

## **Bamboo resources of Manipur: an overview for management and conservation**

H. B. SINGH<sup>1</sup>, B. KUMAR<sup>1,\*</sup> and R. S. SINGH<sup>2</sup>

<sup>1</sup> *Regional Research Laboratory, Manipur Substation, Lamphelpat 795 004, Manipur, India*

<sup>2</sup> *Regional Research Laboratory, Jorhat 785 006, Assam, India*

**Abstract**—Manipur, one of the eight states of north eastern India, including Sikkim state, harbours a high diversity of bamboo. More than 54 species of bamboo under 9 genera have been reported from Manipur against 136 species under 23 genera from India as a whole. Pure bamboo brakes constitute 18.6% of the total forest area of the state and the bamboo play a vital role in the life of Manipurians in their day-to-day requirements. Bamboo has multiple uses and is used in almost all the households needs, for construction, craft, fencing, rituals, firewood, rope, food, utensils and paper manufacturing. Bamboo shoots, both in raw and fermented forms, are largely consumed by the people and can earn a large share of household economy to an amount of Rupees 2130 million (USD 45 million) annually for the nation as a whole. Bamboo is needed from childbirth to death and every household maintains a bamboo colony of certain species in their private land. Revenue of 0.43 million rupees (9000 USD) is generated from bamboo and its products annually by the State Forest Department of Manipur. As bamboo can grow easily with least labour and time, cultivation aspects are least considered. The high potential can be improved by suitable scientific intervention and local capacity building, which will have great implications in improving the socio-economic status of the community. This paper reports species diversity, characteristics, utilization pattern and conservation status of bamboo resources in Manipur state.

*Key words:* Bamboo diversity; socio-economy; marketing strategy; employment opportunity.

### **INTRODUCTION**

Bamboo is popularly known as poor man's timber [1] and plays an important role in the socio-economy of tribal and rural people as it has since ancient times [2, 3]. India is the second largest producer of bamboo in the world next to China and also has the richest diversity of bamboo species in the world [4]. The north-eastern states of India account for nearly 50% of the total bamboo resources of the country [5]. Most of all the species of bamboo in north-eastern India are available in Manipur

---

\*To whom correspondence should be addressed. E-mail: [hbirkumars@yahoo.com](mailto:hbirkumars@yahoo.com)

state and 3268 km<sup>2</sup> area are under pure bamboo brakes, which is 18.6% of the total forest area of the state [6]. Out of India's total growing stock of  $31\,000 \times 10^3$  t (metric tonnes), the highest value of  $11\,400 \times 10^3$  t is obtained from Manipur constituting 36.8% of the stock and potential output of 390 tons/day of bamboo shoot available for consumption [7]. More than 700 000 bamboos are extracted every year in Manipur [8].

Bamboo is well known to the people of Manipur because of its multipurpose economic uses and because it is associated with legends [9]. The need for bamboo exists from childbirth to death. Bamboo is used in domestic needs for house construction, fuel, fodder, food, tools, religious ceremony, etc. Bamboo is the major raw material in the manufacture of varieties of papers. In Manipur almost all the households maintain bamboo colonies in their private land. With accelerated growth of human population, and environmental and cultural changes, economic development has also taken rapid strides during recent years, which is posing threats to natural resources. The present work is on bamboo resources of Manipur, its physical characteristics, utility, market values and propagation success.

## STUDY AREA

Manipur, one of the easternmost border states (22 327 km<sup>2</sup> geographical area) of India is within the 'Indo-Burma' centre of biodiversity hotspots of global significance and is surrounded to the east by Myanmar (Burma), to the north by the Indian state of Nagaland, to the west by Assam and to the south by Mizoram (Fig. 1). The state lies between 94°31' to 94°78' E and 23°83' to 25°68' N and lies from 550 to 3600 m above sea level; it mainly comprises hilly terrain (92%), surrounding a saucer-shaped valley of 1856 km<sup>2</sup>, called Imphal Valley. The area has prevailing monsoon rainfall with an average annual rainfall of 2100 mm and average air temperature range from -1°C to 38°C in a temporal cycle. The mean of the daily humidity is highest during the months of July–Sept., which varies from 80–96% and differs from place to place. Generally, humidity is lowest in March (45%). Sharma [10] has categorized the forests of Manipur on ecological basis as (i) tropical wet evergreen forests; (ii) tropical moist deciduous forests; (iii) sub-tropical broad-leaved hill forests; (iv) sub-tropical pine forests; and (v) mountainous wet temperate forests.

