

TAXONOMY AND SOCIO-ECONOMIC STUDY OF BAMBOOS

a case study on impacts of
bamboo-enterprises
on Pahari community in Badikhel VDC
Lalitpur, Nepal



A DISSERTATION SUBMITTED TO:
CENTRAL DEPARTMENT OF BOTANY
TRIBHUVAN UNIVERSITY, KATHMANDU, NEPAL
FOR THE PARTIAL FULFILLMENT REQUIREMENTS
FOR M.Sc. DEGREE IN BOTANY

SUBMITTED BY:
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ROLL NO: 278, BATCH: 059/060
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INSTITUTE OF SCIENCE AND TECHNOLOGY
CENTRAL DEPARTMENT OF BOTANY
OFFICE OF THE HEAD OF DEPARTMENT

Ref No:

KIRTIPUR, KATHMANDU
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CERTIFICATE

This is to certify that the dissertation entitled "**Taxonomy and Socio-Economic Study of Bamboos – A case study on impacts of bamboo-enterprises on Pahari community in Badikhel VDC, Lalitpur, Nepal**" was carried out by Ms. Merina Shakya Bajracharya under my supervision. This work has been accomplished on the basis of candidate's original research work and submitted here for partial fulfillment of **M.Sc. Degree in Botany (Plant Systematics)**. To the best of my knowledge, the results of this work have not been submitted for any other degree. Therefore, I'm pleased to forward this dissertation for the final approval and acceptance.

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Date: September 22, 2008 (Asoj 6, 2065)



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Letter of Approval

This dissertation entitled "Taxonomy and Socio-economic Study of Bamboos: A case study on impacts of bamboo-enterprises in Pahari community at Badikhel VDC, Lalitpur, Nepal" submitted by Ms. Merina Shakya Bajracharya has been accepted as partial fulfillment of the requirement of M. Sc. Degree in Botany (Plant Systematics).

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DECLARATION

I hereby declare that the dissertation entitled “**Taxonomy and Socio-Economic Study of Bamboos – a case study on impacts of bamboo-enterprises on Pahari community in Badikhel VDC, Lalitpur, Nepal**” submitted towards the partial fulfillment of M.Sc. Degree in Botany (Plant Systematics) is based on taxonomical survey of bamboo species, survey of available literature and socio-economic study on the impacts of bamboo enterprises. This work is carried out under effective guidance and constant support of Ms. Sangeeta Rajbhandary. The dissertation thereof has not been submitted for the award of any degree/diploma of any other University or Institution.



Merina Shakya Bajracharya

Date: August 27, 2008

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Merina Shakya Bajracharya

August, 2008

Abbreviations and Acronyms

CDB	Central Department of Botany
CFUGs	Community Forest User Groups
DFO	District Forest Office
FAO	Food and Agriculture Organization
FBSSEs	Forest Based Small Scale Enterprises
FGD	Focus Group Discussion
FUGs	Forest User Groups
FORESC	Forest Research and Survey Centre
GTZ	German Technical Cooperation
HHs	Households
INBAR	International Network for Bamboo and Rattan
INGO	International Non-Government Organization
NGO	Non-Government Organization
PRA	Participatory Rural Appraisal
RRA	Rapid Rural Appraisal
R&D	Research and Development

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ABSTRACT

The taxonomy of bamboo species and the associate enterprises involving bamboo-based weaving and handicraft making in Badikhel VDC, Lalitpur district, Central Nepal were studied. The aims of the research were to determine the richness of bamboo diversity with their taxonomy and to assess the socio-economic importance of bamboo craftmaking on *Pahari* community, one of the ethnic groups in the study area. It was found that Badikhel impregnates four species of bamboo belonging to two genera viz. *Bambusa* and *Drepanostachyum*. *Bambusa* is the dominant genus with three species in the study area. It was also found that bamboo is an important and traditional source of livelihood for *Paharis*. Forty households were randomly selected from the areas with higher density of bamboo entrepreneurship practiced for questionnaire survey. Perceived stakeholders were interviewed to examine their roles and to find out the contribution of bamboo enterprises to household income from the bamboo enterprises. Group discussions on issues of bamboo cultivation and management were conducted following RRA and PRA techniques. An average bamboo handicraft maker obtained not more than NRs. 5000 per month from the cash sales of assorted handicrafts. All respondents indicated that the income from bamboo enterprise was mainly for household petty cash, i.e., hand-to-mouth consumption. No significant bamboo management practices were carried out by the entrepreneurs. Three out of four community managed forests in the study area practiced bamboo plantations of only one species, *Bambusa nepalensis* in accordance to the demand. A few stakeholders in bamboo enterprise and resource management were merely involved in actual promotion of bamboo handicraft industry and actual bamboo management.

CHAPTER ONE

1. INTRODUCTION

1.1 Background

Bamboo is one of the important NTFPs cultivated widely in the world (FAO, 1978). It spreads in an area covering about 18 million hectares of the world forest ecosystem comprising Asia, Africa, and America (www.inbar.int). There are over 1,250 species of bamboo under 75 genera, which are unevenly distributed in various parts of humid tropical, sub-tropical and temperate regions of the earth (Soderstrom and Ellis, 1987).

Bamboo is a group of woody perennial grasses, belonging to family **Poaceae (Gramineae)**, sub-family **Bambusoideae** and tribe **Bambuseae**. This giant plant species possesses a complex taxonomy and share many significant characters different from the smaller grasses (Stapleton, 1994). Morphologically, bamboo as plant is tall, straight, hollow, smooth, light yet hard and strong. It is pliable, flexible and can easily be curved and split. However, they differ significantly from the tree species as they attain maximum diameter and height in their first year of growth and only the secondary branches and more leaves are produced subsequently (Bahadur, 1979 and Chaturvedi, 1986).

Bamboo roots, called rhizomes form a mat-like structure under the ground. The growth of new shoots is completely dependent upon the nutrition provided by the rhizome and the old culms (McClure, 1966 and Chaturvedi, 1986). Rhizome systems which produce single stemmed culms are known as Leptomorph rhizomes and clump forming rhizomes are known as Pachymorph rhizomes (Liese, 1986). The Leptomorph type is present in bamboos of temperate and warm temperate regions. The Pachymorph type is most commonly present in bamboos of tropical and sub-tropical regions.

New shoots of bamboo start to emerge from soil mostly at the beginning of the rainy season. They emerge with full diameter and reach full height within 60-120 days. During the growing season, shoot elongation continues day and night. Bamboo is one of the fastest growing plants on the earth. A culm of *Phyllostachys bambusoides*, Japan's commonest bamboo, grows almost four feet in 24 hours (Chaturvedi, 1986).

Flowering of bamboos is a strange phenomenon, which is not yet well understood (Liese, 1986), and differ significantly from other vegetation. Unlike most of the herbaceous Bambusoideae grasses, most bamboo species flower only once in many years. The duration of the vegetative state and the incidence of flowering depend on the species and flowering can be annual, sporadic or gregarious. Generally, all culms including those of the current year die soon after flowering. Population of a given bamboo species raised from the same seed source, no matter where they are situated start flowering at the same time and the whole clump die. The reason for sudden simultaneous flowering is still unknown. A short rainy season followed by a severe drought, congestion, over cutting and heavy damage from insects and pathogens are some of the possible stimulants reported for flowering (Bahadur, 1979 and Liese, 1986).

1.1.1 Distribution of bamboo resources in Nepal

Bamboos are widely distributed throughout Nepal in natural forests and on farmlands (Bhattarai, 2002). Farmers mostly grow bamboos in private land including farm boundaries, marginal areas and agricultural fields, gullies, stony and steeply land. In total, this natural resource occupies 62,890 hectares of land. The natural forest hosts 38,000 hectares and the rest by agricultural land (Kesari, 2005).

Due to prevalence of more humid climatic condition, eastern half of the country has a higher biodiversity, from Dhaulagiri to the Sikkim border than the western half. In higher rainfall areas such as those around Pokhara and Illam, a wider variety of genera and species can be found, as well as larger numbers of bamboo clumps. Temperate and alpine genera can be found at altitudes of up to 4,000m in eastern Nepal while tropical species in Terai (Stapleton, 1994).

Seventy-three out of seventy-five districts of the country are known to have one or more species of bamboo (Joshi and Amatya, 2002). Nepal, so far, holds a record of housing 12 genera (Das, 1998) and more than 53 species of bamboos (Karki *et al.*, 1995; Joshi and Amatya, 1999). The 12 genera are *Dendrocalamus*, *Bambusa*, *Thamnocalamus*, *Borinda*, *Ampelocalamus*, *Cephalostachyum*, *Drepanostachyum*, *Himalayacalamus*, *Melocanna*, *Yushania*, *Arundinaria* and *Phyllostachys* (Stapleton, 1994). Among them, the most widely distributed species is genera *Bambusa* and *Dendrocalamus*, which are found all over in the Terai and Midhills of Nepal. Small diameter bamboos, *nigalo*, are found in the Midhills and High Mountains (Das, 1988). Most of the bamboo species of Nepal have Pachymorph type

rhizomes and therefore are clump-forming (Stapleton, 1991). The natural range of bamboo species extends from Terai to the High Mountains (70m-4000m) (Jackson, 1987; Das, 1988; Stapleton, 1994).

Bamboos in Nepal are generally classified into two types as *bans* and *nigalo* (Das, 1988; Stapleton, 1994). Large diameter bamboos above 4 cm at the base are called *bans*, whereas small diameter bamboos usually below 4cm are called *nigalo*. Some local people (particularly in eastern Midhills) also categorize them into 3 classes as *bans*, *nigalo* and *malingo* (Das, 2004). *Malingo* are found in high altitudes usually above 2200-3000m in Nepal and has leptomorph rhizomes.

1.1.2 Multiple uses of bamboo resources

Bamboo has been intimately been associated with human beings since ancient times (Tiwari, 1992). In Nepal, out of over 7000 species of flowering plants reported, bamboos are considered, in different environments, as most versatile and essential commodities and are available to rural communities for many purposes (Stapleton, 1994). They have tremendous versatility with over 1500 uses (Rai and Chauhan, 1998). People make practically everything any anything from bamboo except ploughshare. Every part of it has its own significance and can be used for various household and commercial purposes (Fig.1). Hence, bamboo is an important component of overall livelihood strategies of rural households.

1.1.2.1 Economic Perspectives of bamboo

Bamboo has a high score in terms of economy. It is described as the ‘wood of the poor’ (India), ‘friend of the people’ (China) and ‘brother’ (Vietnam) (Poudyal and Das, 2002 and Das, 2004). Likewise, bamboo is also considered a valuable species in Nepal. It plays a critical role in Nepalese rural economy and sustaining livelihoods of socially and economically disadvantaged groups. The ethnic communities such as *Panjiyar* of hill origin and *Dom* and *Mahali* of Terai origin heavily depend upon bamboos for their survival. It is considered as an important component of livelihood strategies of rural households (Das and Oli, 2001). The importance of bamboo in several major economic sectors such as construction, agriculture, handicrafts, micro enterprises, transportation, etc. can hardly be overemphasized (Stapleton, 1994). Mature culms are used in Nepal in more than 300 ways (Poudyal, 1998). Bamboo also forms an ideal raw material for many industries like bamboo furniture, paper and pulp, textiles (rayon), etc.

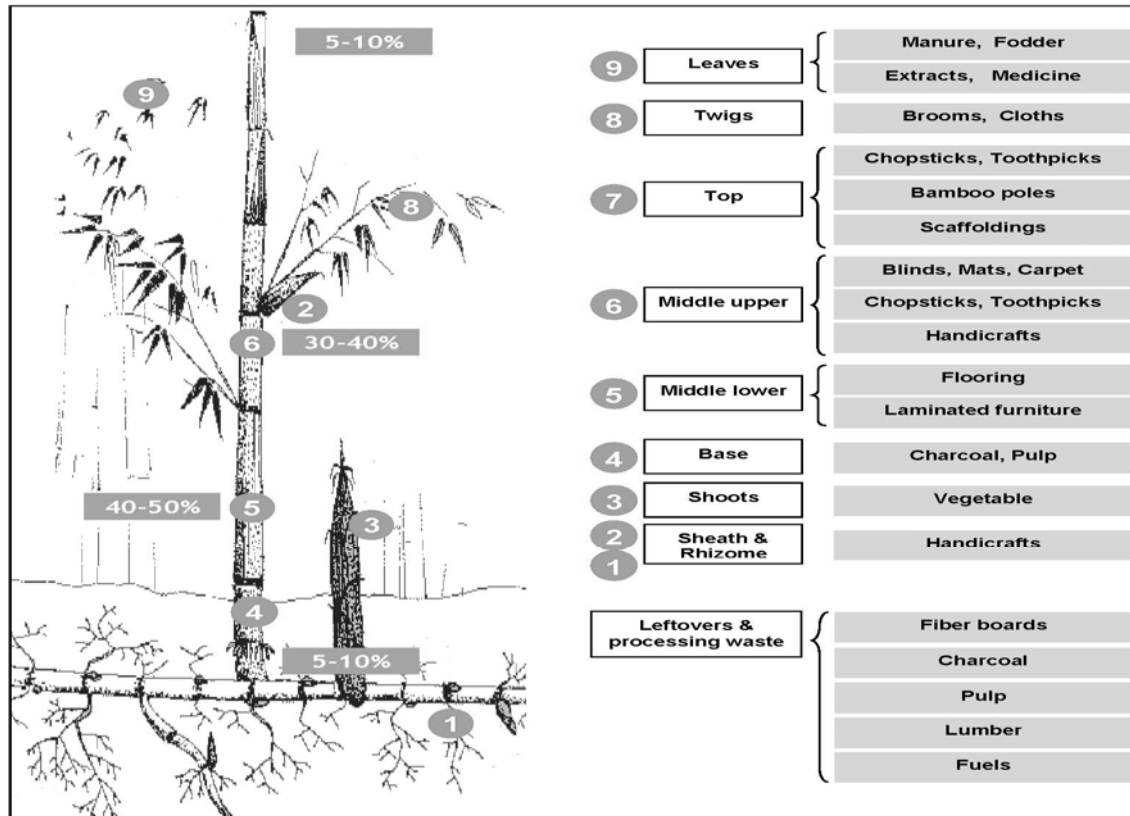


Fig. 1 Multiple uses of different parts of bamboo (Source: Subramony, 2007)

1.1.2.2 Environmental perspectives of bamboo

Bamboo is an environmentally friendly plant, producing more than 35% more oxygen than trees and absorbing as much as 12 tons of carbon dioxide per hectare annually (<http://www.inbar.int>). The dense structure of its root system makes it the best species for soil stabilization, thus protecting against erosion and landslides. Bamboos in combination with those tree species with deep penetrating roots are now considered as an important component of bioengineering techniques in Nepal, assessing an obligate application of a low cost means of slope stabilization and useful products as well (Stapleton, 1994).

Bamboo is a viable economic alternative to deforestation so that biodiversity and their other possible benefits can be conserved. The extensive consumption of wood from forests leaves them empty raising a need to be covered and protected. And bamboo serves an ideal plant specimen for this purpose. However, this high-strength woody perennial with many of its characters similar to trees, do not just act as a timber substitute but fulfill the demand of the very large, conventional wood-based industry as well. A large range of innovative items, previously manufactured from wood, is now being made from bamboo, and the list is rapidly increasing.

Another major advantage of bamboo is that, as a source of fuel, it is a significant material. Bamboo charcoal, which is generally used by goldsmiths are also used for water filtering and purification plants in several countries like China, Japan and South Korea (Shibata, 1988). It can also be used in electric batteries, while in special purpose electric lamps bamboo is used as carbonized filaments.

1.1.2.3 Socio-cultural perspectives of bamboo

The attachment of bamboo in Nepalese culture is very old and interesting. For example, freshly cut stems of small sized bamboo species are very essential in marriage and many other festive and religious ceremonies of Hindus. In weddings, bamboo is used as the pillars at four corners of special structure called *Jagya* and the bride may be carried in the bamboo sedan chair or cage. Bamboo culms are also used to support the symbols of deities and prayer flags on mountain passes and summits and around houses. A special bamboo species in Dharan is preserved in temple premises. Likewise, Sherpas in Himalayan region make *Tomba*, their famous drink, in a vessel made from bamboo culms. Bamboos are equally important for carrying corpses to cremation.

Women are heavily involved in forest-based small-scale enterprises (FBSEs) in many developing countries (FAO, 1990). This is because the bamboo-based products, such as woven products, incense-sticks, etc. easily fit within the average daily schedule of women. As such bamboo craftmaking has provided off-time and part time employment for women of rural communities. Most of the families with bamboo-based business have a strong family orientation. This helps in strengthening the social bond and at the same time, it also gives a platform for children, the possible enterprises to learn a trade to earn their living in the future (Karki *et al.*, 1999).

This conversion of socio-cultural traditions and indigenous knowledge into economic opportunity has a dual advantage. It helps to preserve culture that are rapidly diminishing in today's context due to globalization and cultural homogenization of people, while in other way, it accounts high for reconciling the need of millions of job. Bamboo-based trades can create an enormous number of jobs for the poor and illiterates, as the business do not need higher levels of education.

1.1.3 Socio-economics of bamboos in Nepal

Bamboo technology is wide spread and processing skills have been traditionally practiced and mastered by large section of hill rural communities among whom a high level of traditional skill still exist (www.abari.org/economic). Bamboo and bamboo products, besides providing the local people with their various needs, also provide them with additional cash income. Thus, it plays an important role in uplifting the socio-economic condition of the rural people and national economy as well (Das, 1999). It is an integral part of rural life without which subsistence will be extremely difficult. There is a growing demand of bamboo and its products not only in the urban centers (Poudyal, 1998) but also in the rural areas of Nepal.

Ninety percent of the Nepalese labor force is rural based and they practice subsistence agriculture (Sharma, 1989; Amatya and Newman, 1993). These people deal with NTFPs in one or the other way. In the Forestry Master Plan, a need to develop NTFP especially *lokta* paper and bamboo was recognized. Most of the users of NTFPs tend to be the vulnerable sector of the community like women and the marginalized group, since they are deprived of other sources of livelihood. It is estimated that about 3.3 million farming families are somehow involved with the bamboo sub-sector either as producers or as users of bamboo-based products (Pant, 2006). Development and encouragement of cottage industries based on bamboo have thus, a very high potential of providing the locals with much needed cash income and making a very important contribution to their household economy (Poudyal, 1992; Karki *et al.*, 1995; Sherchan *et al.*, 1996). Further, it can contribute much more to the regional and national economy.

However, the government has not considered bamboo and other NTFPs as important as other sectors, because they were considered easily accessible, cheap and their potential to the regional and national economy is not well understood. Their importance is put in periphery in order to give priority to development of physical infrastructure supporting agriculture, tourism and industry and hydropower industry (Interim Plan 2007). Despite Nepal's geographical and cultural richness of bamboo, due to governments indifference, lack of support for subsistence farmers, disorganized market, limited skills, bamboo based economy only contributes 1-2% to the national GDP (Karki *et al.*, 1998).

Although statistics on the actual economic contribution of bamboo is not available, bamboos that is harvested from natural forests and from farmlands makes significant contribution in

household economy of many communities. It has been estimated that the total growing stock of bamboo in Nepal is around 15 million cubic meters with an approximate biomass value of 1060 metric tons (www.inbar.int/country-report/Nepal). The annual production of bamboo is estimated at 3.01 million culms, out of which 2.64 million culms are consumed locally and 0.64 million culms are exported to India (Kesari, 2005). On an average, each household consumes about 46 culms/ per year. Around 102 metric tons of bamboo shoot is estimated to be produced and sold annually in Nepal all of which are consumed locally (Karki *et al.*, 1995). It is estimated that there are around 81 processors and 509 trading firms in Nepal directly employing over 1500 people (www.inbar.int/country-report/Nepal).

Table 1: Estimated production, consumption, and percent sold of bamboo stems

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

Source: Karki et al., 1995

Bamboos play a major role in the rural economy and in sustaining livelihood (Das, 2004). This group of plant species reaches its structural maturity within three year of time span. Once established, it produces an annual crop for many years. Due to its fast growing rate, versatility in producing wide range of items and possessing all the qualities similar to trees, yet available in cheap cost rate make this renewable resource in a great demand by bamboo- based small enterprises.

1.2 Statement of the problem

The study of the woody perennials, bamboos open a dynamic path to improve the socio-economic condition of poor and rural inhabitants, thus leading to sustainable development. This multi-purpose species is used increasingly to earn the living. Certain villages in Nepal are involved in manufacturing woven products, while few even in producing authentic, higher value products (Das, 1998). Several ethnic groups, especially those who are socially and

economically underprivileged are dependent upon bamboo-craftmaking to sustain their livelihood. For them, it is the main source of family income, while for others it is a good source of off-the-farm and part-time income. Bamboo products produced by these craftsmen are sold in the local markets, as well as some have a good international market.

Bamboo's prominent role in the traditional life of Nepal is well acknowledged. (Poudyal 2006; Bista, 2004; Das, 2001; Karki *et al.*, 1997 and Storey, 1990). It is one of the popular plant species in farmlands of Nepal with wide variety of uses. Except plough, anything and everything can be made from bamboo. However, in spite of such extensive applications of bamboo, Nepal still lags behind with its clutch on old traditions and practices. No modern technologies have been introduced in this sector so far. Almost all the aspects, like production (in both quantity and quality), processing and manufacturing of various items and marketing of products (both raw and processed) are in the need of prioritization for development. There is lack of knowledge among producer not just about marketing prospects of their products, but also about bamboo cultivation, its harvesting, fertilization, shoot protection, soil conditioning, and weeding, thinning and pest control. Above facts suggest that the degrading condition of bamboo stands in the country is mainly because of excessive and unmanaged use and lack of basic knowledge about its regeneration. People are unaware of the importance of bamboo cultivation and its potential benefits other than economics.

No proper attention is given in the conservation of bamboo species. Nepal has established national parks and conservation areas in sub-tropical, temperate and alpine eco-geographic zones. These national parks and conservation areas cover 17% of the country's geographical area and fortunately, many of these national parks have some bamboo species being conserved. As such, there is no project focusing specifically on the conservation of biodiversity of bamboo (Joshi and Amatya, 1999).

So far, only few studies have been carried out in the country regarding bamboo and its perspectives. Taxonomically, a lot of work has to be done for the accurate identification of different bamboo species in Nepal, their distribution and uses.

1.3 Justification of the study

Although, bamboos have been playing an important role, a systematic inventory of bamboos and their ethno botany countrywide have not yet been done. No detailed studies have been

conducted on the socioeconomics of bamboos other than in eastern Nepal. The studies need to be expanded in central and western regions of Nepal. Such surveys are important to know the current status and to set future research priorities and appropriate strategies for proper development of bamboo sector. Thus, the survey of bamboo resources is required to quantify and evaluate their potential development.

The present study conducted in Badikhel VDC of Lalitpur district has made an effort to document the diversity of bamboo species and their status. This study also attempts to investigate the relationship between *Pahari* community, one of the ethnic groups residing in the area, and bamboos based on the socio economic impacts. *Pahari* is the dominant group with more than half (55.22%) of the total population of the area. They depend upon agriculture and bamboo craftmaking for their subsistence. However, agriculture only is not satisfactory for them due to less fertile land, small landholding size and lack of modernization in the sector. As a result, they have adopted an alternative source of income through bamboo entrepreneurship. Locally available bamboo resource was the main source of raw material and the reason for the initiation of bamboo enterprises in the study area many decades ago, which is still continuing today to bridge up a gap between subsistence and cash economics. It scores high in reconciling the need for economic growth and job-creation with limited educational opportunities available to the poor and underprivileged *Pahari* community of the area. Hence, the present study has tried to analyze the socio-economic importance of bamboo-based enterprises in this very ethnic group of the study area.

This study also attempts to explore better measures to be carried out in future planning and research of similar nature. It is assumed that the finding and recommendation will be a valuable contribution to the concerned organizations and policymakers in making guidelines and institution designing on the practice of sustainable use of the economically important bamboo resource and towards the well-being of the community. Hence, the study holds much importance in the present context of Nepal.

1.4 Objectives of the study

The major objective of the present research is to document the availability of various bamboo species in Badikhel VDC, their use pattern in the local inhabitants residing in the study area and to analyze the socio-economic value of the resource available for all sectors of the society.

