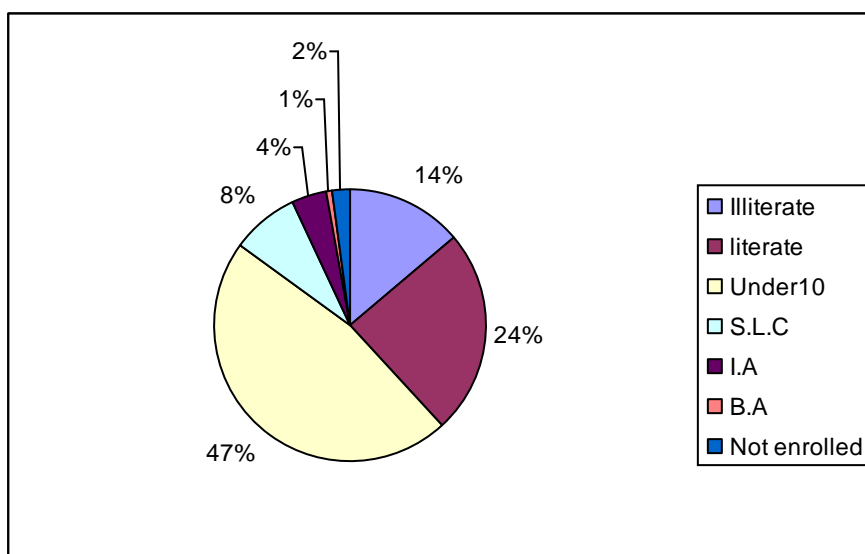
*Bijuwa* and *Phedangma* are the key persons who are involved in their various rituals. Upon the sudden accidental death of a person, the Bijuwa is involved in the death ritual to send the soul to the afterlife. The Phedangma is the priest who recites the *Garud* Name for a child, a name given only after four months of the birth and for female child it is given after three months. For a marriage, once the bride is selected, the family from the groom has to submit *Sunauli and Rupauli* (sunauli means Gold and Rupauli means cloths) as per the demand of the bride's family. During the death ritual, the body of a person who has died a normal death is buried and is the body is burnt for an unusual accidental death (*Agati parera mareko*).

#### 4.2.2.5 Literacy and Education

The information on literacy rates was collected by asking respondents whether each household members of six years and above could read and write and if they could where they had learnt how to. It was noted that people generally refer to a person as literate if that person was enrolled in school for a short time or graduated from a non-formal education. Out of the total population of the sampled household, 24% were found literate from an informal education, 47% dropped out before completing Grade 10, 8% have passed S.L.C, 4% have passed intermediate level, 1% Bachelor level 2% not admitted at school and 14% Illiterate.

Figure:6 represents the literacy level of respondents in the study area. It shows that majority of the population (86%) are literate and only 14% of are illiterate.

Figure 5: literacy Status of the SHHs



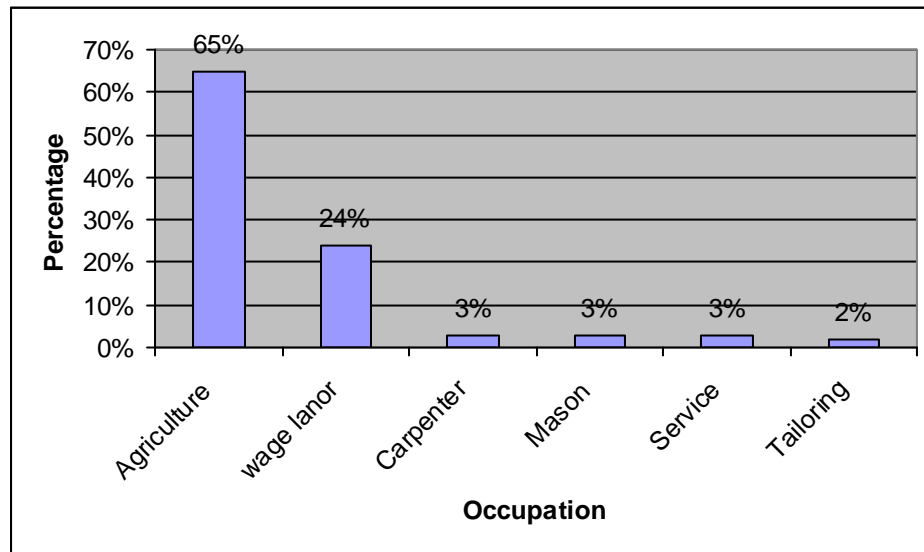
Source: Field survey, September 2008

#### 4.2.2.6 Occupation

The majority of the families occupation is agriculture. Many families also work as seasonal wage laborers. 65% of the respondents are engaged in agriculture, which includes working in the field, rearing cattle, managing bamboo planted field etc.

Male youths of some SHH have migrated to Gulf countries to work as daily laborers.

Figure 6: Occupation of the SHHS



*Source: Field survey, September 2008*

#### 4.2.2.7 Income and Expenditure of the SHH

The monthly income range of the SHH was divided in to four categories. Categories were Rs.2000-3500, Rs.3600-5000, Rs 5100-6500 and 6500- above.

Out of those categories, the majority of SHH were found in to be the category of Rs.3600-5000, 41%, and then in category Rs.2000-3500, 32%.

**Table 9 Monthly Income range of the SHH**

S. N	Income range	2000-3500	3600-5000	5100-6500	6500-above
1	Frequency	20	26	12	5
2	Percentage (%)	32	41	19	8

*Source: Field survey, September 2008*

Likewise, the monthly expenditure of the SHH was also divided in to four category, Rs.2000-3000, Rs.3100-4000, Rs.4100-5000 and 5100-above. Out of the four categories majority of the SHH were found in the second category Rs.3100-4000, 43% and in the first category Rs.2000-3000, 32%. Monthly expenditure range of the SHH has been presented in the table below.

**Table 10 Monthly expenditure range of the SHH**

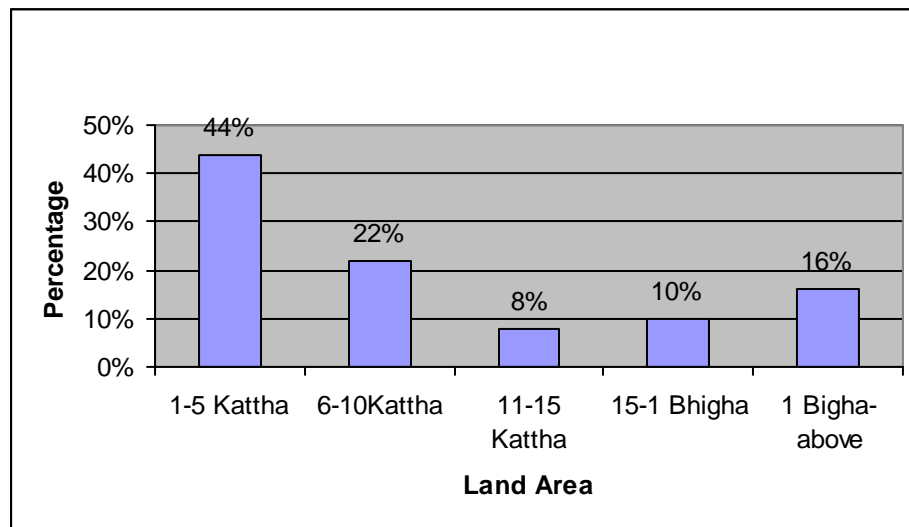
Expenditure range	2000-3000	3100-4000	4100-5000	5100-Above
Number	20	27	14	2
Percentage (%)	32	43	22	3

#### **4.2.2.8 Land holding Size ownership and food sufficiency of the Village**

Almost all the land belong to the people of the village apart from those without any land title, called *Ailani jagga*. Type of the land is both *pakho and Khet*. Land holding size varies significantly in the household economy of the area. Some

household have occupied up to five *bigha* and some households only have a few Kattha. The SHH were classified in to five categories depending in the landholding size.

**Figure 7:Land Occupied by the SHHs**



*Source: Field survey, September, 2008*

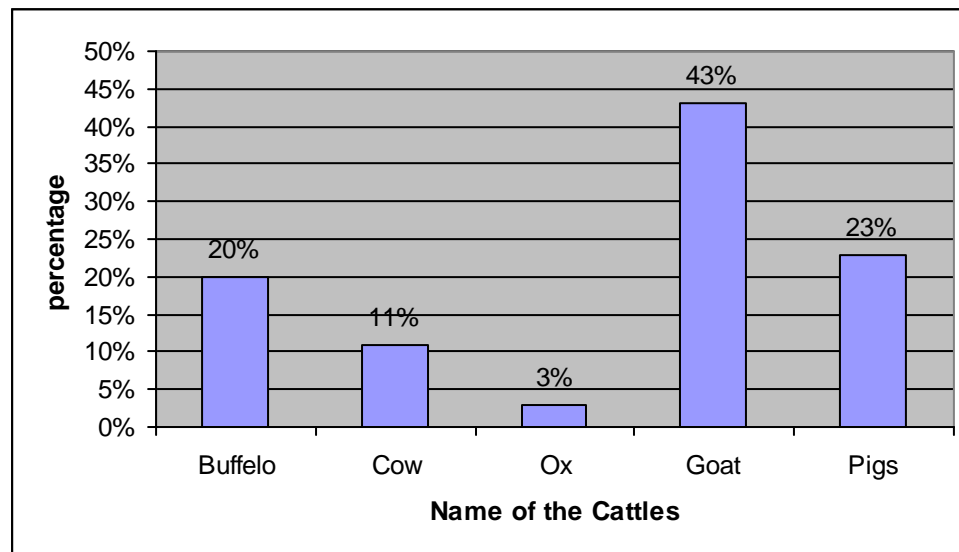
Majority of the respondents face food deficits. Out of the total SHH ,75% of households have sufficient food only for two months of the year, 15% of the SHH have sufficient food for 5 to 7 months and only 10% household have sufficient food for 10 months. 75% of the household face food deficit for 10 months, 15% for 6 months and 10% for 2 months.

#### **4.2.2.9 Livestock**

Livestock is an important activity in the rural economy. This is the most common type of agricultural operation after farming. Types of domestic animals reared by

the respondents household were divided in to five categories, buffaloes, cows, oxen, goats and pigs. Majority of the families reared goats, followed by buffaloes and pigs. Buffaloes and cows were reared for their milk, goats and pigs for butchering and oxen for ploughing land.

**Figure 8: Livestock of the SHHs**

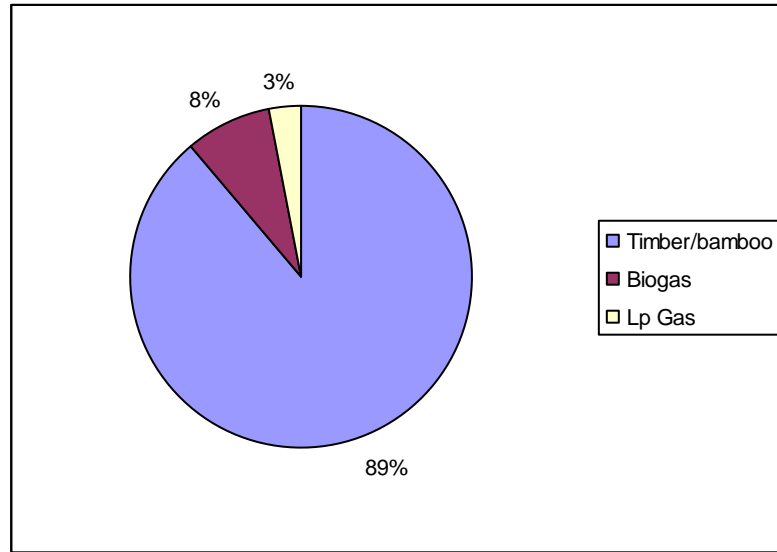


*Source: field survey, September2008*

#### **4.2.2.10 Cooking fuel use pattern**

Majority of the SHH 89%, use timber and bamboo for cooking fuel, firewood are collected from the community forest nearby the village. Only 8% SHH use Biogas and 3% use LP Gas.

**Figure 9: Cooking fuel by the SHHs**



*Source: field survey, September 2008*



# **CHAPTER V**

## **INTEGRATED BAMBOO FARMING (IBF) AND LIVELIHOOD**

### **5.1 Socio economic Aspects**

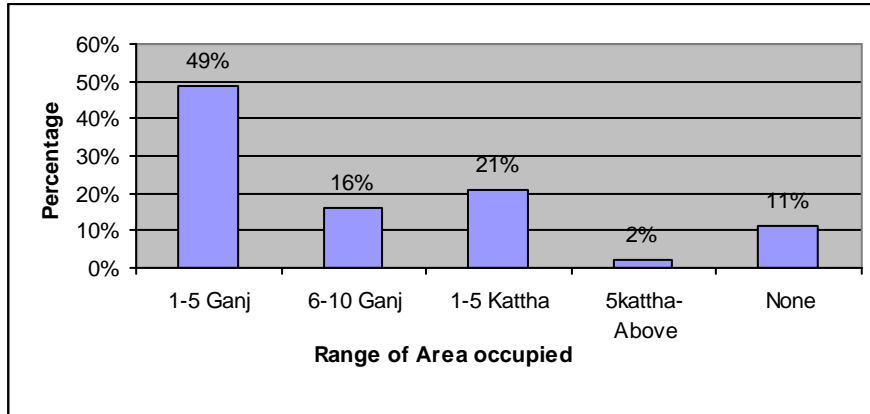
#### **5.1.1 Community involvement in IBF activities**

All sixty-three sampled households were found to already be involved in IBF activities. Community owned and run Bhorleni bamboo plantation area is spread over 25 hectares. All the SHH families are involved in the cultivation of bamboo with accessories crops, management of the planted area, harvesting of fruits, crops and cash crops in various season and planning and reviewing work.

#### **5.1.2 Bamboo plantation in to individual land by SHH**

Apart from the community, Bamboo farming occurs in the majority of families as they have planted bamboo in their own private land. Out of 63 households, 49% of the families have planted 1-5 clumps of bamboo, 16% of the families have planted 6-10 clumps, 21% have planted 1-5 Kattha, 2% have planted above than 5 Kattha and 11% of the SHH have not planted bamboo in their individual land.

