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Utilization Pattern of Bamboo in North Eastern Region of India

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ABSTRACT

The study was conducted in the states of Assam and Meghalaya of India in the year 2020-21. Total 380 respondents were selected using multistage sampling method. The states Assam and Meghalaya, were selected purposively based on availability of processing units and highest productivity, respectively among the North Eastern states. The utilization pattern was classified into household, construction, handicraft, agricultural purpose, and food and other uses. The results indicated of total of 42062 numbers of bamboo culms were utilized by sample respondents. The construction uses contributed highest number of culms and accounted of 35541 numbers (84.50%), followed by household uses 4001 culms (9.51%) and agricultural uses 1350 culms (3.21%). The food consumption was observed of 2.11 per cent while for making handicraft products use was only 0.62 per cent of the total uses. The least bamboo was utilized in the musical instruments (0.05%). The use of bamboo would remain a vital part of the livelihood of people of the region. Therefore, with advancement of technology, trainings and support from government schemes on bamboo in the region would provide ample scope to develop new products and marketing opportunities and thereby generating employment and income to the youth.

INTRODUCTION

Bamboo is the fastest growing plant in the world (FSI, 2017). India has 30 per cent of the world's bamboo resources (FSI, 2017) with the world's largest growing area of 16 million hectares and is producing a total of 39458 million culms with equivalent weight of 278 MT (FSI, 2019). Because of its diversified uses, the bamboo is now addressed with different names such as 'the plant with thousand faces', 'friend of the people' and 'green gold of forests', which was earlier popular as 'poor man's timber' (Goyal & Brahma, 2014). It is used for house construction, bamboo ply, agricultural implements, handicraft, irrigation, brooms, medicine, food, fuel, fodder, paper and pulp, especially bamboo as a perfect substitute for some wood based products (Ingram et al., 2011; Tamang et al., 2013; Sharma et al., 2018). The usual consumption pattern of bamboo in India indicated that 30 per cent of bamboo being consumed by pulp and paper industries (Borah et al., 2008) but the consumption has dropped from 50 per cent to 18 per cent in paper industry over the last four decades while increasing the supply of raw culms (40-63%) (Tambe et al., 2020). Bamboo craft has been practiced by the North Eastern states of India for centuries as their prime livelihood and income source (Unais et al., 2017). Forest cover in NER constitutes 65.05 per cent of its geographical area as compared to the national forest cover of 21.67 per cent. The region along with West Bengal contributes 50 per cent of the bamboo area of the country (FSI, 2019). The region harbour nearly 90 species of bamboos, 41 of which are endemic to the region (Loushambam et al., 2017). The economy of North Eastern states

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of India, especially hilly states depends on organic crop production (Rajavardhan et al., 2020) as it is known to be organic hub of India (Chiphang et al., 2022), animal husbandry (Das et al., 2020), and also on non-timber forest products (NTFP) like bamboo, rattan, broom grass (Tiwari, 2000), bay leaf (Singh et al., 2021) *etc*. Bamboo is grown naturally in the forests and also homestead cultivation is practiced in few parts of the region. Therefore, the study was conducted with the objective to study the different uses of bamboo in the North Eastern Region of India at household level.

METHODOLOGY

The study was carried out using multistage sampling technique. The state Assam and Meghalaya were selected among the North Eastern purposivly. Assam was considered based on the availability of processing units of bamboo such as paper mills, furniture making units, handicraft units which collected bamboo from all other North Eastern states. Meghalaya was selected based on the highest productivity (19.28 ton/ha) of bamboo among all the North Eastern states (FSI, 2017). In Assam, Barpeta and Nalbari district were selected purposively based on highest producer of variety of products with involvement of very large group of artisans/ stakeholders. In Barpeta district, one block was selected purposively as there was highest concentration of the stakeholders available and total of 130 respondents were taken randomly using proportionate sampling method. Similarly in Nalbari district, two blocks were selected purposively and a total of 150 respondents were drawn randomly.