The population of the state [11] was 2 389 000 (with a density of 107 per sq. km and annual growth rate of 3%). The major ethnic community in the state is Meitei, which constitutes around 57% of the total population of the state. There are altogether 29 ethnic tribal communities dominated by Nagas and Kukis (29.9% of the state). Although each tribe has its own dialect, overall they speak a highly developed common language known as Manipuri/Meiteilon while communicating among themselves, which is the only Tibeto-Burman language included in the 8th Schedule of the Indian Constitution to date.

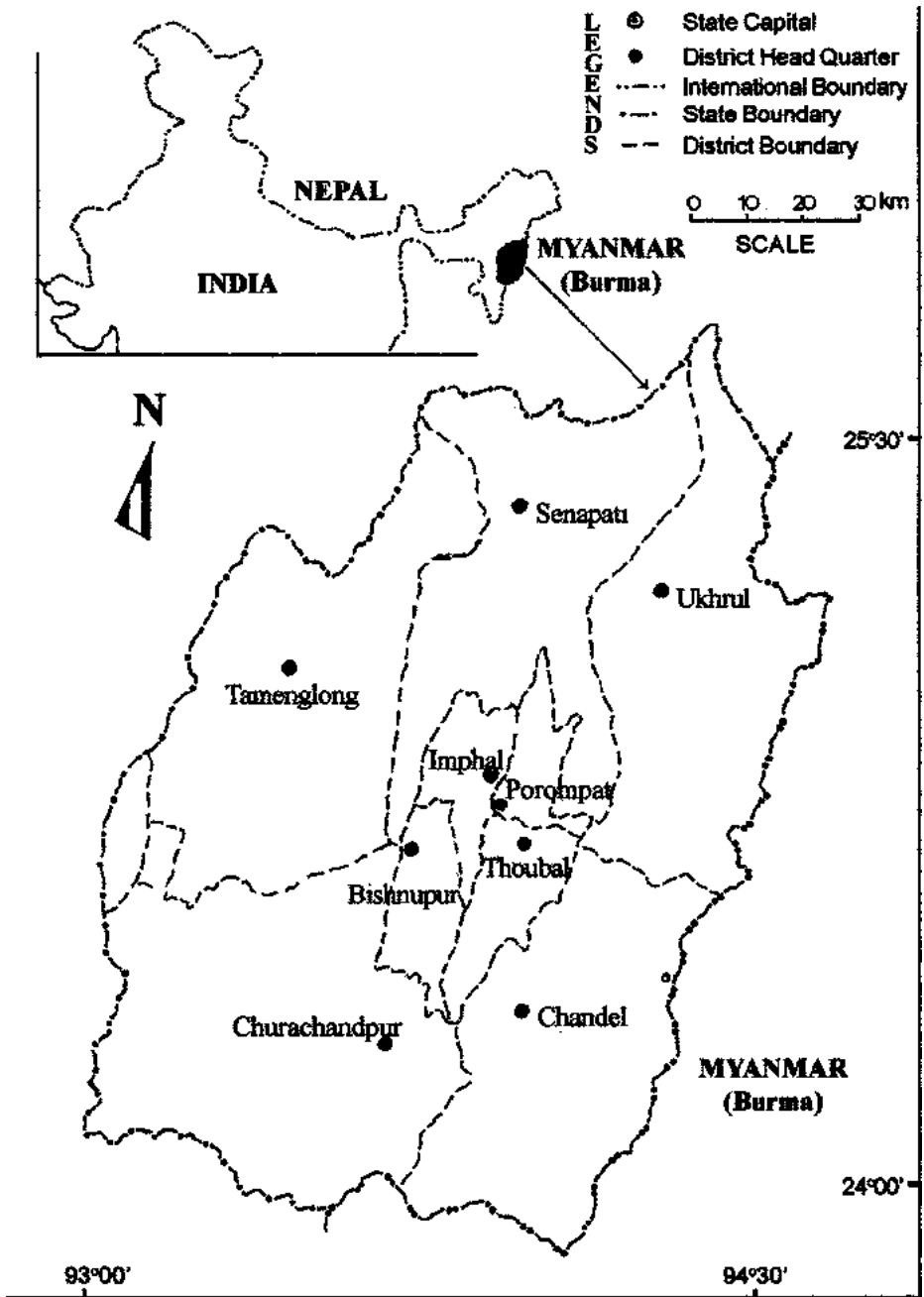


Figure 1. Location map of Manipur showing different administrative districts.