**Figure 10: Bamboo plantation individually by SHHs**



*Source: field survey, September 2008*

### **5.1.3 IBF and local economy**

IBF has been a significant contributor in the subsistence life of the local community. Most of the families have been involved in growing vegetables, fruits, broom grass and bamboos. Each member has set apart some area to grow the vegetables within the Bamboo plantation area. They also have to care for the planted bamboo alongside growing vegetables and fruits. In the first year of the Bamboo Plantation, bamboo plants were small and more vegetables were grown, in the second year banana was the major source of income, from the third year, along with vegetables and fruits, broom grass also became a major source of income to the community. In the fourth year animal husbandry became the main source of income. After fifth year bamboo matured and some amount of bamboo was harvested and sold to the local market. Vegetables, fruits, broom grass can be grown and sold individually but bamboo should be sold commonly and the income also collected commonly.

### Box-1 case history of Buddha Rani Limbu

*Name: Buddha Rani Limbu*

*Age:49*

*Address:Khudanabari-6,Jhoda*

*Family size: 5 (husband, wife and three children)*

*Occupation: Agriculture*

*Budhrani limbu is inhabitant of Khudanabari -6,Jhoda and she is also a group member of Bhrleni bamboo plantation group ,She was migrated from Taplejung in 2047,and started to settle in Jhoda.Her family has adopted agriculture as means of subsistence life. She has planted bamboo both in group and individual land also.*

*She says, we were migrated from the hilly areas with the hope of better life in Terai but I couldn't experience the life as we had expected, we started to live in Jhoda,we had no means of living rather than the degraded land, we tend to occupy more land so still we clear the jungle, still we couldn't have better life, we had a long debate with forest, though when we planted bamboo in the degraded land along with other crops and cash crops gradually our source of income is increased and we became able to manage our daily need ,health improvements and children education.we have also planted bamboo in t kattha of our individual land which now we are getting income from animal husbandry and bamboo selling.*

**Table 11 Income Analysis of the first five years of SHH**

S.N	Type of crops	Average Yearly income				
		1 <sup>st</sup> year	2 <sup>nd</sup> Year	3 <sup>rd</sup> Year	4 <sup>th</sup> Year	5 <sup>th</sup> year
01	Vegetables	7000	6500	4000	3000	2000
02	Fruits	15000	16000	14000	12000	12000
03	Broom grass	0	0	7000	8000	8000
04	Livestock	0	5000	10000	15000	20000
05	Bamboo	0	0	0	0	15000

*Source: field survey, 2008*

After Fifth year, bamboo culms have reached maturity and income can be earned by selling bamboo. According to the field survey there are a total of 4500-bamboo clump occupied in 25 hectares of land. Each clumps can yield 5, 6,7and 8 culm per year in 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup>, 8<sup>th</sup>, 9<sup>th</sup> and 10<sup>th</sup> year respectively. The average market price per culm in present at present is Rs 40. These 25 hectares may yield 22500 bamboo culm in fifth year and if it is sold in the market 9,00,000 will be the income in fifth so on the following years.

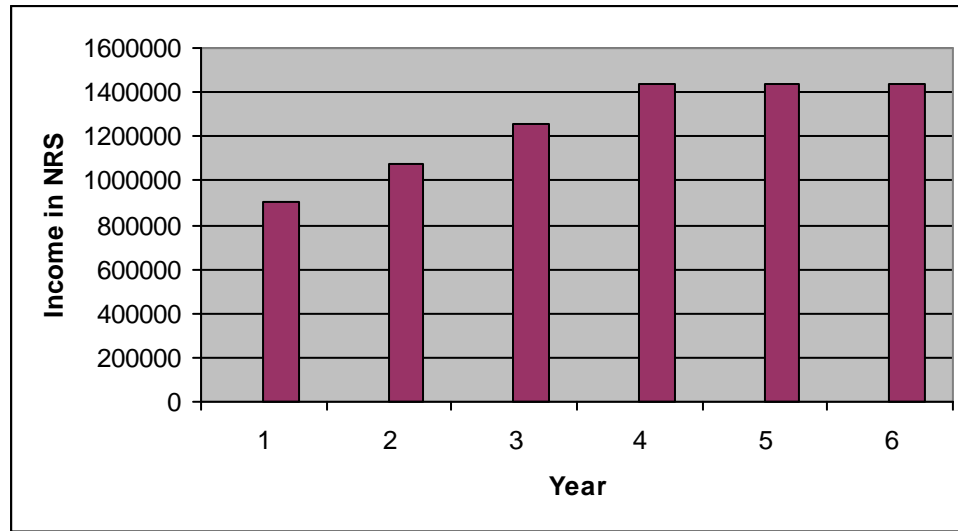
**Table 12 Projected income of the first 5-10 year from selling bamboo**

S.N	Year	Culms/Clump	Clums/hec.	Culms/25hec	Income/Yr
1	5 <sup>th</sup>	5	900	22,500	9,00,000
2	6 <sup>th</sup>	6	1,080	27,000	10,80,000
3	7 <sup>th</sup>	7	1,260	31,500	12,60,000
4	8 <sup>th</sup>	8	1,440	36,000	14,40,000
5	9 <sup>th</sup>	8	1,440	36,000	14,40,000
6	10 <sup>th</sup>	8	1,440	36,000	14,40,000

*Source: Field survey September.2008*

The chart below show that income in 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> year continuously increases and remains constant after 8<sup>th</sup> year.

**Figure 11:Income from bamboo selling 5-10 Yrs**



*Source :field survey, September 2008*

#### **5.1.4 IBF and Fodder supply**

**IBF** is also a major source of the fodder supply for domestic livestock as bamboo leaf is used as fodder. Apart from bamboo, every household has planted fodder trees around the houses as well as along with the bamboo in Bamboo planted area. Crops and vegetables residues are also sources of fodder. They have also planted special variety of grasses in vacant land which provides a regular supply of fodder. Due to the sufficient fodder supply villagers were encouraged to add more cattle, especially Buffaloes and goats. During the last six months, 65 families have purchased buffaloes for milk generating. **IBF** and the animal husbandry has dual benefits as they provide fodder and make land fertile by providing manure.

**Table 13 No of the cattle dependent in IBF fodder supply**

<b>S.N</b>	<b>Name of Cattle</b>	<b>Number</b>	<b>Percentage</b>
01	Buffaloes	56	20%
02	Cow	32	11%
03	Ox	9	3%
04	Goat	124	43%
05	Pigs	65	23%
	Total	276	100%

*Source: Field survey September, 2008*

### **5.1.5 IBF and Supply of bamboo shoot**

Bamboo shoots (*locally called tama*) are a popular food item in the locality, as well as being nutritious. During the monsoon season, young shoots are harvested and put in a curry by the villagers. However this is discouraged as the young shoots become the bamboo culm later, and if it is eaten then there will not be good bamboo culms for the future. Those members who are involved in IBF have special management system to use the young shoots for curry, individually it is not allowed to cut the young shoots for curry. However, families who have cultivated bamboo in their individual land may earn additional money by selling the shoots to the local market.

### **5.1.6 IBF and Handicrafts**

Almost all the SHHs have household utensil made of bamboo. Baskets like *Doko, Dalo, Thunse, Nanglo, Chalnu (shiver)* the most important items using in their daily life likewise *Bhakari* is used for storing grains, *Mats (mandro), arbane, and ghum* are also essential items. Local craftsmen prepare these items and sell them to the larger community as well as in the local market.

## **5.2. Environmental Aspect of IBF**

### **5.2.1 Soil erosion control**

The land presently occupied by the IBF was previously deforested land. Due to the steepness of the land, rain running down the hill used to erode a huge amount of top soil every year and the land was highly degraded every monsoon. After Integrated bamboo farming, the net-like root system of bamboo has strongly stitched the soil together and protected from the erosion, like wise broom grass, timbers and other plants along with the bamboo have played an important role in protecting the soil from erosion.

### **5.2.2 Increase soil fertility**

IBF has also played an important role in increasing the soil fertility as degraded leaves and twigs and waste of bamboo and accessory plants maintain the soil fertility and also protect the soil from drying out by keeping it moist. IBF has supplied fodder to the animals and in turn the animal manure has been used to make the soil more fertile.

### **5.2.3 Natural beauty and healthy environment**

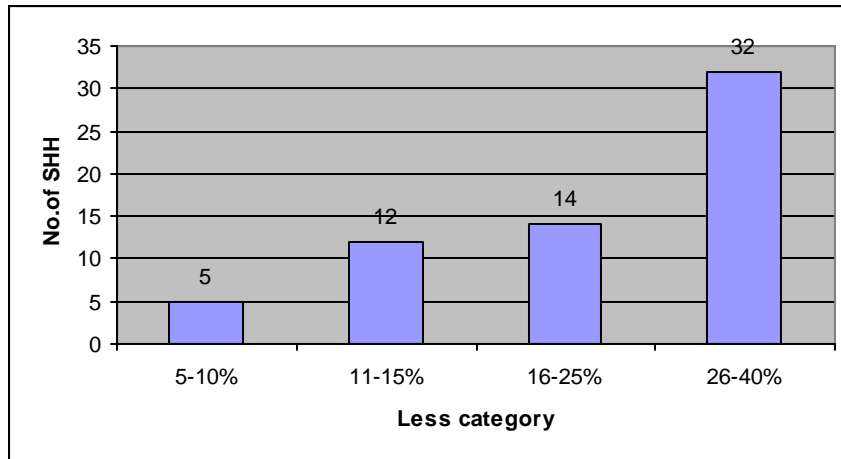
Bamboo is an evergreen plant, so it causes the area to look green. In addition, various types of other plants have made the local area more beautiful. According to the discussion held with the respondents it has also lowered the temperature of the local area during hot season.

### **5.2.4 Protection of forest and less in using timber**

Almost all the rural people of Nepal are dependent on forest resources and due to the dependency on forest resources the forest has been increasingly overexploited. Jhoda village itself is established by clearing the jungle so all the households were dependent on forest resources for firewood for cooking, fodder for animals, timber for housing, furniture, landscaping and household items. IBF has overcome the pressure on the forest by providing an alternative option for timber. In comparison of the previous years before establishing IBF, a remarkable difference was found in timber use. Out of the 63 SHHs, 5 households were found 5-10% less in timber use, 12 SHHs were found 11-15% less in timber use, 14 SHHs were found 16-25% less and 32 SHHs were found 26-40% less in timber use. Figure 11 shows that Majority of the SHHs are gradually being less dependent in the timber and assisting in protecting forest.



**Figure 12: less in Timber use**



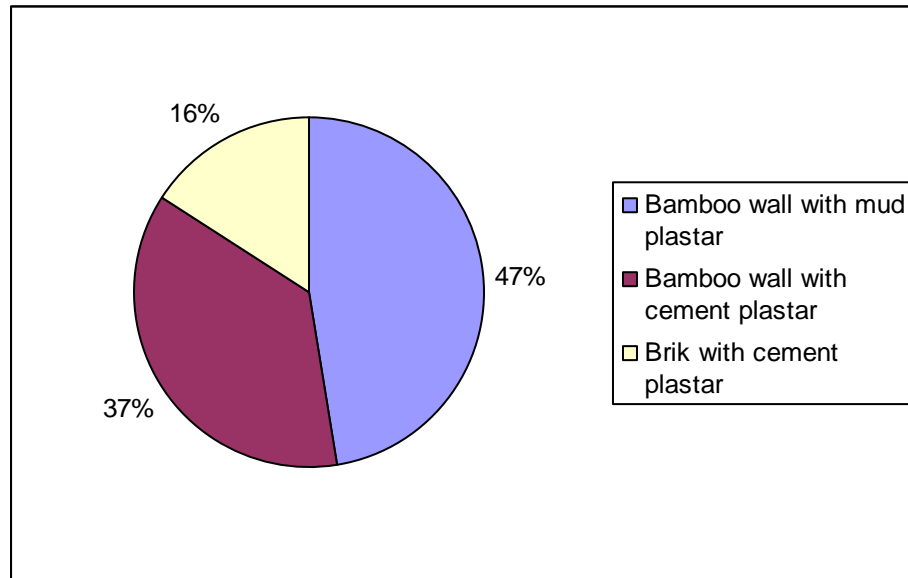
*Source: field survey, September 2008*

#### **5.2.4.1 Bamboo as Cost effective housing material**

Access to safe and healthy shelter is essential to a person's physical, psychological and economic well being and is a fundamental livelihood element. However a large number of people in the world live either without shelter or in very temporary shelters. Forests have been facing more pressure on supplying timber, while building houses to meet the need of an increasing population is steadily increasing. Bamboo is one of the oldest materials used for the construction of houses and other structures. It is strong, flexible and versatile, therefore it is suitable material for every component of the house. Bamboo is also locally available and is environmental friendly as well as an affordable housing material.

Almost all the SHHs have used bamboo material while constructing their house, usually bamboo is used in wall construction and as purlins, however bamboo pillars have also been used in some houses. The majority of the houses are two storeys, made up of a mud floor, bamboo walls with mud and cement plaster, wooden pillars and a tin roof.

**Figure 13: Type of house of SHHs on the basis of wall**



*Source: Field survey, September 2008*

Normally houses are differentiated on the basis of wall type. There are three types of the house on the basis of the wall, the majority of the houses of the SHH were made up of woven bamboo wall with mud plaster (*thokuwa tattti*), second type of houses were found bamboo wall woven in wooden frame with cement plaster (*centre bera*) and the third one is brick and cement wall.

Figure 12 shows that majority of the SHHs 47% have of the wall of *Thokuwa tattti* with mud plaster followed by *Centre bera* 37 % and Brick wall 16%.

#### **5.2.4.2 IBF and fuel for cooking**

SHHs families are also obtaining fuel for cooking food from IBF. Waste roots, nodes and branches of the bamboo are used as fuel for cooking. Likewise, branches of the trees grown along with the bamboo cane of the broom grass are also used for cooking food by all SHHs.

### 5.2.4.3 Use of Bamboo in landscaping

All the SHHs of the study area have used bamboo in landscaping and fencing around their house as well as cultivated land to protect from the entry of cattle and other animals. Bamboo landscaping has provided both safety and beauty. Bamboo fencing protects the soil by preventing soil from washing away in the rain.

### 5.2.5 Protection of biodiversity

IBF has been playing an important role in maintaining local ecosystems by protecting various flora and fauna. It has provided habitat to different birds, reptiles, insects and animals. There are different types of medicinal plants that are also available along with the other plants in IBF areas.