In case of Meghalaya, East Khasi Hills and Ri Bhoi districts were considered based on the pilot survey data which indicated maximum number of stakeholders engaged in the bamboo business among all the districts. In the East Khasi Hills district two blocks were selected purposively based on the concentration of the stakeholders and from each block one village was selected randomly for the study. Similarly in Ri-Bhoi district, Umsning block was selected and two villages were selected randomly. A total of 47 respondents from Ri-Bhoi, and 53 respondents from the East Khasi Hills districts were drawn randomly. Therefore the total sample respondents was summed up to a total of 380 from both the states. Primary data was collected from the sample respondent during 2020-21 through a pre-tested schedule comprising of the use of different products of bamboo, species used and the market price of the products. Simple percentage analysis was applied by taking the total number of bamboo culms used as hundred per cent.

The commercial uses of bamboo were classified into categories given by Unais et al., (2017) as; Household (bamboo furniture, baskets, broom, firewood, etc.), Construction (bamboo houses, scaffolding, bridge and fencing), Handicraft (wall hanging, flower vase, tray, show pieces), Agricultural purpose (grain storing basket, bamboo as support to crop, winnowing tray, ladder, fish traps and collecting baskets, honey collecting baskets etc.) and Food (traditional cuisine in the form of fresh, fermented, dried, shredded or pickled) (Padhan, 2015).

RESULTS AND DISCUSSION

The key bamboo uses in the study area included bamboo house construction, residential fencing, furniture, agricultural purpose, food, fuel and other minor cottage industry handicraft products like basketry, tray, showpiece, lamp and flower vase (Chihongo et al., 2000). The results indicated total of 42062 numbers of culms which were utilized by sampled respondents. The construction uses contributed highest number of culms and accounted of 35541 numbers (84.50%) to the total, followed by household uses 4001 culms (9.51%) and agricultural uses 1350 culms (3.21%). For food consumption, it was observed of 2.11 per cent while for making handicraft products its use was only 0.62 per cent of the total uses. The least bamboo was utilized in the musical instruments (0.05%). Hence, larger use of bamboo was found in construction work. Similar findings were reported by Gogoi (2020).

Household uses of bamboo

The use of bamboo at household level is further categorized into 11 uses namely, bamboo bed, sofa set, dining table, arm chair, sitting stool, broom, fuel, bamboo mat, basket, Polo and Khoh. Furniture use and making of different products has been reported highest use of bamboo culms followed by firewood and other traditional items (Table 1). Bamboo bed was prepared by artisans

Table 1. Household uses of bamboo

Uses	Species	Market price (Rs)	n	No. of bamboo culms
Bed	*Bambusa pallida, Bambusa nutans, Dendrocalamus hamiltoni*	20000-35000/unit	39(10.26)	653(1.53)
Dining table	*B. nutans, B. pallida*	12000-15000/unit	35(9.21)	280(0.67)
Arm chair	*Melocanna baccifera, Dendrocalamus strictus, B.nutans*	1000-1500/unit	44(11.57)	225(0.53)
Sofa set	*B.nutans, B. balcoa*	15000-25000/unit	50(13.15)	353(0.84)
Sitting stool	*B.nutans, B. balcoa*	500-600/unit	105(27.63)	155(0.37)
Firewood	All the species	50/bundle	380(100)	2090(4.97)
Broom	*B.tulda, B. pallida*	100-150/unit	380(100)	38(0.09)
Mat	*B.nutans*	250-300/unit	380(100)	198(0.47)
Basket (Khorahi)	*B.tulda*	100-150/unit	380(100)	291(0.69)
Polo	*Bambusa jaintiana*	120-200/unit	100(26.31)	98(0.23)
Cone basket (Khoh)	*Bambusa jaintiana*	150-200/unit	100(26.31)	101(0.24)
Sub total				4001 (9.51)
Total				42062(100)

Note: Figures in the parentheses indicate percentage to total; *Source:* Field Survey (2020-21)

using 15-16 numbers of bamboo culms from three different species of bamboo namely *Bambusa pallida, Bambusa nutans and Dendrocalamus hamiltonii* for commercial as well as home usage. The market price of such per bed ranged from Rs 20000-35000. On an average, total 653 (1.53% of total) numbers of culms were used by 10.26 per cent of respondents for bed making purpose. Similarly, dining table was made using *B. nutans and B. pallida* contributing to an average 280 numbers of culms. About 9.21 per cent of respondents were using dining table made of bamboo in their house. The price of the dining table was observed and prevailed in the market of Rs12000-15000/unit. Sofa set was found to be used by 13.15 per cent of respondents contributing to 350 numbers of bamboo culms use. It was prepared by the artisans using average 7 number of culms of the bamboo species of *B. nutans* and *B. balcoa* per sofa set. For the sofa set, the price was Rs 15000-25000/unit.