## METHODS

Data on diversity of bamboo in India, the north eastern region of India and Manipur were collected through a survey of published literature [4, 6, 12, 13]. The characteristics of different bamboos were measured physically by using measuring scale and tape (replicates of 5 each). Information on source of bamboo supply, important species collected and their utilization, traditional uses, durability and requirements of raw materials was gathered in a classified format which was developed for the purpose. The data were cross-checked by discussion with elders in selected localities and also by household visits. Imphal market (in the capital city of Manipur) was surveyed regarding the availability, price and the species, that are edible. Discussions were held with aged house members regarding the survivability rate of propagation and the number of shoots developed year after year after transplantation of certain important bamboo species.

## RESULTS

Almost all the species of bamboos of north-eastern India are available in Manipur state. India's bamboo species contributes about 11% of the world's bamboo species whereas 43% of India's bamboo is available in north-eastern region (Table 1). Most of the bamboo species in Manipur are wild while a few species are commonly cultivated in the private lands. For detailed study, 12 species of important bamboos that are generally planted in the private lands are selected (Table 2). The biggest bamboo is *Dendrocalamus giganteus* (outer diameter 200–250 mm; wall thickness 25–35 mm and internodal length 600–700 mm) and the smallest is *Arundinella hookeri* (outer diameter 15–25 mm; wall thickness 5–10 mm and internodal length 200–250 mm). The uses of bamboo range from utensils to fishing implements, pulping, household construction, and edible material (Table 3). Species like *Bambusa kingiana*, *B. tulda*, *B. nutans*, *Dendrocalamus hamiltoni*, *D. strictus*, *D. giganteus*, *Arudinaria callosa* and *Melocanna bambusoides* are edible in both raw and fermented forms. *Melocanna bambusoides* is widely and largely used in the pulp industry. The highest price of bamboo can be fetched by *Dendrocalamus giganteus* (Rs. 60–75 per bamboo) while the least price by *Arudinaria callosa* and *Arundinella hookeri* (Rs. 5–10 per bamboo). The calorific value of bamboos ranges from 4238 to 5500 cal/g (Table 3).

**Table 1.**

Bamboo diversity in different regions

Regions	Genera	Species	Reference
Manipur state	9	>54	G. J. Sharma, 1996 [6]
North eastern India	16	58	Bahadur and Jain, 1981 [4]
India	23	136	Y. M. L. Sharma, 1980 [12]
World	75	1250	Upreti and Sundriyal, 2001 [13]

Propagation survivability rate among bamboos ranged from 40% to 100 % (Table 4). A 100 % propagation success was observed in *Melocanna bambusoides*. *Dendrocalamus giganteus* has the least survivability rate (40 to 50%). After one year of plantation, development of new shoots occurred in *Bambusa kingiana*, *B. nana*, *B. nutans*, *B. tulda*, and *Melocanna bambusoides* while in *Dendrocalamus hamiltoni*, *D. longifimbriatum*, *D. giganteus*, *Arundinaria callosa* and *Arundinella hookeri*, new shoots developed only in the second year after transplantation. A colony of bamboo is regarded as full when the colony has more than 20 culms. Species like *Dendrocalamus hamiltoni*, *D. longifimbriatum*, *D. sericeus*, *D. giganteus*, *Bambusa kingiana*, *Arundinaria callosa* and *Arundinella hookeri* attain full colony during the sixth year of plantation while *Bambusa nutans*, *B. nana*, *B. tulda* and *Dendrocalamus strictus* attained full colony during the fifth year after plantation. *Melocanna bambusoides* attain full colony just within four years of plantation (Table 4).