However, the specific objectives of the study are as follows:

- To explore the diversity of the bamboo species in the study area and study their taxonomy
- To document the utilization patterns of bamboo species in the study area
- To assess the socio-economic impacts of the bamboo-based craftmaking on *Paharis*, an ethnic group residing in the study area

1.5 Limitation of the study

The present study was carried out in Badikhel VDC of Lalitpur district focusing only the pocket areas (selected wards) of craftmaking. During the research, many constraints were faced with regards to time and finance. Despite of these limitations, every effort was taken to make the study sufficient and empirical.

CHAPTER TWO

2. REVIEW OF LITERATURE

Bamboo belongs to the grass sub-family of **Bambusoideae** (Oprins Plant-BTN, 2002). Bamboo is a self-regenerating natural resource. Bamboos occur in the natural vegetation of the tropical, subtropical and temperate regions, but are found in great abundance in tropical Asia. While bamboo taxonomy is still incomplete, it has been recorded that 75 genera and 1250 species occur in the world (FAO, 1978, 1987 cited in Kigomo, 1988). Eighty percent of the world bamboo resource is distributed mainly in the South Asian tropical region. Africa and South America are thus poorly endowed with bamboo resources while there is total absence of the resource in the former Union of Soviet Socialist Republics (USSR), North America, Central and South Australia and the regions near the poles (Kigomo, 1988).

2.1 Botanical survey on bamboos in Nepal

Bamboos are one of the most widely distributed groups of species throughout Nepal. However, they are common in the eastern half of the country due to more favourable climatology. According to Das (1989, 2004) and Stapleton (1994), there are 12 genera and more than 55 species of bamboos in Nepal (Appendix-XI). Bamboos in Nepal are generally classified into two types known locally as *bans* and *nigalo* (Das, 1988; Stapleton, 1994). Some local people (particularly in eastern Midhills) also categorise them into 3 classes as *bans*, *malingo* and *nigalo*.

Hara *et al.* (1978) reported 10 species of bamboo belonging to 5 genera from east and central part of Nepal.

Stapleton (1987) described five species of *Bambusa* species, 11 species of *Dendrocalamus* species, six species of *Drepanostachyum* species, two species of *Arundinaria* and several species of *Thamnocalamus* along with their silviculture characteristics, method of propagation, importance and uses of the species from the Eastern Nepal.

Poudyal (1992) listed 33 species of bamboo belonging to 12 genera from Nepal.

Stapleton (1994) described 32 species of bamboo species belonging to 11 genera from Nepal.

Manandhar and Bhattarai (1998) surveyed the bamboo distribution in twenty-six localities of Kathmandu valley and reported 23 species of bamboos belonging to five genera.

Das (2004) described 20 economically important bamboo species belonging to 8 genera of Nepal. It includes 8 species of *Bambusa*, 4 species of *Dendrocalamus*, 1 species each of *Ampelocalamus*, *Cephalostachyum*, *Melocanna*, *Drepanostachyum*, *Yushnia* and 3 species of *Himalayacalamus*.

Poudyal (2006) described 66 species of bamboos under 18 genera within Nepal, Bhutan and Sikkim.

2.2 Work related to bamboo cultivation and its socio economic aspects

2.2.1 Inside Nepal

Acharya (1975) wrote a sensible feasibility study of bamboo as the basis of cottage industry expansion in Central Nepal without attempting specific identification. He used the three categories into which bamboo species are commonly grouped in Nepali as *bans*, *nigalo*, and *malingo*. These three groups probably constituted a more rational taxonomy at that time than the official genera.

Metz (1987) carried out a study in eastern Nepal to understand utilization and marketing pattern of bamboos.

Das (1991) carried out a study on harvesting method of bamboo. Out of the three methods, traditional, (removing matured, dead and dying culms only), horse-shoe method and tunnel method tested, the tunnel method was reported to be best for better production and management.

Rajbhandari (1991) studied the grassland ecology and preliminary studies of *Bamboo* in the Apsuwa valley from Eastern Nepal.

Poudyal (1993) analysed the fodder value of *Tama bans* (*Dendrocalamus* sp.), *Taru bans* (*Bambusa tulda*) and *Dhanu bans* (*Bambusa balcooa*). He also reported that people of

Khumaltar Village, however do not feed bamboo fodder to the milking cows because people from all 11 houses surveyed believed that it decreases the amount of milk.

Karki *et al.*, (1995) described how marketing improvement needs to be done starting from bamboo production to processing possibility and marketing in national as well as international sector.

Das and Seeley (1996) carried out a research in eastern Nepal (in the hill district of Dhankuta and Terai (lowland) to assess the contribution of bamboos to the economy of rural people in Nepal making use of the wealth-ranking tool. Five wealth-ranking categories were made based on food sufficiency and income. They reported that bamboos, which are widely used by households in the region but particularly in the Terai, varied with the socio-economic status of the villages.

Forest Research and Survey Centre (FORESC) and Institute of Forestry (1996) carried a study on marketing and socio-economics of bamboo in Eastern Nepal and reported that the sale of raw culms is not providing the farmers adequate economic benefits but for which they do not have other better alternative.

Karki *et al.*, (1998) examined the extensive bamboo production-to-consumption systems in the three districts of eastern Nepal, an area known for its relative richness in bamboo resources and bamboo-based rural enterprises. The authors make a case for speeding up the implementation of recent forest policy reforms, and providing additional backing through financial and technical support to bamboo-based enterprises. They also recommend that bamboo be accorded top priority in development schemes planned by the government and private sector participation be actively encouraged.

Manandhar and Bhattarai (1998a) reported *Bambusa balcooa* was the most commonly grown species in Kathmandu valley. Out of the 23 species reported, 6 species were found occurring in wild state while the rest of species were cultivated.

Manandhar and Bhattarai (1998b) reported genus *Bambusa* to be the largest genus with 10 species in Kathmandu valley.

Thapa *et al.*, (1998) carried out a study to understand growth performance and culm production of bamboo of 5 bamboo species viz. *Bambusa nutans* subsp. *cupulata*, *B. nutans* subsp. *nutans*, *B. balcooa*, *B. tulda* and *Dendrocalamus giganteus* of the eastern Terai, Nepal. Among them, *B. nutans* subsp. *cupulata* was found to possess the highest survival (86%) followed by *B. nutans* subsp. *nutans*. *B. nutans* subsp. *cupulata* was considered the best in terms of culm production, diameter and height growth, followed by *B. nutans* subsp. *nutans* and *B. tulda*. *D. giganteus* was reported to show very poor growth and survival which was followed by *B. balcooa*.

Das (1999a) reported that the main factors determining the household decision for cultivation of bamboo in the farmlands of eastern Nepal are (a) landholding (b) household size (c) household income and (d) old superstition and taboos especially in the Terai (lowlands) region of the country.

Das (1999b) reported that *tama* (young bamboo shoot) derived from *Tama bans* (*Dendrocalamus hamiltonii*), *Dhungre/Rachhasi bans* (*D. giganteus*) and occasionally from *Kalo bans* (*D. hookerii*) were collected and sold between June and September in eastern Nepal. The study also revealed that a well-managed single clump could provide 100 kg of bamboo shoots which means one hectare of bamboo plantation offers about 2000 kg or more *tama* worth about Rs. 20,000/year. The study also identified the main problem faced by the *Tama* traders, which is the non-availability of bamboo shoots the year. They lack cost effective packing facility to keep the bamboo shoots fresh and in good condition.

Poudyal (1999) suggested a wise and scientific method to minimize a pathetic depletion of soil in Nepal by rainwater and flood. He suggested the planting of selected bamboos viz. *Kalo nigalo* (*Phyllostachys nigra*), *Taru bans* (*Bambusa tulda*), *Bhalu bans* (*Dendrocalamus giganteus*), *Choya/Ban bans* (*D. hamiltonii*), *Latthi bans* (*D. strictus*) and *Mal bans* (*Bambusa nutans*) whose rhizomes and roots are with good soil-holding capabilities to minimize a pathetic depletion of soil in Nepal by rainwater and flood.

Poudyal (2000) mentioned a short note on bamboo for soil stabilization and other usage in Nepal.

Adhikari (2005) carried out a detailed study on the infraspecific variation and phytochemical screening of *Bambusa nutans* Wallich ex. Munro subsp. *nutans* of Central Nepal.

Das and Mitchell (2005) conducted a detailed study on taboos, beliefs and superstitions in the Terai and Midhills and its implications on bamboo growing. They reported that taboos and superstitions against bamboo planting have some effects on bamboo growing in the Terai but have no significant effect in the Midhills and Kerabari VDC, Morang. The households carried out bamboo planting despite having serious reservations along with many superstitions and taboos that discourage bamboo planting because the benefits that accrue from bamboo planting are far higher than so-called risks (superstitions like ‘will die early’, ‘infertility’) and disbeliefs (‘reduced production’).

Pun (2007) described the ways of bamboo utilization for their livelihood by poor people in Siraha. He has described briefly about bamboo growers, bamboo products manufactured and socio-economic conditions of bamboo workers of Siraha district. He has also about the findings of bamboo sub-sector analysis.

Adhikary (2008) conducted a study focusing on how traditional bamboo users, who amount to around 3.3 in Nepal alone, can be integrated into the modern market. He commented that though bamboo has historical and cultural association in Nepal, it is used in almost all aspects of life from construction, marriage, death to livelihood. The use of bamboo however, has been only subsistence, and the modern market for it is not well developed. With the growing bamboo demand in the world, abundant availability of the resources, vast traditional knowledgebase and cultural affinity of this material in Nepal, he concluded that there is a tremendous potential for it to contribute to the people’s livelihood.

2.2.2 Outside Nepal

Karki *et al.*, (1997) reported the three NTFPs, bamboos, rattans and medicinal plants are the keystone commodities appropriate for the low-input and low technology situation prevailing in the mountain regions, though the present rate of exploitation of these is untenable. They have made an attempt to chart out strategies in developing a more comprehensive knowledge base and much-needed strategic approaches for achieving sustainable production systems that matches population and employment challenges.

Muraleedharan and Rugmini (1988) carried out a study to trace the history of the bamboo-based traditional industry in Kerala. They conducted the survey to ascertain the socio-economic conditions of bamboo workers and the extent to which the present structure helps them to improve their living conditions.

Sosola-Banda and Johnsen (2005) carried out a study to find out the contribution of bamboo enterprises to household income and the management practices of the bamboo handicraft makers and bamboo collectors, and the activities of stakeholders in the bamboo industries in Mvera, Dowa district, Malawi. It was found that an average bamboo handicraft maker used 681 bamboo culms per year and an average bamboo culm vendor cut 1146 culms per year. It was also found that an average bamboo handicraft maker obtained MK 20 684 (US\$ 190) per year from the cash sales of assorted handicrafts and an average bamboo culm vendor obtained MK 10 833 (US\$ 100) per year from bamboo culm cash sales. An average bamboo entrepreneur obtained MK 3251 (US\$ 30) from farm cash sales. However, the average bamboo entrepreneur consumed an amount of their own farm produce worth MK 26 679 (US\$ 247), which was about 1.5 times as much as average bamboo income of MK 18 417 (US\$ 170). All respondents indicated that the income from bamboo enterprise was mainly for household petty cash, i.e., hand-to-mouth consumption. No significant bamboo management practices were carried out by the entrepreneurs. Bamboos were naturally growing in Thuma Forest Reserve, where most of the bamboos were collected. A few stakeholders in bamboo enterprise and resource management were merely involved in actual promotion of bamboo handicraft industry and actual bamboo management by their policies and interventions.

Thammincha (1988) studied some socio-economic aspects of bamboos as raw material for making bamboo-based products and as a primary product for export. He conducted a detailed study on the production and marketing of steamed bamboo shoots and presented a preliminary economic analysis for bamboo plantation establishment.

Vongvijitra (1988) studied the vegetative propagation of some Thai bamboos by traditional methods (offset planting, culm and branch cuttings) and by tissue culture. He concluded that both offset planting and culm cuttings were effective but expensive.

Yuming *et al.* (1998) studied some key techniques concerning the whole process from cultivation to integrated development of sympodial bamboo, which include the techniques of

propagation and seedling growing, silvicultural activities, management techniques, integrated development and utilization in Yunnan province.

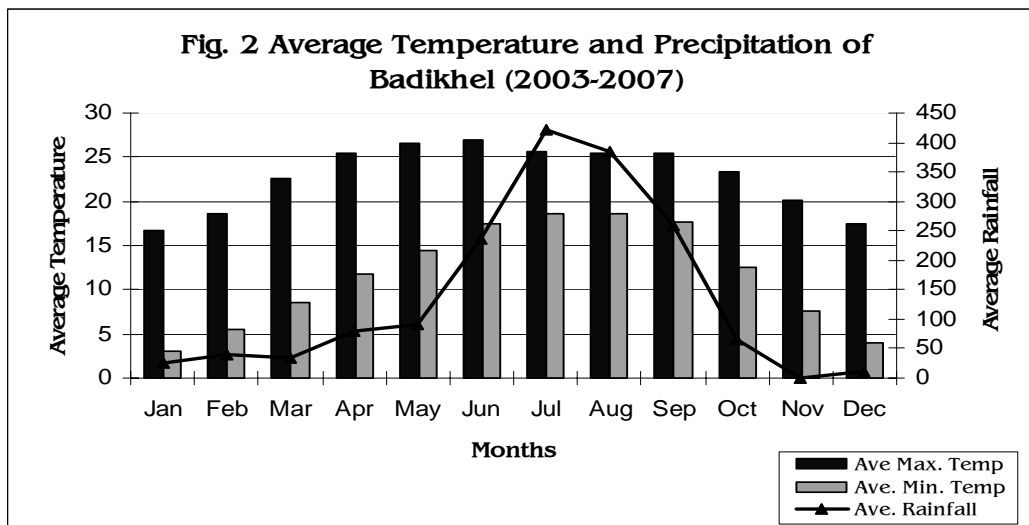
CHAPTER THREE

3. DESCRIPTION OF THE STUDY AREA

3.1 Geographical location and climate

Badikhel lies in the northern part of Lalitpur district between $27^{\circ} 36' 04.88''$ N latitude and $85^{\circ} 20' 48.96''$ E longitude. It covers an approximate area of 905.2 hectares. The study area is bordered by Godawari in the east, Jharuwarashi and Chapagoan in the west, Lele and Chapagoan in the south and Godawari again in the north. It stands in an elevation of 1290-1710m above from the sea level and about 12 km south east of Kathmandu proper. Karmanasha and Kodku Khola are the two major streams that bound the village. Besides, there are four important water sources namely Gwalindaha, Sirupadhayamul, Chandumul and Harramulare.

The climatology of Badikhel is estimated from the meteorological data of its neighbouring village, Godawari due to non-availability of the meteorological stations at higher elevations in the site. Its climate is sub-tropical to lower temperate characterized by moderate temperature throughout the year. Day temperature in summer frequently rises up to 27°C and falls below 17°C at night. While in winter, temperature ranges from 19°C to 3°C or even less during December to February. The average rainfall of the area during rainy season is 421mm (Fig. 2).



Source:-Department of Hydrology and Metrology, Kathmandu, HMG/Nepal

3.2 Soil

The geographical formation of Badikhel is found to be of Precambrian to Devonian period. The middle part of Phulchoki range including Godawari and Badikhel area is composed of light fine crystalline limestone. The upper part is composed of dark slate with white quartz whereas summit of Phulchoki is composed of light brown dolomite. The land structure of this VDC can be divided into different types - slope, mountainous, terrains, plains and gullies. Soils in these lands are also of different types. Hence, soils of Badikhel VDC can be grouped into three major categories upon its texture. Haplaquepts are dominant in lower plain part. The texture ranges from sand to heavy clay with silty clay loam to loam. These are poorly drained soils found in aquic moisture regime.

Dystrochrepts (brown) and Hapludalfs (red brown) are common on relatively lower part of hilly region (Mahabharat range) which needs high organic matter in order to retain its fertility.

The upper, relatively steep slopes of the hilly region are dominated by Hamplumbrepts and Dystrochrepts. Hamplumbrepts are acidic black shallow soils originally developed under forest. These are quite stony soils and it needs high organic matter in order to maintain its productivity.

3.3 Vegetation and Flora

The area under investigation mainly covers sub-tropical to temperate type of vegetation. The area covered by forest in Badikhel VDC is only 36% while total existing forestland inclusive of shrubs, grasslands and other land occupies 52%. Forestlands in Badikhel can be classified into three categories based on management responsibility viz. Government-managed forest, Community-managed forest and Private forest.

According to the altitudinal zone and climatic variations, the study area consists of mixed forests with large number of herbs, shrubs, herbs and climbers. The sub-tropical vegetation is mainly represented by broad-leaved *Schima wallichii-Castanopsis indica* and *Alnus nepalensis* (*Utis*). There are various other elements in the forests, the predominant ones are *Myrica esculanta* (*Kafal*), *Eriobotrya dubia* (*Jure Kafal*), *Myrsine semiserrata* (*Kalikath*), *Choerospondias axillaris* (*Lapsi*), *Holboellia latifolia* (*Guphalo*), Ferns, *Melia azadirach* (*Bakaino*), etc. Coniferous forests are well represented by *Pinus roxburghii* and *P. wallichiana*.

The lower temperate forest consists of the oak forest of *Quercus semecarpifolia* (*Khasru*) and *Q. lanuginosa* (*Banjh*) associated with *Acorus calamus* (*Bojho*), *Zanthoxylum armatum* (*Timur*), *Gaultheria fragrantissima* (*Dhasingare*), *Osyris wightiana* (*Noondhiki*), *Rhododendron arboreum*, etc.

Bamboos (*bans* and *nigalo*) are available in both hill forest areas and low altitude forest areas. Local people use the resources both for domestic and commercial purposes.

3.4 People, population and socio-economics

According to the CBS (2058B.S.), the total population of Badikhel VDC is 3212 of which 1656 are male and 1556 are female. The total number of household is 530 with the average household size of 5.84 persons. The study area is inhabited predominantly by one of the ethnic groups, the *Paharis* occupying approximately 55.22% of the total population. They mainly inhabit in ward no. 4, 5, 6, 7 and 8. Besides, *Brahmins* and *Chhettris* cover almost 40% of the population and the rest 10% of the population comprises of other minor caste groups like *Newar*, *Gurung*, *Rai*, *Magar*, *Kami*, *Damai* and others (Table 2).

Table 2: Different caste/ethnic groups and their percentage in Badikhel VDC

S. N.	Ethnicity/Caste of the households	Total no. of population	Percentage (%)
1.	<i>Brahmin</i>	1129	35.15
2.	<i>Chhettri</i>	177	5.5
3.	<i>Newar</i>	16	0.5
4.	<i>Pahari</i>	1774	55.22
5.	Others (<i>Gurung</i> , <i>Rai</i> , <i>Magar</i> , <i>Damai</i> , etc.)	116	3.63
	Total	3212	100

Source: CBS, 2058

3.4.1 Economic characteristics

People in the study area are found to be depending upon agriculture and other seasonal trades. *Brahmins* and *Chhettris* depend mainly upon agriculture whereas for *Paharis*, bamboo-based craftmaking is the main source of their livelihood. They are the traditional weavers and craftmakers. They lack sufficient agricultural land for cultivation, while other ethnic groups

are engaged in services, labour and others (Table 3).

Table 3: Occupational division of working age (15-59 yrs) population of Badikhel VDC

S.N.	Type of occupation	No. of male	No. of female	Total	Percentage
1.	Agriculture	379	595	974	76.75
2.	Bamboo cottage industry	72	13	85	6.70
3.	Labour	66	3	69	5.44
4.	Services	54	7	61	4.8
5.	Business	12	4	16	1.30
6.	Administrator	8	-	8	0.63
7.	Technician	29	5	34	2.70
8.	Others	20	2	22	1.73
	Total	640	629	1269	100

Source: CBS, 2058

3.4.2 Educational status

Among the major caste groups in the study area, Brahmins are highly educated group with 53.6% of them literate. *Paharis* are the second highly literate caste group followed by the Chhettris (Table 4).

3.4.3 Religion and culture

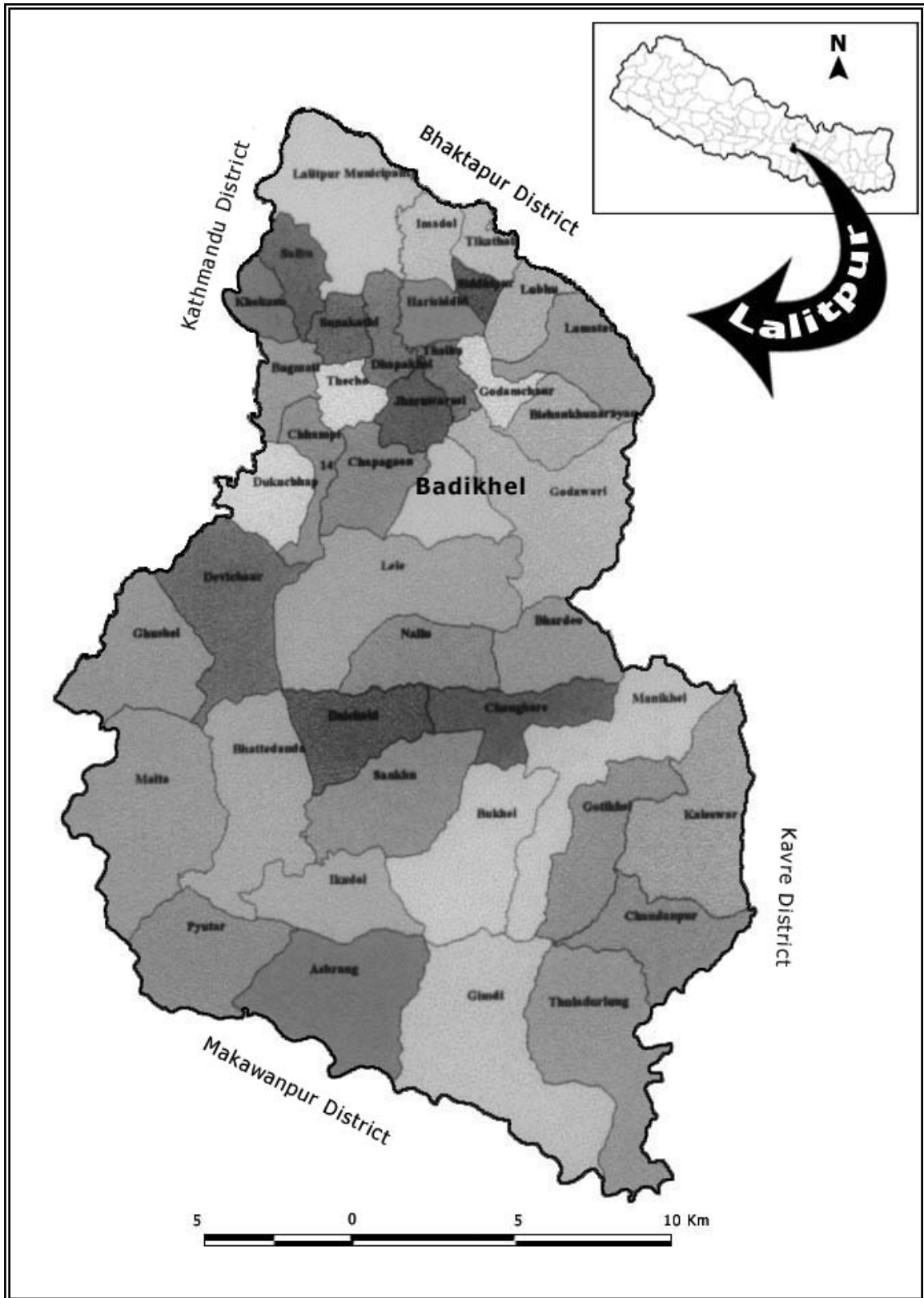
People of Badikhel are found to follow different religions. There are followers of Hinduism, Buddhism and Christianity as well. However, majority of the households are Hindus. *Paharis*, the main ethnic group shows their close affinity to *Newari* culture. They have their own culture and language. They celebrate festivals like *Dashain*, *Tihar*, *Maghe Sankranti*, *Chaitye Dashain*, *Sawane Sankranti* and *Janai Purnima*. At the same time, they give special importance to their community (*Guthi*), festival (*Jatra*) and *Chaitra Purnima*. They also celebrate *Gathe Mangal*, one of the festivals of *Newar* community. *Dhimay Baja*, a special type of drum is also practiced by *Pahari* community.