**Table 14 List of the Medicinal plant found around in the IBF area**

S.N	Scientific Name	Local Name	Parts and use
01	<i>Acorus calamus</i>	Bojo	Rhizome
02	<i>Bombax ceiba</i>	Simal	Fruit
03	<i>Phyllanthus emblica</i>	Amla	fruit
04	<i>Piper longum</i>	Pipla	Fruit
05	<i>Syzyzim cumini</i>	Ban jamun	Fruit
06	<i>Terminalia belerica</i>	Barro	Fruit
07	<i>Terminalia chebula</i>	Harro	Fruit
08	<i>Chenopodium abrosoids</i>	Bethe	Whole plant
09	<i>Mentha arvensis</i>	Pudina	Whole plant
10	<i>Cannabis sativa</i>	ganja	Leaf
11	<i>Betulas utilis</i>	Bhojpatra	Leaf

*Source: field survey 2008*

**Table 15 Bamboo species found in the IBF area**

SN	Scientific Name	Local Name	Use
01	<i>Bambusa nutans</i>	Mal Bans	Mat and basket weaving
02	<i>Bambusa spp</i>	Phor Bans	Pillars,scaffolding,supporter
03	<i>Melocanna becifera</i>	Philling bans	Mat weaving
04	<i>P.edulis</i>	Kat bans	Fencing
05	<i>D.nepalensis</i>	Tame bans	Eating shoot,weaving items
06	<i>D.hamiltoni</i>	Choya bans	Weaving items
07	<i>B.vulgaris</i>	Singare bans	Weaving
08	<i>B.nutans spp</i>	Taru bans	Weaving
09	<i>D.giganteus</i>	Bhalu bans	Construction material.

*Source: field survey 2008*

Tigers, elephant, deer, wild pigs, rabbits, bandhade, dumsi, jackals are the major animals found around the area, different types of snakes are present inside the IBF area. There are various kinds of birds including,luiche, Koili,Mayur and Koili.

### **5.3. IBF and Cultural aspects**

Bamboo has a close relationship with the cultural aspects of the people of Jhoda. They use bamboo in many of their different rituals. In the death ritual they use bamboo to make a stretcher for the dead body. In Limbu culture they make the stretcher all from bamboo of the same clump. During weddings, bamboo is used to make jogiya and lingo. Bamboo is use in bratabandha also. During Dashain people enjoy playing Linge Ping using a structure made up of bamboo. They also have a cultural practice of not using or harvesting bamboo on Tuesday.

# **CHAPTER VI**

## **MANAGEMENT OF IBF**

### **6.1 Management structure of IBF**

All the members of the Bhorleni Bamboo plantation group are responsible for the management of the overall aspects of the IBF. To assist in managing the project systematically, a management committee has been formed which includes a chairperson, Vice Chairperson, treasurer, secretary and members. The whole area has been divided into 9 clusters each cluster includes 20 member households, every cluster sends one member to the management committee. The management committee internally coordinates the group members, makes plans, and reviews the overall project as well as keeping records of all financial transactions.

#### **6.1.1 Cluster based management system**

The purpose of separating clusters is to manage the IBF with due care by dividing the responsibility into small groups. Each cluster has been given a certain area to care for and cultivate crops, each member of a household of the cluster looks after the bamboo within that area coordinating with the other members of the household. Again the cluster area is divided into certain areas to each member for the cultivation of vegetables, fruits, grass, broom grass and other crops. Group members are not allowed to cut and sell bamboo individually if they need for household use they have to request to the management committee and get only after the decision of the management committee. But the member households are allowed to cultivate, harvest and sell the other crops and cash crops individually which are grown within the given periphery of land. The income earned by the

member of the household does not need to be shown in the groups but income earned from the bamboo is collected into the group fund.

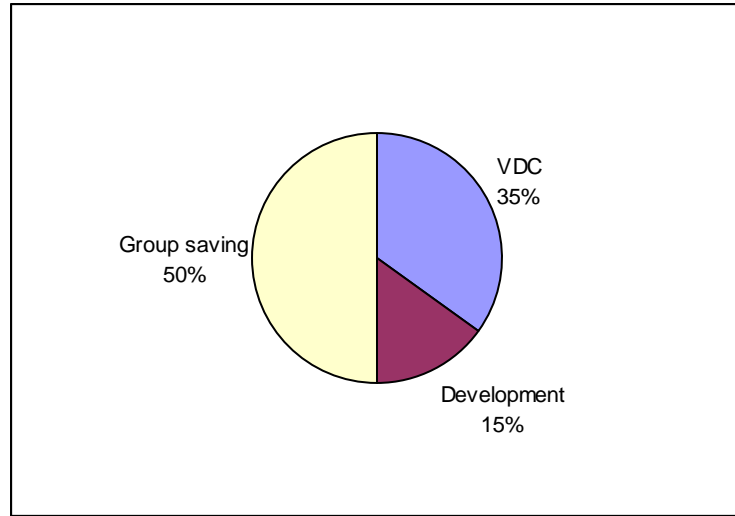
### **6.1.2 External Monitoring**

This IBF was initiated by the local government (Khudanabari V.D.C) and district forest office with financial support of LWF. One field staff has been assigned to look after the IBF, and is responsible for monitoring overall activities of the group members. They also provide guidance to the management of the IBF and suggestions for improvement. The District forest office also provides technical support as well as monitors the progress and yield of the bamboo plantation and other crops. Apart from V.D.C and DFO, local leaders of political parties and Civil society are also involved in monitoring the progress, transparency and accountability of the group.

### **6.1.3 Benefit Sharing**

Income earned by the group by selling bamboos of IBF is collected into the group account and divided into three categories. A certain amount of the income goes to V.D.C, a certain percentage is used for the caring of and extending the IBF and some Percentage is shared among the group members.

**Figure 14:Benefit Sharing of the IBF**



*Source: field survey 2008*

### **6.1.4 Conflict Management**

Any conflicts that occurred in the group members first should be solved among the group members of the same cluster, if the case is more serious then that goes to the management committee and management committee makes a decision and acts on that. Sometimes the management committee may invite a VDC representative, local leaders and civil society to manage the conflict.

## **6.2. Intercrop management**

### **6.2.1 Agricultural pattern**

Various agricultural patterns were found in the first three years. In the first year as the Bamboo plants were small and there was enough empty land among the bamboo plant so that vegetables, bananas, guava, kathar, supari (hard nut), millet could be grown. In the second year broom grass was planted along with vegetables and fruits. By third year new shoots of bamboo appears and bamboo clumps occupies more area, So different types of grasses *dale ghas and bhui ghas*

were planted to provide the fodder for the animals, after three years onwards the same pattern has been carried up. Banana and vegetables were major products in the first and second year. By the third year broom grass also became the major product and source of income along with vegetables and fruit. As enough fodder was found around the IBF area, Member households were encouraged to adopt animal husbandry and started buffeloes, goat and pig keeping for selling milk and meat respectively. After the initial five years, bamboo becomes mature and can be sold in the market.

**Table 16 Agricultural pattern**

S.N	Year	Agricultural pattern
1	First year	Vegetables and fruits, turmeric
2	Second Year	Vegetables, fruits and broom grass
3	Third year	Vegetables, fruits, (animal husbandry)

*Source: field survey September 2008*

### **6.2.3 Seasonal crop pattern**

There are three cropping seasons in a year, monsoon (from June to September), winter (October-February) and summer (March – May). Major crops planted during the monsoon seasons are, beans, pulses, millet, maize, lentils, *rahar* and paddy *etc.*, Ginger, potato, tomato, barely, mustard, wheat, onion, garlic, cabbage, pulses cauliflower, peas, gram, carrot, radish, simal *tarul* and beet root are the major crops during winter season. Beans, maize, guards, cucumber, pumpkins are the main crops planted during summer season.



## **6.3. Management of adult bamboo**

### **6.3.1 Caring of buds and Application of fertilizer**

New buds of bamboo should be exposed to the sun during February to March every year. This will stimulate buds to sprout earlier and increase sprouting potential. During this time, attention should be paid to buds and roots to protect them against damage. After 6 to 10 days of exposure to the sun, organic fertilizer is applied around the bamboo clump. Fermentation of organic fertilizer in the soil raises the soil temperature. Air circulation and water retention in soil will help shoots sprout early, thereby increasing the output of bamboo shoots. Usually, application of more fertilizer produces higher shoot production. During the early and the middle stages, quick acting fertilizers are recommended. If mixed fertilizer (N: P:K=5:3:2) is used, fertilizer should not come in contact with the new sprouts to avoid damaging them.

### **6.3.2 Caring of shoots covering with soil**

During the initial stage when the shoot is inside the soil, the shoot is tender and delicious for eating. After the shoot comes out of the soil, shoot sheath become green or brown and the shoot becomes bitter, sour and stringent as fibers mature. Thus, before the bamboo shoots emerge, they should be frequently covered with soil to keep them in the ground for longer. This way, the shoot will be bigger and of better quality. The shoots should be covered with 15cm to 20cm of soil. If covered with more than this, the temperature of the soil will decrease, inhibiting sprouting of shoot.

### **6.3.3 Weeding, soil loosening and providing shades**

The bamboo plantation should be weeded and soil loosened 1 to 2 times every year. Weeding may not be necessary if light grass is under the bamboo; however, soil loosening should be done. In addition, covering ground with straw or plastic film is recommended as it maintains moisture and temperature of the soil.

### **6.3.4 Removal of old bamboo and adjustment of the bamboo structure**

Defective, broken and undeveloped bamboo should be removed during winter, leaving only healthy bamboo. Bamboo over 4 years old or should also be removed. To improve the productivity of bamboo reasonable density must be maintained.

## **6.4 Harvesting system**

### **6.4.1 Traditional method of harvesting system**

- ) Sharp knife is used to cut the bamboo culm and each culm are cut above the two nodes leaving a minimum of 20 cm.
- ) Harvesting bamboo is prohibited during monsoon season to protect the new shoots from the damage.
- ) Due to the cultural factor, bamboos are not harvested on Tuesday.
- ) Only bamboos which are more than three years old are harvested
- ) If there are crops around the bamboo clumps, it is harvested and collected with due care and precaution.
- ) Respondents prefer to harvest bamboo only after full moon to 15 days onwards,

- ) they do not harvest bamboo near to full moon because they have belief that if it is harvested during this period bamboo may be affected by termites.

#### **6.4.2 Shoot harvesting system**

For commercial shoots, they must be cut out when they are 20 -50cm high, else they become old and bitter. For dried bamboo shoots, bamboo shoot of height 1 - 1.5m may also be acceptable. Due to low temperature and high humidity, it is better to cut off bamboo shoots before the sun rises. This is good for the mother bamboo and seedlings. All shoots in early stage can be cut, but 3 to 4 shoots in later stages should be left. After cutting, the cut portion is easily infected and thus should not be covered with soil until it is dry.

#### **6.4.3 Harvesting Guidelines of Bamboo**

The following guidelines should be followed:

- 1 Immature culms of 1-2 years have a very high water content and shrivel up when cut - this makes them useless for construction (Haun *et al.*, 1961 ). Speed of development depends on the condition of the clump and the position of the culm: if the clump is vigorous and the culm is in an exposed position it matures much sooner; culms at the centre of a poor clump mature more slowly (Storey, 1988a).
- 2 In a clump containing 12 culms or more, at least 6 culms over 1 year old should be retained, and in a clump containing less than 4 mature culms over 1 year old, all should be retained during harvesting (Bahadur *et al.*, 1980).

Mature culms should be left evenly distributed throughout the clump to provide mechanical support as well as nourishment (Gautam, 1988)

- 3 All culms older than 4 years should be removed
- 4 Culms should never become so overcrowded that they touch one another at the base. There must be sufficient space between them to allow movement of the cutting instrument (Sharma, 1988).
- 5 The culms should not be cut lower than the first node above ground level, to ensure that the rhizome is not damaged, and not higher than 30 cm (Gautam, 1988). Thinning the clumps reduces rhizome overcrowding and encourages the production of new culms in the centre of the clump (Sharma, 1988)
- 6 Large bamboos should ideally be thinned annually during the winter, as this is the time when growth is slowest. However, it is possible to harvest at any time of year except when new shoots are developing (Storey, 1988a).
- 7 Damaged culms, debris and cut branches which may have become infested with shoot-boring moths (family: *Pareuplexia*), should be removed (Bahadur *et al.*, 1980; Stapleton, 1985a) and burnt (Storey, 1988a), as well as all dead and dry culms (Gautam, 1988).
- 8 The smaller *Arundinaria* and *Drepanostachyum* species [*nigalo*] are according to local practice harvested by removing the shoots of a lighter green colour, which are readily distinguishable in March (Thompson, 1986). Harvesting age should be 16 - 20 months (Stapleton, 1987). This leaves the clump not congested and produces culms of consistent size and quality (Lamichhaney, 1988).

# **CHAPTER-VII**

## **CULTIVATION**

### **7.1 Cultivation practices in Jhapa**

Largest stock of bamboo around the district is in forest form. Due to the traditional mindset regarding the durability of bamboo and lack of proper market, people are still not convinced to cultivate bamboo commercially. Rural people grow bamboo in homestead just to meet their need of making the household items (mainly baskets and mats items), fencing their land, shoots for eating and fuel for cooking.

While establishing of the Bhutanese refugee camps in Jhapa, there was a great demand of local bamboo for constructing the huts of the refugees, later on people were aware of importance of bamboo and homestead cultivation of bamboo was increased, Community Forest Users Groups (CFUGs) also started to cultivate bamboo in degraded land, Government and Non government organization also started to plant bamboo in riversides, waste lands and disaster effected areas to protect the land from disaster.

#### **7.1.1 Bamboo cultivation by Disaster Management Committees (DMC)**

Disaster Management committees are the groups formed by the families around the disaster effected areas who play active roles in mitigating disaster, specially flood disaster by growing plants in the river side. Due to the fast growing nature and net like root structure, bamboo plantation has been found to be an effective tool in controlling flooding. There are Major DMCs and several sub DMCs in the Jhapa district who have planted bamboo in riverside. District forest Office (DFO) District Soil conservation office(DSCO), Lutheran World

Federation (LWF), Caritas Nepal and Sahara Nepal have taken initiatives to plant the bamboos for mitigating Natural disasters.