The uses of bamboos in day-to-day requirements range from household construction to utensils to food and medicine (Table 5). Almost all the items made of bamboo last at least for one year while some of them are used up to 8 years. Most of the bamboo items are essential for each and every household. Manipur has bamboo forest of 11 700 km<sup>2</sup> area against 204 000 km<sup>2</sup> in India as a whole, which is 5.7% of the country (Table 6). About 53% of the total geographical area of Manipur comprises bamboo forest, against 6.2% for the whole of India. It is estimated that the growing stock of bamboo in the whole of Manipur is  $1.14 \times 10^7$  tons against India's  $3.1 \times 10^7$  tons, which represents 36.8% of the whole country. In other terms, bamboo stock in Manipur is 9.6 tons/km<sup>2</sup> against India's stock of 1.5 tons/km<sup>2</sup>. Manipur has the potential output of pulpwood to an amount of 1.5 million tons/year and edible bamboo shoot of 142 350 tons/year [7]. It has been estimated that the average consumption

**Table 2.**  
Important bamboo species of Manipur; availability, characteristics and propagation

Species	Local name	Availability	Average outer diameter (mm)	Average wall thickness (mm)	Inter-node length (mm)
<i>Arundinaria callosa</i>	Laiwa	Wild	25–30	5–10	260–290
<i>Arundinella hookeri</i>	Telwa	Wild	15–25	5–10	200–250
<i>Bambusa kingiana</i>	Watangkhoi	Planted/wild	100–150	12–20	480–620
<i>B. nana</i>	Khokwa	Planted	45–65	10–15	400–450
<i>B. nutans</i>	Utang	Planted	100–160	15–20	470–550
<i>B. tulda</i>	Waa	Planted	90–120	15–20	500–600
<i>Dendrocalamus giganteus</i>	Maribob	Planted	200–250	25–35	600–700
<i>D. hamiltoni</i>	Saneibi	Planted	100–140	25–30	550–620
<i>D. longifimbriatus</i>	Woonan	Planted	100–150	20–25	540–620
<i>D. sericeus</i>	Ooei	Planted	100–140	15–20	520–600
<i>D. strictus</i>	Saneibi	Planted	100–140	201–28	550–600
<i>Melocanna bambusoides</i>	Waak/Moubi	Wild/Planted	50–65	7–10	460–530

**Table 3.**

Uses of common bamboos, their values in the local market and energy contents

Species	Uses	Market price (Rs./bamboo)	*Energy content (cal/g)
<i>Arundinaria callosa</i>	Tender shoot edible, fencing for kitchen gardens, used in rites and rituals, arrows, smoking pipe, tender shoot is fed to cattle in various diseases, flute.	5–10	—
<i>Arundinella hookeri</i>	Bow and arrows, smoking pipe, religious purposes, flute, as decorative hedge plant.	5–10	—
<i>Bambusa kingiana</i>	House construction, binding, rope making, baskets, fishing implements, branch as spindle, umbrella, tender shoot edible.	20–40	—
<i>B. nana</i>	Fencing, agricultural implements, chairs and other furniture, pulping, handle for knife and other agricultural implements, used in death rituals, tender shoot given to cattle to cure various diseases.	25–40	4244–4892
<i>B. nutans</i>	Rope, young shoot edible both fresh and fermented, household construction, cowshed, water transporting pipe, spindle, largely used for religious purposes.	35–45	4238–4947
<i>B. tulda</i>	Baskets, households construction, shoot edible, hats, winnowing fan for rice and food grains, fishing and agricultural implements, tooth brush, fuelwood, shoot edible, knife handle, support for tendril climber vegetables, tender shoot decoction paste is applied in wounds and injuries, ash obtained after burning is used in the preparation of a traditional food item locally called utee.	30–40	4299–4717
<i>Dendrocalamus giganteus</i>	Shoot edible, poles, water transport pipe, kitchen utensils, decorative handicraft products, house pillar, roof ceiling, money (coin) saving box, wine storing vessel.	60–75	4482–5500
<i>D. hamiltoni</i>	House pillar, poles, fencing, fishing and agricultural implements, mats, knife handle, branchlets used as tooth-brush, shoot edible, fixing substitute-needle in furniture, bows.	30–40	—
<i>D. longifimbriatus</i>	House pillar, poles, fencing, mats, fishing and agricultural implements, knife handle, handicraft products.	30–40	—
<i>D. sericeus</i>	Rope, tightening materials, baskets, hat, tooth-brush, other handicraft products, umbrella, water transporting pipe.	35–55	—