Table 4: Educational status of Badikhel VDC

Caste	Primary (1-5)	Secondary (6-10)	SLC	PCL	Bachelor	Degree	Other	Total
<i>Brahmin</i>	188	188	111	41	21	5	92	646
<i>Chhettri</i>	34	13	6	1	-	1	27	82
<i>Pahari</i>	255	123	10	1	1	-	53	443
<i>Kayastha</i>	1	-	-	-	-	-	-	1
<i>Rajput</i>	2	-	-	-	-	-	-	2
<i>Newar</i>	2	3	1	-	-	-	-	6
<i>Magar</i>	6	3	-	1	-	-	-	10
<i>Damai</i>	8	-	-	-	-	-	-	8
<i>Kami</i>	7	1	-	-	-	-	-	8
Total	503	331	128	44	22	6	172	1206

Source: CBS, 2058

MAP 1. LALITPUR DISTRICT



Source: <http://www.ddclalitpur.gov.np>

CHAPTER FOUR

4. METHODOLOGY

This study has been carried out in a descriptive framework. The study aims at exploring the different bamboo species existing in Badikhel VDC and their documentation. It includes identification and taxonomic description of the available species. The research also targets to analyze the socio-economic importance of bamboo-based work on an ethnic group of the study area, the *Paharis* (Flowchart 1). The following are brief discussion of the research methods employed to obtain relevant data and to analyze them.

4.1 Research design

The main objective of the present study is to explore and document the existing bamboo in the study area and their role on the rural livelihood. Therefore, exploratory as well as descriptive qualitative research designs were employed to make the present study more considerable and intensive.

4.2. Selection of the research site

A brief market survey revealed that Badikhel is one of the suppliers of bamboo-based crafts in Kathmandu valley. A variety of bamboo species were found within the area. This area is popularly known for bamboo craftmaking as most of villagers, especially the *Paharis*, one of the ethnic groups, are engaged in this business. Bamboo craftmaking is their traditional job inherited from their ancestors and is one of the major sources of their household economy. This indigenous knowledge practiced by *Paharis* in terms of utilization and management of bamboos has great potentialities to provide them sustainable livelihood. Thus, on the basis of richness of bamboo diversity, rate of exploitation by the residing community and its impacts on their livelihood, the present research site has been chosen.

4.3 Sampling design

Sampled households were selected purposively from among the local villagers to assess the diversity and status of bamboo species to meet the first objective of the research. However, to meet the second objective, bamboo entrepreneurs were randomly selected.

4.3.1. Sample size

Badikhel is inhabited by the total population of 1774 *Paharis* under the roof of 300 households. Out of them, 40 households were selected for the study. Selection was done based on the wards with high density of bamboo entrepreneurs.

There are 285 *Paharis* inhabited in the total 40 sampled households, which include the bamboo craft makers, growers, traders and sellers (Table 5). Each household was considered as a sample unit.

Table 5: Ward wise distribution of sampled households

S.N.	Ward no.	No. of HHs	Percentage (%)
1.	4	10	25.0
2.	5	9	22.5
3.	6	8	20.0
4.	7	5	12.5
5.	8	8	20.0
Total		40	100

Source: Field survey, 2006/07

4.4 Methods of data collection

4.4.1 Field visit and household survey

Due to the unavailability of requisite information on the bamboo sector profile of Badikhel VDC, an attempt has been made to prepare a record by conducting survey through the structured interview. To meet the goal, a set of questionnaire was designed and developed. Thus, the investigation was preceded with the objective-oriented questionnaire using interview method. The prepared questionnaire is included in Appendix-I. The questionnaire mainly covered the biophysical and socio-economic characteristics.

4.4.2 Key informants interview

Key informant interviews were used to collect data about the socio-economic information on bamboos during the field study. Local bamboo craftsmen of the study area belonging from *Pahari* community were selected as key informants. Structured and semi-structured questions

with few open-ended questions were used to gather as much information as possible. Beside key informants, the researcher also took interviews with many other people to collect the information related to bamboos and its impacts imposed on them.

4.4.3 Group discussion, Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA)

To formulate an understanding of any traditional and ethnic resource management system, using one particular methodology is quite inaccessible, rather is problematic. Therefore, to carry out the investigation with convenience and to make it fruitful, a multi-method approaches were applied using the tools such as group discussion, RRA and PRA.

Group discussion was carried out with different groups of persons like traditional craftsmen, senior citizens, family members, community forest officer and VDC officer by following Participatory Rural Appraisal (PRA) technique given by Martin (1995). This method was employed to obtain information on the different uses of different bamboo species existing in the study area, their distribution pattern, cultivation, harvesting and management practices.

RRA methodologies are designed for interdisciplinary investigation of socio-culturally and biophysically complex rural systems, which facilitates rapid and progressive learning (Vityakon *et al.*, 1995). Six helpers, i.e. 'what, when, where, how, who and which were used as a tool to formulate a standard questionnaire in the study.

The important source of primary data was the key informants. Rapid Rural Appraisal tool was applied to collect the relevant data concerning bamboo species used in craftmaking, their status and sources, harvesting period, products manufactured, methodology and technologies practiced and existing conservation practices for the species. Interviews were carried out among *Pahari* community to assess the socio-economic impacts of bamboo-based craftmaking of this very ethnic group of Badikhel VDC. In the process, craftsmen of different age groups and different sex were included. A good intimacy was built with them for the documentation of the information and their knowledge. During field surveys, good rapport was built with the local people, craftsmen and other personnel which created a sound relationship.

4.4.4 Plant collection, herbarium preparation and identification

The collection of voucher specimens of bamboos from the study area was done along with the field note to keep permanent and accurate records for representation of the bamboo species from the area and to assist in identifying the bamboo specimens. Collection and preparation of herbarium was accomplished by using standard herbarium technique as mentioned by Stapleton (1994) and Poudyal (2006).

Unlike of other grass species, separate parts of bamboo species like culm sheath, leaves, new shoot and of those possible ones. Culms with few nodes were collected. The inflorescence of one of the species flowering during the time of survey was also collected. The task of collection was conducted with the assistance of local informants.

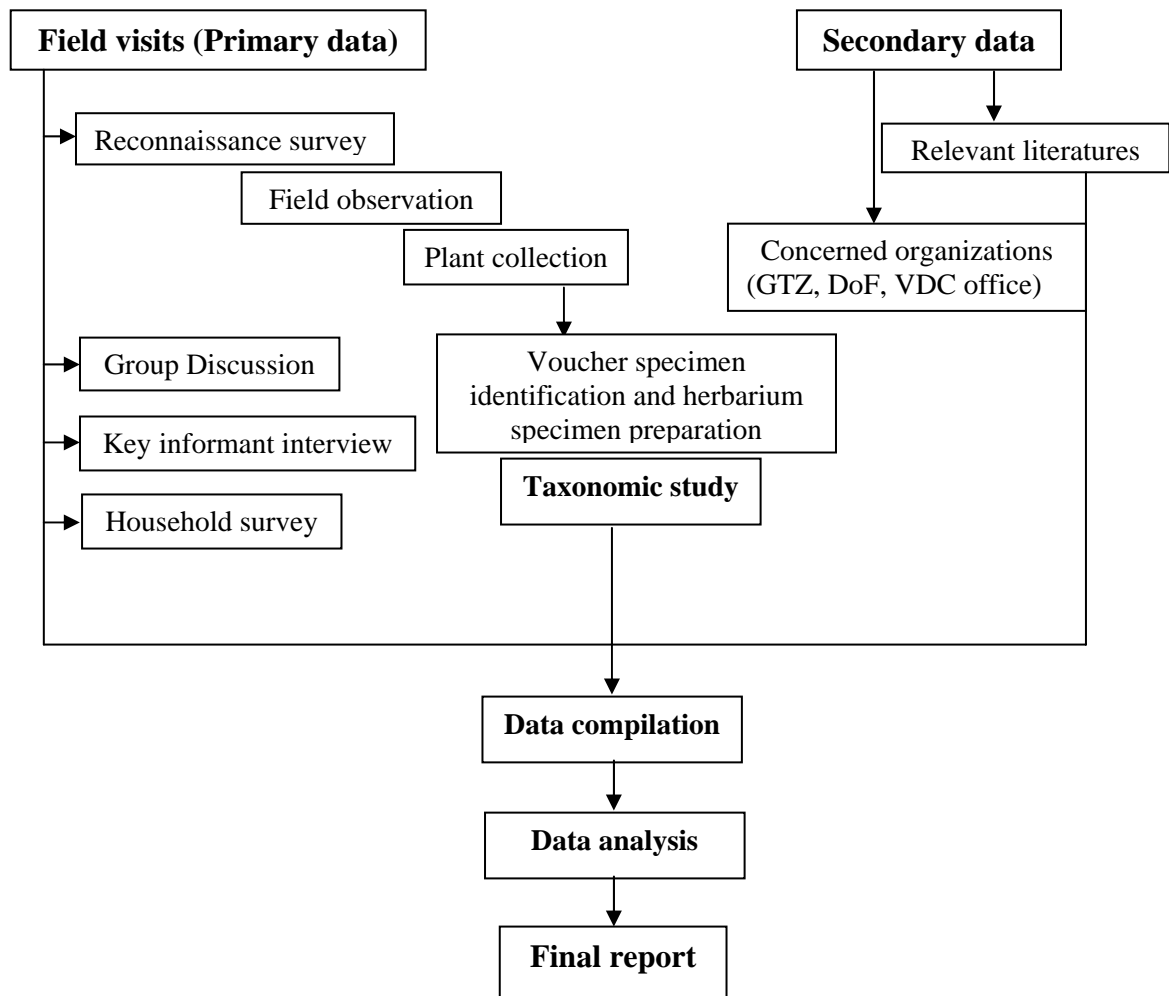
Taxonomic identification of the collected specimens was done with the help of various standard literatures (Stapleton, 1994; Tiwari, 1992; Das, 2004) and with the guidance of experts.

4.4.5 Secondary data collections

Related publications, research papers, reports, books, journals available at Tribhuvan University Central Library (TUCL), Library of Department of Forest and Research Survey (DFRS), GTZ, Badikhel VDC and internets were the major source for secondary data. Secondary information regarding Badikhel VDC and other data were collected from Village Development Committee Office, District Forest Office (DFO), Community Forest User Groups (CFUGs), Central Bureau of Statistics (CBS), Department of Meteorology and TUCL.

4.5 Data analysis

For the purpose of data analysis, all the information obtained from the field was compiled to make the analytical work easier, systematic and reliable. These data are categorized and tabulated in different tables according to the objectives of the study. The descriptive statistics such as simple means including the frequencies, percentage, pie chart, bar graph, figures and maps had been employed to make the findings comprehensible at a glance. The Microsoft excel tools was used to process the data.



Flowchart 1- Methodology

CHAPTER FIVE

5. RESULTS

5.1 Exploration and distributional pattern of bamboo species in the study area

From the survey, it is found that the two species of two different genera, *Bambusa nepalensis* and *Drepanostachyum annulatum* occur in natural as well as in cultivated forms, whereas the other two species of *Bambusa*, *B. balcooa* and *B. nutans* subsp. *nutans* exist only in cultivated stands.

To state the pattern of bamboo distribution in the study area (Table 6 and 7), five categories of frequency class as has been mentioned by Manandhar and Bhattarai (1998) was used in which A: abundant with more than 20 clumps; C: common with 10 to 19 clumps; F: few having 3 to 9 clumps; and R: rare with 1 to 2 clumps.

Table 6: Distribution of bamboos in Badikhel VDC and their local names

S. N.	Species	Local names	Distribution
1.	<i>Bambusa nepalensis</i>	<i>Tama Bans</i>	WC
2.	<i>B. nutans</i> subsp. <i>nutans</i>	<i>Taru bans</i>	C
3.	<i>B. balcooa</i>	<i>Dhanu bans</i>	C
4.	<i>Drepanostachyum annulatum</i>	<i>Ban nigalo</i>	WC

C: cultivated; W: Wild; WC: Wild as well as cultivated (Source: Field survey, 2006/07)

In community forests of the study area, *Bambusa nepalensis* is the most common species occurring in three out of four community forests viz. Chandolmas Daanda, Bandevi Shanti and Kumari Community Forests. Another species, *Drepanostachyum annulatum* is categorized as second widely occurring species and is found to exist in the same community forests where *B. nepalensis* exists. Whereas one of the species of *Bambusa*, *B. nutans* subsp. *nutans* is found only in Chandolmas Daanda Community Forest and is listed as the least occurring species in the community forests. From the survey, it is found that Gwalindaha Community Forest do not possess bamboos.

Table 7: Distribution of bamboos in community forests of Badikhel VDC

Name of community managed forests	<i>Bambusa nepalensis</i>	<i>B. nutans</i> subsp. <i>nutans</i>	<i>Drepanostachyum annulatum</i>
Chandolmaas Danda Community Forest	A	F	C
Kumari Community Forest	A	-	F
Bandevi Shanti Community Forest	A	-	C
Gwalindaha Community Forest	-	-	-

A: abundant with more than 20 clumps; C: common with 10 to 19 clumps; F: few having 3 to 9 clumps; and R: rare with 1 to 2 clumps (*Source*: Field survey, 2006/07)

Furthermore, the survey for the wardwise distribution of bamboos showed the similar trend as above. It was found that *Bambusa nepalensis* is the most commonly occurring species and occurred in all eight visited wards, followed by *Drepanostachyum annulatum*, which also existed in all surveyed wards. Another species, *Bambusa nutans* subsp. *nutans* occurred only in Ward no. 2, 6, 8 and 9 while the least distributed species is *B. balcooa* which is found only in Ward no.2 (Table 8).

Table 8: Distribution of bamboos in different wards of Badikhel VDC

Ward no.	<i>Bambusa nepalensis</i>	<i>B. nutans</i> subsp. <i>nutans</i>	<i>B. balcooa</i>	<i>Drepanostachyum annulatum</i>
2	C	F	R	F
3	C	-	-	C
4	A	-	-	C
5	A	-	-	C
6	A	F	-	F
7	C	-	-	F
8	A	F	-	C
9	C	C	-	C

Source: Field survey, 2006/07

5.2 Taxonomy of the bamboo species in the study area

Three species of bamboo belonging to genera *Bambusa* and one species of *Drepanostachyum* are found growing in Badikhel VDC of Lalitpur district. *Bambusa* is the dominant genus in the study area. All the species belonging to genera *Bambusa* and *Drepanostachyum* are identified to species level.

5.2.1 Taxonomic Treatment:

Key to genera

- A. Thick culms with diameter more than 3.5cm, culm sheath blade broad, length less than twice the width.....*Bambusa*
- B. Thin culms with diameter less than 3.5cm, culm sheath blade narrow, length more than twice the width..... *Drepanostachyum*

Bambusa Schreber

Clump-forming bamboo. Rhizomes pachymorph or sympodial or clumper. Culms to 25m, woody, erect to pendulous, usually glabrous, or lightly waxy; internodes often with a single, wide groove above branches. Culm sheaths usually broad and triangular in shape, usually with auricles. Branches one to many, small and uniform, or large and variable. Leaves sheaths with auricles. Leaves blades under 25cm.

Key to Species

1. Culm sheath auricles large, more than 1.5cm in width*B. nutans* subsp. *nutans*
+ Culm sheath auricles small. Less than 1.5cm in width.....2
2. Auricles absent, leaf sheaths with brown hairs..... *B. balcooa*
+ Auricles small, rounded; leaf sheaths with white hairs.....*B. nepalensis*

The taxonomic description of the above bamboo species are as follows:

Bambusa nepalensis Stapleton, Bamboos of Nepal, Royal Botanic Gardens, Kew, 22, 1994.

Vernacular/Local Names: *Tama/ Phusre/ Khosre bans* (Nep)

A clump-forming bamboo. Culm 15-20m high, 10.0-12.0cm in diameter, pubescence, whitish green; internode 13.0-45.0 cm long, internode not very prominent; branchlets 7-8 along mid-culm. Culm sheath 27.0-38.0cmx25.0-38.0cm, yellowish brown inside and dark-brown outside with short, dense and flattened and uniformly scattered hairs, much broader at the base, tapering at tip; auricles very small 0.5cm and ciliated; blade 15.0-23.0 cm long, broad, intact. Leaves 20.0-25.0cmx4.0-5.0cm, lanceolate with pointed tip, yellow green in color.

Distribution

This species is commonly cultivated in eastern, central and western mid-hills of Nepal occurring abundantly between 1000-2000m but can grow as high as 2200m.

Uses

Due to the flexibility of this species, it is widely used for weaving. This species is used for making different types of baskets and grain stores. The rope (*choya*) are also made and used for tying up of roof thatches during house construction. The old mature culms are occasionally used as poles for house construction, when superior strength culms of the species such as *B. nutans* subsp. *cupulata* (Mal bans) and *B. nutans* subsp. *nutans* (*Taru bans*) are not available. New shoots are consumed as edible shoots. Leaves of this species is also used as fodder but is considered less nutritious than *B nutans* subsp. *cupulata* eastern Terai.

Voucher specimen: Lalitpur, Badikhel, 2000m. Sep. 29 2006. Merina Shakya, 30. (Photo plate no.1)

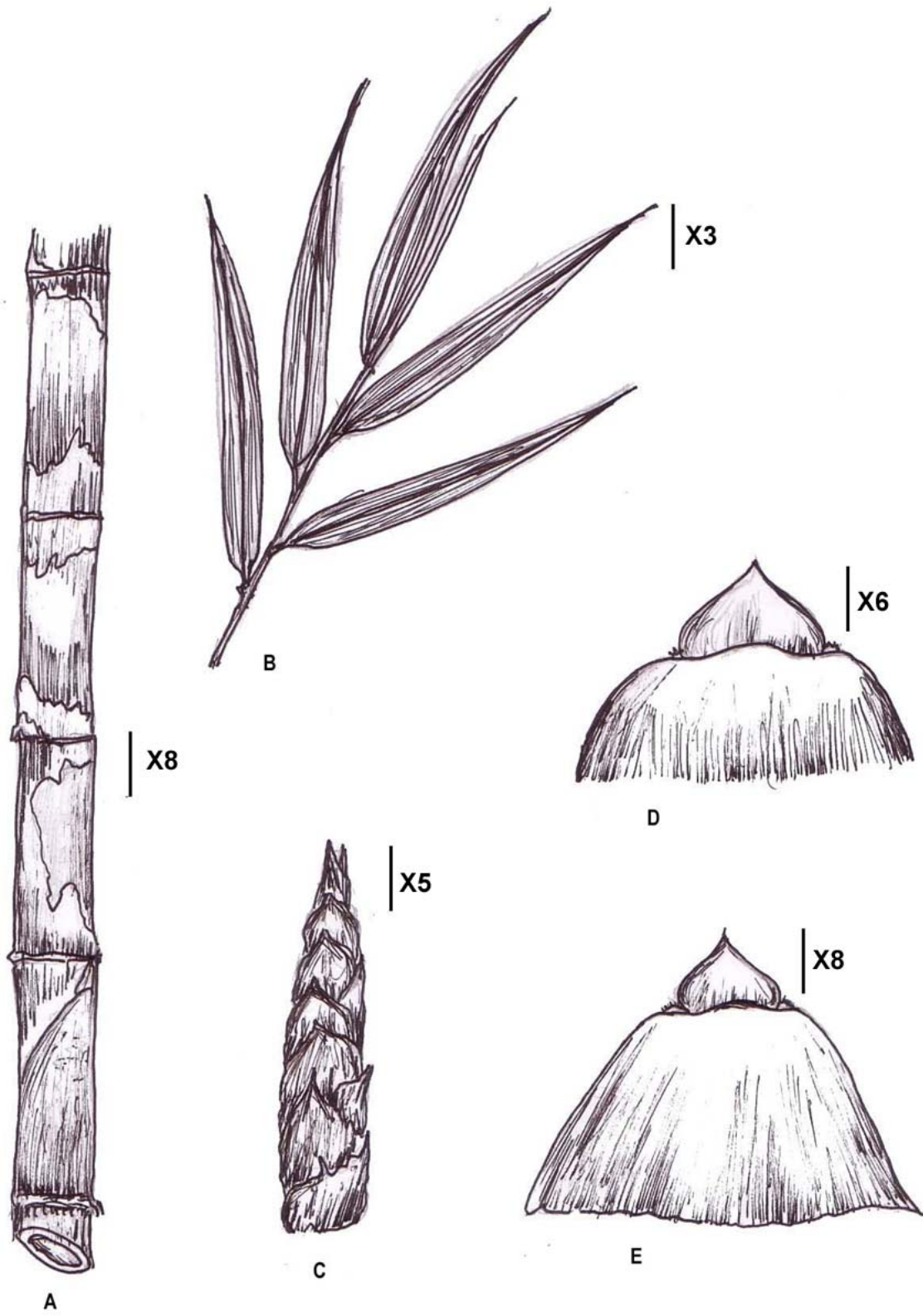


Diagram 1. *Bambusa nepalensis* A.Culm B.Leaf C.Young shoot D.Culm blade E.Blade

Bambusa nutans subsp. *nutans* Stapleton, Bamboos of Nepal, Royal Bot. Gard., Kew, 23, 1994.

Bambusa nutans Wallich ex. Munro in Trans. Linn. Soc. Lond. 26; 92, 1868.

Vernacular/Local Names: *Taru bans* (Nep) in Kathmandu valley, *Satay bans* (Nep) in west Nepal; *Tharu bans* (Maithali) in the Terai or plains.

A clump forming bamboo. Culm 14.0-22.0m high, 6-10 cm in diameter, smooth, straight and dark green; node slightly thickened, internode not very prominent, usually 25-45cm long; branchlets 2 smaller ones and few still smaller subsidiary ones. Culm sheath 19.0-32.0x19.5-29cm, hairy, dark brown inside and appressed and scattered dark brown deep blackish green outside; base broader; auricles present, large wavy fringed with bristles, blade 8.0-15.0cm long, weakly cupped and persistent, Leaves 12.0-25.0cmx1.5-3cm, lanceolate. Sporadic flowering recorded in the Kathmandu Valley in 2000, 2005 and 2006 (Poudyal, 2006).

Distribution

Most commonly cultivated bamboo in the hills up to 1500m of central, western and Mid-western regions of Nepal and to a lesser extent in the Far-western region. Also cultivated in valleys, inner plains and the Terai regions. Recently been introduced into eastern Nepal on Dharan-Dhankuta road for slope stabilization works and by some private landholders. Reported to be found in the Bardia National Park in the natural forests.

Uses

The culm of this species is considered strong and resistant to termite attack. They are used for all constructional purposes like for walling of the houses, roofing and as pillars and beams. They are also used for making mats, various types of baskets, handicrafts and furniture. The shoots are bitter and are not eaten. Even the branches of the species are used for fencing. Leaves of this species are considered as a good fodder.

