Chapter-IV

Distribution of cultivated bamboo species, traditional cultivation practices of important bamboo species and their economic contribution to the bamboo growers

4.1 Introduction

Bamboo is a versatile group of plants which is capable of providing ecological, economic and livelihood security to the people. Till today, it has remained confined to the forest (12.8% of total forest cover of the country), two third of the growing stock is located in the North eastern states of India. Arunachal Pradesh comprises 60% of the total area of North East India, having 57 bamboo species (Bhuyan et al., 2007), which has the highest diversity (Annexure-I) in India. Not having a bamboo grove is unthinkable for the farmers in this part of India and it is managed and grown by the local people (Sundriyal et al., 2002). The life of the people of this state is also intricately woven around the forest especially bamboo, canes and their products and thus one cannot imagine rural life without the use of these species (Sarkar & Sundriyal, 2002). The tribal people of Arunachal Pradesh have been utilizing different bamboo species in every aspect of their day to day activity, mostly for the construction of houses, furniture, handicraft, agricultural implements, household utensils and for religious rites and industrial applications. Their housing patterns are also different in different tribal groups of Arunachal Pradesh.

But it has been observed that the availability of traditionally important bamboo species has been threatened due to encroachment, overgrazing, land slide, land slip, deforestation and shifting cultivation in this hilly state. If this situation continues, a number of bamboo species will become extinct from this region. On the other hand, the demand for traditionally important bamboo species has been increasing day by day. Realizing this necessity, some people of this area have taken initiative for cultivation and management of these species in and around the homestead gardens as well as in one’s own forest plots. They are cultivating the required species following the traditional cultivation practices, which are modified by
centuries of trial and error methods that require careful scientific modification for commercial application.

Before venturing into commercialization, it is most essential to understand the existing cultivation practices and extent of adoption of improved scientific cultivation practices among the tribal groups. Once the value addition of some selected species, their existing traditional cultivation pattern and extent of adoption of scientific methods of cultivation are studied, subsequent improvement can be taken up step by step for the socio-economic upliftment of the people.

It is also an urgent need to document, the present and past utilization and possibility of development and introduction of bamboo based livelihoods or small scale craft based industry in Arunachal Pradesh. Hence documentation of bamboo made articles and their role in economic contribution to the family is necessary for economic upliftment of the region.

Such a study will also provide a basis for future planning for organizing training on scientific cultivation and their management.

4.2 Materials and methods

The study was conducted in Papumpare district of Arunachal Pradesh following purposive random sampling technique (Sampling plan-fig 4.a) for selection of circles, villages and respondents. There are two sub-divisions in the district namely, Itanagar and Sagalee which were selected for this study.

There are 6 circles under Itanagar sub-division and 4 circles under Sagalee sub-division. It is not possible to conduct an intensive study in the entire district covering all the family members within a limited time and resources. On the other hand, it is also not possible to access the whole area. Hence, only 4 numbers of circles were selected purposively, 2 each from Itanagar and Sagalee subdivision based on the following criterias:

a. Circles selected based on elevation i.e., from lower elevation to higher elevation

b. Bamboo species cultivated and available in the area

c. Accessibility of the area
For conducting the survey and experiment, two numbers of villages from each of the circle (Fig 4.a - Sampling plan) were selected purposively using the same criteria as employed for selection of circles. Accordingly, Khamlee and Rach basti from Sagalee circle and Mowa and Geram basti from Toru circle were selected purposively. Model village and Durpa-III from Kimin circle and Balijan Nyishi and Lenka basti from Balijan circle were selected purposively.

As such, 80% respondents (Bamboo growers) were selected randomly using lottery method from each of the above 8 villages. A research schedule was prepared with the help of supervisors and experts on bamboo from State Forest Research Institute (Itanagar) to collect all the relevant information from the respondents. A pre-test was also conducted before going to final data collection.

All total of 160 number of bamboo growers were surveyed systematically in consultation with the Gaon Burah (Village Head) of the locality.

The bench mark scientific bamboo cultivation practices are taken from the “Field Manual on Bamboo Cultivation and Management”, SFRI Information Bulletin-25 (Taj et al., 2007) published by Mission Director, State Bamboo Mission and Director, SFRI, Itanagar, Arunachal Pradesh.