**Table 3.**

(Continued)

Species	Uses	Market price (Rs./bamboo)	*Energy content (cal/g)
<i>D. strictus</i>	Shoot edible, bow and arrows, tender shoot used as medicine in wounds and injuries, branchlets used as tooth-brush, house construction, fishing implements, tender shoot decoction applied in injuries, bows, support for tendril climber vegetables, roots as cleaning brush and as brooms.	35–45	—
<i>Melocanna bambusoides</i>	Fencing mats, granary walls, poultry and pig-gery cages, cattle sheds, roof ceiling, pulping, house wall, cloth hanging rod, shoot edible, low quality baskets.	8–20	4436–5085

\* After Sharma [6]; Rs. 47 = 1\$.

**Table 4.**

Propagation potential of important bamboo species

Species	Survivability rate (%)	Number of new bamboo shoot (s) after plantation					
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
<i>Bambusa nutans</i>	70–80	1–2	3–4	5–7	8–12	CC	—
<i>Bambusa tulda</i>	70–80	1–2	3–4	5–7	8–12	CC	—
<i>Dendrocalamus hamiltonii</i>	60–70	Nil	1–2	2–4	5–6	8–10	CC
<i>D. longifimbriatum</i>	70–80	Nil	1–2	2–4	5–6	8–10	CC
<i>D. sericeus</i>	80–90	Nil	1–2	2–4	5–6	8–10	CC
<i>D. giganteus</i>	40–50	Nil	1–2	2–4	5–6	8–10	CC
<i>D. strictus</i>	70–80	1–2	3–4	5–7	8–12	CC	—
<i>Melocanna bambusoides</i>	90–100	2–3	4–5	7–10	CC	—	—
<i>Bambusa nana</i>	60–70	1–2	2–4	3–8	8–12	CC	—
<i>B. kingiana</i>	70–80	1–2	2–4	3–5	5–10	10–15	CC
<i>Arundinaria callosa</i>	60–70	Nil	1–2	2–3	4–7	10–15	CC
<i>Arundinella hookeri</i>	50–60	Nil	1–2	2–3	4–7	10–15	CC

Bamboos of more than 20 numbers in a group is regarded as a complete colony (CC).

rate of bamboo shoot is about 60 kg/person/year. The estimated annual income from edible bamboo shoot in Manipur state is some Rs.  $213 \times 10^7$  (Table 6) (USD 45 million). The State Government earned revenue of Rs. 426 000, which is around 5% of the total forest products during 1999–2000 (the State Government collects only royalty fees, which are much less than the actual revenue). A decrease of 29% revenue from bamboo was observed from 1994–1995 to 1999–2000 (Fig. 2).

## DISCUSSION

Bamboo is one of the most important resources in Manipur and the need for bamboo among the people is tremendous, ranging from house construction to utensils, food and medicine. Bamboo leaf supplements a good share of fodder