Voucher specimen: Lalitpur, Badikhel, 2000m. Oct. 20 2007. Merina Shakya, 43. (Photo plate no.2)

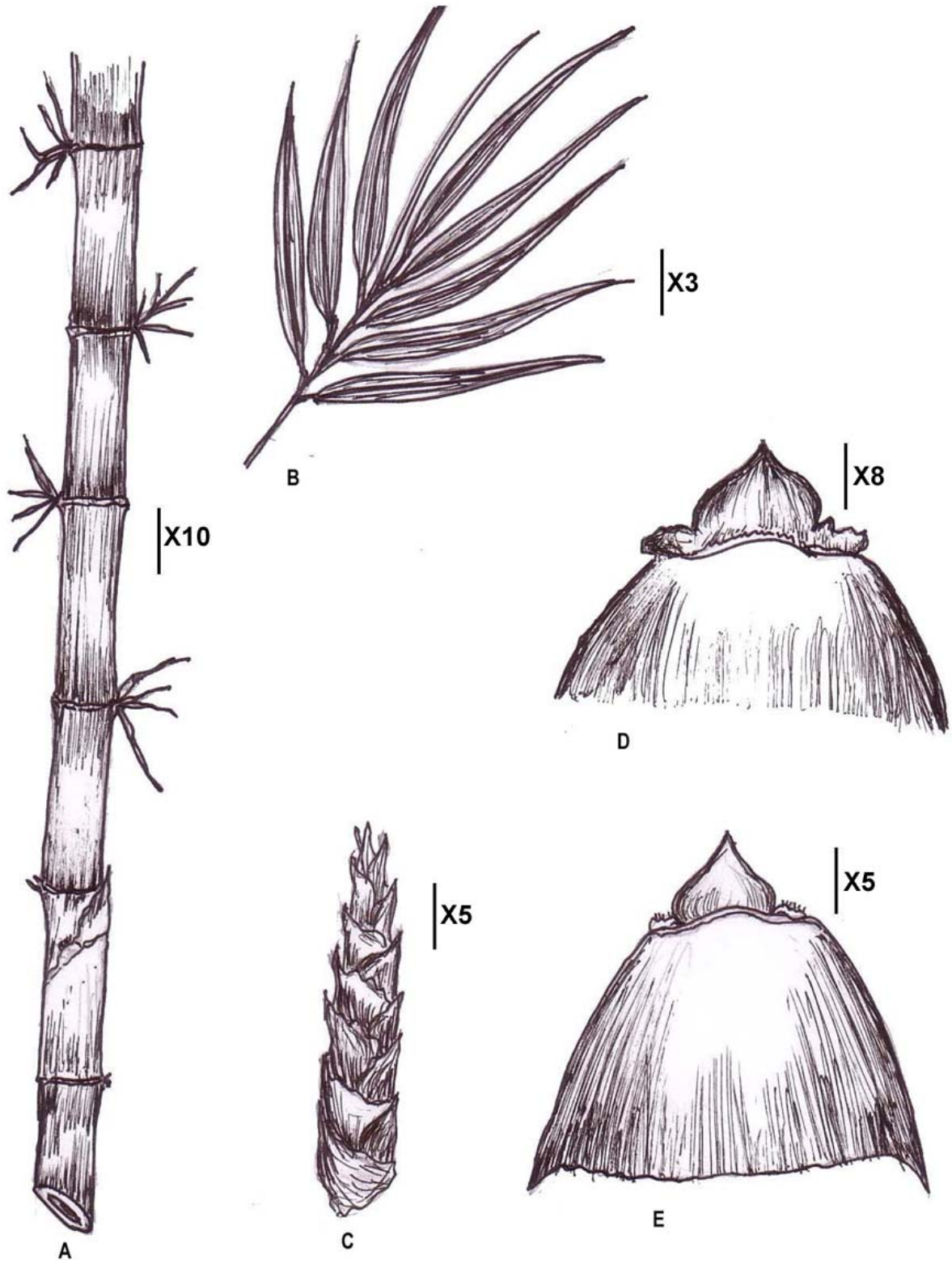


Diagram 2. *Bambusa nutans* subsp. *nutans* A.Culm B.Leaf C.Young shoot D.Culm blade E.Blade

Bambusa balcooa, Roxb. Hort. Beng. 25, 1814; Fl. Ind. 2: 196, 1832; Munro in Trans. Linn. Soc. Lond. 26: 100, 1868; Tewari, Monograph on Bamboos, 31, 1992; Stapleton, Bamboos of Nepal, Royal Bot. Gard. Kew, 20, 1994; Stapleton, Bamboos of Bhutan, Royal Bot. Gard. Kew, 20, 1994; Seethalakshmi *et al.*, Bamboos of India, 37, 1998.

Dendrocalamus balcooa (Roxb.) Voigt, Hort. Suburb. Calc. 718, 1845.

Vernacular/Local Names: *Dhanu Bans, Bhalu Bans* (Nep)

Culms 15-25m high, 8-15cm in diameter, erect to drooping; grayish green, pubescence, nodes with aerial roots, bearing branches to base; central branches very large, ultimate branchlets thorn-like. Culm sheath 15-20cmx10-15cm, whitish brown inside, dense dark-brown hairs outside; auricles absent, blade 6-8cm long, triangular. Leaves 15-25cmx2.5-4cm, oblong-lanceolate, glabrous above, pale and puberulous beneath, pointed apex, sub-cordate or rounded at base with a short petiole; leaf sheaths with dense, deciduous brown hairs.

Flowering

Gregarious flowering in Bangladesh during 1983-85 (Banik,1987); in Rollins Plains, New south Wales, Australia in 1985; in Western Australia during 1985-86; in New South Wales during 1986-87; gregarious flowering in Uttar Pradesh, India in 1986; in south-western Australia in May 1993 (Shor, 1997); in Siding, Kaski district, Nepal in 1990 (Poudyal, 1998).

Distribution

Species grown all over the Terai and Inner-roots, region of Nepal but more common in the eastern half of Nepal. Also cultivated in Kathmandu, Pokhara, and Surkhet valleys and at lower altitude of the Midhills up to 1400m in all hilly regions of Nepal.

Uses

The most common use of this sturdy and strong bamboo is in house construction as pillars and beams. It is a good bamboo for scaffolding and ladders. It is also used for construction of bullock carts. This species is also good for slope stabilization. The leaves are used as fodder. The large branch with prominent nodes makes it one of the best species for soil conservation. This specie is successfully introduced on large number of sites for slope stabilization in Dharan-Dhankuta in the eastern Nepal.

Voucher specimen: Lalitpur, Badikhel, 2000m. Oct 20 2007. Merina Shakya, 41. (Photo plate no.3)

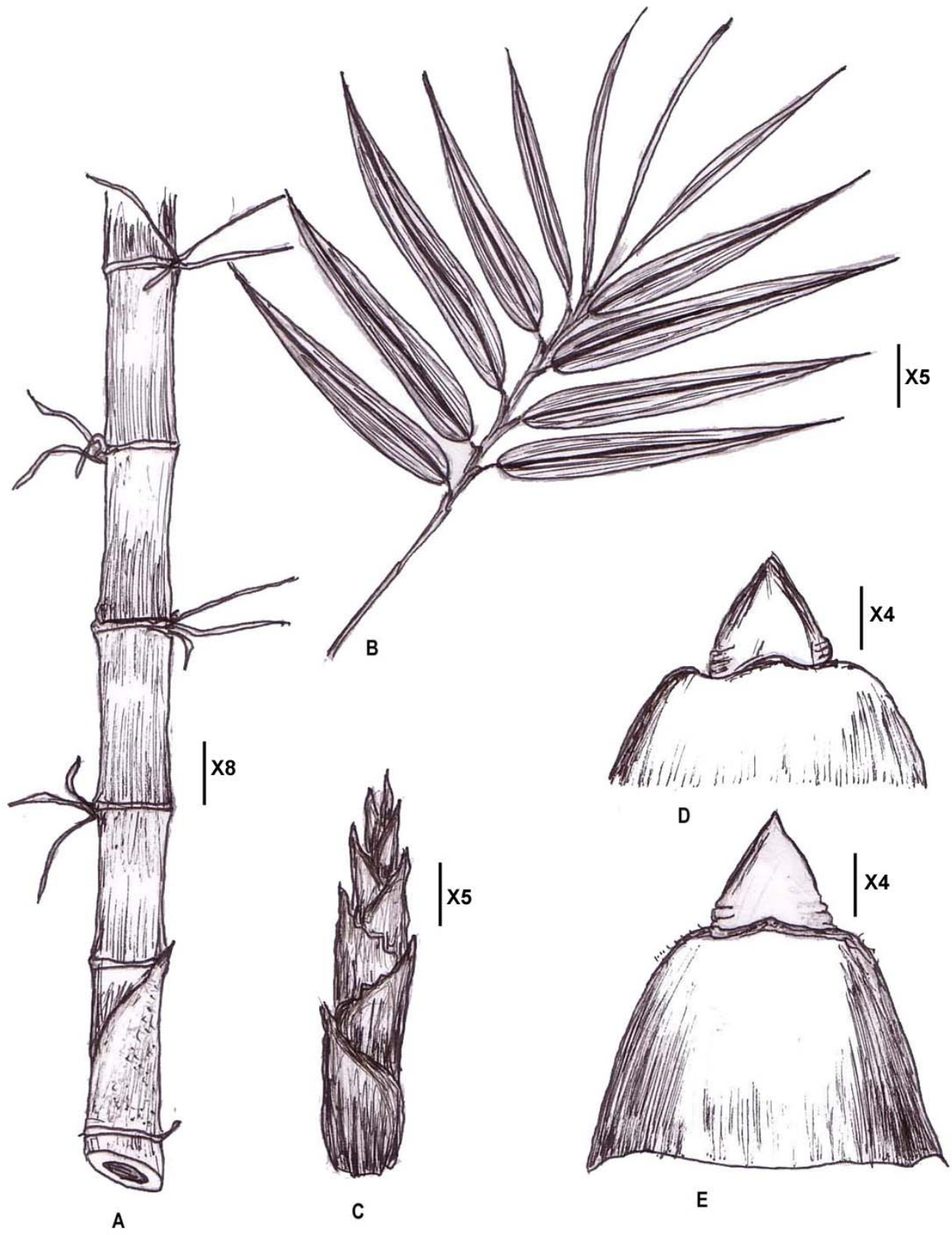


Diagram 3. *Bambusa balcooa* A.Culm B.Leaf C.Young shoot D.Culm blade E.Blade

Drepanostachyum Keng f.

Clump-forming thornless bamboos. Rhizomes pachymorph. Culms in a single dense clump (unicaespitose), to 5m, usually smooth, erect below, pendulous above; internodes to 25cm; nodes prominent, a ring present below the nodes; culm branches c. 25 in first year, later to 70, subequal. Culm sheath deciduous or persistent, scabrous at apex or pubescent on interior, distally acuminate; culm sheath auricles present or absent. Leaves linear-lanceolate to oblong-lanceolate; cross-veins inconspicuous.

Drepanostachyum annulatum Stapleton, Bamboos of Bhutan, Royal Bot. Gard. Kew, 20, 1994.

Vernacular/Local Name: *Ban Nigalo* (Nep)

A clump forming small-stature bamboo. Culm 2-4m high, 1.2-2.5cm in diameter, smooth, deep green; internode 15.0-20.0cm in diameter, smooth, deep green; node swollen with a prominent ring of deciduous brown hair; branchlets 20-50 from each node, fasciculate, uniform. Culm sheath 14.0-16.0x4.0-6.0cm, glabrous, papery with basal ring of dense brown hairs, tapering to a truncate tip; blade 2.0-5.0cm long, narrow, recurved; auricles absent. Leaves 12.0-17.0x1.0-2.0cm, linear-lanceolate to oblong-lanceolate, scabrous, transverse veinlets inconspicuous.

Distribution

A common small-stature bamboo species found in eastern Nepal, from 1200m to 2400m, in cultivated land, gullies and wastelands, and in forest areas occurring naturally, usually from 1200m to 1800m.

Uses

This species widely browsed by livestock and sometimes planted to provide fodder. Culms are valuable for weaving mats and baskets. This species is also considered good for soil conservation as they can grow even in drier sites and wasteland. The unsplit, whole culms are also used for making furniture and fencing.

Voucher specimen: Lalitpur, Badikhel, 2000m. Sep, 29 2006. Merina Shakya, 35. (Photo plate no.4)

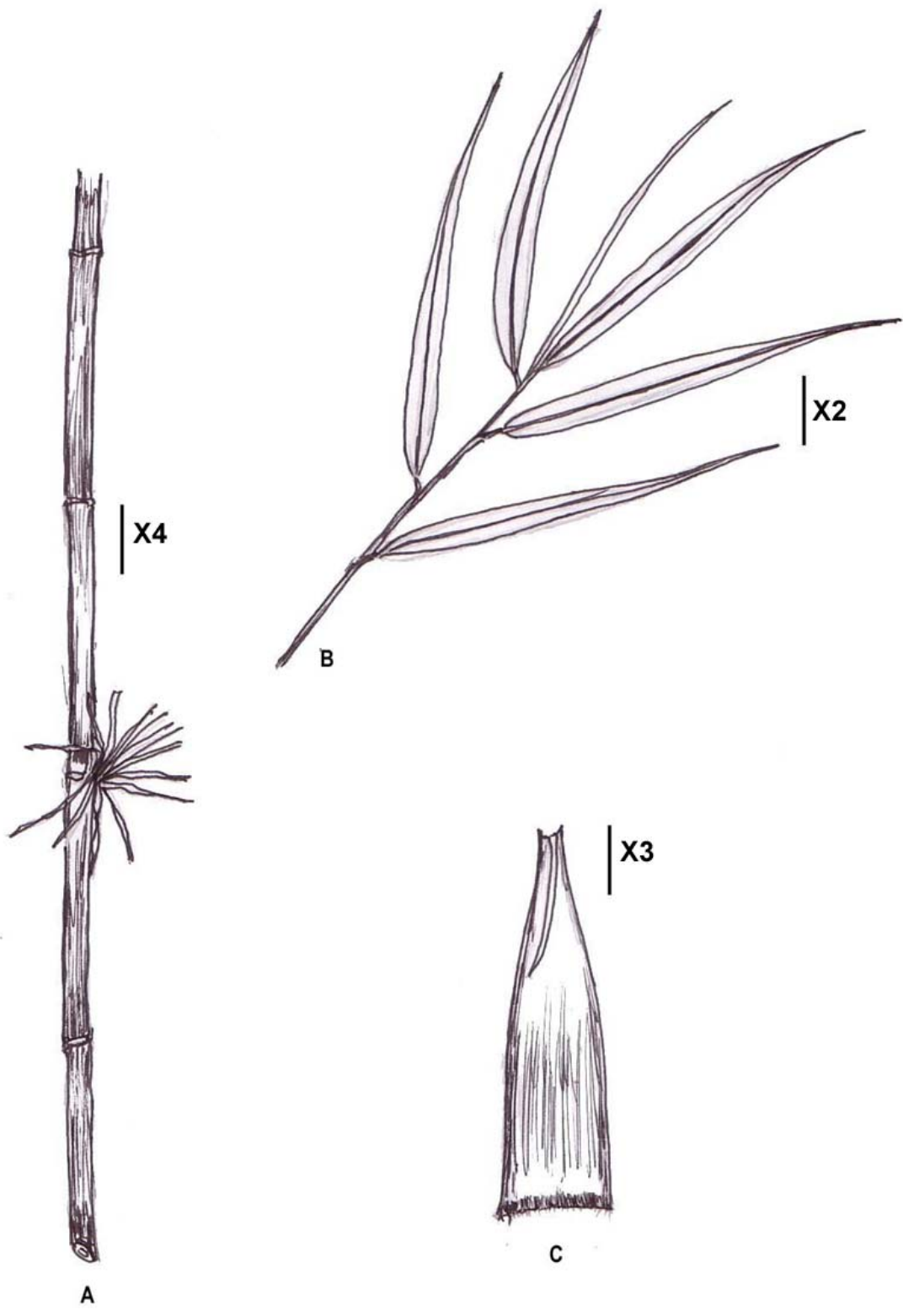


Diagram 4. *Drepanostachyum annulatum* A.Culm B.Leaf C.Culm blade

5.3 Utilization of bamboo resource in the study area

There are no other plant species with as many utility as bamboos. Among the available four different species of bamboo, *B. nepalensis* is the most commonly used species in the study area (Table 9). It serves as the main raw material for craftmaking business in the area. Various traditional household appliances like *Nanglo*, *Chalne*, *Doko*, *Dalo*, *Mandro* and *Ghum* are made from this species. It is also used for making different types of baskets, racks, dustbins, handicraft items and innovative value added products such as handbags, tea-cup mats, decorative items and flower vase for export purpose. Old and matured culms are occasionally used in scaffolding and other constructional works. The spilt culms of this species are used for fencing and roofing. Young shoots of this species are consumed as edible shoots. Its leaves are used as fodder for domesticated animals. This species assists in soil stabilization. The remains of handicraft work used as supplementary fuel. The species is useful in all kinds of general fieldwork.

Another species, *B. nutans* subsp. *nutans* is used sparingly in the study area. Local craftsmen hardly make use of this species in craftmaking and other purposes. However, the old culms of this species are harvested for constructional purposes. Occasionally, this species is also used for making different types of baskets, handicraft products and light furniture. Leaves of this species are used as good fodder at the place where they are found. Their growth helps to check soil erosion.

B. balcooa, the least occurring species in the study area, is not used in any of the craftmaking work. The old and mature culms of this species are used as excellent scaffolding for construction. This clump forming bamboo helps in slope stabilization and soil conservation.

Drepanostachyum annulatum found in the area is used for making light furniture like bookracks and shoes rack. They are also used in weaving baskets and mats. The foliage of this species is fed to livestock as fodder. This species also helps in soil conservation. It is also used as garden props.

Table 9: Bamboo species preferred among the respondents

S .N.	Particulars	<i>Bambusa nepalensis</i>	<i>B. nutans</i> subsp. <i>nutans</i>	<i>B. balcooa</i>	<i>Drepanostachyum annulatum</i>
1.	Weaving material	***	*	-	*
2.	Racks	***	-	-	*
3.	Edible shoots	***	-	-	-
4.	Fodder	***	*	-	**
5.	Construction	***	*	-	-
6.	Fencing	***	*	-	-
7.	Soil stabilization	**	*	*	**

Highest (** *), Medium (**), Lowest (*), Nil (-) (Source: Field survey, 2006/07)

5.4 Socio-economic importance of bamboo based work in Badikhel VDC

Bamboos are one of the very important sources of livelihood for the rural people in Badikhel area. Moreover, they have a unique and significant role in the lives of *Pahari* community, an ethnic group residing in the area. Bamboos have received high social and economical value in the study area.

The natural forests are the main source of bamboo supply. Over-exploitation and shrinkage of the habitat has resulted into bamboo resource depletion at an alarming rate. However, the establishment of the community-managed forests in the area has helped in some ways to conserve the depleting resource. Nevertheless, an attempt to manage the resource and rehabilitate it technically is lacking. The main reason for this is the insufficient research on the field of bamboo sector.

The limited availability of the bamboo resource base in the study area has caused a profound socio-economic impact on *Pahari* community who depends on bamboo for their livelihood. With the depletion of forest, bamboo has also been dwindling fast as the forest management cared only for firewood, fodder and timber production. The bamboo in the forest has not received the attention of the forest managers as they deserved. There is thus a need of

sustainable forest management that can provide timber, fuel wood and fodder and also the adequate raw material such as bamboos for local and industrial uses.

Human interference is the main cause of environmental degradation. Rapid growth in population exerts heavy pressure on limited natural resources. Bamboos at present are one such resource in a wait to receive proper attention. Bamboos, which have been playing a vital role in improving the economy of the rural people, especially the underprivileged people, are in need to be identified and prioritized in the present study area.

The potential role which bamboo could play in rural development and conservation of environment and bio-diversity is remarkable. There is a lack of proper management of bamboos, its cultivation and harvesting. Also, no measures are taken to enhance the quality of the goods and awareness to market value added products are not forthcoming as well. Likewise, efforts are lacking for increasing their production to expand their business. Adequate measures for generation of employment and income are lacking due to poor management.

5.4.1 Socio-economic profile of the craft makers in the study area

In the study area, the main caste group that depends on bamboos for their subsistence is *Pahari*, one of the ethnic groups of Nepal. *Paharis* are the socially and economically disadvantaged groups of people in the study area. They are found in different districts of Nepal. In Lalitpur district, *Paharis* mainly inhabit in Badikhel VDC. This community covers 55.22% of the total population of the area.

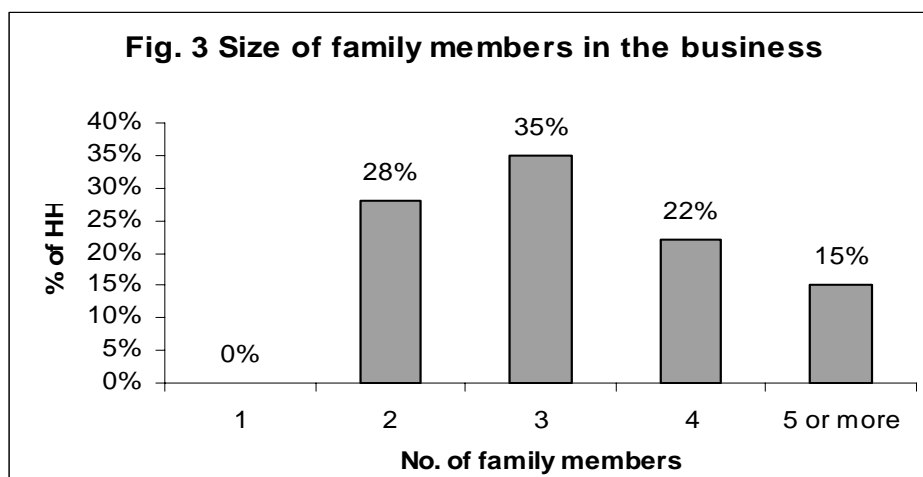
Paharis are the traditional weavers of various bamboo products. They consider bamboo craftmaking as one of the main sources of livelihood. Agriculture is another major source of income while, they also derive the supplementary income through labor, services and other businesses. Most of them are engaged in bamboo-based craft work but it is not enough to sustain their livelihood. They also have to depend on other sources such as family and off-farm employment to meet the household needs. The poverty is deep-rooted in the *Pahari* community, as their income from the occupation is low. They follow religious values and have cultural beliefs that demands lavish expenditure and thus enforce them to fall into

poverty trap. Furthermore, the literacy rate as well as the educational status of *Pahari* people is not satisfactory which make their ineligible for good job opportunities that would generate good earnings.

Out of 285 sampled households, 171 have been found involved directly and indirectly into the business. The findings of the socio-economic survey are as follows:

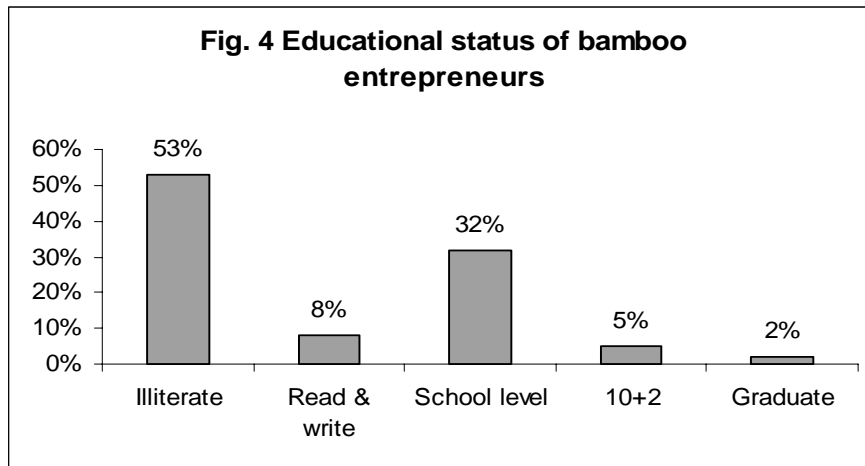
5.4.1.1 Number of persons (family members) involved in the business

It was found that bamboo craftmaking is a family business with no outside workers involved in the study area. From the households surveyed, 28% households had two members involved in the business, whereas 35% households have three members, 22% households have four and the rest 15% households have five or more members involved as employees in their family business (Appendix-IV). During the survey no such households with one-man entrepreneurship was found. Thus, each family had in average of three family members involved in the business.



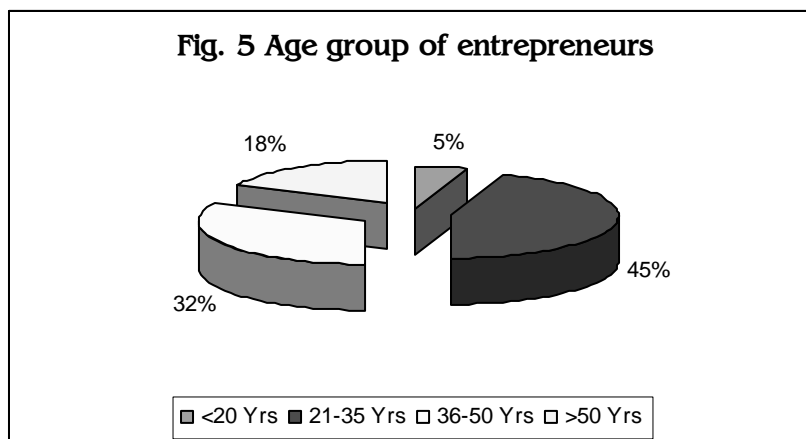
5.4.1.2 Educational status of entrepreneurs

Educational status of people determines their social status. The percentage of literate bamboo entrepreneurs in the study area was found to be 47% only and the rest 53% are illiterate. Maximum literate entrepreneurs (32%) had studied up to the school level, whereas 8% entrepreneurs could just read and write. 5% entrepreneurs were qualified up to 10+2 level and very few entrepreneurs (2%) were educated above higher secondary level (Appendix-V).