**Table 17 List of DMCs in Jhapa**

<b>S.N</b>	<b>Name of DMC</b>	<b>Location/River</b>	<b>Supported by</b>
01	Khudanabari DMC	Tangting Khola	LWF
02	Dharmpur DMC	Kamala river	LWF
03	Budhabare DMC	Hadiya Khola	LWF
04	Arjundhara DMC	Tangting Khola	LWF
05	Topgachhi DMC	Kamala river	LWF
06	Ratuwa DMC	Ratuwa khola	LWF
07	Mauwa Khola DMC	Mauwa Khola	LWF
08	Kohabara DMC	Ratuwa Khoala	LWF
09	Ghailadubba DMC	Biring Khola	LWF
10	Khayarbari DMC	Lakhanpur	LWF
11	Dangibari DMC	Biring Khola	Sahara Nepal
12	Satasidham DMC	Mai khola	Sahara Nepal
13	Shivagunj DMC	Shivagunj	Sahara Nepal
14	Saranamati DMC	Sharanamati	Sahara Nepal

*Source : LWF, Sahara Nepal and DSCO*

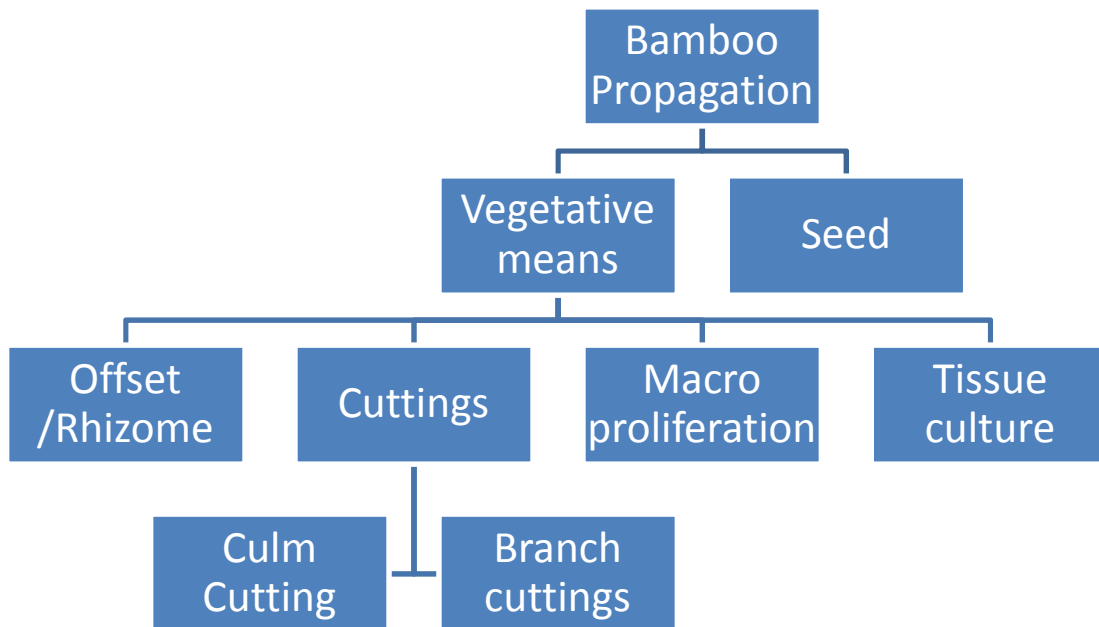
### **7.1.2 Bamboo cultivation by CFUGs**

Community Forest Users Groups have also taken initiative in cultivating bamboo along with timber plant in degraded land, wasteland and watershed areas. Since timber takes long time to grow, it is used in combination with bamboo

which grows fast and helps to change the degraded land in to green quickly. Normally CFUGs have planted bamboo in the border areas of land owned by the Users group to separate land from others as well as a living fence to protect from the cattle and other entry inside the forest. Almost all CFUGs have planted bamboo more or less in their community forest though Chandragari Samudaik Ban, Duwagari Samudaik Ban, Sukhani Samudaik Ban, Dhaijan Samudaik Ban, Shantinagar Samudaik Ban, Khudanabari Samudaik Ban, Bahundangi Samudaik Ban, Budhabare Samudaik Ban, Kamala Samudaik Ban, Pathamari Samaj Bikas Kendra and Kechana Jana Kalyan Kendra are the main CFUGs who have planted bamboo in large areas varying from 10 hectares to 30 hectares.

## **7.2. Different methods of Bamboo Propagation**

Conventional methods of propagation of bamboo are based on seeds and vegetative methods. Availability of seed is limited to certain specific period as bamboo rarely flowers. Most bamboos flower only in long cycles ranging 10 to over 60 years depending upon species. Usually the cyclic flowering is gregarious and after flowering, the entire flowered population of bamboo dies. Due to the rarity of the seed bamboo is grown through vegetative propagation. Bamboo can be propagated by the following methods.



### 7.2.1 Seed base propagation

Seeds formed after gregarious flowering are collected and cleaned. The cleaned seeds can be stored for 6 months or even more than a year through special storage techniques like controlled moisture, low temperature etc. The viability of bamboo seeds is lost gradually so it is better to sow the seeds soon after collection. Sowing is carried in to the mother beds with overhead shade containing a mixture of compost 40%, sand 40% and soil 20%. Regular watering systems should be in place after planting the seed. After 8-10 days, seeds germinate and develop into seedlings. Seedlings can be transplanted to poly pots when they are at three-leaf stage. The transplanted seedlings are to be kept in partial shade initially for a month and then in open beds. Except for the rainy season, they need to be watered regularly. Seedlings are to be shifted locally after 3 months to avoid root penetration. 6months to 1-year-old seedlings can be used for plantation purpose.



## **7.2.2 Vegetative Propagation**

As much of the time seeds are not available, bamboos can be propagated through vegetative propagation. Various methods of vegetative propagation like offset & rhizome cuttings, branch and culm cuttings are commonly used for bamboo propagation.

### **7.2.2.1 Off-set Cuttings**

Vegetative propagation by rhizome or offset is an age-old method and has been used extensively in most areas of the country. According to the Off-set method, 1-2 year old culms are cut at about 1.0-1.5m height (3-5 nodes bearing viable branch buds), that is excavated along with its root system. The rhizome must be separated by cutting it from its neck carefully. The extracted Offset should be planted immediately after extraction from the mother clump and should be kept in moist gunny bags during transportation. Extracted culms should be planted in to a ditch covered with soil up to 5 cm and regular water should be provided to keep the soil moist. After one year, other culms grow from the rhizome.

### **7.2.2.2 Propagation through Culm Cuttings**

Vegetative propagation using culm or stem segments is a viable alternative and has several advantages over other methods. The success and the survival rate is also higher in this method. Large-scale multiplication of superior varieties is possible through this method. When planted, plants raised from cuttings develop into culms much faster than seedlings. The practical steps involved in propagation of bamboo through culm cuttings are as follows.

- ) Prepare Nursery bed and fill with Soil, Sand and fully decomposed Farm Yard Manure (FYM) in 2:1:1 ratio
- ) Select 1 to 2 years old healthy culm
- ) Extract the selected culm from the mother clump with proper care.
- ) Discard top portion of culm and trim lateral branches
- ) Cut the culm in to 2-3 noded segments
- ) Make a hole in the internodes
- ) Pour boric acid & solution in to the hole for treatment.
- ) Cover the hole
- ) Plant the prepared segments horizontally in the raised nursery bed.
- ) Water regularly apply manure if necessary.
- ) After 4-6 months well sprouted seedlings are separated carefully.
- ) Separated seedlings are transplanted in the well prepared field

### **7.2.2.3 Propagation thorough Branch Cutting**

Thick walled bamboo species produce stout branches often with basal nodes of branches with root primordial. These branches are cut and carefully extracted from 1-3 year old culms. 3-4 noded cuttings are prepared from such branches and planted into propagation beds obliquely vertical. The cut portion above is sealed with molten wax. A treatment of rooting hormone IBA, NAA or some commercial preparation will give better results. Cuttings are best propagated in a mist chamber. The cuttings are buried at least 7-10 cm below in sand bed in mist chamber. The sprouting and rooting will take place in 1-4 months time and can be transplanted to poly pots kept in shade beds initially and then these seedlings can be stocked in open beds. These seedlings are ready for planting in 6 months to 1-years time. Though not so commonly practiced, this is a more economical and effective propagation.

#### **7.2.2.4 Propagation thorough Macro proliferation**

This method is generally practiced in small seedlings usually raised in small seedlings usually raised through seeds. The multiplication of bamboo seedlings by rhizome separation leading to smaller sized planting material is known as micro-proliferation. Through this technique 5-9 month old seedlings of *B.bambusa*, *B.tulda*, *D. hamiltonii ec*, are multiplied 3-5 times. Every year this can be repeated.

When the bamboo seedling shows rhizome development in 30-40 days it also produces culms. Seedlings with 4-5 culms are taken out from the bed. Then the soil is removed by washing or shaking. Each culm with a piece of rhizome and roots are carefully separated using sharp knife or secateur and planted in separate poly pots as seed lings. Under proper nursery conditions, these will further produce culms and process can be repeated thus perennially making a good stock of plantable seedlings.

#### **7.2.2.5 Propagation through Tissue Culture**

This method involves propagating the plant through the tissue or cell of the mother, nurturing with controlled nutrient medium. This is effective method in mass propagation. Mass propagation through tissue culture can be done through auxiliary shoot proliferation as well as somatic embryogenesis.

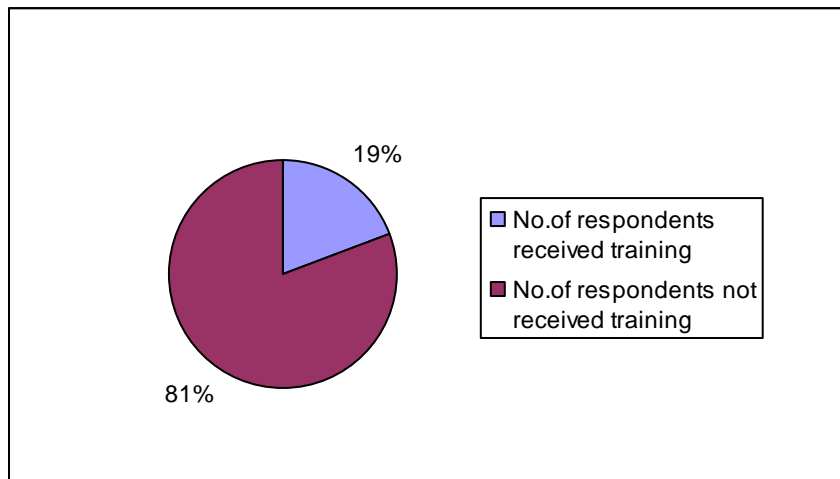
- J Seeds, buds or leaves are used for tissue culture.
- J Not easily available, as sophisticated equipment and specialist knowledge is required
- J The method is suitable for large-scale seedling production.

- ) When roots develop, transfer to the nursery and hardening unit.
- ) After 4 to 6 months, it is ready for plantation.

### 7.3 Knowledge of the respondents on Bamboo cultivation

Most of the respondents were found familiar only with the cultivating method called *Sakhar* (locally used method similar like offset cutting) though they do not have knowledge on proper knowledge on using fertilizer and timely watering. Only 12 members of respondents were found having general training on bamboo cultivation provided by district soil conservation office (DSCO),. Whereas 51 members of the respondents were found not receiving any training.

Figure 15: Training on bamboo cultivation



Source: Field survey, September, 2008

### 7.4 Cultivation practices adopted in the study Area

Only three methods of cultivating bamboo were found used by the respondents around the study area. The widely used method was *offset cutting*, in

some areas culm cuttings and seed base plantation method were also used. According to them offset cuttings was found successful one out of three methods. Plants are directly cultivated in the field with out any nursery management.

#### **7.4.1 Cultivation through offset cutting**

This is the traditional method used on cultivating bamboo in the study area. This method is locally known as *sakhar*. Almost all the bamboo plants in the IBF were cultivated by using this method. This *Sakhar method* consists of following steps.

**Area preparation:** While selecting the site for the plantation road access, soil compositions, sheds and watering facilities should to be taken as consideration. The selected site should to be cleared by removing shrubs and unwanted vegetation

**Collection of planting material:** while selecting the plant material, 1-year old healthy culm having well-developed rhizomes should to be selected. The selected culm is cut at about 2-metre height and branches are pruned then it is excavated from the mother clumps carefully without damaging other shoots .The excavated off-set is covered by the polythene bags preventing the rhizome from damage and also not to let fall of soil from the rhizome. Extracted plant material should carry with great care to the planting site protecting the moisture content.

**Digging holes and plantation:** After collecting the plant material 1.5ft deep and 1ft wide hole is digged half of the part is filled with mixture of forest soil and fully decomposed farm yard manure (1:1) ratio. Collected plant material is placed carefully in to the hole with 75° angle with the ground. Each newly

cultivated plant is provided extra support to protect roots from sacking. The planted are should watering as per necessary.

#### **7.4.2 Cultivation of bamboo through seed**

Since the bamboo seeds are rare to get, very few plants has been found planted though this method. Although, during the plantation time fruits of the *Melocana becifera* were available in the study area and some of the bamboos were cultivated by using those small mango shaped fruits. According to this method, freshly collected green fruits were collected and planted in to the open land containing soil and cow dung 3:1 ratio. The planted area were covered with the straw and the twigs above the ground to protect it from direct sun and maintaining moisture. After 8 to 10 days the planted seeds germinates and develop in to bamboo shoots.

#### **7.4.3 Culm Cutting**

According to this methods two years old bamboo culm with well-developed buds in the nodes are cut and pruned the site branches. The prepared culm is laid down under the ground and buried it covered by the soil and cow dung. Later all the buds were developed in to new plants.

## **CHAPTER VIII**

### **PRESERVATIVE TREATMENT OF BAMBOO**

#### **8.1 Existing methods of preservative treatment**

Durability of bamboo, unless treated, is inherently very short (1-36 months). The presence of large amounts of hemi cellulose and starch, and the abundance of moisture makes it highly susceptible to biodegrading agents. These include white-rot, soft-rot, brown rot, group decay fungi, stain fungi and insects like borers and termites. More than 40% volume of bamboo is destroyed because of these biological agents during use and storage when untreated. The durability of bamboo can be greatly enhanced by preservative treatments. Preservative treatment of bamboo falls in two broad categories

- 1 Temporary Treatment
- 2 Permanent Treatment

##### **8.1.1 Temporary Treatment (Prophylactic treatment)**

This treatment is given as soon as possible after bamboos are harvested and is meant to prevent biodegradation of bamboos during transport and in storage while waiting processing. These treatments have been used traditionally to preserve bamboo.