**Table 5.**  
Traditional bamboo products and their annual household demand

Bamboo items	Local name	Species of bamboo used	Average life with regular use (in year)	Average no. of piece (s) reqd. every year per household	No. of bamboo used per article
1. Agricultural implement	Ukai	<i>Bambusa nana</i> , <i>B. tulda</i> , <i>Dendrocalamus hamiltoni</i> , <i>D. longifimbriatus</i>	4-5	—	1
2. Arrow	Tenjei	<i>Arundinaria callosa</i> , <i>Arundinella hookeri</i> , <i>Dendrocalamus strictus</i>	1-2	—	1/2
3. Bow	Lirung	<i>Arundinaria callosa</i> , <i>Arundinella hookeri</i> , <i>Dendrocalamus strictus</i>	3-4	—	—
4. Broom	Sumjit	<i>Dendrocalamus strictus</i>	1-2	2	1/2
5. Cattle mouth cover	San-chinkhum	<i>Bambusa kingiana</i> , <i>B. nana</i> , <i>B. tulda</i> , <i>Dendrocalamus sericeus</i>	1	2	1/8
6. Carrying basket	Leibak-polang	<i>Bambusa kingiana</i> , <i>B. tulda</i> , <i>Dendrocalamus sericeus</i>	1	2	1/2
7. Cleaning-washing brush	Brush	<i>Dendrocalamus strictus</i>	1-2	2	—
8. Cloth hanging rod	Polangkhok	<i>Melocanna bambusoides</i>	2-3	1	2
9. Cooking and serving spoon	Khabei	<i>Dendrocalamus giganteus</i> , <i>D. strictus</i>	1	2	—
10. Fish drying gauge	Nga-kharai	<i>Bambusa kingiana</i> , <i>B. nana</i> , <i>B. tulda</i>	2-3	1	1/2
11. Fish trap	Kao	<i>Bambusa kingiana</i> , <i>B. tulda</i> , <i>Dendrocalamus hamiltoni</i> , <i>D. longifimbriatus</i>	1	1	1
12. Fishing implements	Loo Tekhao-loo Long-ooop Hangel Luang Hui	<i>Bambusa kingiana</i> , <i>B. tulda</i> <i>Bambusa kingiana</i> , <i>B. nana</i> , <i>B. nutans</i> , <i>B. tulda</i> <i>Dendrocalamus strictus</i> <i>Dendrocalamus strictus</i> , <i>D. hamiltoni</i> <i>Bambusa nana</i>	2-3 3-4 5-6 2-3 4-5	2 1 1 1 1	1 1 1 1 1
13. Fixing needle	Bangsi	<i>Dendrocalamus hamiltoni</i> , <i>D. strictus</i>	5-10	—	—
14. Flute	Kei/Kot	<i>Arundinaria callosa</i> , <i>Arundinella hookeri</i>	3-4	—	—
15. Food grain container (granary basket)	Kei/Kot	<i>Dendrocalamus giganteus</i> , <i>Melocanna bambusoides</i>	4-6	1	10



**Table 5.**  
(Continued)

Bamboo items	Local name	Species of bamboo used	Average life with regular use (in year)	Average no. of piece (s) reqd. every year per household	No. of bamboo used per article
16. Garden fencing	Sambal	<i>Arundinaria callosa</i> , <i>Dendrocalamus hamiltoni</i> , <i>D. strictus</i>	1-2	—	10-15
17. Hammer	Theng-goo	<i>Bambusa nana</i> , <i>Dendrocalamus hamiltoni</i> , <i>D. strictus</i>	1-2	1	1/3
18. Head carrying basket	Sam	<i>Bambusa kingiana</i> , <i>B. nutans</i>	2	3-4	2
19. Hen coop	Yen-polang	<i>Bambusa kingiana</i> , <i>B. nutans</i> , <i>B. tulda</i>	1-2	1	1
20. House pillar	Yumbi-makhong	<i>Bambusa tulda</i> , <i>Dendrocalamus longifimbriatus</i> , <i>D. hamiltoni</i> , <i>D. strictus</i>	5-8	20	1
21. House roof ceiling	Ceiling	<i>Dendrocalamus giganteus</i> , <i>Melocanna bambusoides</i>	5-7	20-30	20-30
22. Knife handle	Thang-khok	<i>Bambusa nana</i> , <i>B. tulda</i> , <i>Dendrocalamus hamiltoni</i> , <i>D. longifimbriatus</i>	2-3	3	1/2
23. Money coin saving-box	Sen-phu	<i>Dendrocalamus giganteus</i>	2-3	1	—
24. Paddy drying mat	Phou-ra	<i>Bambusa kingiana</i> , <i>B. nutans</i>	3-4	1	2
25. Rabbit/chicken cage	Theba/Yen-kon	<i>Bambusa nana</i> , <i>B. nutans</i> , <i>B. tulda</i> , <i>Melocanna bambusoides</i>	3-4	1	3-4
26. Rice measuring basket	Meruk	<i>Bambusa kingiana</i> , <i>B. tulda</i> , <i>Dendrocalamus sericeus</i>	3-4	1	1/4
27. Rice winnowing fan	Yang-kok	<i>Bambusa tulda</i>	4-5	1	1