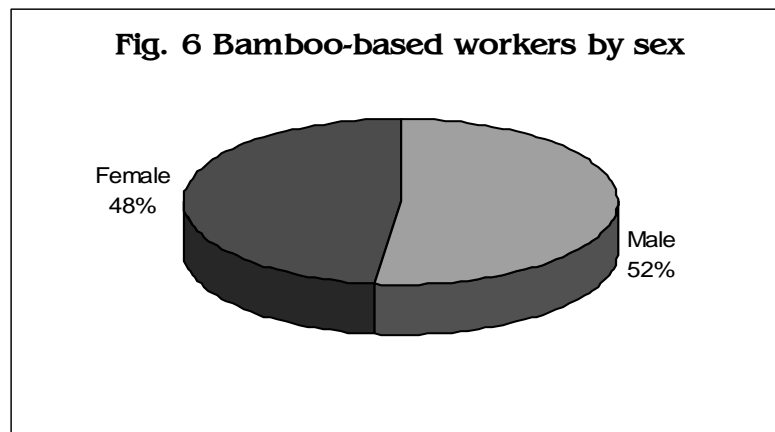
5.4.1.3 Age group of bamboo entrepreneurs

The average age group of bamboo entrepreneurs is 35 years. It is observed that maximum percentage i.e., 45% entrepreneurs were of age group ranging from 21-35 years, whereas 32% entrepreneurs are from age group 36-50 years. The study area also shows the involvement of older generation whose age is above 50 years. 18% of such entrepreneurs are continuing their traditional job. Few younger generations (5%) with age below 20 years are also found involved in the business (Appendix-VI).



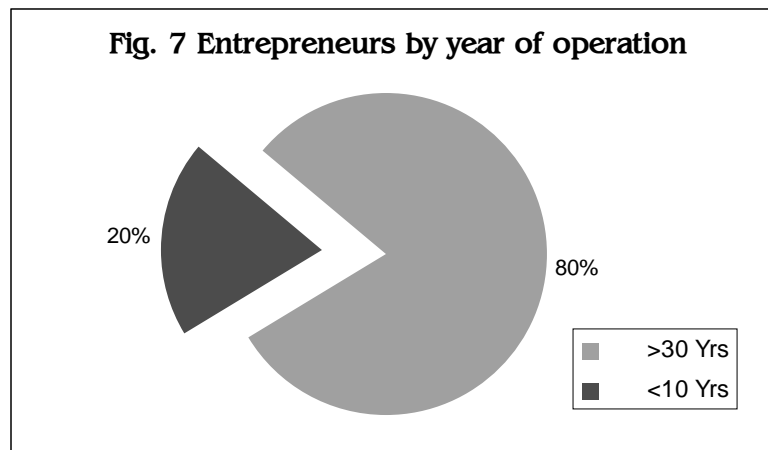
5.4.1.4 Bamboo-based workers by sex

100% of the surveyed bamboo enterprises are owned and managed by male entrepreneurs. However, it is found out that though male governs the trading business, almost half of the workers are female. Out of the total 171 bamboo workers from 40 families, 48% is that of female population and the rest 52% workers are male (Appendix-VII).



5.4.1.5 Entrepreneurship by year of operation

Majority of the respondents could state the average year but not the exact date when they started their entrepreneurship. The report showed that 80% entrepreneurs were operating the business since last 30 years. The rest 20% has this business last 10 years (Appendix-VIII).



5.4.1.6 Landholding of bamboo entrepreneurs

From the survey, it is found out that *Pahari* people have very small landholding. 87.5% of sampled households possess less than 15 ropanies of land. Maximum entrepreneurs (35%) possess land size ranging from 0-5 ropanies, while 30% has 6-10 ropanies of land. Likewise 17.5% of the total surveyed households owe 11-15 ropanies land and only 12.5% households have more than 15 ropanies of land (Table 10). The survey also found two households without any still property.

Table 10: Size of landholding of the respondents

S. N.	Size of land (in ropanies)	No. of HHs	Percentage (%)
1.	No land	2	5
2.	0-5	14	35
3.	6-10	12	30
4.	11-15	7	18
5.	>15	5	12
	Total	40	100

Source: Field survey, 2006/07

5.5 Cultivation and harvesting practice system of bamboo in the study area

In the study area, *Bambusa nepalensis* followed by *Drepanostachyum annulatum* are two bamboo species favoured by the local villagers for cultivation. The plantation is carried out by vegetative multiplication method achieved by planting culm offsets with rhizomes. This is the traditional method of bamboo propagation in which 2-2.5m tall offsets with undamaged dormant buds at rhizome from 2 years old culms were selected for planting during the months of June-August.

Among the existing species in the study area, *Bambusa nepalensis* is the main bamboo species used and harvested. They selectively harvest culms of 2-3 years old for weaving twice or thrice a year during the months of November-February and much older clumps are harvested for fodder and construction. Harvesting is also practiced in other months of the year as per work demand except in between mid-March to mid-May (Baisakh-Jestha).

5.5.1 Availability of raw material in the study area

The study area fulfills only a very small portion of the raw material requirement of bamboo enterprises (Table 11 and Table 12). The main suppliers are community forests. Chandolmaas Daanda Community Forest produce the highest number of culms i.e. 80-180 culms per year whereas Kumari Community Forest lies in the second category with an annual harvest of 60-120 culms. Bamboo culms are also harvested from Bandevi Shanti Community Forest and it numbered 60-105 in a year (Table 11). Comparatively, supply from the homestead areas and farmlands are very low. Those surveyed craftsmen who own bamboo clumps harvest only 2-3 culms from a clump in a year. They generally keep the clumps secured for emergency need.

Table 11: Annual harvesting of culms of *B. nepalensis* from community forests of the study area

S. N.	Source area	No. of culms harvested at a time	Frequency of harvesting in a year	Total culms harvested
1.	Chandolmas Daanda	40-60	2-3	80-180
2.	Bandevi Shanti	30-35	2-3	60-105
3.	Kumari	30-40	2-3	60-120
4.	Gwalindaha	-	-	-

Source: Field survey, 2006/07

In contrary, the survey found that the annual consumption of the raw material by the sampled respondents exceeds greatly than the local production. Maximum respondents i.e. 27 households consume 150-200 culms/year; while only 4 households are found to consume 300 culms/year. In total, the annual consumption of the total surveyed respondents ranges to 6863-8850 culms (Table 12).

Table 12: Annual consumption of bamboo culms by the sampled HHs in the study area

S.N.	No. of culms purchased/HH	No. of HH	Total culms consumed
1.	150-200	27	4050-5400
2.	201-250	9	1809-2250
3.	251-300	4	1004-1200
	Total	40	6863-8850

Source: Field survey, 2006/07

5.6 Source of raw material for bamboo craftmaking

Bamboo resource available in the study area is not sufficient to fulfill the requirement of bamboo based craftmaking business. Thus, the local craftsmen get supply of the raw material from various places including neighboring villages like Bhardeu, Gundu, Sisneri, Lele, Chaling, Dharachaur, Lubhu or from far distant places like Panauti, Suryavinayak, Banepa, Kwapari, Damaitar, Sitapaila and Thapathali or from bamboo retail shops situated at Satdobato (Chart 2).

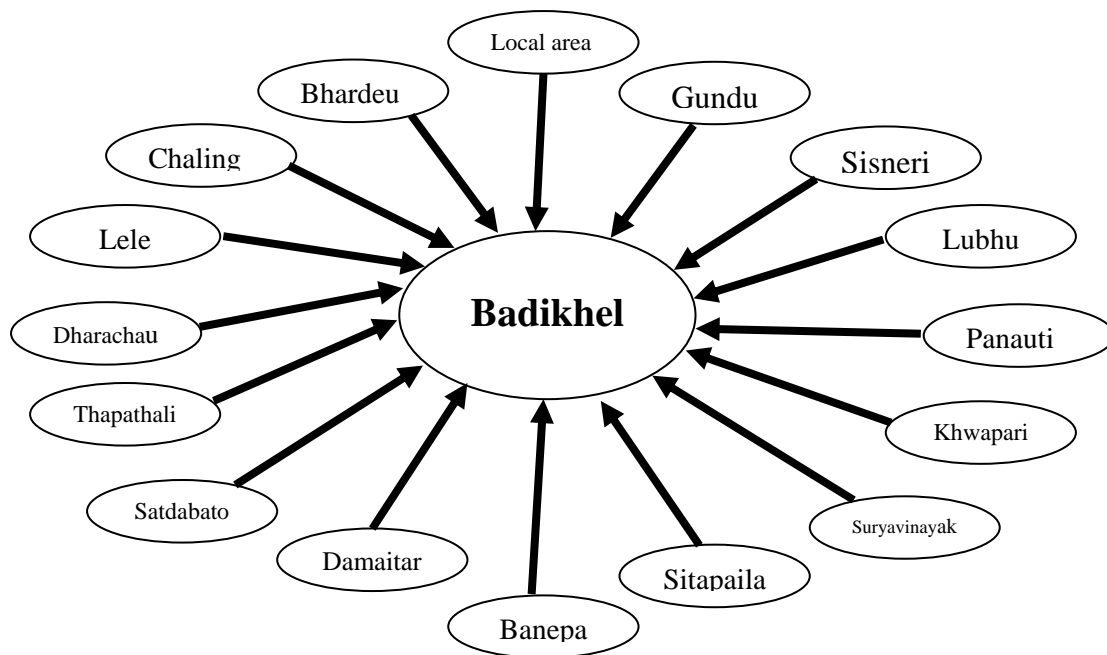


Chart: Sources of raw materials for Badikhel craftmakers

Craftsmen usually visit bamboo forests directly to collect the raw material (bamboo culms) in a group composed of members of 3-4 households. Reaching the site, they talk preferably with the bamboo growers and make an agreement. Then they themselves enter the private bamboo forest with cutting devices like axe and knives to fell, load and reload the materials from the site to their native village. Going together in groups allow them to save extra expenses spent in vehicle fare. Depending on the type of vehicle and the distance of the source site, a single reserved trip charges NRs.1000-NRs.2000 excluding the price of raw material.

From the survey, it is found that there is considerable difference in the price of the bamboo culms purchased from outside and from the local village. Locally, the price of a single culm ranges from NRs.25-NRs.100 whereas those bought from outside cost NRs.40-NRs.150 per culm depending on culm size and species.

5.7 Production and marketing of bamboo artifacts

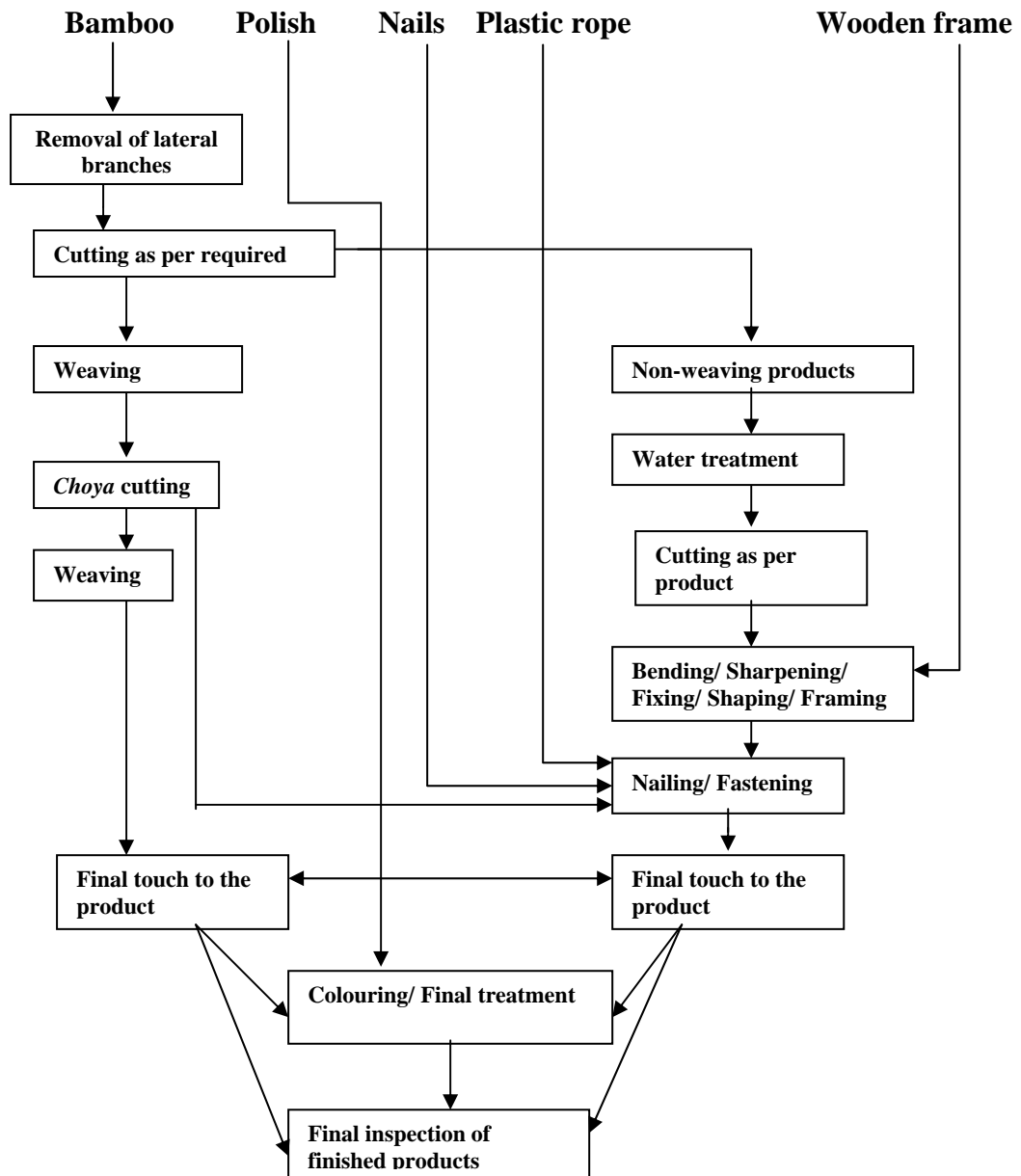
5.7.1 Bamboo processing technique and methodology

Fresh raw material is found to be used directly to prepare make various bamboo artifacts. Local craftsmen in the study area have their own traditional method of bamboo processing and

craftmaking (Flowchart 2). In average, the craftsmen in the study area are found to work for 9 months in a year.

For weaving, generally the craftsmen directly use freshly cut culms to prepare goods. They remove lateral nodes from the culms and smooth them with knife. Likewise, softer parts of bamboos are also removed to protect it from insect attacks. The culms are then cut into pieces as per required size, followed by splitting (*choya* cutting) them into thin stripes. Such stripes are dried in the sun for twenty four hours during summer and thirty six hours during winter and are used for weaving. While in case the craftsmen are to use the old stored dry culms harvested before, which are generally preferred for making racks and lighter furniture, such stored culms are first cut into pieces as required and immersed into water for about 2-3 months or even longer to soften them as well as to make it disease resistant. Beside this, some craftsmen are found to expose the bamboo culms to smoke created in kitchen or by burning process. Besides, the local craftsmen in the study area are not found to use or be acquainted with any other advanced processing technologies that would add more longevity and quality to their local products.

The treated culms are further cut into the required size and are dried in the sun. Such well-dried materials are used to make the desired products with the help of various traditional tool/equipments (Appendix-XII; Photo plate no.9). During the process, few other materials are used, such as wooden stripes of *Alnus nepalensis* (*Utis*) for framing, plastic stripes/ropes for binding and finishing, iron nails for joining and bark of *Acacia catechu* (*Khair*) and soda for colouring purpose are used. These extra materials are purchased from the local village or from market places. Products made are checked thoroughly for the extra makeover as the final touch. Craftsmen prefer to sell the products in the market as soon as they prepare them.



Flowchart 2 Detail analysis of bamboo product manufacturing

5.7.2 Major products dealt by bamboo entrepreneurs

Majority of the entrepreneurs deal with traditional household products like *Nanglo*, *Chalne*, *Doko* and *Dalo* and few new products like racks, dustbins and baskets (Table 13). These products have different demand at different time. From the survey, it is found that *Nanglo* and *Chalne* are in top demand priority. Rack lies in the second category followed by *Doko/ Dalo* and dustbin. Further, it is also found that 12.5% of the surveyed entrepreneurs are found involved in making innovative value-added bamboo products like Tray, Lampshade, Photo frame, fruit basket, clothes hanger, flower vase, pencil stands, worship baskets, and many

other decorative items (Photo plate no.7 & 8). Likewise, 5% of the surveyed entrepreneurs make export-quality products like handbags, flower vase and other exclusive items with the same material but with few added treatments like quality coloring, which enhance its outlook and durability and made more refine and quality product. The average cost price, selling price and production rate of some of the bamboo products they make given in the Table 14.

Table 13: Major Products dealt by the respondents and their demand

S.N.	Items	Demand ranks
1.	<i>Nanglo/ Chalne</i>	1
2.	Racks	2
3.	<i>Doko / Dalo</i>	3
4.	Dustbin	4
5.	Photo frame, decorative items, etc.	5

Source: Field Survey, 2006/07

Table 14: Economical account of some bamboo products

S.N.	Name of items	Ave. C.P. (NRs/piece)	Production rate (Piece/person)	Ave. S.P. (NRs/piece)
1.	Small <i>Nanglo</i> (20" diameter)	15	½ day	35
2.	Big <i>Nanglo</i> (22" diameter)	25	1day	60
3.	Rack	80	1day	100
4.	Dustbin	100	2days	225
5.	<i>Chalni</i> (filter purpose)	20	½ day	40
6.	Small <i>Doko</i>	50	1 ½ days	85
7.	Big <i>Doko</i>	100	2days	150
8.	Small <i>Dalo</i>	50	1 ½ days	85
9.	Big <i>Dalo</i>	70	2 ½ days	115
10.	Photoframe	50	¼ day	225
11.	Handbag	65	1/2 day	135

Source: Field Survey, 2006/07

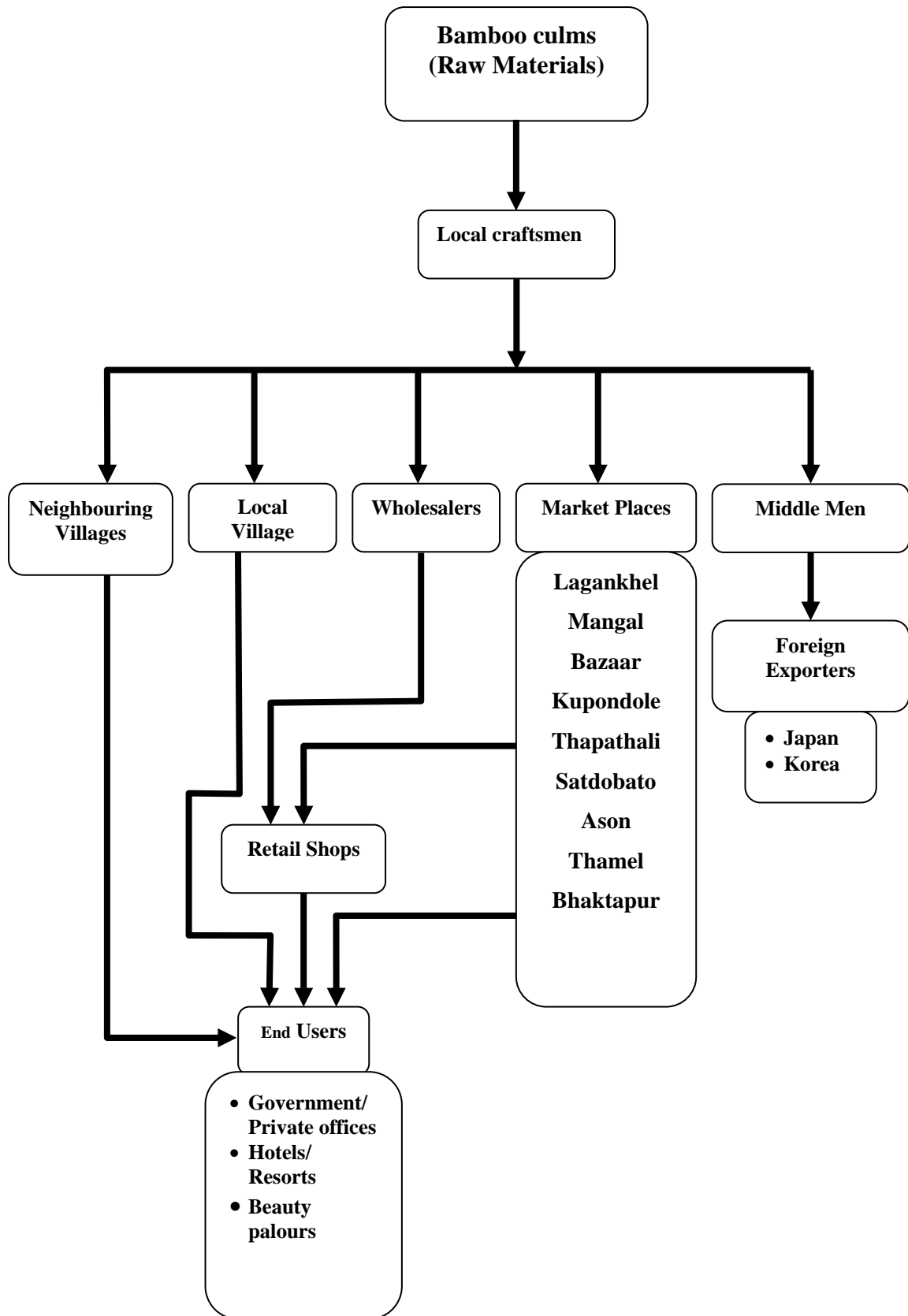
5.7.3 Market and market channels of Bamboo Products

From the survey, it has been found that maximum percentage i.e. 64% of the total respondents sell their products in various market places to market businessmen or directly to the end users of Kathmandu, Lalitpur and Bhaktapur. 17% of the respondents sell their readymade products in the neighbouring villages like Lele, Jharuwarashi, Chapagaon and Godawari. Only 11% respondents have their products sold to the wholesalers whereas 5% of the respondents sell the products in their own village. The remaining 3% of the respondents have exported their products to foreign countries like Japan and Korea but through middlemen (Table 15 and Chart 3).

Table 15: Mode of marketing by the respondents

S.N.	Nature of marketing	No. of respondents	Percentage (%)
1.	Sell in local market	38	64
2.	Sell in neighbouring villages	10	17
3.	Sell to middlemen	2	3
4.	Sell to wholesaler	6	11
5.	Sell in own village	3	5
	Total	59	100

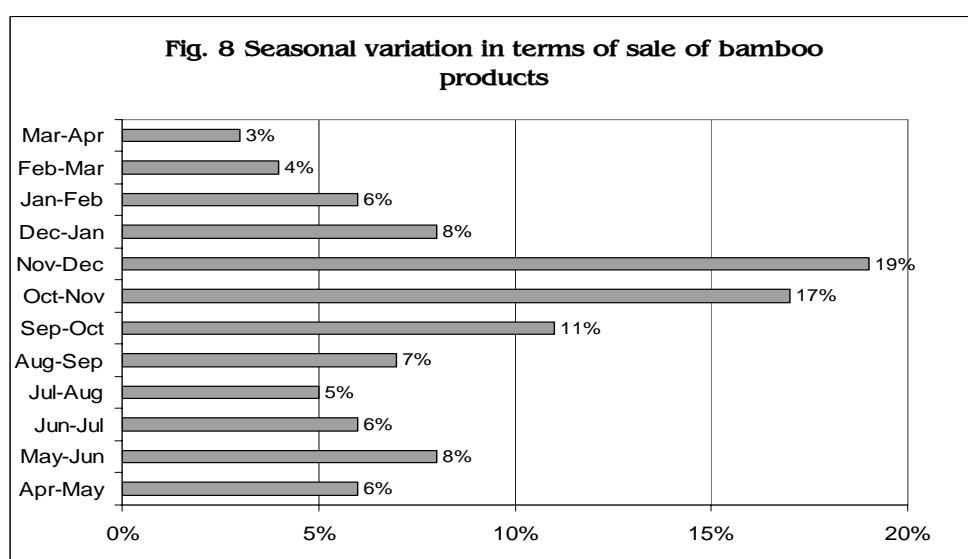
Source: Field Survey, 2006/07



Flowchart 3 Trade Route of Bamboo products from Badikhel VDC

5.7.4 Seasonal variation in terms of sale of bamboo products

Sales of the bamboo products are found to be considerably affected by season. Kartik (October-November) and Mangshir (November-December) are considered to be the peak selling season while Baishakh (April-May), Jestha (May- June), Asadh (June-July), Shrawan (July-August), Bhadra (August-September), Ashoj (September-October) and Poush (December-January) and Magh (January-February) to be the moderate selling season. Remaining Falgun (February-March) and Chaitra (March-April) are the low selling season found (Appendix-IX).