Each village was visited before actually administering the schedule. Group discussions were first held with the key informants to prepare the village profile. This helped in establishing good rapport with the villagers.

An extensive personal interview of the respondents was undertaken with the help of structured schedule to know the way they manage and conserve their bamboo resources. Field visits to the forest and their bamboo plantation areas were also made to identify the bamboo species and survey the areas to determine the total number of clumps, culms/clump, and to study the existing cultivation practices.

Local markets were also surveyed to find out the cost and demand of the bamboo based products. In addition to these, local artisans were interviewed to get an idea about the demand and supply of bamboo articles. The women were especially questioned about the durability of different bamboo products used by them. The data and other information collected were cross-checked at various levels and compared with available sources.
4.3 Result

4.3.1 Distribution of cultivated bamboo species in the study sites

The diversity of cultivated bamboo at different circles of Papumpare district is given in Table 4.1. It is observed that three genera (3) and seven (7) species of bamboo are cultivated by the farming communities of the study areas. These species are Bambusa balcooa Roxb., B. nutans Wall.ex Munro, B. pallida Munro, B. tulda Roxb., B. vulgaris Schrad.ex Wendl, Dendrocalamus hookerii Munro and Phyllostachys bambusoides Sieb and Zucc. Among all the species, B. pallida and B. tulda are the most extensively cultivated and maintained in the farmer’s plantation plots in all the study sites. B. vulgaris is a bamboo species cultivated only in Kimin which is reported to be introduced from Assam. Except, Phyllostachys bambusoides all are sympodial (clump forming) in nature.

Table 4.2 reveals that B. tulda is cultivated by all the farmers (100%) in four study sites followed by B. pallida (96.25%). Except in Toru (89.47%) and Balijan (95.24%), B. pallida is cultivated by cent percent of the farmers in other two sites in their own plantation plots. D. hookerii is also extensively cultivated by the farmers of Toru (100.00%) followed by Sagalee (90.00%) but not in Balijan and Kimin.

Species-wise average bamboo clumps per family in the study areas is shown in Table 4.3. Bamboo clumps of Bambusa tulda per family is observed to be the highest in Sagalee (23.00 clumps/family) followed by Kimin (16.88 clumps/family) and Toru (16.08 clumps/family). Cultivation of B. pallida is also popular among the farmers of Kimin (10.28 clumps/family) followed by Sagalee (10.25 clumps/family) and Balijan (8.26 clumps/family). Availability of D. hookerii in Toru (8.79 clumps/family) is the highest as compared to Sagalee (7.58 clumps/family). Cultivation of other species was found to be negligible.

The cultivated bamboo culms per family are presented in Table 4.4. It is noted that culms per family of B. tulda is highest in Balijan (699.84 nos) followed by Kimin (605.31 nos) and Sagalee (564.42 nos). Though the number of bamboo clumps in Balijan is least yet it has been observed that number of culms / clump is highest as compared to other study sites.
In case of *Bambusa pallida* number of culms per family is highest in Kimin (428.57) followed by Sagalee (378.12) and Balijan (349.92). The popular species of high altitude areas *D. hookerii* is highest in Toru (421.89) followed by Sagalee (199.15). During the field visit it has been observed that age of *D. hookerii* was more in Toru as compared to Sagalee, therefore production of total culms are higher in Toru.

**4.3.2 Traditional cultivation practices of bamboo species in the study sites**

**4.3.2.1 Propagation**

Table 4.5 shows (Fig 4.5) that the existing cultivation technique was evolved by the villagers through past experiences based on trial and error method. The practice of propagation of bamboo by planting offset /rhizome was done by all the (100%) villagers. More than 50.00% growers, select 1– 4 years old disease-free planting materials with a length of 1-4 m (≥5 nodes) and collected from the outer ring of the clumps. On the other hand, some people also propagate with offset/rhizome without considering the healthy disease-free planting material having age between 1-4 years collected from the inner or outer ring of bamboo groves planted in plain boundary areas of rice field or home garden.