**Table 5.**  
(Continued)

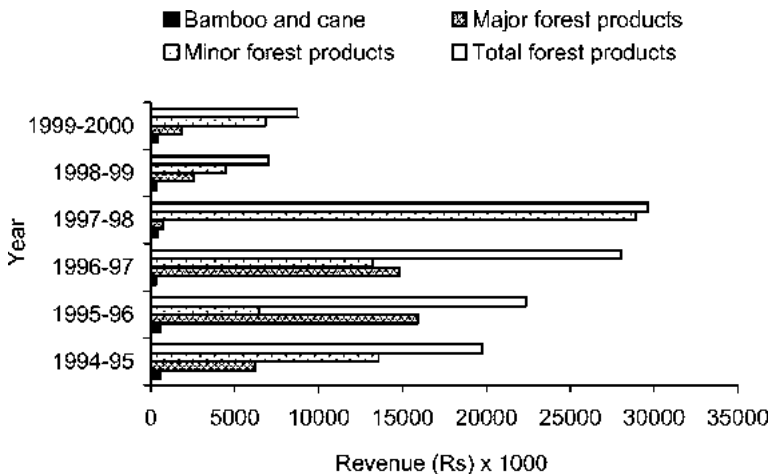
Bamboo items	Local name	Species of bamboo used	Average life with regular use (in year)	Average no. of piece (s) reqd. every year per household	No. of bamboo used per article
28. Rope	Thouree	<i>Bambusa kingiana</i> , <i>Dendrocalamus sericeus</i>	2-3	2	1
29. Salt and chilli container	Thum/morok chafu	<i>Dendrocalamus giganteus</i>	2-3	2	1/10
30. Smoking pipe	Hidakpu-machei	<i>Arundinaria callosa</i> , <i>Arundinella hookeri</i>	2-3	1	—
31. Spindle	Lang-chak	<i>Bambusa kingiana</i> , <i>B. nutans</i>	2-3	10-20	—
32. Stool	Mora	<i>Dendrocalamus hamiltoni</i> , <i>D. strictus</i>	3-4	2	1/2
33. Storing basket	Thumok	<i>Bambusa kingiana</i> , <i>B. nutans</i> , <i>Dendrocalamus sericeus</i>	7-8	2	1
34. Tooth-brush	Yathin-paya	<i>Dendrocalamus hamiltoni</i> , <i>D. sericeus</i> , <i>D. strictus</i>	disposable	1800-2100	—
35. Umbrella	Yempak	<i>Bambusa kingiana</i> , <i>Dendrocalamus sericeus</i>	2-3	1	1/2
36. Vegetable container	Yendai	<i>Bambusa kingiana</i> , <i>B. tulda</i> , <i>Dendrocalamus sericeus</i>	2-3	1	1/2
37. Water pipe	Ishing-utong	<i>Dendrocalamus giganteus</i> , <i>D. sericeus</i>	1-2	—	1
38. Winnowing fan	Humai	<i>Bambusa tulda</i>	4-5	2	1/2

**Table 6.**

Production potential of bamboo resources in India and the study area (Manipur)

Parameters	Manipur	India	Percent of Manipur to India
Geographical area (km <sup>2</sup> )	22 327	3 287 263	0.7
Bamboo forest area (km <sup>2</sup> )	11 700	204 000	5.7
Percent of bamboo forest to the geographical area	52.5	6.2	—
Total bamboo growing stock (tons × 10 <sup>3</sup> )	11 400	31 000	36.8
Rate of bamboo stock (tons/km <sup>2</sup> )	9.6	1.5	—
Potential output of pulp wood (tons/year)	1 500 000	—	—
Edible bamboo shoot production (tons/year)	142 350	—	—
Average bamboo shoot consumption rate (kg/person/year)	59.6	—	—
Income from bamboo shoot (Rs/year)	2130 × 10 <sup>6</sup>	—	—

Rupees 47 = 1\$; Edible bamboo shoot cost @ Rs. 15 per kg.

**Figure 2.** Revenue generated from various forest products by the Forest Department during 1994–1995 to 1999–2000.

for cattle during less bountiful periods. Bamboo is effective in the conservation of soil erosion due to its intricate rhizome system. In Manipur, villagers prefer bamboo plantation along the riverbanks to help control flooding during the rainy season. Therefore, plantation of bamboos along the riverbanks especially in flood-prone areas is advisable. Plantation of bamboos can be established in wastelands, shifting cultivation-fallows, village lands and on private lands. Bamboo requires only a small area for plantation and production, and short duration to maturity; it is wise to opt for plantation of bamboos rather than other trees. Bamboo can be raised with least care and expenditure and can be harvested continuously from year to year. Bamboo shoots, both raw and fermented, provide a delicious food item and can earn a large share of the local economy. An estimated amount of Rs. 2130 million can be generated annually from bamboo shoots only. Sharma [6] has