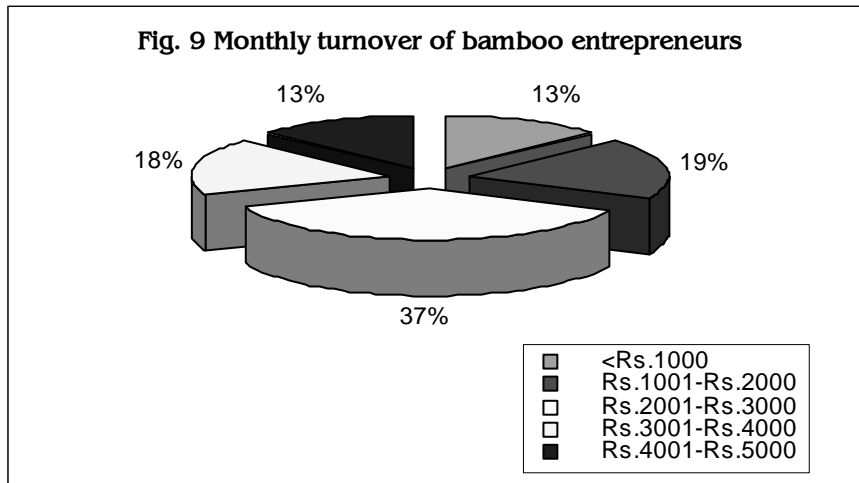


5.8 Contribution of bamboo-based craftmaking into livelihood

Bamboo entrepreneurship is one of the chief sources of income for *Pahari* community. They work in an average of 9 months in a year. The survey showed that their monthly turnover is not more than NRs.5000/- per month. Maximum entrepreneurs (37%) have their monthly income ranging from NRs.2001-NRs.3000. Only 13% of entrepreneurs enjoy the monthly income NRs.4001-NRs.5000. Coincidentally, it is the same percentage (13%) of entrepreneurs that draw the smallest monthly income which is less than Rs.1000. The rest 19% entrepreneurs are found to draw the monthly income of NRs.1001-NRs.2000, while 17% entrepreneurs earn NRs.3001-NRs.4000 per month (Appendix-X). Thus, in an average, bamboo entrepreneurs earn the monthly income of NRs.3000 which is equivalent to NRs.27, year with 9 months of involvement.

During the interviews, most of the respondents hesitate to disclose their actual monthly turnover. Majority of the entrepreneurs do not have proper balance sheets to keep record of

the sales. They calculate turnover and profit-loss based on their judgment or simply guesses.



6. DISCUSSION

Bamboos are linked with mankind ever since the beginning of civilization. Thus, considering the importance of bamboo resource in human welfare and its impacts on livelihood, the present study has been undertaken with three main objectives: To explore and identify the bamboo species in the study area, to document their utilization and to study the socio-economic importance of bamboo-based craftmaking on *Pahari* community, the dominant ethnic group in the study area. All the information mentioned here are solely based on field observations, applying RRA, PRA tools and interviewing with local villagers, bamboo entrepreneurs and VDC official personnel.

6.1 Taxonomy and distribution of bamboos in the study area

Bamboos, the woody perennial grasses are most abundant in Nepal. The identification of bamboos is difficult as their flowering is irregular and unpredictable and thus, vegetative parts have been used as for the purpose.

Hara *et al.*, (1978) reported 10 species of bamboo belonging to 5 genera from east and central part of Nepal. Poudyal (1992) listed 33 species of 12 genera. Stapleton (1994) reported 32 species of 11 genera. Manandhar and Bhattarai (1998) reported 23 species of 5 genera in Kathmandu valley (2002). In the present study, 4 species of 2 genera were found growing in the study area. Three species of *Bambusa* and one species of *Drepanostachyum* were identified to species level with the help of non-floral characteristics.

Three species that have thick culm wall with brownish fur on culm and show uniform multiple branches on each node confirms that they belong to genus *Bambusa*. One of them is characterized by the presence of dull whitish green culm, culm sheath with uniformly scattered short and flattened hairs, less dense than in other species of *Bambusa* and the presence of very small ciliated auricles confirms it to be *B. nepalensis* (Stapleton, 1994).

Another *Bambusa* species, locally called *Taru bans* shares many characters such as the presence smooth and glossy culm, linear leaf and ciliated auricles with size more than 1.5cm are similar to *B. nutans* subsp. *nutans* (Stapleton, 1994). The species has number of branches at each node that extends somewhat horizontally to give thorny appearance (Das, 2004).

The other large clump forming bamboo with its local name *Dhanu bans* was identified as *Bambusa balcooa*. Its character such as large mid-culm central branches, well-developed aerial rooting and absence of culm sheath auricles are similar to *B. balcooa* (Stapleton, 1994; Tiwari, 1992). Their culm size of diameter up to 16cm is also similar. This species has a different character like the early breaking of new young culm tip and drooping new culms like of *Dendrocalamus* sp. is quite contrast to other *Bambusa* sp. However, Das (2004) has mentioned that the character as one of the unique characteristics of this species. He has reported such character in the eastern variety of *B. balcooa*.

The common small-stature bamboo with its height up to 4m, swollen node with many (more than 40) branches, tessellate leaves and rough inside of culm sheath tip confirms it to be *Drepanostachyum* (Stapleton, 1994). Further, the characters like culm sheath blade with turf of brown hairs at base, long leaf sheath with a long ligule and persistent hairs (Stapleton, 1994) identified the species as *D. annulatum*.

Genus *Bambusa* with three species is the dominant species of bamboo in the study area. Manandhar and Bhattarai (1998) have reported this genus with 10 species as the largest and widely distributed bamboo species in Kathmandu valley. They have also reported that *B. balcooa* and *B. nutans* subsp. *nutans* are growing well in the valley and seem like wild species slowly entering in the adjoining forests of villages. In contrast, the present study area has only few clumps of both these species; especially *B. balcooa* is traced only in one of the private lands of Ward no. 2. Das (2004) has also reported the cultivation of *B. balcooa* in Kathmandu, Pokhara and Surkhet and at lower altitudes of Midhills upto 1400m in all hilly regions of Nepal. Moreover, he has reported its cultivation to be more common in eastern half of Nepal. Poudyal (2006) too has reported the occurrence of this species in Kathmandu valley and western mid-hills. The poor existence of these commonly occurring species in the study area is because of less cultivation practices and exploitation. Locals prefer only the traditionally and commercially demanded species that is *B. nepalensis*.

Likewise *B. nutans* subsp. *nutans* has been reported as the most commonly cultivated bamboo species in the hills of central, western and Mid-western regions of Nepal and to lesser extent in the Far western region (Stapleton, 1996; Das, 1998). According to Das (2004), large number of this species has been introduced into eastern Nepal Dharan-Dhankuta road for slope stabilization works and by some private landholders. He has reported that natural

occurrence of this species in Bardiya National Park, Nepal. However, the poor distribution of these two species in the study area is because of insufficient knowledge about bamboo species, their specialties and utilization, which led to meager cultivation in the area. Lack of information flow to make the local villagers aware of higher possibilities from locally available resources and their potentialities are other reasons behind the negligence of the available resource. As a result, locals are missing numerous opportunities to expand their business that directly influence livelihood status.

Comparatively, the occurrence of *B. nepalensis* is common among the existing species in the study area. This is in the same line as the study report by Manandhar and Bhattarai (1998). According to them, this is a common species occurring in 15 different localities in Kathmandu valley. Likewise, Das (2004) and Poudyal (2006) have also reported the common cultivation of this species in eastern, central and western hills of Nepal. This is because of its high utility in craftmaking and in other daily household activities, which make it a preferred species for cultivation in the area.

The occurrence of *Drepanostachyum annulatum* in the study area is found in all the surveyed wards and in the same three community-managed forests where *Bambusa nepalensis* existed. However, its abundance is comparatively less than that of *B. nepalensis* due to its less utility and poor and unsuccessful propagation especially in the community forests where the CFUGs have tried to cultivate.

6.2 Utilization of bamboo species in the study area

In the study area, the major use of bamboo is in craftmaking. However, the locals take other benefits like construction fencing, fodder, vegetables, for soil stabilization and many daily household purposes and field works.

For bamboo craftmaking, *B. nepalensis* is found to be the most commonly used species. Various artifacts such as *Nanglo*, *Chalne*, *Doko*, *Dalo*, racks, dustbins, and few other innovative products like photo frames, flower vase, hand bags, etc. are made. Stapleton (1996) consider it as a multipurpose species used for weaving, construction and for edible shoots. Das (2004) has reported the use of this species for weaving different types of baskets and grain stores in the hills. Poudyal (2006) has also mentioned the similar use of the species in handicraft productions in eastern Nepal.

Edible shoots from *B. nepalensis* are obtained by the locals for vegetables and pickles. Similar utilization of this species has been reported from eastern Nepal by Das (2004) and Poudyal (2006). Leaves of this species serve as a good source of cattle feed to the locals who are rearing cattle as a subsidiary source of living. Das (1999) has mentioned the similar use of the leaves in the Midhills and the Terai of eastern Nepal and in central and western Nepal.

Another species *B. nutans* subsp. *nutans* found in the study area is used scarcely by the locals. Due to its limited availability and lack of knowledge about its qualities, this local resource is not utilized and prioritized to its potential. Its use in weaving is very scarce. To the sharp contrast, Pun (2007) has reported it as the main species for weaving various bamboo products in Eastern Nepal. Das (2004) has also reported the extensive use of this species making handicrafts and furniture in Central and Western Nepal and for construction in Eastern Terai.

Bambusa balcooa, locally called *Dhanu bans* has rare occurrence and hence is used very less. It assists only as a soil stabilizer at the place of its growth. Das (2002) have mentioned similar use in the slopes of Dharan-Dhankuta Road in eastern Nepal. The old, mature culms of this species are scarcely used in construction. But it is found popularly used for constructional purposes in central and eastern Nepal (Stapleton, 1996; Karki *et al.*, 1998; Poudyal, 2007; Das, 2004) and in India as well (Gamble, 1896; Bor, 1940 Chakraborti, 1988). The negligence of this species in the study area is found due to lack of proper knowledge of local species. Otherwise this species could have been a good alternative for extensively used *B. nepalensis*.

The only species of small stature bamboo, *Drepanostachyum annulatum* is also used in weaving and making light furniture but its utility is secondary to *B. nepalensis*. Products made from this species are expensive, so locals find it difficult to sell in the market. Hence, the products from this species are made only on order.

6.3 Socio-economic importance of bamboo-based work in Badikhel VDC

Bamboos are one of the very important sources of livelihood for *Pahari*, an ethnic group in the study area. They are the traditional craftsmen and make use of all the existing bamboo species in one or the other ways. However, their dependency towards *Bambusa nepalensis* is incredibly higher than other existing species, as it is the commonly existing species in the area.

6.3.1 Socio-economic profile of the craft makers in the study area

All the employees in the study area for bamboo entrepreneurs belong to their own family. This shows that bamboo enterprises are playing an important role in employment generation and effective instrument for generating self-employment, off-farm employment and part-time employment for their family members. This subsequently affects their living standard. Kattel *et al.*, (2007) has also reported similar condition from eight Municipal towns of Nepal and surrounding areas.

The study has shown that literacy percentage of bamboo entrepreneurs in the study area is 47.5%. Kattel *et al.*, (2007) has also reported similar level of education in the bamboo entrepreneurs from eight Municipal towns of Nepal and surrounding areas but in higher percentage. i.e. 87%. Further similar condition is reported from Pho-ngam village in Thailand where nearly all the bamboo entrepreneurs were qualified with primary level education (Thammincha, 1988). Muraleedharan and Rugmini (1988) also reported similar educational status among 47 to 80 percent bamboo entrepreneurs in Kerala. Thus, the facts clear out that education is not a limiting factor for running bamboo business. Bamboo entrepreneurship is a right choice for the educationally underprivileged *Paharis* in the study area for self-interdependent and improving their living standard.

Though all the bamboo enterprises are owned and governed by male entrepreneurs, almost half i.e. 48% of the family workers involved are female. Bamboo craftmaking is one of the enterprises where a considerable number of women are involved. The situation is similar in the eastern Nepal among many poor women (Das, 1999). The fact that bamboo craftmaking can be done in harmony with domestic tasks is particularly important, therefore can be taken as an extension of household activities. Thus, this traditional business has been providing a means for upgrading the living condition of *Pahari* women in male dominated society. Though the contribution made in the family economy is not big, the result has been helpful to strengthen the dignity of women in home as well as in society.

Bamboo craftmaking is a traditional job of the *Paharis*. About 80% of the surveyed bamboo entrepreneurs in the area are found operating the business since last 30 years and more, which shows their dependence on bamboo resource. Das (1999) reported the existence of similar condition in the people, especially the socially and economically disadvantaged group in the

Terai and the Midhills of Nepal. Pun (2007) also reported the bamboo craftmaking business as the life sustaining business among the lower caste groups like *Dom*, *Dalit*, *Kami*, *Damai*, *Sarki*, etc. in Siraha. The study area has its 20% entrepreneurs involved into the business since last ten years back. Such an involvement of young and fresh entrepreneurs can contribute in quick growth, development, promotion and expansion of the business. They are enthusiastic and proved to be of greater benefit as they are quite receptive and attribute many innovative and creative ideas in comparison to the older entrepreneurs (Kattel *et al.*, 2007).

6.3.2 Availability of bamboo as the raw material for bamboo entrepreneurs in the study area

Most of the traditional industries in the developing countries have been suffering from non-availability of sufficient raw materials (Nair and Muraleedharan, 1983) and the bamboo enterprises in the study area is not an exception. It is seen that three out of four community-managed forests are the main suppliers of raw material (*Bambusa nepalensis*) in the area. The total annual production of three community managed forest ranges to 200-405 culms when the annual consumption of the sampled 40 households only reaches 6863-8850 culms.

Average entrepreneur has one or two bamboo clumps. Likewise, in the community-managed forests, bamboos (*Bambusa nepalensis*) are considered as minor products and are planted only in between major vegetations and marginal areas. However, they are scattered and they are not able to supply in bulk. Their uses are subsistence; they only use in order to meet emergency raw material needs and bamboo cultivation is not done at the cost of food production (Karki *et al.*, 1998). The return period for bamboo is three years, and there is not enough financial security for the poor people to wait that long. Furthermore, with their small landholdings, it is not feasible to do intercropping with other major crops. The average size of landholding of each bamboo entrepreneur in the study area is only 0.43 hectares (*6 ropanies*). Thus, the small size of landholding put the constraints in bamboo growing. Das (1998) and Karki *et al.* (1998) also agrees the fact that landholding is one of the main factors determining the household decision for cultivation of bamboo in the farmlands. Moreover, 5% of the surveyed bamboo entrepreneurs in the study area are landless. Therefore, for the supply of raw materials the craftsmen have no choice but to depend completely upon the outer sources. Such a condition adversely affects the employment and income status.

Besides, the old and traditional method of bamboo plantation practiced further decreases

prioritization for cultivation. This method of planting of culms with attached rhizomes (offset planting) is the best method successful in bamboo species with thick walls (Vongvijitra, 1988). However, Vongvijitra (1988), Das (2004) and Stapleton (1994) have pointed out certain drawbacks of this method. They commented that out of about 3-7 large buds of the one-year-old parent culm which tend to grow simultaneously, only one or two grow completely. At the same time, this method is expensive as it demands the destruction of a single bamboo culm for obtaining the offset (planting stock), high labour charge for uprooting plus there are many chances of failure cases of plantation as a little damage caused to the buds results into the failure of regeneration. Das (2004) too agrees the fact and has advised this method to be unsuitable for much large diameter sized bamboos belonging to genera *Bambusa*.

As per work demand, the villagers are interested only in the plantation of *B. nepalensis* and to some extent *D. annulatum*. The survey showed that out of the total 40 surveyed households, 95% have one or two clumps of *B. nepalensis* in their homestead area, while 62.5% households possess *D. annulatum*. No preference is given to cultivate other species or to preserve the species (*B. nutans* subsp. *nutans* and *B. balcooa*) existing in limited localities of the study area which hold even more significant. This is due to poor knowledge of bamboo characteristics, properties and proper information flow; the craft makers are unaware of high end use of locally available species (Das, 1998; Das, 2001).

Due to less abundance of bamboo resource in the site, only 5% of the raw material demand of bamboo entrepreneurs is fulfilled. The rest 95% is supplied from outside for which the craftsmen have to bear more expense. If the raw material can be made available at the site, then their annual income can improve tremendously because the maximum price they pay per culm when bought from the local village ranges from NRs.25-100 whereas when bought from outside ranges from NRs.150-200/culm as according to the size.

6.3.3 Production and contribution of bamboo-based enterprises

Most of the entrepreneurs in the study area deal with traditional household appliances like *Nanglo*, *Chalni*, *Doko* and *Dalo*. These products especially *Nanglo* and *Chalni* being required in everyday life in both rural and urban areas have high demand and hence are easily marketable. In addition, because the making of these products do not require much sophisticated technologies, their business relied on these traditional products seem to continue

in a steady pace. However, the introduction of few modern products like racks and dustbins has helped them rise from the primitive economical status. It is found that bamboo entrepreneurs savor an improved benefit from the sale of such modern products. For example, a profit of NRs.125 is made by selling a single piece of dustbin, which is equivalent to the profit made, by selling 4-5 pieces of *Nanglo* or *Chalni*. Likewise, more profit is found to obtain by the locals dealing with decorative creations like photo frame, lady bag, flower vase, etc. However, there are only 12.5% of the total surveyed entrepreneurs involved in making such innovative value-added products. These entrepreneurs too are not fully involved as they suffer from the problem of poor marketing channels and lack of information flow. Other constraints that hinder growth and development of this business are limited knowledge and of poorly treated bamboo, improper handling, poor jointing, deficient of finishing material and skills affect the quality. With these deficits, the bamboo entrepreneurs find difficult to get an easy market for their modern products. Moreover, the bamboo entrepreneurs have another challenge in the market and that is due to the introduction of plasticwares. Bright and beautifully coloured and designed plasticwares are available in cheaper price and are disease resistant unlike bamboo products. Hence, such items are replacing most of the bamboo products. Bamboo entrepreneurs in the study area have not been able to standardize their production in terms of quality, durability and design as to overtake non-degradable plastic products.

It is seen that the market of bamboo products and their sales are affected by season. It is found that the highest sales take place during October to December. These months are the festival (*Tihar*) and marriage seasons. Because bamboo holds traditional and cultural significance, there is a higher demand of the traditional bamboo products especially *Nanglo*, *Chalne*, and *Dalo* during these months. Baishakh (April-May), Jestha (May- June), Asadh (June-July), Shrawan (July-August), Bhadra (August-September), Ashoj (September-October) and Poush (December-January) are the moderate selling season and Magh (January-February), Falgun (February-March) and Chaitra (March-April) are the low selling season found. Being an agricultural country, sales are affected by agricultural seasons. Due to the involvement in various agricultural activities like cultivation, harvesting, selling, earning and other related activities, the market is affected. Cultural diversification imposes a considerable amount of effect on the bamboo product sale in the market.

The cash income generated from the sales of woven products and crafts is an important

livelihood strategy of the *Pahari* community in the area studied. In average, bamboo craftsmakers of Badikhel work 9 months in a year and earn NRs.27,000. This additional income is very important to them to sustain their living. However, this income is in contrast to the income of Terai craftsmakers who earn an average of NRs.45,000 working for 9.9 months in a year (Pun, 2007). Likewise, the bamboo craftsmakers of Dhankuta earns an average annual income of NRs.5, 500 working for 5.6 months in a year (Das, 2002). Further, the report by Kattel *et al.*, (2007) from eight Municipal towns of Nepal has mentioned that the average yearly income of the bamboo entrepreneurs is NRs. 1,000,00. The sharp contrast in the yearly income is due to fact that the bamboo entrepreneurs in the study area are purely into craftmaking while those from Terai, they are engaged in selling of the bamboo culms too. Likewise, the bamboo entrepreneurs in eight municipal towns are drawing the high income mainly by the sale of culms. However, income so earned plays an important role.

CHAPTER SEVEN

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

7.1.1 Diversity of bamboo species and their utility in the study area

A total of three species of genera *Bambusa* and one species of genera *Drepanostachyum* are recorded from Badikhel VDC. Three species of *Bambusa* are *B. nepalensis*, *B. nutans* subsp. *nutans* and *B. balcooa* and the single species of *Drepanostachyum* found is *D. annulatum*. Among them, *B. nepalensis* is the most commonly found species occurring in marginal areas, roadsides, and homestead areas and in community forests of the study area. They exist both in natural state and in cultivated form. In the second category lies the *D. annulatum* followed by *B. nutans* subsp. *nutans* and *B. balcooa*. *D. annulatum* also has a common appearance in the study area while the latter two show the poor existence. In fact, *B. balcooa* in the present study area is highly under threat.

All the existing bamboo species are found to serve the local villagers in more than a single purpose. These multipurpose plant resources hold cultural and historical significances because of their symbolic meaning during birth, wedding and death rituals. The old and mature culms of *B. nepalensis* and *B. nutans* subsp. *nutans* are used for building tall swings during Dashain and Tihar festivals. Bamboo is ubiquitous in the lives of the locals as they provide building materials, raw materials for bamboo enterprises in the production of woven products like winnows, baskets, light furniture, handicrafts, etc., handles for agricultural implements and fodder for livestock. The new shoots (*Tama*) of *B. nepalensis* are used as vegetables and making pickles by the locals. They (especially *D. annulatum*) are also grown as ornamental plants. The existing bamboos also help in preventing soil erosion as bamboos are considered the best species for soil conservation.

7.1.2 Socio- economic significance of bamboos in the study area

Bamboo enterprise has been a livelihood strategy for *Paharis*, one of the socially and economically disadvantaged groups of Nepal residing in Badikhel, for decades. Beside contributing significantly to the livelihood security, bamboo handicraftmaking, based on their

traditional practices is also assisting in promotion of indigenous knowledge and technology, development of craft-based cottage industry and improvement in socio-economic condition of marginalized and poor *Paharis* especially women and landless families in the area studied. Such traditional utilization of bamboos for domestic as well as for commercial purpose is helpful in stimulation of indigenous entrepreneurship.

Bamboo entrepreneurship in the area showed gender imbalance as it is mainly governed by males. However, in terms of working team, both the sexes are involved almost in an equal ratio. Thus, a well organization and proper management of the bamboo enterprises can motivate and raise devotion of these traditional weavers towards their ancestral job. They prepare various household appliances like *Doko*, *Dalo*, *Nanglo*, *Chalne*, etc. and few commercial products like dustbins, racks, baskets, etc. from the main raw material, *Bambusa nepalensis* and selected items from *Drepanostachyum annulatum* as per demand or order. The extra earning from the sale of bamboo artifacts is very important for the poor and landless *Paharis*. It helps them in fulfilling their necessities and educates their children. It is found from the survey that the average monthly income of a bamboo entrepreneur from the bamboo-based work ranges to NRs.2001-3000.

The bamboo enterprises of the area studied, however, suffer from many problems. There are no profound bamboo management practiced by bamboo entrepreneurs in both handicraftmaking and bamboo cultivation. The practice of traditional method of bamboo cultivation still prevails among the local cultivars with very few of such cultivations accomplished in the area. Consequently, the demand of raw material by the bamboo enterprises is unable to be fulfilled with a huge percentage (95%) of it been found to be derived from the outer sources. Further, lack of introduction of modern tools and technology and poor market information is found as another hindrance in further progress and promotion of this traditional business in the area. Currently, except the CFUGs, there are no other stakeholders working with the communities in sustainable management of bamboos. Nevertheless, in spite of these drawbacks, the business helps the local bamboo entrepreneurs to generate an additional earning. Under proper supervision and management of this traditional craftsmanship, the enterprises possess a tremendous potential in uplifting the socioeconomic condition of poor and unprivileged rural lives of the *Paharis*. This “green

gold” should be recognized and user groups should be made well aware of its sustainable management and utilization.