Arm chair and sitting stool were other furniture products which were lower priced compared to other products and it ranged from Rs. 1000-1500/unit and Rs. 500-600/unit, respectively. Bamboo species, *viz*, *Melocanna baccifera, Dendrocalamus strictus* and *B. nutans* were used to make arm chair which added upto an average 225 number of culms. On the other hand, 155 numbers of culms were used for making sitting stool from the bamboo species of *B. nutans, B. balcoa*. These results have been supported by Abdullah et al., (2019). Bamboo was used as firewood by all the respondents and its contribution was estimated of 4.97 per cent. All species of the bamboo when dried up used as fuel for cooking and other purposes. It has good fuel qualities like high heat values and volatile contents, as well as low ash and moisture content (Sharma et al., 2018). Bamboo mat, broom and baskets *(khorahi)* were used by all the respondents where it contributed to 198 culms (0.47%), 38 culms (0.09%) and 291 culms (0.69%), respectively. The market price of bamboo broom was observed as Rs 100-150/ unit, bamboo mat 250-300/unit and baskets were ranged from Rs. 100-150/unit, The bamboo species namely, *B. bambos, B. balcooa, B. nutans, B. tulda, B. jaintiana, B. cacharensis, D. hookeri, D. strictus, D. sikkimensis, D. hamiltonii, M. baccifera,* were used by a large population of rural Meghalaya as the principal construction material for building houses, for making mats, baskets, and handicrafts and as food (Lynser et al., 2014). *Polo* and *Khoh* were traditional bamboo baskets made in different forms for various uses in the state of Meghalaya. It was prepared using the bamboo species of *Bambusa jaintiana* (Skhen). The market price of these products ranged from Rs 100-200 based on the sizes. Nongkynrih et al., (2019) also reported similar uses of bamboo in Meghalaya.

Bamboo uses in construction and scaffolding

The highest share of bamboo used was in construction and scaffolding purpose. In rural areas of the NER, bamboo houses played important role in providing shelter, and bamboo for basic requirements like scaffolding, fence and bamboo bridges. All the respondents used bamboo for the same purposes in a larger quantity that made to the largest contribution in the utilization of 35541 culms (84.50%) (Table 2). Out of the this, 48.65 per cent (20462 culms) of bamboo were used for house construction, 25.91 per cent for scaffolding and 8.52 per cent for fencing purpose. Bamboo bridges were prevalent in the rural and hilly areas used on an average of 594 culms (1.41%). Similar studies reported by Kumar et al., (2017); Li & He (2019) on uses of bamboo by local communities to build their houses, scaffolding and fencing of bamboo and bamboo poles were also used as foot bridges over rivers and creeks in the rural areas (KoLwin & Garcia, 2015).

Bamboo uses in handicraft products

There were different handicraft products prepared and used by the respondents. Among them, most common products used in the households were documented (Table 3). *B. pallida, B. nutans* were the bamboo species commonly used for making the handicraft products. Tray contributed around 533 numbers of culms and 75 per cent of respondents used tray at their home and the market price was Rs. 200/unit. Similarly, the market price of the table lamp

Table 2. Bamboo uses in construction and scaffolding

Uses	Species	Market price (Rs)	F	No. of bamboo culms
Bamboo house	*B. tulda, B. pallida*	100-120/culm	380(100)	20462(48.65)
Scaffolding	*B. tulda, B. pallida*	100-120/culm	380(100)	10900(25.91)
Fencing	*B. tulda, B. pallida*	100-120/culm	380(100)	3585(8.52)
Bridges	*B. tulda, B. pallida*	100-120/culm	23(6.05)	594(1.41)
Sub total				35541(84.50)
Total				42062(100)

Note: Figures in the parentheses indicate percentage to total; *Source:* Field Survey (2020-21)