reported that a single species, *Melocanna bambusoides*, has a production potential of 100 tons/day bamboo shoot in Manipur. This single species contributes about 26% of the total bamboo shoot production in Manipur. Although bamboo has high potential for income generation, the State Government could generate only Rupees 426 000 annually, which is very low compared with the possible output. Bamboo generally produces high calorific values, ranging from 4200 to 5500 cal/g dry tissue, thereby showing higher energy contents compared to the common fuel woods [6]. A development programme of bamboo could be undertaken for under-privileged weaker section of society, because bamboo has high-energy release and is readily available as an inexpensive alternative source of energy. Since they are recognized as the fastest growing plants (5–100 cm/day), having high photosynthetic efficiency and low photorespiration, their culms mature and acquire full strength and density in about 2–3 years. Hence, energy plantation projects involving bamboos are advocated in many rural sectors [14]. Because of its easy propagation through vegetative means and because it attains maturity and full colony within a few years, bamboo is preferably planted in every household in Manipur. Bamboo could be a preferred species in a social forestry programme. Extraction of bamboo shoot from the wild habitat should be monitored systematically and a suitable technique should be developed so that the growth of other shoots and culms are least affected. In the hilly districts (92% of the geographical land area of the state), bamboo grows in the wild, whereas bamboos in the valley (8% area of the state) are under cultivation. Therefore, cultivation of bamboos should be prioritised more in the vast areas of the hilly districts. A large quantity of bamboo in Manipur has been transported to the neighbouring states for pulp and paper industry. Proper canalisation and marketing strategy is the next immediate step required from the Government's side. If the vast resource of bamboos could be developed scientifically and systematically, it would generate significant employment opportunities for the people and thus promote the socio-economic status of the ordinary people.

### *Acknowledgements*

The authors thank the Director, Regional Research Laboratory, Jorhat for the facilities provided.

### **REFERENCES**

1. C. B. Sastry, Bamboo: timber for 21st century, Draft paper for *International Network for Bamboo and Rattan* (INBAR) (2001).
2. D. N. Tewari, *A Monograph on Bamboo*. International Book Distributors, Dehra Dun, India (1992).
3. H. Y. M. Ram and R. Tandon, Bamboos and rattans; from riches to rags, *Proc. Indian National Science Academy* **63**, 245–267 (1997).
4. K. N. Bahadur and S. S. Jain, Rare bamboos in India, *Indian Journal of Forestry* **4**, 280–286 (1981).

5. N. S. Adkoli, Bamboo in Indian pulp industry, in: *Bamboo in Asia and the Pacific*, pp. 250–254. IDRC, FAO and UNDP, Thailand (1994).
6. G. J. Sharma, Survey, collection and utilization of bamboo resources, Final technical report submitted to the G. B. Pant Institute of Himalayan Environment and Development, Almora, India (1996).
7. V. P. Agarwala, *Forest of India*. Oxford and IBH, New Delhi (1985).
8. *Statistical Bulletin of Manipur Forest*. Forest Department, Govt. of Manipur, India (1999–2000).
9. P. K. Singh and H. B. Singh, Superstition in botanical folklore with reference to Meitei culture, *J. Econ. Taxon. Bot., Add. Series* **12**, 367–372 (1996).
10. B. M. Sharma, Ecological studies of the forests of Manipur, *Frontier Botanist* **1**, 53–68 (1987)
11. Census, *Statistical Abstracts of Manipur*. Govt. of Manipur, India (2001).
12. Y. M. L. Sharma, Bamboos in the Asia-Pacific Region, in: *Bamboo Research in Asia*, G. Lessard and A. Chouinard (Eds), pp. 99–120. IDRC, Canada (1980).
13. T. C. Upreti and R. C. Sundriyal, Bamboo and cane resources of Arunachal Pradesh: Utilization pattern and implications for management, *Bamboo and Science Culture* **15** (1), 20–34 (2001).
14. R. V. Singh, Solution of energy crisis in rural areas lies in farm forestry, *Indian Forester* **104** (7), 465–468 (1978).

Copyright of Journal of Bamboo & Rattan is the property of VSP International Science Publishers and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.