During planting time they cover the cut portion of the culm with banana leaves or with mud plastering (63.75%) to avoid drying of propagules during root initiation.

**4.3.2.2 Site selection and planting (Table 4.6 & Fig 4.6)**

The study areas are mostly hilly terrain. Therefore, majority (82.50%) of bamboo growers cultivate the bamboo in hilly slopes in the boundary of rice field/home garden or forest/ bamboo plot with a wide spacing of 2-12 meter.

Majority of the farmers (69.38%) do not go for cleaning the field before planting and 80.00% farmers plant the propagules in pit size having 30x30x30cm-45x45x45cm. It is observed that high altitude farmers (43.75%) plant bamboo in June – July, whereas medium to lower altitude farmers (56.25%) plant in March –May. However, 73.13% farmers of the study sites plant the propagules keeping 1-2 nodes into the soil following North-South row direction. Irrigation is done by only 32.50% of bamboo growers after planting.
4.3.2.3 Management of bamboo groves (Table 4.7 & Fig 4.7)

Management of bamboo groves is the most important factor for better production of new culms in the clump. New sprouting is generally trampled by Mithun, cattle, buffalos etc., Therefore, some people (32.50%) fence the areas accordingly. Weeding and earthing up is done by 42.50% and 35.63% of the farmers respectively. Similarly, branch pruning, clump cleaning and mulching are done by 51.88%, 43.75% and 45.00% of the farmers, respectively.

Regarding harvesting, 47.50% of the bamboo growers harvest the culms round the year when required whereas, 52.50% farmers harvest the culms in between December to March. On the other hand, 60.00% farmers harvest the culms “keeping few old culms and all 1-2 year old culms in the clump” and 40.00% farmers harvest by felling of all the old culms. It is also recorded that 13.75% farmers followed clear felling in 1-2 clump every year for selling or making their traditional huts.

4.3.3 Uses and economic contribution of bamboo to the families

4.3.3.1 Number of bamboo culm utilization for different purposes per family

Table 4.8 shows that among the cultivated bamboo species Bambusa tulda is highly utilized in every location of Papum Pare district for making huts, fencing and crafts and for firewood. The second popular cultivated bamboo species is B. pallida. The third position is occupied by Dendrocalamus hookerii although it is not cultivated in Balijan and Kimin. Out of the four study sites, Bambusa tulda is highly utilized by the farmers of Sagalee, followed by Kimin and Toru. The next popular species B. pallida, is highly utilized in Kimin followed by Balijan and Toru.

4.3.3.2 Bamboo culm sale per family

It is observed that the B. tulda is a popular species among the farmers as evident from the Table 4.9. It shows that the selling number of bamboo culms per family is more for B. tulda compared to other species as the market demand for this species is high. The selling of B. tulda is highest in Balijan (114.26 culms/ family) followed by Toru (67.37 culms/ family) and Kimin (63.00 culms/ family). On the other hand, B. pallida is highest selling in Balijan (80.43 culms/ family) followed by Toru (42.84 culms/ family) and Kimin (41.08 culms/ family). The market demand of third popular species D. hookerii is highest in Toru (31.68 culms/family) as compared
to Sagalee (11.00 culms/ family). As the market demand of *B. tulda* is the highest, definitely economic benefit is highest from this species as compared to *B. pallida*. Table 4.10 reveals that economic benefit received from the *B. tulda* is the highest in Balijan ((Rs. 3427.86/ family) followed by Kimin (Rs. 1890.00 /family) and Toru (Rs. 1697.37/ family). Similar trend was also observed for *B. pallida*.

### 4.3.3.3 Traditional craft and local requirement

A total of 20 most prominent bamboo craft products (Table 4.11) are reported to be used by the Nyishi community in the study areas. Almost all the bamboos used for traditional craft work come from the individual plantation. The only species used for making different household articles collected from wild habitat is *D. hamiltonii*.

The uses of the different important products are discussed below:

**Grain drying mat (Oph):** It is a huge size, bamboo made tray used for drying millet and rice. It is smoothly woven out of bamboo and smoked over the fire to give an attractive and protective sheet.