7.2 Future research priorities

The above study shows a detailed overview of bamboo species existing in the area and illustrates the socio-economic impacts of bamboo-based enterprises on *Paharis*, the dominant ethnic group residing there. It is found that bamboo has a very strong cultural association with *Paharis*, but these traditional users of bamboo have not been able to make a smooth transition to the modern economy due to lack of awareness and proper co-ordination and management. Furthermore, local entrepreneurs are facing inertia due to lack of new design ideas, skills, market and raw material supply. From the study, it is seen that there is an urgent need for the formation of a larger association of bamboo users for the growth and development of the bamboo entrepreneurship in the area. Hence, the future research activities in the study area have to be mainly focused on the following aspects:

- The biology of the bamboo species found in the study area and their significance should be made thoroughly understood to the locals so as to develop appropriate interventions on the particular bamboo in the area. For this purpose, dissemination programs, proper counseling/ awareness programs on the conservation and importance of indigenous resources, sustainable utilization, management and harvesting of the valuable bamboo species at the local level need to be conducted.
- Due to limited bamboo resource and scorching demand of the raw material in the study area, the bamboo enterprises are compelled to depend upon the raw material (bamboo culms) from the outer sources. Hence, CFUGs as well as individual bamboo entrepreneurs need to be encouraged and mobilized to expand bamboo cultivation in private areas, community forests, gullies, riversides and in all other possible areas. This will contribute not only in an easy availability of the raw material but directly help in promotion of the local bamboo enterprises.
- Unavailability of bamboo planting stock and lack of knowledge on effective and appropriate propagation techniques are the major constraints for bamboo planting in the study area. Hence, effective training, demonstration and distribution of planting materials are of urgent need for expanding bamboo cultivation.

- Traditional method of bamboo plantation is time consuming and expensive and need to be replaced by new technology. Local entrepreneurs should be motivated to plant and utilize different varieties of bamboo species as such practice help prevent degradation of particular species and help in conservation. In the study area, *B. nepalensis* is the most used species.
- Market is another main constraint for the development of the resources. Hence, market should be identified or created. Private, government and corporate agencies should help to find new markets and promote the local bamboo products, processing, utilization and marketing of the bamboo products.
- Bamboo utilization in the study area is based on old age traditions and practices, therefore it is an imperative need for blending scientific techniques to these traditional knowledge and skill systems so as to achieve rational and economical utilization of the resources, otherwise these enterprises will be affected negatively in terms of cost of production, product quality, etc.
- Developing new products and diversifying to new bamboo enterprise is required to overcome the limitation of bamboo being used mostly in the production of the traditional house appliances like *Nanglo*, *Chalne*, *Dalo*, *Doko*, etc. For this purpose the entrepreneurs should be avail of provision of information on new products and demands in addition to the market linkage development. Similarly, intensive training programs on product design and development, marketable craftsmanship skill, market expansion and development techniques as well as micro credit facility may help the entrepreneurs to develop marketing competencies for their trading growth.
- Involvement of local NGOs is necessary in conservation and promotion of bamboo based enterprises. This will help in preservation of the indigenous knowledge and simultaneously provides an environment friendly alternative to non-degradable plastic goods.

REFERENCES

- Adhikari, R. 2005. Intraspecific Variation and Phytochemical Screening of *B. nutans* Wallich ex. Munro subsp. *nutans* of Central Nepal. (M.Sc. Dissertation) Central Department of Botany, Tribhuvan University, Nepal.
- Adhikary, N. 2008. Economic Potential of Bamboo for the Traditional Users in the Modern Economy in www.abari.org/economic
- Amatya, S.M., S.K. Poudel and C.L. Choudhary. 1998. Ecolographic Survey of Rattan. Forest Research and Survey Centre Kathmandu, Nepal and International Plant Genetic Resources Institute, Singapore.
- Anantachote, A. 1987. Flowering and Seed Characteristics of Bamboos in Thailand. **In:** Recent Research of Bamboos. 33-44. IDRC, Canada.
- Anonymous, 1979. Bamboos: State of the Art on their Property, Growth Requirements and Utilization. PCARRD, Los Banos, Laguna, Phillipines.
- Bahadur, K. N. 1979. Taxonomy of Bamboos. *Indian J. Forestry*, **2**: 222-241
- Banik, R.L. 1987. Techniques of Bamboo Propagation with special reference to Pre-rooted and Pre-rhizomed branch cuttings and tissue culture. in. Recent Research on Bamboo.
- Bhattacharai, S.H. 2002. Bamboo Cultivation and Processing in Nepal. Seminar paper presented at the International Training Workshop on Tropical Bamboo and Rattan cultivation, processing technologies for Rural Small Enterprises. Hainan and Gwangdong, People Republic of China.
- Bista, D.B. 2004. People of Nepal. Ratna Pustak Bhandar, Kathmandu Nepal.
- Bor, N.L. 1940. Flora of Assam, **5**: 39-41.
- Casin, R.F. & A.D. Mosteiro. 1970. Utilization and Preservation of Bamboos. Wood Preservation Report. **5**: 86-92.

- Chaturvedi, A.N. 1986. Bamboos for Farming. U. P. Forest Bulletin No. 52, R & D Circle, Lucknow.
- Chakraborty, D. 1988. Utilisation of Bamboos as raw material in the handicraft industries in Tripura. *Ind. For.* **114**: 635-636.
- Chaudhary, R.P. 1998. Biodiversity in Nepal (Status and Conservation). Tecpress, Bangkok, Thailand.
- Das, A.N. 1988. Bamboo Research in Nepal. In: *I.V.R. Roa, R. Ganaharan and C.B. Sastry (eds.), Bamboos Current Research Proceeding of the International Bamboo Workshop, 14-18 November 1988, Cochin, India.* 1-5.
- Das, A.N. 1989. Annual Report 1989 of Field Visits for Bamboo Research. FRD, Kathmandu, Nepal. 6.
- Das, A.N. 1991. Training Manual on Bamboo Propagation. Prepared for Rapti Integrated Rural Dev. Project, Nepal.
- Das, A.N. 1992. The Potential of Bamboo Growing in Rural Development Forestry in Nepal. M.Sc. (Forest Management) Dissertation, University of Aberdeen, UK.
- Das, A.N. 1999. Socioeconomics of Bamboos in Eastern Nepal. PhD Thesis, University of Aberdeen, UK.
- Das, A.N. and J.A. Seeley. 1996. Bamboo Use as the basis for Wealth Ranking in Eastern Nepal. *Banko Janakari*, **6 (2)**: 89-92.
- Das, A.N. 2001 Bamboo: Species for Economic Prosperity, Environmental Conservation and Rural Development in Nepal. *Bamboo Update: Res Nepal*, **2 (1)**.
- Das, A.N. and Oli. 2001. Tree Growing Practices on Farmland: an option for sustaining rural livelihoods. *Banko Janakari*, **6 (2)**: 8-12.

- Das, A.N. 2002. Bamboo Growing and its Market Development Potential for Sustaining Rural Livelihoods and Poverty Reduction in Eastern Nepal. *Banko Janakari*, **12 (1)**: 8-19.
- Das, A. N. 2003. Bamboos in Rural Farming Systems in Terai and Midhills of Nepal. *Banko Janakari*, **13 (2)**: 34-41.
- Das, A.N. 2004. Manual of Bamboos of Nepal. Community Forestry Component. Tree Improvement and Silviculture, Ministry of Forests and Soil Conservation, HMG/Nepal.
- Das, A.N. and C.P. Mitchell. 2005. Beliefs, Superstitions and Taboos associated with Bamboos of Nepal. *Banko Janakari*, **15 (2)**: 13-21.
- Das A.N. 2006. Bamboos: Species for Economic Prosperity, Environmental Conservation and Rural Development in Nepal. *Bamboo Update*, **2 (1)**: 5-6.
- FAO, 1978. Bamboo forest news for Asia and the Pacific. Food and Agricultural Organizations, Bangkok, Thailand.
- FAO, 1990. Case Studies in Forest Based Small Scale Enterprises in Asia: Rattan, Matchmaking and Handicrafts. Campbell Jeffery (edit.). Community Forestry Case Study No. **4**. FAO, Bangkok, Thailand.
- Gamble, J.S. 1896. The Bambuseae of British India. *Ann. Review of Bot. Garden, Calcutta*, **VII**.
- Ghimire, S.K., Shrestha, A.K., Shrestha, K.K. and Jha, P.K., 2000. Plant Resource use and Human Impact around National Park, Nepal *J.Nat. Hist. Mus.* **19**: 3-26.
- Gurung, L.J. 2007. Indigineous Knowledge on Non-Timber Forest Products (NTFPS) and Utilization of Bamboo (*Nigalo*) and Himalayan Nettle (*Allo*) in Sikles Area of Kaski District, Central Nepal. (M.Sc. Dissertation) Central Department of Botany, Tribhuvan University, Nepal.
- Hajra, P.K. and D.M. Verma. 1996. Flora of Sikkim, Botanical Survey of India. 1:239.

- Hara, H.W.T., Stearn W.T. and L.H.J. Williams. 1978. An Enumeration of the Flowering Plants of Nepal. British Museum (National History) London.
- HMG/N. 1997. Climatological Records of Godawari. 2003-2007. Kathmandu, Nepal.
- HMG/N. 2001. Flowering Plants of Nepal (Phanerogams). Bulletin of Plant Resources. No.18. Ministry of Forest & Soil Conservation. Dept. of Plant Resources, National herbarium & Plant Laboratories, Godavari, Lalitpur, Nepal.
- HMG/N. 2002. District Profile of Lalitpur,
- Hooker, J.D. 1897. Flora of India. 7. L. Reeve and Co, Ltd. London.
- Jackson, J.K. 1987. Manual of Afforestation in Nepal. Forest Research Division. Min. of Forests & Soil Conservation. 2: 401-427.
- Janssen, J.J.A. 1981. Bamboo in Building Structures. PhD. Thesis. Wibro, Helmond, The Netherlands.
- Janssen, J.J.A. 1985. A series of articles on the use of bamboo in building construction. Univ. Techn. Eindhoven. The Netherlands.
- Janssen, J.J.A. 1988. Building with Bamboo- a handbook. Intermediate Technol. Publ. England.
- Joshi, R.B. & S.M. Amatya. 1999. Bamboo & Rattan development in Nepal. A Paper presented at member country workshop of INBAR, 12-19 April 1999, Beijing, Republic of China.
(www.inbar.int/documents/country_report/nepal.htm).
- Karki, L. 2001. Documentation of Indigenous Knowledge on the Utilization of Plant resources by the Chepang Community of Dhusa VDC. Dhading District, Central Nepal. [M.Sc. Dissertation]. Central Department of Botany, Tribhuvan University, Kathmandu, Nepal.

- Karki M.B. and J.B.S. Karki. 1995. National Bamboo and Rattan Information Database, Nepal, Tribhuvan University, Institute of Forestry, Pokhara, Nepal.
- Karki, M.B., G.R. Sherchan and J.B.S. Karki. 1998. Extensive Bamboo Production and Consumption in Eastern Nepal: a case study. INBAR working paper No. 17. INBAR.
- Kattel *et al.*, 2007. A Study of the Bamboo and Rattan Sub sector in Eight Municipal Towns and Surrounding Areas of Nepal. INCON Pvt. Ltd., Lalitpur, Nepal.
- Kesari, V.P. 2005. Bamboo: From Poor Man's Timber to Green Gold. *Hamro Kalpabriksha* 15 (164): 10-14, Department of Forest, Kathmandu, Nepal.
- Kigomo B. N. 1988. Bamboo Resources in East Africa : In Rao I.V.R., R. Gnanaharan, C. B. Sastry (eds.), Bamboos Current Research, Proceedings of the International Bamboo Workshop, 14-18, November, 1988, Cochin, India, (eds), Proceedings of the International Bamboo Workshop. India
[URL:http://www.inbar.int/publication/txt/INBAR_PR_02.htm](http://www.inbar.int/publication/txt/INBAR_PR_02.htm)
- Liese, W. 1986. Bamboos: *Biology, Silvics, Properties and Utilization*. GTZ, Germany. 132.
- Mabberley, D.J. 1997. The Plant Book. Cambridge Uni. Press
- Manandhar, N.P. 2002. People and Plant of Nepal. Timber Press, USA.
- Manandhar, R. and T. Bhattarai. 1998. Distribution of bamboo in Kathamndu Valley. Banko Janakari (A Journal of Forestry Information for Nepal), 8(1): 19-23.
- Martin, G.J. 1995. *Ethnobotany, a methods manual*. Chapman and hall, London.
- McClure, F.A. 1966. The Bamboos: A Fresh Perspective. Harvard Univiversity Press. Cambridge, Massachusetts, US.A. 347.
- Metz. J.J. 1987. An Outline of the Forest Use Practices of an Upper Elevation Village of West Nepal. Banko Janakari, 1 (3): 21-28.

- Muraleedharan, P.K. and P. Rugmini. 1988. Problem & prospects of Traditional Bamboo-based Industry in Kerala.: 328-333. **In** Rao I.V.R., R. Gnanaharan, C. B. Sastry (eds.), Bamboos Current Research, Proceedings of the International Bamboo Workshop, 14-18, November, 1988, Cochin, India, (eds), Proceedings of the International Bamboo Workshop. India.
- Nair, C.T.S. and Muraleedharan, P.K.1983. Rural institutions for development of appropriate forestry enterprises: A case study of reed industry in Kerala State, India KFRI Research Report 18, KFRI Peechi, India.
- Narayan, V.V.D. 1988. Watershed Development and Resource Conservaton for Rangrland Improvement. In: P. Singh (ed.), Rangelands Resource and Management. Proceedings of the National Rangeland Symposium Nov. 9-12, 1987, IGFRI, Jhansi, India. 229-237.
- Negi, S.S. and H.B. Naithani. 1994. Handbook of Indian Bamboos. Oriental Enterprises, Dehradun. 138-140.
- Nicholson, K 1995. Income Generation through Production and Marking of Handicrafts and Non-Timber Forest Products. The Makalu Barun National park and Conservation Project Working Paper.
- Noda, N. 1986. Community Forest Development in Nepal. Farming Japan. Agriculture Forestry and Fisheries **20**: 58-61.
- Noltie, H.J. 2000. Flora of Bhutan, Royal Botanical Garden. Edinburgh, **3**(2).
- Oli B.N. 2003. Biomass estimation of *Bambusa nutans* subsp. *nutans* grown at eastern Terai, Nepal. *Banko Jankari*, **13** (2): 42-45.
- Oli, B.N. and C.M. Kandel. 2005. Biomass estimation of *Bambusa nutans* subsp. *cupulata* grown at Eastern Terai, Nepal. *Banko Janakari*, 15 (2): 22-25.

- Oli, B.N. and C.M. Kandel. 2006. Biomass Estimation of *Dendrocalamus hookerii* grown at Far-western, Nepal. *Banko Janakari* (A Journal of Forestry Information for Nepal), 16(2): 12-16.
- Oprins Plant-BTN, 2002. <http://www.bamboonetwork.org/about%20bamboo.htm>
- Poudyal, P.P. 1992. Bamboos-Field manual for community and private forestry in Nepal. Part II Field Document No 20, HMG/FAO/UNDP, Community Forestry Development Project (Phase II), May 1992.
- Poudyal, P.P. 1994. Utilization of Bamboo in the Kathmandu Valley of Nepal. In: *Proceedings of the 4th International Bamboo Workshop*, Chiangmai, Thailand, FORSPA Publication No. 6. 258-262.
- Poudyal, P.P. 1993. Fodder Value of Some Bamboo Species of the Kathmandu Valley of Nepal. *Journal of American Bamboo Society*. Vol. 1& 2: 15-19.
- Poudyal, P.P. 1998. End use of bamboo in Nepal. *American bamboo Society Newsletter*. 19 (3): 12-17.
- Poudyal, P.P. 2000. Bamboo for Soil Stabilization and Other Usage in Nepal. *Banko Janakari, a Journal of Forestry Information for Nepal*, 10 (2): 57-58. Department of Forest Research and Survey, Kathmandu, Nepal.
- Poudyal, P.P. and V. P. Kesari. 2005. Depletion of Bamboo from the Kathmandu Valley. *Bamboo Update*, 1(2): 4.
- Poudyal, P.P. 2006. Bans ko shikshya. (Education on Bamboo). *Swayambhu Environmental Education*, 171-202. Swayambhu Printing Press, Swayambhu, Kathmandu, Nepal
- Poudyal, S.K. and A.N. Das. 2002. Bamboo Research and Development in Nepal. *Journal of Forest and Livelihood*, 2(1): 59-61, Forest Action, Kathmandu, Nepal.
- Press, J.R. *et al.* 2000. Annotated Checklist of the Flowering Plants of Nepal. *The Natural History Museum, London*. 124-130.

- Pun, B.R. 2007. Siraha as Potential District for Bamboo Promotion in Nepal. Submitted to INBAR for International Seminar on Bamboo for Sustainable development, Kathmandu, Nepal.
- Rai, S.N. and K.V.S. Chauhan. 1998. Distribution and Growing Stock of Bamboos in India. *Indian Forester*, **124** (2): 89-98.
- Rajbhandari, K.R., 1991. Grassland Ecology and Preliminary Studies of Bamboo in the Apsuwa valley. *The Makalu Barun Conservation Project Working Paper Publication series*. Report **13**.
- Rana, G. 2002. Socio-economic Impact of Bamboo-based Cottage Industry on the *Pahari* Community: A Case study of Badikhel VDC, Kathmandu, Nepal. (M.A. Dissertation) Central Department of Sociology, Tribhuvan University, Nepal.
- Ranjan, M.P., N. Iyer & G. Pandya. 2004. Traditional Wisdom Bamboo and Crafts of Northeast India. *National Institute of Design*.
- Regmi, P.P. 1999. Fiber-Yielding Plants. In: T.C. Majupuria and R.K. Majupuria (eds.) *Nepal Nature's Paradise*, M.Devi, and Gwalior, India.
- RES-Nepal. 2005. Bamboo Update. *RES-Nepal newsletter*. **1** (3).
- Seeland, K. T. 1980. The Use of Bamboo in a Rai village in the Upper Arun Valley: An example of a traditional technology. *Journal of the Nepal Research Centre (TUCL)*, **4**: 35-41.
- Seethalakshmi, K. K. & M.S. Muktesh Kumar. 1998. Bamboos of India - a compendium. Bamboo information centre, India, Kerala forest research institute, Peechi & INBAR.
- Sharma, Y.M.L. 1988. Production and Utilisation of Bamboos and Related Species in the Southern Asian Region in the Rural Sector. *Indian Forester*, **114(10)**: 603-609.

- Shibata, S. 2001. Bamboo Cultivation and Management in Japan. In: *Proceedings of The International Seminar on Bamboo Cultivation, Processing and Utilization*. 21-29.
- Shrestha, A.K. 1997. Documentation of indigenous knowledge in the utilization of plant resources by the Tharu community around Royal Bardia National Park, West Nepal. M.Sc. Dissertation, CDB, T.U., Kathmandu, Nepal.
- Shrestha, K. 1984. Grasses and Sedges- Their ecology, distribution and economic uses in Manang-Mustang. *Journal of Natural Historical Museum*. **8** (1-4): 41-54.
- Shrestha, K. 1987. Report on edible wild plants from Pokhara and its northern region. *Journal of Natural Historical Museum*, **11**: 85-98 (TUCL)
- Shrestha, K. 1998. Dictionary of Nepalese Plant Names. *Mandala Book Point, Kathmandu, Nepal*. 267.
- Shrestha, K. 1998a. Distribution and Status of bamboos in Nepal. Bamboo conservation, diversity, ecogeography, germplasm, resource utilization and taxonomy. *Proceedings of training course cum workshop 10-17 May 1998, Kunming & Xishuanbanna, Yunnan, China*.
- Sherchan, G.P., M.B. Karki, J.B.S. Karki. 1996. Case Study in extensive collection, production, utilization and marketing of bamboo in Eastern Nepal. A report submitted to INBAR/IDRC.
- Siopangio, J.O. and M. Munandar. 1987. Technology on Bamboo as building material. Forest Products Research & Development institute, Philippines.
- Soderstrom, T.R. and Ellis, R.P. 1988. The Woody Bamboos (*Poaceae: Bambuseae*) of Srilanka: a morphological and anatomical study. Smithsonian Contribution No. 72.
- Sosola-Banda, B.G. and F.H. Johnsen. 2005. Rural livelihoods on bamboo handicraftmaking and culm vending in Mvera, Malawi. *Journal of Bamboo and Rattan*, **4**(1): 93-107.
URL: <http://www.umb.no/>

- Stainton, J.D.A. 1972. *Forests of Nepal*. John Murray, London.
- Stapleton, C.M.A. and S.M. Tamrakar. 1983. Planting large bamboos, 'Bans' by the traditional method. *Nepal Forestry Technical Information Bulletin*, No. 9.
- Stapleton, C.M.A. and S.M. Tamrakar. 1983. Pipar bamboos. Appendix to Picozzi, N. An Ecological Survey of a proposed reserve for Himalayan Pheasants. Inst. Terrestrial Ecol. Project 839, Report London: NERC.
- Stapleton, C.M.A. 1991. A Morphological Investigation of Some Himalayan Bamboo of Taxa In Nepal and Bhutan. A PhD thesis submitted at the University of Aberdeen.
- Stapleton, C.M.A. 1994. Bamboos of Nepal: An Illustrated Guide. Royal Botanical Gardens, Kew, Richmond, Surrey TW9 3AE, England, U.K.
- Stapleton, C.M.A. 1987. "Bamboos". In Jackson, J.K., Manual of Afforestation in Nepal. HMG Department of Forest, Kathmandu, Nepal.
- Storey, P. 1990. Bamboo: A valuable crop for the Hills. HASP Tansen, Nepal.
- Subramony, T.P. 2007. South and South East Asia: Bamboo Status and Perspective. In: *Workshop on Bamboo for Sustainable Development 11 April 2007, Nepal*.
- Thammincha, S. 1985. Role of bamboo in rural development and socio-economics: A case study in Thailand. In Rao, A.N.; Dhanarajan, G. and Sastry, C.B. (eds) *Recent Research in Bamboos*. CAF, China & IDRC, Canada.
- Thapa, H.B., Das, A.N. and Oli, B.N. (1998). Growth Performance and Culm Production of Bamboo at the Eastern Terai, Nepal. *Banko Janakari*, 8 (1): 13-18.
- Tiwari, D.N. 1992. A Monograph on Bamboo. International Book Distributors, Rajpur Road, Dehradun 248001, Uttaranchal, India.
- TIS. 2004. Manual on Bamboos of Nepal. Tree Improvement & Silviculture (TIS). Kathmandu, Nepal.

- Vityakon, P., V. Limpinuntana and S. Subhadhira 1995. The use of rapid rural appraisal techniques in local level biodiversity studies. *In: P. Shenghji and P. Sajise (eds.), Regional study on biodiversity: Concepts, frameworks and methods.* Yunnan University Press, China.
- Vongvijitra, R. 1988. Traditional vegetative propagation and tissue culture of some Thai bamboos. Bamboo Current Research. *In: I.V.R. Roa, R. Ganaharan and C.B. Sastry (eds.) Bamboos Current Research. Proceeding of the International Bamboo Workshop, 14-18 November 1988, Cochin, India.* 148-150.
- Yuming, Y. & X. Jiru. 1998. Bamboo resources and their utilization in China. Bamboo conservation, diversity, ecogeography, germplasm, resource utilization and taxonomy. *Proceedings of training course cum workshop 10-17 May 1998, Kunming & Xishuanbanna, Yunnan, China.* 9-13.

Appendix I Questionnaire

Respondent information:

Name of the informant: _____

Age: <20, 21-35, 36-50, >50

Sex: Male/Female

Education: Illiterate, Read & write, School level, 10+2, Graduate and more

Ward No.:

Questionnaire related to bamboo resource

1. Could you please mention the name of locally available bamboo species and their distributional status?

S.N.	Name of bamboo species	Cultivated	Wild

2. Mention the various uses of the locally available bamboo species.

S.N.	Name of bamboo species	Uses

Questionnaire related to bamboo-based entrepreneurship

3. How long have you been into this handicraft business?

4. Do you have your family members involved in this work? If yes, how many?

a) Yes (Male: /Female:)

b) No

5. What are the products you make? How much time do you require? What is the cost price and selling price of the item?

S.N.	Name of products	Time required	C.P. (NRs.)	S.P. (NRs.)