### **8.1.1.1 Water immersion treatment**

The normal practice followed in many bamboo-producing areas is to immerse freshly cut bamboos in water for about three months. This treatment sees the removal of starch from bamboo, making the culms immune to insect attack.

### **8.1.1.2 Smoking**

In this method bamboos are kept in a smoke chamber at 120–150°C for about 20min.to destroy starch.

### **8.1.1.3 Chemical treatment**

The chemicals / insecticides are dissolving in water. Either the solution is sprayed onto stacked bamboos, or bamboos are dipped in the solution for 10 to 15 minutes. Following treatment bamboos are stored in the shade.

The following chemicals can be used for treating bamboos:

Gamma-BHC 0.5%

Formaldehyde 0.5%

Phenol + Copper sulphate (1:1) 1%

Sodium Pentachlorophenate 0.5 + 1.5%

Borax 2%



### **8.1.2 Permanent treatment**

Several permanent treatment methods are available to protect bamboos from insect and fungal attack. These methods are both preventive and remedial.

#### **8.1.2.1 Steeping**

Freshly cut culms are placed upright in containers of preservative solutions. A solution of 8-10% is used, with the butt end of the bamboo, up to 20 cm, for 7 to 10 days. This method is suitable for bamboo pieces up to 6ft in length. Bamboos can be treated in this way without any equipment or technical skill. Preservatives are water soluble and include; boric acid, borax or combinations of these

CCA: Copper, chrome, Arsenic

CCB: Cooper, Chrome, Boric

Acc Acid, Copper, Chrome +Zinc chloride etc.

#### **8.1.2.2 Diffusion Process**

In diffusion process freshly felled bamboo culms with a moisture content of above 50% are kept submerged in preservative solutions for 1-2 days, and then stacked in shade for 10-15 days. Dry bamboo culms need to be wet before treatment, so their moisture content will be about 50%. This can be done by keeping them under water or storing them in water originally. Split bamboos and slivers can be treated this way and in this form treatment is more effective. By puncturing or drilling holes near the internodes, preservative solution can be drained from the bamboo before it is stacked. This will also enhance penetration of the treatment solution through the bamboo.

Preservatives, which could be used in this diffusion method:

Boron compounds CCA, CCB, ACC

Copper Chrome-Boric

Acid Copper chrome

### **8.1.2.3 Boucherie Process**

The preservative solution is kept container raised above ground level. The bamboo culm is placed horizontally. A tube from the container is connected to the butt end of the bamboo. Gravity forces the solution through the culm. The process require about 5-6 hours. The process can be accelerated by pushing the preservative through the bamboo using a simple hand pump. With this method, it is possible to treat a bamboo of 10 ft in one hour.

Preservative which may be used include: Boric Acid, Borax, CCA, CCB, ACC

### **8.1.2.4 Hot and Cold Process**

Bamboos, in particular those used for poles, are placed in a drum with lower end down. The drum is filled with creosote oil up to 2-3 ft from the base. Alternatively, an equal quantity of fuel oil and creosote oil mixture (ratio 1:1) may be used. Heat the drum directly for 2-3 ft followed by cooling the solution overnight will give adequate penetration. This method is used for the cut ends of whole bamboo, which are to be put in the ground, when used as poles.

### **8.1.2.5 Internodal injection**

This treatment is applied to whole bamboo culms, such as used for poles and columns. Between 20 to 25ml of creosote oil is injected through a 6mm hole

in each node and the hole is closed with wax or putty. The culm is rolled once every in two days for one week to complete the treatment. The oil is absorbed through the inner walls throughout the cross structural area. This treatment is applied to dry bamboos.

### **8.1.3 Miscellaneous treatment methods**

- i. Dry bamboos, both whole and split can be treated with light diesel oil through dipping
- ii. Light organic solvent preservative. Finished bamboo articles can be treated by light organic solvent preservative by dipping or brushing. Preservative that may be used includes Gamma BHC 1%, in mineral turpentine or paint thinner, and Chloropyrifos 1% in paint thinner or kerosene. Treatment is fast and penetration is quite deep. The process does not impart any color on the product.

## **8.2 Traditional methods of bamboo treatment used by the local people**

Bamboo is an inevitable resource used in the daily life of Jhoda people though they don't have knowledge on preservative treatment by using chemical. The commonly used traditional methods of treatment by the SHH are smoking, immersing in water, using burnt Mobil and creosote oil (*alkatra*). Bamboo materials which are used in constructing walls of houses with cement plaster do not require treatment because cement plastered in the wall preserves the bamboo from decaying and it goes long lasting. While using bamboo in exposed areas and underground they use dry bamboo rather than the freshly cut bamboo.

### **8.2.1 Smoking method**

According to this method freshly cut bamboo are kept in to a stand at height of 4ft. .Twigs, thatched, bamboo leaf and branches are burnt below the stand to provide the enough smoke for the bamboo. Bamboos are rolled and adjusted continuously to ensure the effect of smoke in all part. Precaution has to be taken not to let the bamboo caught by direct fire otherwise bamboo may crack due to high temperature. After 30 to 45 minutes of smoking the green bamboo changes in to brownish colour and those bamboos are removed from the stand and kept in to the shed for 5 days. The treated bamboos are used only after when it gets completely dry. Local people normally use this method for the treatment of the bamboos, which they use in the pillars, and the rafters of the house.

### **8.2.2 Water immersion method**

Majority of the SHH of the study area have been found of applying this method to increase the durability of the bamboo. According this method, They cut the bamboo before starting the monsoon season and when the monsoon starts they keep immersing the bamboos in the pond of collected rain water. While immersing the bamboos in the water starch and cellulose contained in it are extracted and becomes less infected from the termite attack and the bamboo becomes more durable. After three months, once the monsoon ends those immersed bamboos are taken out and keep in shed for a week and use in different purposes. This method is normally used for the bamboos, which are use for weaving baskets, and strips for the housing wall.

### **8.2.3 Other methods**

The people of the study area were found having used other simple methods also. Bamboos using for pillars of the house as well as fence are treated with burnt

Mobil and creosote oil by rubbing in the surface and the bottom part of the bamboo that goes underneath the ground is covered by polythene. Bamboo slivers using for basket weaving and binding purpose are treated by spraying mixture of hot water and ash.

### 8.3 Durability of the locally available bamboo species

Durability of the bamboo varies species to species. Some bamboo species are found more durable and some are not so durable. Durability of the bamboos also depends upon area of using. If bamboos are used in external purpose exposing in sun and rain as well as buried under ground without treatment then it becomes less durable where as bamboos that has been used for internal purpose becomes more durable. Mal bans, Bhalu bans, Philing bans, Phor bans, Choya bans, Ban bans and Singare bans are the main species found in the study area. Among those species, Mal bans and Phor bans are found more durable than the other is.

**Table 18 Durability of the locally available bamboo**

S.N	Local Name	Botanical Name	Durability	
			Without treatment	With temporary treatment
1	Mal Bans	<i>Bambus nutans</i>	2 yrs	3 to 5 yrs
2	Bhalu bans	<i>D.hookeri</i>	1 yrs	3yrs
3	Choya bans,	<i>D.hamiltoni</i>	1yrs	3yrs
4	Ban bans	<i>D.hamiltoni spp.</i>	1 Yrs	3yrs
5	Philing bans	<i>M.becifera</i>	1 yrs	3yrs
6	Phor bans	<i>B.spp</i>	2 yrs	5yrs-8 yrs
7	Singare bans	<i>B.vulgaris</i>	2yrs	3yrs

Source: field survey, January,2009

# CHAPTER IX

## INDUSTRIAL APPLICATION OF BAMBOO

### 9.1 Bamboo based industrial products

Bamboo has various industrial applications to produce several products. According to the technology developed by the Indian Plywood Industries Research and Training Institute (IPIRTI) following products can be produce in industrial level by using bamboo as raw material.

#### 9.1.1 Bamboo toothpicks

Bamboo toothpicks are the safest tool for clearing the locked in solid food materials/particles between the teeth. These are hygienic and user friendly material to be use inside the mouth .These are made of bamboo thin sticks with pointed tip .It is harder than synthetic & wood toothpick. As consumers (specially in developed markets such as North America &Japan0 have become increasingly environment conscious, this has become a strong marketing aspects of bamboo. This product is competable with synthetic and wood materials.

#### **Manufacturing procedure:**

- ) Cutting the original bamboo poles in to properly sized sections with round bamboo cross cutting machine.
- ) Splitting the sized poles with hand splitter
- ) Splits is put through a slicing machine
- ) Making sticks from the slices by stick making machine
- ) Sizing of tooth picks by tooth pick sizing machine

- ) Polishing of tooth picks by tooth pick polishing machines
- ) Drying of tooth picks by dryers
- ) Quality control and packaging.

**Socio-Economic Benefits:** It creates direct employment for the 25 persons and indirect employment to 10-12 thousand persons.

### **9.1.2 Bamboo mats and blinds**

Bamboo mats and blinds are machine made round sticks. These are used as door and window curtain, blinds for opening mats for table, chair and seats, wall hanging, carpets. this product is competable with synthetic and wood materials.

#### **Manufacturing process:**

- ) Cross cutting of the selected bamboo
- ) Splitting
- ) Sizing
- ) Drying
- ) Weaving with yarn

**Socio-economic benefits:** Creates direct employment for 73 persons and indirect to more than 10 thousands.

### **9.1.3 Bamboo stick**

Round bamboo sticks are mostly used in the manufacture of incense (Agarbati) stick. Also are used for manufacturing of handicraft items, kulfi-ice cream kites, Novelties and agricultural products.

**Manufacturing process:**

- ) Matured bamboo is cross cut in to the required size
- ) Bamboo is put through a splitting machine
- ) Splits are put though the stick making machine
- ) Sticks are put though a stick sizing machine
- ) Packaging and marketing

**Socio-economic benefits:** create direct employment for the 35 persons and indirect employment to more than 5 thousand persons.

**9.1.4 Bamboo flooring and Bamboo Panel Boards**

Bamboo flooring/board is the latest entry in the flooring and interior concept. This unique product provides an exotic oriental beauty to interior of any room and high quality of bamboo compared to wood guarantees a lifetime of enjoyment. Bamboo flooring and bamboo board is also most environmental friendly construction material Environment conscious countries are the main potential market for this product. The product is competable with marble, granite, wooden flooring, ceramic tiles and laminated flooring etc.

**Manufacturing process:**

- ) Straight 4-5 yrs matured bamboo is cut in to the required length
- ) Preparing the stripes by splitting ,knot removing and sizing by machines
- ) Strips are boiled and treated in mixture of water, hydrogen peroxide and boric acid to remove sugar, starch, mildew and pests.
- ) Drying of the strips through drying chamber
- ) Each strips is then passed through four side planning machine to get accurate rectangular shape.



- ) Strips are cut in to the required length in the sizing machine.
- ) Application of the glue to the strips
- ) Assembled of the glued strips in to rough board
- ) These boards are pressurized in to hot press machines
- ) Sizing of the prepared board.

**Socio-economic benefits:** creates employment, improves in human health and protects environments.

### **9.1.5 Bamboo ply (mat) board**

Bamboo ply (mat) board are better than common wood for its strength and longer durability. which has perfect water proof function for its shrinking rate and expanding rte. water absorbing rate are better than wood texture and also the board is never rusted and humidity resistant and smooth.

#### **Manufacturing Process:**

- ) Cutting of bamboo poles in required sizes with cross cutting machine.
- ) Splitting bamboo in to desired size of strip & skin removing
- ) Making of slivers in to required thickness
- ) Weaving of mats with the slivers
- ) Treatment of the mats with preservatives
- ) Application of the resin and fabrication of the mats in to hot press machine
- ) Sizing and packaging

**Socio-economic benefit:** Job creation, and environment protection

### **9.1.6 Bamboo Mat Corrugated Sheets (BMCS)**

BMCS has very high use potential as eco-friendly roofing alternate to asbestos cement, galvanized iron and aluminum corrugated sheets. BMCS has several other potential use like walling container/packaging, prefabricated houses etc. BMCS are found water proof and resistant to decay, termites/insects and fire. This product is manufactured from woven bamboo mats.

#### **Manufacturing process:**

- ) Mature bamboo poles are hand harvested and longitudinally dimensioned using a cross cutting machine or hand tools.
- ) Slivers for weaving are cut by hand or with a splitting machine to split.
- ) Surface skins are removed by hand to create slivers 0.6 mm in thickness.
- ) Slivers are woven by hand into herringbone pattern mats.
- ) Mats are transported from by truck to a central lamination facility.
- ) A prophylactic treatment against fungal/borer infestation is applied to mats.
- ) Mats are coated with formulated PF resin and preservatives.
- ) Resin-coated mats are stabilized by open-to-air stacking for about two hours.
- ) Stabilized mats are dried and coated with a modified PF resin adhesive to exterior surfaces prior to layering and pressing.
- ) Sheets are prepared as layers of five mats each.
- ) Sheets are laminated and corrugated using a mechanical hot press.

- ) Sheets are set to dry in open-to-air stacks.
- ) Sheets are trimmed and trimmings are collected for recycling.
- ) A protective weathering coat is applied to top sides of sheets and dried.
- ) Sheets are warehoused until delivered by truck to construction sites.
- ) Roofs are sheeted by hand using traditional methods.

**Socio-Economic Benefits:** The micro-enterprise will generate full-time local employment in a lamination facility for up to 15 persons at peak production and as many as 240 seasonal and daily “cottage industry” home-partner bamboo cultivation and mat weaving groups. CBRS production will reduce the cost of house construction thereby making housing more affordable to lowest income families while at the same time making habitation more environmentally friendly. Within 3-5 years it is anticipated that the roofing market in Nepal will grow and additional economic advantages will be had throughout the cultivation-lamination-construction cycle.

## **9.2. Bamboo based Enterprises in Jhapa**

Very few enterprises based on bamboo resources were found around the Jhapa district during the research period. Most of the people have used bamboos to make household utensils but very few people have involved in running commercial enterprises. There are two micro enterprises for handicraft production and one for manufacturing furniture.