**Bamboo sieve (Chaloni):** It is used for sieving rice husk and millet to separate unwanted grains and particles.

**Rain shield (Boio):** It is a traditionally bamboo made raincoat used extensively in farming by the Nyishi tribe which saves head and back side of the farmer during rainy season.

**Bamboo stool (Murha):** It is made from the splitted bamboo which is used for sitting.

**Haversack (Igin/ Nara):** It is used to carry grains and vegetables from one location to other. It is generally carried on back side of the farmers.

**Winnowing tray (Opio):** It is used for cleaning / winnowing the rice or millet to separate them from unwanted materials.

**Lidded container (Paha):** It is a hexagonal container with lid used for keeping vegetables.

**Fishing trap (Eddar):** It is a conical equipment used to catch fish from the sloppy water falling areas.
**Hen coop (Pattar):** It is a hexagonal perforated container with lid used for keeping chicken for sale in the local market.

**Tiny hexagonal basket (Khotta):** It is also a small hexagonal basket with lid used for keeping vegetables.

**Bamboo fan (Map):** Locally hand made bamboo fan.

**Sword cover (Boiha):** Splitted bamboos bound together to keep the sword safely.

**Hexagonal narrow necked basket (Dungsi):** Special type of container made from smoothly woven splitted bamboo used for keeping rice.

**Bamboo mug (Patta):** It is made from bamboo culm used for drinking millet or rice beer.

### 4.3.3.4 Economic benefit from bamboo and its products

#### Benefit from using of bamboo culm

All the farmers extract the bamboo culms from their own fields for making their traditional houses, fencing, crafts, for religious activities and for fire wood. Therefore, they save a huge amount of money which otherwise they would have spent on the purchase of the same from others. Table 4.12 shows that an amount of Rs. 4299.22 has been saved by cultivating *B. tulda* followed by *B. pallida* (Rs.1923.58) and *D. hookerii* (Rs. 437.00) in the study sites. The highest indirect benefit is received from *B. tulda* by the farmers of Kimin (Rs. 5275.50) followed by Sagalee (Rs. 4701.88) and Toru (Rs. 3714.47). On the other hand, highest indirect economic benefit from *B. pallida* is received by the farmers of Kimin (Rs. 2841.88) followed by those of Balijan (Rs. 2103.75).

Table 4.13 indicates that the highest economic benefit (Rs. 2916.08) is received by the farmers of Kimin followed by Toru (Rs. 2870.90) and Balijan (Rs. 2684.00) by making bamboo articles for their own use and for selling.

### 4.3.3.5 Bamboo shoot and its consumption

The local demand for bamboo shoot is very high as it forms a major part of the Nyishi diet. The women collect it from the forest and rarely from the plantation plots and processes it by indigenous way and keeps it for further use. The villagers rarely buy any bamboo shoot. The tribal people of Sagalee and Toru circle collect *D.
hamiltonii, D. hookerii, Phyllostachys bambusoides and B. pallida, whereas farmers of Balijan and Kimin circle collect D. hamiltonii, B. balcooa and B. pallida from wild or plantation plots (Table 4.14). Bhatt et al, (2003) also reported that the bamboo shoot of D. hamiltonii was sold in the different markets of Arunachal Pradesh.

The quantity of bamboo shoots collection depends upon the distance of the villages from the natural habitat or cultivated plot. Fresh bamboo shoots are collected during June-Sept. It is evident from the table 4.15 that the average annual consumption of fresh bamboo shoot is estimated to be 13.73 Kg per household. It is comparatively higher in Sagalee (15.33 kg/ household) than Toru (14.40 kg/ household). The average annual consumption of roasted whole shoot is 7.68 kg / house hold followed by crush fermented shoot (5.70 kg/ household) and fermented dry shoot (4.02 kg/ house hold). The annual consumption is more in Sagalee and Toru as compared to Balijan and Kimin, which may be due to shifting of food habit to other delicious dishes.