6. Name the bamboo species that you use in making the products.

a) *Tama Bans*

b) *Taru bans*

c) *Dhanu bans*

d) *Nigalo*

7. From where do you bring the raw materials?

- a) Community forest
- b) Private forest
- c) Homestead area
- d) Outer sources (Specify.....)

8. What is the average number of culms consumed in a year?

9. How much does a single bamboo culm cost?

S.N.	Source	Rate (per culm)
1.	Local village	
2.	Outer source	

10. If the raw material is bought from outside, mention the reason.

- a) Lack of space for cultivation
- b) No land for cultivation
- c) Home production not enough
- d) Others (Specify.....)

11. Do you owe the land? If yes, what is its size?

Yes (.....)/ No

12. Would you please kindly mention the methodology/technique of preparing bamboo products?

13. How do you sell the products?

- a) Sell in local market (Specify.....)
- b) Sell in neighbouring villages (Specify.....)
- c) Sell to middlemen
- d) Sell to wholesaler
- e) Sell in own village

14. Which is the highest demanded item?

15. In terms of sales, which are the peak seasons (months) for the products?

16. What is the monthly sale?

>Rs.5000/ Rs.5000-10,000/ Rs.10,000-20,000/ <Rs.20,000

17. Can you run this work throughout the year?

a) Yes

b) No (Specify the reason.....)

18. If no, how many months in a year do you get engaged into this work?

19. What are the problems related to this entrepreneurship?

a) Transport b) Market c) Low price d) Raw material e) Others (Specify.....)

20. Do you know about any activities being organized to promote this bamboo-based entrepreneurship in the VDC?

.....
.....

Thank you very much for your cooperation.

Appendix- II
Glossary for Local Terms

<i>Chalne</i>	: Round and flattened tray for winnowing purposes especially for filtering small granules
<i>Choya</i>	: Fine stripes of bamboo culms cut for weaving purposes
<i>Dalo</i>	: A kind of basket
<i>Doko</i>	: A conical shaped basket for carrying various things
<i>Listi</i>	: A wooden stripe
<i>Mandro</i>	: A kind of mat
<i>Nanglo</i>	: A round and flattened tray for winnowing purposes
<i>Mudha</i>	: Bamboo stool
<i>Perungo</i>	: Big Basket to keep chicken that can be taken place to place
<i>Tama</i>	: Young bamboo shoot

Appendix-III
Average Temperature and Precipitation in Badikhel VDC (2003-2007)

Month	Ave. Max. Temp	Ave. Min. Temp	Ave. Rainfall
Januaury	16.7	3.0	25.76
February	18.6	5.5	39.14
March	22.6	8.5	33.28
April	25.5	11.8	79.62
May	26.5	14.5	91.06
June	27	17.5	235.2
July	25.6	18.6	421.1
August	25.5	18.6	383.44
September	25.5	17.6	259.7
October	23.4	12.5	65.84
November	20.2	7.6	1.34
December	17.5	4.0	10.48

Appendix- IV

Size of family members in respondent group

S.N.	No. of family members	No. of HHs	Percentage (%)
1.	1	0	0
2.	2	11	28
3.	3	14	35
4.	4	9	22
5.	5 or more	6	15
	Total	40	100

Appendix-V

Educational status of bamboo entrepreneurs

S.N.	Educational status	No. of entrepreneurs	Percentage (%)
1.	Illiterate	21	53
2.	Read & Write	3	8
3.	School level	13	32
4.	10+2	2	5
5.	Graduate	1	2
	Total	40	100

Appendix-VI

Age group of bamboo entrepreneurs

S.N.	Age group	No. of entrepreneurs	Percentage (%)
1.	<20 Yrs	2	5
2.	21-35Yrs	18	45
3.	36-50 Yrs	13	32
4.	>50 Yrs	7	18
	Total	40	100

Appendix-VII

Bamboo-based workers by sex

S.N.	Sex	Frequency	Percentage (%)
1.	Male	89	52
2.	Female	82	48
	Total	171	100

Appendix-VIII

Entrepreneurs by year of operation

S.N.	Time duration	No. of entrepreneurs	Percentage (%)
1.	>30	32	80
2.	<10	8	20
	Total	40	100

Appendix-IX

Seasonal variation in terms of sale of bamboo products

S.N.	Months	Total respondents	Percentage (%)
1.	Apr-May	13	6
2.	May-Jun	16	8
3.	Jun-Jul	13	6
4.	Jul-Aug	10	5
5.	Aug-Sep	15	7
6.	Sep-Oct	23	11
7.	Oct-Nov	36	17
8.	Nov-Dec	40	19
9.	Dec-Jan	16	8
10.	Jan-Feb	13	6
11.	Feb-Mar	8	4
12.	Mar-Apr	6	3

Appendix-X

Monthly turnover of the bamboo entrepreneurs

S.N.	Monthly income	No. of households	Percentage (%)
1.	<Rs.1000	5	13
2.	Rs.1001-Rs.2000	8	19
3.	Rs.2001-Rs.3000	15	37
4.	Rs.3001-Rs.4000	7	18
5.	Rs.4001-Rs.5000	5	13
	Total	40	100

Appendix-XI

Distribution of bamboos, their ecological range, habitat and uses in Nepal

S. N.	Local name	Scientific name	Location	Ecological range	Habitat	Uses
1.	Nibha/ Gopi/ Leyas Bans	<i>Ampelocalamus patellaris</i>	Eastern and western Midhills, cultivated as well as occurs naturally.	1200-1800m	Mixed sal forests and evergreen forests and prefers well drained moist sites with moderate shade.	Woven products, flutes, and fodder.
2.	Sano Malingo	<i>Arundinaria racemosa</i>	Spreading bamboo rarely found in temperate forests and open grazing lands of eastern and central Nepal	2600-3500m	High mountain forests of Oaks, abies, fir and spruce.	Broom, woven products, habitat and fodder for wildlife.
3	Mugi Bans	<i>Bambusa alamii</i>	Cultivated in eastern Terai, Chitwan and lower hills in central and western Nepal	Terai - 1000m	Prefers well drained moist sites and moderate shade.	Construction, woven products, ropes, shoots shoots as vegetables.

4.	Kaante Bans	<i>B. arundianaceae</i>	Thorny bamboos cultivated all over the Terai regions but more common in Midwestern and Farwestern Nepal.	Terai- 3000m.	Grows well in even drier sites but growth is better in well drained moist sites.	Bio-fence, construction, scaffolding, soil conservation, woven products.
5.	Dhanu/ Bholka/ Harouti/ Ghar Bans	<i>B. balcooa</i>	Cultivated all over the Terai region (flat plains) of Nepal and in the lower Midhills.	Terai - 1400m	Grows well in well-drained moist sites but can withstand short period water logging.	Construction, scaffoldings, fodder, old stump with rhizomes as fuel in the Terai.region.
6.	Chinese bamboo	<i>B. multiplex</i>	Terai, lower hills, Kathmandu valley	Terai- 1400m	Prefers well drained moist sites and moderate shade	Woven products, ornamental, gardening, fodder.
7.	Chinese bamboo	<i>B. multiplex</i> var <i>riverorum</i>	Kathmandu Valley in Gardens	Terai - 1400m	Prefers well drained moist sites and moderate shade	Woven products, ornamental, gardening, fodder.
8.	Tama/ Khosre/ Phusre Bans	<i>B. nepalensis</i>	Eastern to Midwestern Midhills and valleys such Kathmandu, Pokhara and Surkhet, both cultivated and found in natural forest.	500 - 1500m	Prefers well drained, moist sites of mixed sal forest and evergreen forest.	Woven products, ropes, shoots as vegetables, construction., fodder.
9.	Mal/ Makla Bans	<i>B. nutans</i> subsp <i>cupulata</i>	Commonly cultivated east of Ramechhap in the Midhills and Rauthat in the	Terai- 1400m	Prefers well drained moist site with moderate shade.	Construction, scaffoldings, woven products, handicrafts,

			Terai, but now also in Chitwan, Makwanpur and other western districts.			fodder, and old stump with rhizomes as fuel.
10.	Tharu bans, Sate Bans, Chille Bans	<i>B. nutans</i> subsp <i>nutans</i>	Commonly cultivated westwards of Hetauda and also occurs in the lower hills and foothill forests including Chitwan and Bardiya National Parks.	Terai - 1500m	Well-drained moist sites in mixed sal forests and evergreen forests.	Construction, scaffoldings, woven products, handicrafts, fodder, and old stump with rhizomes as fuel.
11.	Japhta/Chaha v Bans	<i>B. tulda</i>	One of the most commonly cultivated species all over the Terai regions of Nepal	Terai- 1000m	Well drained moist sites in mixed sal forests and evergreen forests.	Construction, woven products, fodder, shoots as vegetables, old stump with rhizome as fuel.
12.	Koraincho Kada, bans	<i>Bambusa</i> sp/ <i>B. tulda</i>	Cultivated species in the Bara, Makwanpur and Chitwan districts and also found in the natural forests of these three districts.	Terai- 1000m	Prefers well-drained moist site with moderate shade but also grows in dry sites of Churia forests and foothills (mixed sal forests).	Construction, woven products, fodder, shoots as vegetables, old stump with rhizomes as fuel.
13.	Pahenlo/Butte Bans	<i>B. vulgaris</i>	Occasionally cultivated on farmlands westwards of	Terai- 1400m	Grows well in even drier sites but growth is	Ornamental, construction and woven products.

			central region.		better in well-drained moist sites.	
14.	Chigar	<i>Borinda chigar</i>	Commonly found bamboo in the high mountain forests in Central and western Nepal.	2600-3100m	High mountain forests composed of Abies, fir and rhododendrons.	Fodder, fencing, furniture, woven products, habitat for wild animals and birds.
15.	Kalo Nigalo	<i>Borinda emeryi</i>	Commonly found bamboo in the high mountain forests.	2600-3100m	High mountain forests composed of Abies, fir and rhododendron forests in eastern Nepal.	Fodder, fencing, furniture, woven products, habitat for wild animals and birds.
16.	Gopi/Murali Bans	<i>Cephalostachyum latifolium</i>	Farmlands of eastern, central (common in Chitwan) and western Midhills.	600-2000m	Prefers well-drained moist sites with moderate shade.	Woven products, flutes, and fodder.
17.	Thai Tama Bans	<i>Dendrocalamus asper</i>	Clump forming Thai bamboo species introduced in eastern Nepal at Belbari.	Terai-1400m	Grows well in well-drained moist sites.	New shoots as vegetables, woven products.
18.	Dhungre / Rachhasi Bans	<i>D. giganteus</i>	Eastern Nepal, in farmlands of the Terai.	Terai - 1000m.	Grows at well-drained moist sites and moderate shade but can also grow in full sunlight.	Construction, woven products, fodder, shoots as vegetables.

19.	Choya/ Tama Bans	<i>D. hamiltonii</i> var. <i>hamiltonii</i>	Cultivated all over hills of Nepal but also found in natural forests.	Foothills - 2000m	Grows well in moist sites at the mixed sal forests of foothills and in evergreen forest of Midhills.	Woven products, ropes, shoots as vegetables, construction.
20.	Choya Bans	<i>D. hamiltonii</i> var. <i>undulatus</i>	Cultivated all over hills of Nepal but also found in Natural forests.	Foothills - 2000m	Grows well in moist sites at the mixed sal forests of foothills and in evergreen forest of Midhills.	Woven products, ropes, shoots as vegetables.
21.	Kalo Bans, Bhalu Bans	<i>D. hookerii</i>	Cultivated mainly in eastern Nepal and rarely in Central Nepal, in farmlands.	1200 - 2000m	Grows well under Moderate shade but can also grow on dry sites.	Construction, woven products, shoots as vegetables, fodder, soil conservation.
22.	Bhalu Bans	<i>D. sikkimensis</i>	Eastern Midhills	1400 - 2000m	Grows well in welldrained moist sites and gullies.	Woven products, soil conservation, milking pot.
23.	Kath/ Geniya/ Laathi Bans	<i>D. strictus</i>	Cultivated all over in the Terai.	Terai - 1000m.	Grows well under moderate shade but can also grow on dry sites.	Construction, sticks, woven products, shoots as vegetables, soil conservation.
24.	Kath/Ban Bans	<i>D. strictus</i> . var. <i>wild</i>	Dry Churia and Siwalik forests, mainly in Saptari, Siraha, Udaypur, Chitwan, Banke	Below 1200m.	Semideciduous/mixed sal forests mainly of <i>Terminalia sp.</i> , <i>Adina cordifolia</i> etc.	Construction, sticks, woven products, shoots as vegetables, soil

			and Bardiya districts.			conservation.
25.	Dhungre Bans	<i>Dendrocalamus</i> sp.	Commonly cultivated species in Eastern and Central Midhills	1400-2000m	Grows well in well-drained moist sites and gullies.	Construction, woven products, new shoots as vegetables, and fodder.
26.	Diu/Tite Nigalo	<i>Drepanostachyum falcatum</i>	Drier subtropical forest and on farmlands of western Nepal	1000-2000m	Evergreen forests of <i>Schima wallichii</i> , <i>Castanopsis</i> forests and occasionally in chirpine forest.	Woven products, fodder and soil conservation.
27.	Tite Nigalo	<i>D. falcatum</i> var. <i>glomeratum</i>	Clump forming small diameter bamboo species found in the dry as well as moist forest sites, and also cultivated on farmland in Midhills of Farwestern	1000-2000m	A.. <i>nepalensis</i> / <i>Pine</i> / rhododendron forest.	Woven products, fodder and soil conservation.
28.	Tite Nigalo	<i>D. intermedium</i>	Both in forests and on farmlands of western Nepal	1000-2000m	Oak and Chestnut forest also in drier subtropical forests.	Woven products, fodder and soil conservation.
29.	Ban Nigalo	<i>D. khasianum</i>	Drier subtropical forest and on farmlands of central and western Nepal	1000-2000m	Oaks, Schima walichii and chestnut forests.	Woven products, fodder and soil conservation.

30.	Putru /Putre/ Suruwal Nigalo	<i>Drepanosta chyum</i> sp.	Clump forming small diameter bamboo species	1500- 2300m	<i>A. nepalensis</i> and Rhododendron forest, also cultivated at well drained moist sites.	Woven products, fodder and soil conservation.
31.	Ghunre/ Malinge Nigalo	<i>Himalayacala mus asper</i>	Found in cool/temperate broadleaved forests of Central and western Nepal.	1800- 2300m	Oak, rhododendron and castonopsis forests.	Woven products, fencing fodder and soil conservation.
32.	Malinge Nigalo	<i>H. brevinodus</i>	Found in cool/temperate broadleaved forests and also cultivated on farmlands of eastern Nepal.	1800- 2300m	Oak, rhododendron and castonopsis forests.	Woven products, fodder , shoots and new buds as vegetables.
33.	Malinge Nigalo	<i>H. cupresus</i>	Found in temperate broadleaved forests of Central and western Nepal.	2300- 2800m	Oak, rhododendron and castonopsis forests.	Woven products, fodder , shoots and new buds as vegetables.
34.	Thudi/ Singhan e Nigalo	<i>H. falconerii</i>	Found in cool/temperate broadleaved forests of Central and western Nepal.	2000- 2500m	Oak, rhododendron and castonopsis forests.	Woven products, fodder , shoots and new buds as vegetables
35.	Tite Nigalo	<i>Himalayaca lamus fimbriatus</i>	Commonly cultivated species in central and western Midhills and also occasionally	1100- 2000m	Oak, rhododendron and castonopsis forests.	Woven products, fodder and soil conservation.

			found in the broadleaved forest.			
36.	Padang	<i>Himalayaca lamus hookerianus</i>	Cultivated on farmlands of eastern Midhills.	2000-2500m	Prefers well drained moist sites and grows well under moderate shade of Alnus, rhododendrons and oaks.	Woven products, fodder and soil conservation.
37.	Seto Nigalo	<i>Himalayaca lamus porcatus</i>	Found in cool broadleaved forest and also cultivated in eastern Nepal	2000-2300m	Oaks, rhododendrons and castanopsis forests.	Woven products, fodder and soil conservation.
38.	Malingo Nigalo	<i>Himalayaca lamus</i> sp.	Broadleaved forests (oaks and rhododendrons) of Khaptad National Parks and also found in Dadeldhura, Doti and Baitadi	2300-2700m	Oaks and rhododendrons	Woven products, fodder and soil conservation.
39.	Lahure Bans/ Nigale Bans	<i>Melocanna bacifera</i>	Cultivated in eastern Terai and lower hills in eastern Nepal and also cultivated in Chitwan, Tanahun, Palpa and Syangja districts.	Terai-1400m	Prefers well drained moist sites and reported to be grown well in mixed sal forests of Bangladesh and Northeastern India.	Woven products, fruits and shoots as vegetables, construction, furniture, handicrafts.

40.	Pahenlo Nigale Bans	<i>Phyllosat chyus bambusoides</i>	Spreading Japanese bamboo species introduced in gardens of Kathmandu valley, probably from Hongkong.	1200- 1800m	Grows well in well drained moist sites.	Woven products, gardening, ornamental, new shoots as vegetables, and fodder.
41.	Japani/ Kalo Nigalo	<i>Phyllosat chyus nigra</i>	Spreading japanese bamboo species introduced in gardens of Kathmandu valley.	1400- 2500m	Grows well in well drained moist sites.	Ornamental, woven products.
42.	Jarbuto	<i>Thamnocalam us spathiflorus subsp nepalensis</i>	Commonly found bamboo in the high mountain forests in Central and western Nepal.	2800- 3500m	Found at well drained, moist sites in northern aspect of high mountain forests composed of abies, fir and rhododendron forests.	Fodder, fencing, furniture, woven products, habitat for wild animals and birds.
43.	Rato Nigalo	<i>T. spathiflorus subsp spathiflorus</i>	Commonly found bamboo in the high mountain forests in Central and western Nepal.	2800- 3500m	Found at well drained, moist sites in forests composed of abies, fir and rhododendron	Fodder, fencing, furniture, woven products.
44.	Ghoredo / Bhodar Nigalo	<i>Thamnocalam us sp</i>	High Mountain Forests of Farwestern Nepal	2400- 3000m	High Mountain Forest of <i>Cedrus deodara</i> , oak and spruce.	Fodder, fencing, furniture, woven products, habitat for wild animals and birds.

45.	Malingo Nigalo, Khosre Malingo	<i>Yushania maling</i>	Most common spreading bamboo found in temperate forests and open grazing lands in eastern Nepal	2300- 3000m	Oaks, rhododendron ,abies and high mountain grazing lands in the forests.	Woven products, fodder and soil conservation.
46.	Maling, Malingo	<i>Yushania micophylla</i>	Spreading bamboo rarely found in temperate forests and open grazing lands of eastern and central Nepal	2300- 3500m	Oaks, abies, fir and spruce high mountain forests.	Woven products, fodder, soil conservation., shoots and buds as vegetables.
47.	Kucho Nigalo	<i>Yushania</i> sp	Most common spreading bamboo found in temperate forests and open grazing lands, north of Dhaulagiri in Jumla, Humla, Dailekh and Kalikot districts of Midwestern Region.	2600- 3500m	High mountain forests of conifers (<i>Taxus baccata</i> , <i>Abies pindrow</i> and <i>Cedrus deodara</i> and <i>Betula utilis</i>).	Broom, woven products, habitat and fodder for wildlife.
48.	Deo/ Deo Ringal/ Baghbut te Nigalo	<i>Yushania/ ChimnoBambu sa</i> sp	Khaptad National Parks and also found in natural forests of Dadeldhura, Doti and Baitadi districts.	2500- 3000m	Broadleaved forests (oaks and rhododendron s) as well as in abies and fir forests.	Woven products, fodder and soil conservation.
49.	Thai Nigalo	<i>Schizosta chyum</i> sp	Thai small diameter bamboos introduced into eastern Nepal.	Terai - 1000m	Grows in well-drained moist sites.	Woven products, gardening, ornamental, new shoots as vegetables,

						and fodder.
50.	Thai Nigalo	<i>Thyrostachys siamensis</i>	Clump forming Thai bamboo species introduced in eastern Nepal.	Terai-1000m	Grows in well-drained moist sites and moderate shade.	Woven products, gardening, ornamental, new shoots as vegetables, and fodder.

Source: Das, 2004

Appendix-XII

List of tools and equipments used by local entrepreneurs in the study area

Measuring Tape	Hammer	<i>Khukuri</i>	<i>Penchis</i>
<i>Chibi</i>	<i>Retee</i>	Saw	File
Hexo Frame and blade	Blue torch/ blue lamp		

Appendix-XIII
Photographs

Photo Plate no. 1:- *Bambusa nepalensis*



1. A clump



2. Young shoot



3. Branching nodes



4. Culm sheath



5. Sporadic flowering



6. Inflorescence

Photo Plate No. 2:- *Bambusa nutans* subsp. *nutans*



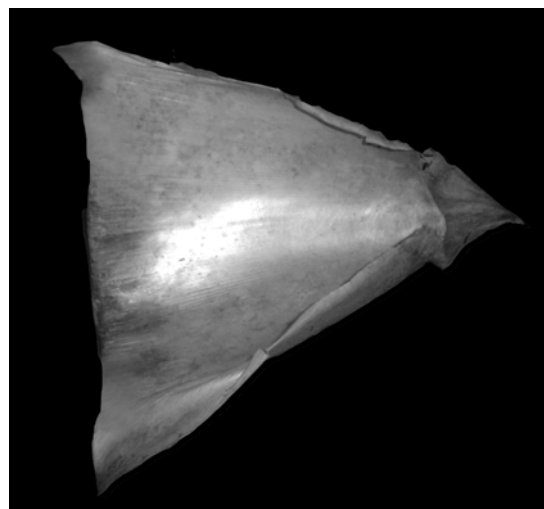
1. A clump



2. Branching nodes



3. Young shoot

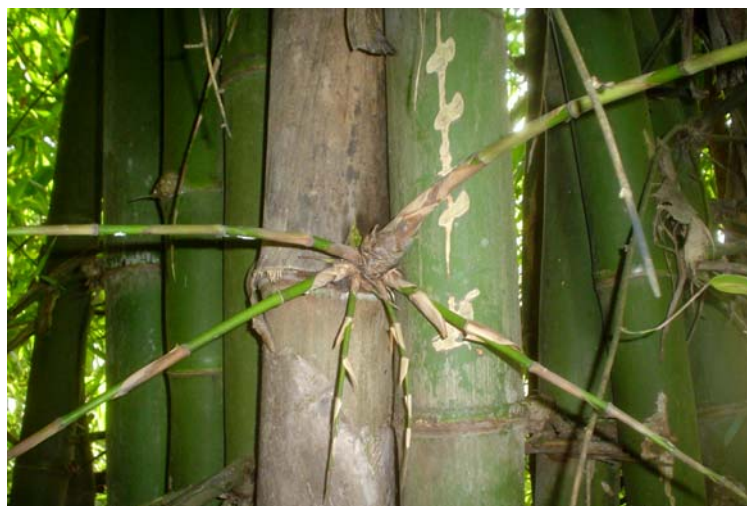


4. Culm sheath

Photo Plate No. 3:- *Bambusa balcooa*



1. A clump



2. Branching node



3. Young shoots



4. Culm sheath

Photo Plate No. 4:- *Drepanostachyum annulatum*



1. A clump



2. Branching node

Photo Plate No. 5:- Bamboo processing



1. Bamboo culm cuttings



2. Water treatment



3. Choya cuttings being dried in sun

Photo Plate No. 6:- Bamboo entrepreneurs at work



1. Woman making rack



2. Woman weaving *nanglo*



3. Family at work



4. A young girl weaving mat



5. Old man at work



6. Craftsman making dustbin

Photo Plate No. 7: - Bamboo products of Badikhel



1. Different sized dustbins



2. Handbag



3. Photo frames



4. Varieties of bamboo products



5. Decorative item



6. Rack

Photo Plate No. 8: - More bamboo products



1. Lampshade



2. Wall clock



3. Baskets of different shapes & size



4. Flower vase



5. Multipurpose container



6. Miscellaneous items

Photo Plate No. 9: - Tools/equipments used by bamboo entrepreneurs in Badikhel



Photo Plate No. 10: - Male entrepreneurs supplying bamboo products for market



Photo Plate No. 11:- Myself during field work