### **9.2.1 Mahima Bamboo Handicraft**

Mahima Bamboo handicraft is located in Mechinagar-5 Jhapa owned by Puspa Chaudhary. Puspa Chaudhary became inspired when he saw various types of bamboo handicrafts when he had visited in Assam of India, . When he returned in Nepal he started to make some handicrafts as a hobby, gradually his work was recognized and he started to increase the volume of production. Later on his family members also involved on production of handicrafts and he adopted it professionally. In these days, not only his family members but also the women of the church are also involving to produce handicrafts. The products of the enterprise are, different kinds of bamboo houses, Photo frame, Tea table, Gamala for flower, wall watch, Nameplates, Cupboard, Ladies clips, file racks, Sofa, wall decorating flowers, ladies purse, book covers and other gift items as per order. The chaudhary family is earning Rs.15000 to 20000 per month from the enterprise.

### **9.2.2 Bangalamukhi Hastakala Centre**

Banglamukhi Hataskala Center is registered micro enterprise, located in Bhadrapur -15, Jhapa. This Enterprise was established in 2001 and has recognized locally and nationally. Product of the enterprise is sold in local, National and International market as well. Sanjaya Shrestha, Proprietor of the enterprise is skilled craftsman. Initially he started initially started with small investment later when his product received a good market then he took loan from the Bank and run it professionally. Bamboo root is the main raw material for the production. Idols of different birds and animals, gift items, wall hangings, photo frames, Penholders, small houses are the main products of the enterprise. Products are sold in local and national market. It has also exported it's products in to international market like Spain, United States of America, Denmark and Japan. Currently, the enterprise has

been providing employment for 40 skilled labor to make Bamboo Apple house for the resort in Pokhara.

### **9.2.3 Gyansur Nepal Badhyabandan tatha Handicraft Pariwar**

Gyansur Nepal is an registered micro enterprise established on 2052 B.S. with a slogan “*Kala Sikna Au Kalidas*”. According to the proprietor Gyan Bahadur Pun ,it was established to promote the folk musical instruments and also to provide opportunity to the unemployed youths to learn and work to be self dependent. This enterprise has trained more than 300 people so far, they are being self-dependent. The main product of the enterprise is Bamboo based musical instruments like flute, Sarangi, Tabala, Madal, harmonium etc. Apart from the musical instruments, Gyansur Nepal produces furniture and handicrafts like, Bamboo chair, cupboards, rack, hanger, Sofa, flower holder, penholder, tray teacups and different types of images of God and Goddess of decoration made up of bamboo roots. Product of the enterprise has been sold in local market like Dharan, Katmandu and Biratnagar and exported in to international market like U.S.A and European country.

### **9.2.4 Bamboo Enterprise for Habitat**

Bamboo Enterprise for Habitat is a non profit making project located in Chandragari V.D.C of Jhapa, established by Habitat for Humanity International Nepal in partnership with local organization Sahara Nepal and with the financial support of Canadian International Development Agency (CIDA) and Habitat Canada. This Enterprise is going to start it’s first production by the second week of July 2009.(*Source:BEFH*)

## **The main goals of the project are**

- 1) Make housing more affordable by reducing the “home-partners” out-of-pocket cash costs by enabling them to make in-kind contributions of woven mats used in Bamboo Mat Corrugated Roofing Sheets (BMCS) fabrication
- 2) Give families opportunities to earn income via “cottage industry” sales of woven mats to the fabricator.
- 3) Eliminate thin galvanized metal roofing by substituting more robust and environmentally superior BMCS.

## **This project consists of three major Activities**

### **1. Cultivate and harvest bamboo and weave mats.**

CBRS are made from mats of woven bamboo slivers. This activity lends itself to low-wage labor intensive “cottage industry” production in a region that is rich in available, inexpensive regenerative bamboo and suffers from serious under-employment. HFHI-Nepal aims to make houses affordable and more habitable for the poor. One way is to reduce the cash cost of roofing by substituting galvanized tin with more robust and environmentally friendly BMCS.

It is assumed that the micro-enterprise will operate at 2/3 peak production within five years. Peak production is determined to be roofs for more than 2662 houses per year, requiring a supply of 1500 woven mats per day from a network of as many as 240 women-led Save & Build/home-partner groups. The groups will contribute approximately 15% of the woven mats in-kind and 85% of the woven mats will be purchased from the groups.

(Note: “Home-partners” are the people who purchase homes from Habitat for Humanity)

The groups from three sources will purchase the bamboo required in the production of woven mats to be used in the CBRS, roughly a third from each source:

1. Farmer's associations, who grow bamboo on land leased, in many instances, from the local government. These associations are organized as community groups to cultivate bamboo and engage in other income generating programs. Such bamboo is cultivated mostly on wasteland, marshes and riverbanks.
2. Residents of Jhapa and Ilam, who grow bamboo mainly on their own land. Many of these people will be the "home-partners" themselves who will be benefiting from the production of BMCS.
3. Commercial growers.

During the first three years of the project, the home-partner groups will weave a high percentage of the bamboo mats used in production. It is expected that approximately 60% of the mat weavers will be home-partners. The groups will decide for themselves how much time to devote to mat weaving, depending on their other obligations and priorities. They will also decide the timing of their mat-weaving work, depending on agricultural cycles and other work-related commitments. When focused on mat weaving, it is anticipated that the individuals involved would work 6 to 8 hours per day.

## **2. Fabrication of BMCS**

The fabrication of BMCS is a lamination activity requiring five mats per sheet. Sheets are made in ways similar to those of the Canadian plywood industry: trimming, layering, and gluing, hot pressing, drying and applying a preservative coating to the weathering side. For cost containment, it is not intended to automate

the fabrication process, but rather to train and employ as many as 15 local people – 2/3 women – as managers and fabricators.

The fabrication facility is to be owned by HFHI-Nepal, located on lease land, and managed and operated by Sahara Nepal. Subject to success as a business venture, ownership may be transferred to Sahara Nepal or another organization to grow the market whilst accommodating the HFHI-Nepal product demand. As a charity, HFHI-Nepal is unable to engage the for-profit sector thus constraining the project's strategic aim of developing Nepal's embryonic micro-finance housing sector.

### **3. Sell of the fabricated BMCS to build the house of poor families**

Once fabricated, BMCS will be distributed to HFHI-Nepal home-partners, many of whom will have earlier contributed woven mats. Although peak production is more 10 roofs per day (more than 2662 roofs per year) the realistic expectation is an output of 10 roofs per day in the fifth year. The reliable input of woven mats in large numbers is the determining criterion.

A 30% per sheet cost saving is projected when fabricating from contributed mats, thus reducing the amount of micro-financing required by home-partners and making home ownership accessible to greater numbers of lowest income families.





# **CHAPTER X**

## **BAMBOO TRADE IN JHAPA**

### **10.1 Key pocket area of Bamboo resources in Jhapa**

Bamboo is available in all 47 V.D.C and 3 municipality of Jhapa district, though areas which are connected with boarder of Ilam district are known to be more rich in Bamboo resources. Bahundangi, Khudanabari, Shantinagar, Budhabare, Sanischare lie in the first category. Budhabare, Arjundhara ,Dhaijan, Satashidham, Lakhanpur, Ghailadubba Surunga lie in second Category. All the V.D.C, which are in the south part of the East west highway lie in the third category.

#### **10.1.1 Bamboo harvesting and trading season**

Trading of bamboo occurs only for nine months in a year. During the monsoon season, bamboo is not harvested due to the risk of damaging of new shoots. July, August and September are the off-season of bamboo trading and harvesting. People start to harvest bamboo only after October and keep continue until the monsoon starts. March to June is the peak season of Bamboo selling. Some of the traders harvest large amount of bamboo before monsoon and keep supply even during the monsoon season also.

#### **10.1.2 Some Bamboo exporting key areas of Jhapa**

Shantinagar, Budhabare, Bahundangi and khudanabari areas are key Bamboo exporting areas, those areas export 15 to 25 trucks (1 truck contains 600 culms) per months. Arjundhara, Khudanabari, Snishchare, Ghailadubba, Dhaijan, Duwagadi, Topgachhi, Surunga, and Lakhanpur Areas exports 8 to 14 trucks/months and rest of the V.D.C export 1-5 trucks per months. On the basis of

the field survey and interview with the Bamboo traders, 1142 (685200 culms) trucks bamboo harvested and sell per year in the major key areas mentioned in the table below, remaining 34 VDC sells average 918 truck (550800 culms) per year. In total 12,36,000 bamboo is traded in local and National market from Jhapa.

**Table 19: Yearly Bamboo selling data of key areas in Jhapa**

S.N	Area	Truck/Year	Culms/Year	Remarks
1	Shantinagar	225	135000	
2	Budhabare/Jaipur	207	124200	
3	Khudanabari/Sanischare	180	108000	
4	Bahundangi	135	81000	
5	Arjundhara/Ghailadubba	120	72000	
6	Dhaijan/Duwagadi	90	54000	
7	Lakhanpur/Topgachhi	100	60000	
8	Satashidham/Surunga	85	51000	
Total		1142	685200	

*Source: Field survey & Bamboo traders, March 2009.*

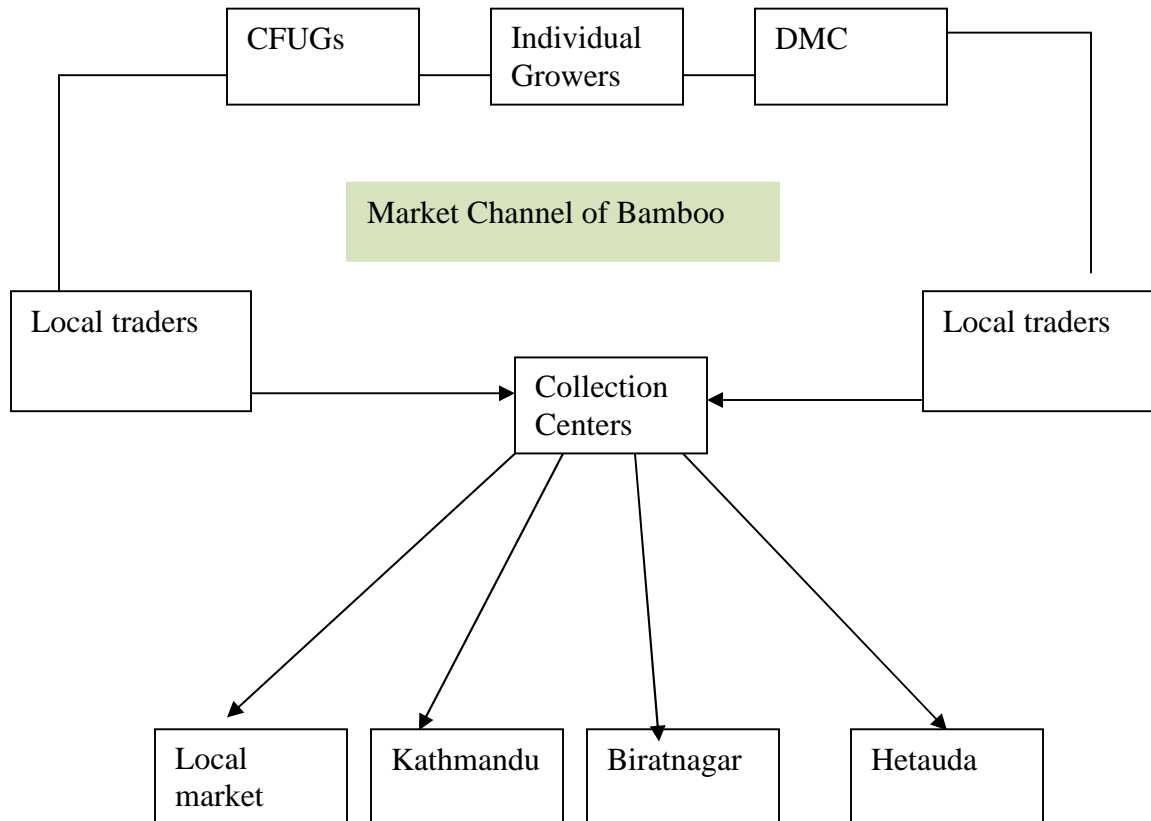
### **10.1.3 Bamboo collected in Ilam and traded from Jhapa**

Ilam district is also known as rich in bamboo resources, Bamboo traders of Jhapa also collect bamboo from Ilam and trade from Jhapa. Danabari, Irautar, Chisapani, Shantipur, Barfelang, Luxmipur, Kolbung, Mamai, Jirule, Panchakanya, Soyak, Barbote, Ranke, Rokse, Chulachuli, and banjo V.D.C are the main Bamboo collecting areas. Local traders of the Ilam collect bamboo from various areas and store in road access areas, traders from the Jhapa collect from those points and bring in Jhapa and send those bamboo in local as well as other parts of the country. According to the field survey and information provided by the bamboo traders,

720 trucks ( 432000 culms) bamboos are traded collected in Ilam and traded from Jhapa.

#### 10.1.4 Market channel and collecting Centre

Local Bamboo traders approach to the individual growers, Community forest users and Disaster Management Committees (DMC) groups with the demand of the bamboo they need. Bamboos, which are matured (at least 3 years old), are cut and transported up to the road near by .All those bamboos are loaded and brought up to the collection centre by means of tractor, trucks and cart. After having transported all the bamboos in collection centers they are screened as per according to their size and species. After the screening, it is supplied to the different part of the country as per the requirement of the costumers, firms and party. Kakarvita, Birtamode, Charali,Surunga and Damak are the main collection centers in Jhapa.



## 10.2. Existing and Potential Markets.

Bhutanese refugee camp, Chandragari Jail, Habitat for Humanity- Nepal and other micro enterprises are the main local markets of the bamboo. Kathmandu, Biratnagar, Dharan and Hetauda are the main Markets outside of the Jhapa. Bamboos of those areas, which are connected, with India are also exported to India. According to the market survey stock of 40% of the bamboo is traded to Katmandu 40% in local market, 17% Household consumption 3% traded to India.