4.4 Discussion

A lot of bamboo species have been utilized by Nyishi people of Papumpare district collected from forest as well as cultivated plots. Out of these, the cultivated species are Bambusa balcooa Roxb., B. nutans Wall.ex Munro, B. pallida Munro, B. tulda Roxb., B. vulgaris Schrad.ex Wendl, Dendrocalamus hookerii Munro and Phyllostachys bambusoides Sieb and Zucc. In Toru and Kimin circle, the diversity of cultivated bamboo (5 species) is observed to be highest among the study sites.

B. tulda is a species having strong mechanical strength, long internodes and medium thickness in culm wall (Rethy et al., 2006) for which all the farmers of the study sites use this species to meet their daily requirement. They utilize it for making long huts, traditional hand made bamboo products, for fencing, as firewood and for ritual purposes. Due to the high utility of B tulda, the number of clumps per family was recorded to be the highest in the study sites. Sarkar and Sundriyal (2002), also reported that B. tulda and B. balcooa were also popularly cultivated and used for various purposes by Tangsa people of Changlang district of Arunachal Pradesh. B. pallida was also a popularly cultivated bamboo species with second highest clump available per family which was also reported by Rethy et al.,(2006). Apart from Arunachal Pradesh, this species is also distributed in Assam, Northern Bengal,
Meghalaya, Mizoram, Nagaland, Sikkim and Tripura upto 1200m asl (Tewari, 1992). *D. hookerii* is also extensively cultivated by cent percent of farmers of Toru followed by Sagalee (90.00%) which may be due to suitability of the species to grow in the high altitude areas as well as its high utility and market demand. The species *B. balcooa* is cultivated by the growers of Kimin and Balijan circles as it suits to the low altitude region. It is the best and strongest species because of which it is used for making huts, agricultural implements, as fire wood, ritual purposes and for edible purposes (Rethy *et al.*, 2006; Sarkar and Sundryal, 2002). According to Tewari (1992), apart from Arunachal Pradesh, the species *B. balcooa* is also distributed in Assam, Nagaland, Tripura, West Bengal, Bihar, extending upto eastern Uttar Pradesh to about 600m asl. The species *Phyllostachys bambusoides* is the only monopodial (non clump forming) bamboo species cultivated and utilized for making household articles, huts and used as edible bamboo shoot (Sundryal *et al.*, 2002) in high altitude areas like Sagalee and Toru circles. Nearly 90% bamboo demand is met by growing this species in every household of Apatni Plateau area of Arunachal Pradesh (Sundryal *et al.*, 2002). On the other hand, *B. vulgaris* is a bamboo species cultivated only in Kimin which is reported to be introduced from Assam.

The local people cultivate the required bamboo species by following the traditional cultivation practices modified by centuries of trial and error method. Many farmers cultivate bamboo in hilly slopes by planting 1-4 years old disease free healthy offset having more than 5 nodes collected from the outer ring of the bamboo groves. They dig a pit in the month of May-June at a spacing of 7 to 12m and plant the off set in North South raw direction. The bamboo plantation plots are protected by raising fencing from wild animals. The matured bamboos are generally harvested during Dec-March leaving few old and all 1-2 years new culms from the clump (Rethy *et al.*, 2006).

Some people are also engaged in selling the bamboo culms to earn livelihood. Various kind of bamboo products are made for their own use as well as for selling in the market. Huge amount of *jati* (*Bambusa tulda*) and *bijuli* (*B. pallida*) bamboo culms are sold from Balijan and Kimin circles to Hindustan Paper Mill, Assam.

Therefore, it can be concluded that the Nyishi people are dependent on *B. tulda* and *B. pallida* for making huts, hand made bamboo products, for firewood as well as
for their socio economic development. Bamboo resources have been identified as integral part of the indigenous people of NE India and it plays a significant role in the food and nutritional security of the tribal population (Bhatt et al., 2004). In the present study, it is observed that the Nyishi people of Papumpare district consume bamboo shoots preparing different delicious food items like Slice bamboo shoot, Crush fermented, Roasted whole and Fermented dry. D hamiltonii is identified as a potential species for nutritative value. Besides, D. hookeri, Phyllostachys bambusoides, B balcooa and B pallida are also identified as edible species in the study areas. Similar findings were also reported by Bhatt et al., (2004).