### 10.2.1 Bamboo consumption by Bhutanese Refugee camp

Bhutanese refugees have been living in seven camps since 1990s. There are altogether 13948 families residing in 16673 huts. All those huts are made up of Bamboo with separate kitchen and toilets. According to the data provided by the Refugee Camp Union (RCU), office there is required of 80 bamboo culms per hut and each hut required to renovate in every two years with same amount of bamboo. Refugee camp has been a regular market for the local bamboo growers and traders. It has been said that people were motivated to grow and nurture bamboo due the high consumption of bamboo by refugee camps. According to the data available in RCU, about 6, 66,920 culms of bamboo per year is consumed by seven refugee camps in Jhapa and Morang.

### 10.2.2 Bamboo consumption by Chandragadi Jail

There is Bamboo based stool making enterprise run by the prisoners inside the Jail. This enterprise has not only providing the opportunity of income generation but also encouraged and engaged the prisoners towards creative work. Monthly requirement of the bamboo for the enterprise is 3000 to 3500. Yearly

consumption of bamboo by the stool making enterprise inside the jail is about 36000 culms to 42000 culms.

### **10.2.3 Bamboo use in Habitat Housing program.**

Habitat for Humanity International Nepal is serving poor and deprived families in need by building and renovating houses. This organization is advocating in shelter rights as well as promoting cost effective technology and using locally available environment friendly construction materials. Bamboo is the best option found as locally available construction material found to use around the region .More than 70% of the houses built and renovated by Habitat is made up of Bamboo.75 culms requires to construct normal Habitat house and about 80 culms requires to construct prefabricated bamboo house for disaster response. About 1,42,000 culms is consumed around the region to build houses according to the Habitat design and model to build both normal and disaster response prefabricated houses.

### **10.2.4 Bamboo Enterprise for Habitat (BEFH) as Potential Market**

The under constructing Bamboo Enterprise for Habitat has emerged as remarkable potential market for bamboo. The Enterprise has aim to open it's operation by September 2009.Main product of the enterprise is Bamboo Mat Corrugated sheet (BMCS) .This is prepared by fabricating the woven mats of bamboo. According to the technical notes provided by the IPIRTI and result of mat weaving in Jhapa 1 sheet of BMCS requires 4 woven mats , 3 bamboo requires to weave 2 mats.6 bamboo is required to for 1 Sheet of BMCS. Machine has capacity of producing 8 panels in one cycle, it can operate 4 cycle per hour and 32 cycle per day producing 256 sheets per day and requires 1536 bamboo/day.

**Table 20: Production Summary of BEFH**

S.N	Year	Production level	Woven mat/day	BMCS/day	Bamboo/day	Bamboo Per month	Bamboo / Year
1	1-2	1/3	340	85	510	13260	159120
2	3-4	1/2	512	128	768	19968	239616
3	5-6	2/3	680	170	1020	26520	318240
4	7+	Peak	1024	256	1536	39936	479232

*Source: Bamboo Enterprise for Habitat, April-2009.*

### **10.2.5 Current market price of Bamboo in Jhapa**

Price of the bamboo depends on the demand, season, distance from the main road, size and the species of the bamboo. It was found that purchasing cost of Bamboo by local traders in the clump with out cutting is Rs.30-33, Rs.35 to 37 after cutting, Rs 40 to 42 after transportation in to the collection center. Selling price of bamboo by the local traders vary Rs.50 to 70 depending up on the quality and the quantity of the bamboo.

**Table 21: Purchasing and selling price of locally available bamboo**

S.N	Name of Bamboo		Size/diameter	Purchasing price/culm	Selling price/culm
	Local	Botanical	In inch		
01	Mal Bans	<i>B.nutans</i>	2 -3.5	40-50	50-70
02	Phor bans	<i>B.spp</i>	2-3.5	35-45	45-60
03	Philling Bans	<i>Melcanna baciferra</i>	1.5-2	25-30	30-35
04	Singare Bans	<i>B.vulgaris</i>	2-3	30-35	35-45
05	Ban bans	<i>D.hamiltonii</i>	2-3.5	35-45	45-55
06	Dhanu bans	<i>Bambusa bambos</i>	2.5-3.5	40-45	55-65
07	Bhalu Bans	<i>D. gignateus</i>	3-4	40-45	50-70

*Source:Field survey and Local bamboo traders, March 2009*



# CHAPTER XI

## SUMMARY, CONCLUSION AND RECOMMENDATION

### 11.1 Summary

The study “*Integrated Bamboo Farming*” is related to the Borleni Bamboo plantation group of Jhoda village, Khudanabari, Jhapa. The main objectives of the study is to analyze the socio-economic, ecological and cultural impact in the rural livelihood, identify existing practices of cultivation & management of bamboo and also promoting commercialization of bamboo and bamboo based product. The primary data was collected by interview, field observation and participatory methods. Secondary data was collected from census, published and unpublished books, articles, reports prepared by individuals and various Non-governmental and Governmental organizations and other key informants and stakeholders such as specialist, scientist and technical person.

The study area was Jhoda village of Khudanabari village of Jhapa district inhabitants of this village are predominantly Limbus followed by Bramin, Dalit, Rai, Chhetri and Tamang. This study was based on descriptive as well as exploratory research designs. Descriptive research design was used to obtain qualitative information about the study area exploratory research design was used for collecting information about respondents’ views and ideas. Since the research is done on integrated bamboo farming, the group was purposively selected and group is taken as universe of the study and 35% of the universe is taken as sampling for the study. Collected data were analyzed by using simple table graphic presentation.

The majority of the respondents were found engaged in agriculture (65%) and daily wage earning. 41% of the households have their monthly income 3600-

5000, while 32% have Rs. 2000-3500. Almost all the families are occupying the land without land title. 89% of the families are using timber and bamboo for cooking fuel.

Integrated bamboo farming was a new thing though it was found active involvement, coordination and cooperation among the group members. This has been adopted even on individually occupied land also. IBF has played a key role in the local economy, livelihood and environment. Bamboo has been used as a major construction material to build their houses. The entire group member has taken part in the management of the IBF; they have a unique model of benefit sharing, conflict management and decision-making. Conventional method of cultivation called *Sakhar* (offset cutting) was applied to cultivate the bamboo. Simple methods such as smoking and water immersion were used for the treatment of bamboo to increase its durability. IBF has created social harmony and unity in the community. People are engaging in nurturing the plantation area as well as other agricultural activities. In the Bhutanese refugee camp, Bamboo Enterprise for Habitat, other local bamboo-based enterprises have created a secured market. This IBF in Jhoda has created a positive impact on other people also which has encouraged replicating the model in other areas also.

## **11.2 Conclusions**

Since the world is suffering from global warming and climate change, such types of plantation of renewable resources can play an important role to maintain the environment. There has been a regular pressure over the natural resources, especially forest base resources, to regenerate them if we plant trees, it takes 25 years to be matured while bamboo matures within three years and it can restore degraded land very soon and support to meet the essential needs of people.

IBF initiated by the people of Jhoda has set a model, which can be replicated in other areas also. There is a chain of activities of income generation under IBF, starting with cultivation bamboo along with vegetables and fruits in the first and second year followed by broom grass in the third and animal husbandry in the fourth year, after fifth year Bamboo can be sell and earn more income. Specially women of the village have played significant role in running, managing decision making of the group. It is observed that people of Jhapa are closely linked with bamboo in many aspects. Bamboo farming in wasteland-degraded land commonly and individually has brought change not only in economic condition but also has maintained environmental sustainability, livelihood security and controlled disaster. Majority of the people have used bamboo as a construction material, which has remarkably reduced the use of timber. Number of people have been engaged in bamboo trading, cultivation and harvestion. In the same time Bamboo based enterprises has provided employment to the local people. Bamboo planted in the riverside through disaster management committee (DMC) has not only mitigating the flood disaster but also has been a source of income to the group.

There are many areas covered by degraded and wasteland, bamboo can be cultivated in those areas adopting the IBF model with improved technology.

Still there are some areas of improvements to carry on IBF, professionally as well as commercially. People of the Jhoda village do not have received any training on cultivation and management of the professional Bamboo farming, they are using conventional methods of propagation, which is not reliable for mass cultivation. Pruning, regular watering and timely fertilization system has not been yet in place. Still there need to be fair market price, Traders provides low price whild purchasing from the growers and sell in to higher price keeping high margin which has exploited to the growers. A well managed IBF with proper irrigation, fertilization and care has several potentiality on maintaining livelihood security, environmental sustainability and employment creation.

### 11.3 Recommendations

In the past, we had a slogan called “*Hariyo ban Nepal ko dhan*” though due to the over exploitation of the forest resources now we are losing our identity of being rich in forest. The pressure on forest resource is still continuing. Due to the deforestation there are lots of degraded and wastelands. Disaster has changed thousands of hectares of land into desert. To restore those lands by planting of timber plants takes a long time so those lands can be used for the bamboo plantation which will not only restore the degraded lands but also supply the increasing demand of the bamboo in the market, substitute the demand of timber and can protect the environment. Bamboo can sequester 12 tons of carbon per hectare that is higher in comparison of the amount sequestered by tree. Since the country has just started carbon business, mass cultivation of bamboo can promote the carbon market and there will be extra advantage. As bamboo is a renewable resource available all parts of the country, Government has to take some intervention to promote cultivation as well as using of bamboo resources.

Based up on the findings and the observations few recommendations are made from the study.

***Scale up cultivation:*** Presently, available bamboo resources are in the forest form, only harvesting without cultivation can ruin the resources, so there is need of cultivation of bamboo professionally. Forest based bamboo plantation in the degraded land of forest, plantation in the riverside for disaster mitigation and integrated bamboo farming in the wasteland can be adopted as a model of professional bamboo farming.

***Promotion of Community Bamboo Nursery:*** Since it is very rare to get seeds of bamboo conventional methods of propagation has been followed by the respondents as well as people of other area are not so reliable for professional bamboo farming, so women saving groups, village banks group should promote to run and manage the community bamboo nursery applying other methods of

propagation like branch cutting and culm cuttings. This can be run in cooperative venture in a minimum investment that can supply the plantlets of bamboo to the cultivators and groups can generate the income as well.

***Capacity build up through Training & Orientation:*** None of the respondents in the study area has taken any formal training on bamboo cultivation, their capacity should be increased by training and orientation on professional bamboo farming and nursery management.

***Advocacy and Awareness creation*** :Still people are not aware on diverse use of Bamboo and also not in confident in durability of bamboo due this traditional mindset they are not encouraged for professional bamboo farming so there is need of advocacy on various application of bamboo it's role in environment, income generation and livelihood.

***Promotion of traditional use of Bamboo:*** Bamboo has various traditional uses especially in handicrafts and household use items. Skillful craft man should encourage running micro enterprise and their product should promote in national and international market.

***Government policy on Bamboo trading*** : Every year there is huge transaction of bamboo trading those traders are not registered as a firm and are conducting business local ,National and India market but there is no any tracking mechanism of government. Most of the bamboos are from forest form but government does not have any record of existing resource and harvesting amount per year so it is necessary to make a policy on trading of bamboo as well as record keeping on demand, supply and stock of the resources.

***Research and resource assessment:*** To keep the updated data on availability of the resource there is required of assessment of the bamboo resources in National level.

## REFERENCES

Ahlawat S. Haridasan K. &Hedge S. 2002 *Field Manual for Propagation of bamboo in North East India*, State Forest Research Institute ,SFRI information bulletin No.14,Department of Environment & Forests ,Government of Arunachal Pradesh.

Annual report of Jhapa District Soil conservation office, Jhapa 2062/63,

Area Development Scheme for Bamboo cultivation in Barak valley of Assam, 2004 , [http://planning.up.nic.in/innovations/inno3/fw/bamboo\\_cachar.htm](http://planning.up.nic.in/innovations/inno3/fw/bamboo_cachar.htm)

Bhattarai S. 2003: *Analysis of Nepali Society and Culture* National Book Centre Bhotahiti Kathmandu.

Banko Jankari 2006. Volume 16 No-2, A Journal of Forestry Information for Nepal, Department of Forest resource and Survey.

Britton C.S 2007,: *Save and Build with Bamboo demonstration project report* , Ilam district ,The Canadian Architects Legacy Fund, Canada

Bishowkrama A.2007: *Environmental Assessment and Screening report*, submitted to Canadian International Development Agency (CIDA) for Bamboo Enterprise for Habitat

Bishowkarma A.2006: *Industrial Processing and Application of Bamboo Habitat for Humanity International-Nepal* , Training report Organized by CBTC and IPIRTI Held in State Forest Service Collage Burnihat Assam India on 17-19<sup>th</sup> April 2006. (unpublished)

Bradshaw R.I 2001, *Bamboo in Nepal :A management Guide*

Bradshaw R.I (1989a) *A Preliminary Report On The Tinau Watershed Project's Bamboo Propagation Trials at Tansen, Palpa, Nepal*

Bishowkarma A.2007, Report on *Discovery Exposure visit to establish BMCS plant*. Place visited Indian Plywood Industries Research and Training Institutes, Bangalore India from 2<sup>nd</sup> to 7<sup>th</sup> September 2007, HFHI-Nepal.(unpublished)

*Bamboo plantation and Management* <http://mizobamboo.nic.in/mizmana.htm>

Central Bureau of Statistics, Government of Nepal National Planning commission  
2008

Diver S.2001: *Bamboo: A Multipurpose Agro forestry crop* National Center for Appropriate Technology (NCAT) CT150, slot 168

District Development Plan 065/066, 2009: Published by Jhapa District Development committee.

Gonzalez E.gukkermo 2000, *Plybamboo wall for housing, structural design*, printed by press University press facilities,Eindhoven University of Technology,Eindhoven,Netherland.

Gadgil M.1998, *Traditional Resource Management Systems*, Life style and Ecology India Gandhi National Centre for the Arts, New Delhi

Joshi B. & Amatya S. 2005 *Bamboo and Rattan development in Nepal*, Department of forest research and survey.

INBAR,1991 Technical Document, FORSPA Publication 6, *Bamboo in the Asia and the pacific*, Proceedings 4th International Bamboo Workshop, Chainmai, Thailand November 1991 INBAR.

Janssen J.2000, *Designing and Building with Bamboo* Technical university of Eindhoven, Netherlands, Technical Report No.20.

Jha M. 1983 :*An Introduction to Anthropological Thought*, Kay Kay printers New Delhi

Janasamsad National Daily *Jarama jibanta kala* June 22 ,2008

Karki M.,Sherchan G.,Karki J. 1998, *Extensive bamboo production-to-Consumption Systems in Eastern Nepal: a Case Study*, INBAR working Paper No.17

Kathmandu Post 2008: *flute bring fortune to this man*” 30 october 2008

Lekhak D. & Lekhak B.2005, *Natural Resource Conservation and Sustainable Development in Nepal*.

Mathews K.C, 2006: *Preliminary processing of Bamboo Manufacture of industrial products*. Paper presented in workshop on Industrial Processing of Bamboo and it's application organized by IPIRTI and CBTC, 17-19<sup>th</sup> April-2006 Assam India (Unpublished)

Mechi times 2007. “*Bans sanga miteri gastai kala sadhana*” 2 March 2007

Nath S.K,2006: *Bamboo based micro Enterprise* Paper presented in workshop on Industrial Processing of Bamboo and it's application organized by IPIRTI and CBTC, 17-19<sup>th</sup> April-2006 Assam India (Unpublished)

Naidu M.V, 2006 :*Properties and Standardization of Bamboo Based products* Paper presented in workshop on Industrial Processing of Bamboo and it's



Nripal Adhikari, 2009 *Economic Potential of Bamboo, for the Traditional bamboo users in the modern economy* Adobe and Bamboo Research Institute.,  
[www.abari.org](http://www.abari.org)

RES –Nepal, 2006. *Bamboo Update Voll, No.3* RES Newsletter, Kathmandu  
Nepal

RES-Nepal, 2004: *Bamboo eco-housing project* Progress report of RES Nepal,  
Bamboo Update Volume 1

Stapleton, Chris 1994. *Bamboos of Nepal, an Illustrated Guide* Forestry  
Department, University of Aberdeen, Royal Botanic Garden Edinburgh, Forestry  
Research Program University of Oxford, London

Sherpa L. June 2004, *A Report on Indigenous Peoples, gender and Natural  
Resource Management*, Submitted to KULU Women and Development Denmark.

Saxena K.G. 2001, *Integrated Natural Resource Management: Approaches  
and Lessons from the Himalaya Ecology and Society* Vol.5 No.2  
Article.14, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi,  
India

Ritzer G. 2000, *Sociological Theory* McGraw-Hill International Editions,  
Singapore

## Websites cited

[www.bioversityinternational.org/publications/Web\\_version/572/ch29.htm](http://www.bioversityinternational.org/publications/Web_version/572/ch29.htm) - 50k

<http://www.americanbamboo.org/About.html>

<http://www.worldagroforestry.org/af1/index.php>

<http://www.flavorandfortune.com/index.html>

[http://www.inbar.int/Ecolo\\_secu/esmain.htm](http://www.inbar.int/Ecolo_secu/esmain.htm)

<http://www.bamboowholesale.com.au/index.html>

<http://attra.ncat.org/fundamental.html>

<http://www.bamboogrove.com/origins-of-bamboo.html>

<http://bambus.rwth-aachen.de/eng/PDF-Files/Bamboo%20as%20a%20building%20material.pdf>

<http://www.inbar.int/totem/totemmainlist.asp?newcode=propagation&br=bamboo>

<http://www.bamboocentral.org/whybamboo.html#top>

<http://www.pacificbamboo.com/>

## Annexes-I

### House hold Questionnaire

Name of V.D.C:

Ward No:

Tole:

House No:

Name of Interviewee:

Main person of the house

#### 1. How Many members are you in your family ?

a. No.of female:

b. No. of Male

#### Family description

S.N	Name	Age	Gender	Education	Occupation	Relationship	Special skill
01							
02							
03							
04							
05							
06							



c. Timber/Bamboo

d. Guintha

**8. Do you have own bamboo in your private land? if you have can tell the occupied area ?**

a.....No. of Clumps

b.5 kattha

c. more than 5 Kathha

d.....Bigha

**9. Have done Professional Bamboo farming in your private land? If you have done can you tell the total occupied area?**

a. 1-5 kattha

b. 5-10 Kattha

c. 10-15 Kattha

d.....Bigha

**10. Do you purchase bamboo for House hold use ?if your purchase how many culms you purchase per year?**

.....  
.....  
.....

**11. Do you sell Bamboo commercially if you sell how many culms you sell per year ?**

.....  
.....  
.....

**12. How much you earn by selling Bamboo per year ?**

.....  
.....  
.....

**13. What type of tree plants have you planted along with Bamboo ?**

.....  
.....  
.....

**14. What type of vegetables, cash crops and fruits have you along with Bamboo ?**

.....  
.....  
.....

**15. How much you earn by selling cash crops, fruits and vegetables ?**

.....  
.....  
.....

**16. What species of bamboo is available around your area ?**

.....  
.....  
.....

**17. What type of Methodology have you applied on Bamboo plantation?**

a. vegetative propagation    b. seed plantation                      c. plant from Nursery

**18. Do you have taken any training on professional Bamboo farming and Nursery Management?**

a. Yes

b. No

**19. Have you ever applied preservative treatment to increase the durability of Bamboo ?**

a. Yes

b. No

**20. Can you explain about the the environmental impact of Bamboo in your area ?**

.....  
.....  
.....

**21. Can you explain about the cultural Value of bamboo in your society ?**

.....  
.....  
.....

**22. For which of the following purpose you use Bamboo ?**

- |   |       |      |
|---|-------|------|
| a. Do you use bamboo for cooking?                       | (Yes) | (No) |
| b. Do you use bamboo shoots for curry?                  | (Yes) | (No) |
| c. Do you use Bamboo leaf for fodder for cattle?        | (Yes) | (No) |
| d. Do you use Bamboo as construction material in house? | (Yes) | (No) |
| e. Do you use bamboo as Medicine?                       | (Yes) | (No) |
| f. Do you use Bamboo to produce Handicrafts?            | (Yes) | (No) |

- g. Do you use Bamboo to protect the land from flood (Yes) (No)  
h. Do you use Bamboo for Fencing (Yes) (No)

**23. Can you tell the list household utensils made of Bamboo which you use in your daily life ?**

.....  
.....  
.....  
.

**24. In which market you export the Bamboo?**

.....  
.....  
.....



## Annexes II

### Bamboo species found in Nepal

S. N	Local name	Botanical Name
01	Nibha Ningalo	<i>Ampelocalamus patellaris</i>
02	Malingo,Malinge Nigalo	<i>Arundinaria racemosa</i>
03	Murali Bans/Mugi Nigalo	<i>Bambosa Alami</i>
04	Dhanu Bans	<i>B.balcooa Roxburg</i>
05	Kande Bans	<i>Bambusa bambos</i>
06	Timor Black	<i>Bambusa lako</i>
07	Pahelo Nigalo	<i>Bambusa multiplex Raeuschel</i>
08	Chituwa Nigalo	<i>Bambusa multiplex 'Riviereorum'</i>
09		<i>Bambusa nana Roxburgh</i>
10	Phusre Bans	<i>B.nepalensis Stapleton</i>
11	Mal Bans	<i>B.nutans sbsps.cupulata stapleton</i>
12	Taru Bans	<i>B.nutans sub sps.Nutans</i>
13	Mungri Bans	<i>B.pallida</i>
14	Phor Bans	<i>B.spp</i>
15	Koraincho Bans	<i>B.tulda Roxborgh</i>

16	Buddha Bans	<i>B.tuldoides</i> 'Ventricoa'
17	Singare bans	<i>B.vulgaris</i> Shrad
18	Phenlo bans	<i>B.vulgaris</i> from Kimmei
19	Phenlo bans	<i>B.vulgaris</i> 'Vittata'
20	Lota Bans	<i>B.vulgaris</i> 'wamin'
21	Chigar	<i>Borinda chigar</i>
22	Kalo Nigalo	<i>B.emeryi</i> stapleton
23	Gopi Nigalo	<i>Cephalostachyum latifolium</i> Munro
24	Seto gopi nigalo	<i>C.latfolium</i> var.Variegata
25	Kande Nigalo	<i>Chimonobambusa quadrangularis</i>
26	Kande Nigalo	<i>Chimonobambusa marmoreal</i>
27	Japanese Dwarf	<i>C.marmorea</i> var.variegata
28	Bhalu Bans	<i>Dendrocalamus gignateus</i> Munro
29	Choya bans,ban bans	<i>D.hamiltonii</i> Munro Var.
30	Kalo Bhalu Bans	<i>D.hookeri</i> Munro
31		<i>D.longipathus</i> Munro
32	Tame Bans	<i>D.nepalensis</i>
33	Bhalu Bans	<i>D.Sikkimensis</i>
34	Lathi bans	<i>Dendrocalamus strictus</i>
35	Diu Nigalo	<i>Drepanostachyum falcatum</i>
36	Tite bans	<i>D. intermedium</i>
37	Ban Nigalo	<i>D.khasianum</i>
38	Ghunre Nigalo	<i>Himalayacalamus asper</i> stapleton
39	Malinge Ninalo	<i>H.brevinodus</i> Stapleton
40	Malinge Nigalo	<i>H.cupreus</i> Staletton
41	Thudi Nigalo	<i>Himalayacalamus falconeri</i>
42	Tite Nigalo	<i>H.fimbriatus</i> Stapleton
43	Paryang	<i>Himalayacalamus hookerianus</i>

44	Seto Nigalo	<i>H.porcatus</i>
45	Lahure Bans	<i>Melcanna baciferra</i> (Roxborgh)
46	Sunaulo Nigalo	<i>Phyllostachy aurea</i>
47	Kat Bans	<i>Phyllostachys edulis</i>
48	Kalo Nigalo	<i>Phyllostachys nigra</i>
49	Chiniya Bans	<i>Phyllostachys sinensis</i>
50	Japanese Nigalo	<i>pleioblastus aureostriatus</i>
51	Bango bans	<i>P. japonica</i>
52	Japanese Dwarf	<i>P.fortunei</i>
53	Tir Nigalo	<i>Pseudosasa japonica</i>
54	Variegated Japanese Dwarf	<i>Sasaella auricoma</i>
55		<i>S.ramosa</i> Makino
56		<i>Shibataea kumasaca</i>
57	Rato Nigalo	<i>Thamnocalamus spathiflorus subsp.spathiflrus</i>
58	Jara buto	<i>T.spathiflorus</i> subsp.Nepalensis stapleton
59	Ghode Nigalo	<i>T.spathiflorus</i> var.crassinodus stapleton
60	Khusre malingo	<i>Yushania maling</i> (Gamble)
61	Malingo	<i>Y.microphylla</i> (Munro)

## Annexes-III

### Classification of Bamboo by traditional uses

S.N	Local Name	Botanical Name	General uses
01	Dhanu Bans	<i>B. balcooa</i>	scaffolding, storage bins, fencing, roofing etc
02	Tama/Choya Bans.	<i>D. Hamiltonii</i>	shoots, weaving materials etc
03	Taru Bans	<i>Bans B. tulda</i>	Basket wares, scaffolding, low quality woven products
04	Mal Bans	<i>B. nutans</i>	construction including bridges
05	Malingo Bans A. maling	<i>A. maling</i>	basket and furniture making
06	Kante Bans	<i>B. arundinacea</i>	construction of buildings
07	Kalo/Balu Bans.	<i>D. hookerii</i>	weaving, construction, fodder
08	Kath/Lathi Bans	<i>D. strictus</i>	sticks and constructions
09	Nigalo Bans	<i>Drepanostachyam sp</i>	construction, mats, weaving, fodder
10	Phosre Bans	<i>Dendrocalamus. sp</i>	weaving and fodder
11	Ringal Bans	<i>Thamanocalamus sp</i>	weaving and fodder
12	Leyas/Murali D.	<i>D. patellaris</i>	flute and weaving

13	Koraincho Bans	<i>Oxytenanthera sp</i>	fencing, construction, weaving
14	Chigar Bans	<i>Thamnocalamus sp</i>	food for black bear and pheasants
15	Dhungre Bans	<i>Bans D. giganteus</i>	construction, weaving, containers

## Annexes-IV

### Photographs

#### A. Photographs of IBF Activities



*Vegetable grown in the 1<sup>st</sup> year of IBF*



*Banana grown with Bamboo 2<sup>nd</sup> year -IBF*



*Broom grass grown with Bamboo 3<sup>rd</sup> Year-IBF*



*Women weaving mats for BMCS*

**B. Photographs Some activities during Research period**



*Researcher interviewing with respondents*



*Researcher collecting bamboo fruits*



*Treatment of bamboo by using chemicals*

**NATURAL TREATMENT BY SMOKE**



*Traditional treatment of Bamboo by smoking*



*Bamboo propagation using offset cutting*



*Seed collected for planting in Nursery*



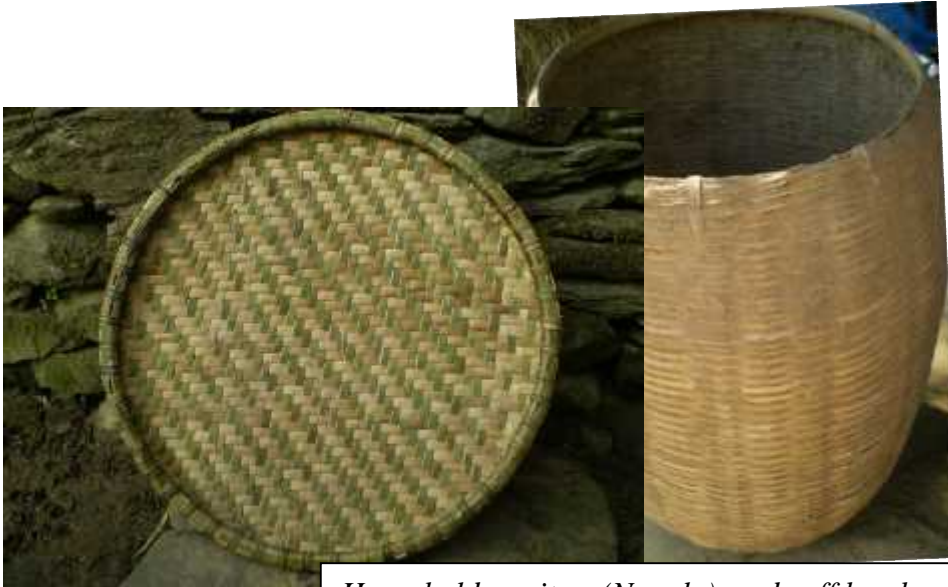
*House*



*Bamboo mats corrugated sheet (ridge cap)*



*Bamboo Table*



*Household use item (Nanglo) made off bamboo*

*Bhakarir to store grain*