Table 3. Bamboo uses in handicraft products

Uses	Species	Market price (Rs)	F	No. of bamboo culms
Tray	*B. pallida, B. nutans*	200/unit	285 (75.00)	53(0.13)
Flower vase	*B. nutans*	80-100/unit	285(75.00)	34(0.08)
Showpiece	*B. pallida, B. nutans*	100-150/unit	276(72.63)	107(0.25)
Lamp	*B. pallida, B. nutans*	250-600/unit	254(67.10)	59(0.14)
Sub total				261(0.62)
Total				42062 (100)

Note: Figures in the parentheses indicate percentage to total; *Source:* Field Survey (2020-21)

was Rs. 250-600/unit according to the sizes and contributed 0.14 per cent of total utilization. Flower vase contributed lowest among all the handicraft products of bamboo (0.08%). The market price per unit ranged from Rs. 80-100 and 75 per cent of the respondents were using flower vase in their houses. Showpieces like pipe scenery, wall hanging contributed highest 107(0.25%) culms, costing around Rs. 100-150/unit. About 19 per cent of the bamboo is used in handicrafts all over India (Gogoi, 2020). Similar study by Gauli et al., (2018) supports this implication.

Agricultural uses of bamboo

Bamboo has different uses in agricultural purpose (Table 4). Among all the uses fish trap and fish collecting basket, honey collecting basket were mostly used by the respondents of Meghalaya. These products made upto 0.16 per cent, 0.18 per cent and 0.38 per cent respectively. Commonly *B. tulda and B. jaintiana* were used for making different products of agricultural purpose. Bamboo as *support to crops* was used by all the respondents for different crop production and on an average contributed 414 number of culms (0.98%). Traditional umbrella (*Halua Japi* in Assamese/ *Knup* in Khasi) used for land preparation and other activities by the farmers prepared using bamboo and leaves of a palm tree (*Trachycarpus martianus*) contributed of 0.29 per cent to total use which market price was Rs. 50-70/unit. Ladder is one of the important products prepared from bamboo in the region and 26.31 per cent respondents used in their household adding upto an average 220 number of culms. Market price for a ladder made of three bamboo culms rise upto Rs. 210/unit. Winnowing tray was used in every household of the respondents. It contributed on an average of 28 culms (0.07%) to the total. The market price was observed of Rs. 150-200/unit. Similarly, the market price of the grain storing basket was Rs. 500-800/unit and used around 266 (0.63%) number of bamboo culms by 86.31 per cent of total respondents.

Food and other uses of bamboo

Bamboo shoots have been used as food in all the states of NER. Bamboo shoots harvested were consumed or sold as unprocessed fresh shoots but only processed shoots were consumed at home (Hogarth & Belcher, 2013). In Meghalaya, all the respondents reported use of bamboo shoots for consumption, on the contrary in Assam, a very few were consuming bamboo shoots (Table 5). The bamboo shoots of different species like *B. balcoa and M. baccifera* were used as food. It was consumed in raw form (0.93%) by 31.50 per cent respondents, fermented shoot (0.80%) by 26.31 per cent and as pickle (0.39%) by 25 per cent respondents, which was prepared with oil, chilli and different spices. Bamboo pickle production and sale on a tourist spot in Meghalaya alone reported at 1,170 kg to 2,210 kg per annum (Gogoi, 2020).

It was identified that musical instruments were some other major products of bamboo used by the respondents (Table 5). *Gogona* (Assamese traditional) is an instrument prepared from bamboo used in the folk music (*Bihu*) of Assam. *Flute* was used in both the states as traditional musical instrument and contributed 0.04 per cent of total use whereas *Gogona* contributed very negligible quantity (0.01%). Similar study by Sharma et al., (2008) mentioned that, traditional musical instruments such as *flutes, rattles, wind chimes* were prepared from bamboo.

Table 4. Agricultural uses of bamboo

Uses	Species	Market price (Rs)	F	No. of bamboo culms
Fish Trap	*B. tulda*	100-150	153(40.26)	66(0.16)
Fish container	*B. tulda*	100-150	153(40.26)	76(0.18)
Support to crop	All the species	70-150/culm	380(100)	414(0.98)
Umbrella (Halua Japi/Knup)	*B. tulda*	50-70/unit	150(39.47)	120(0.29)
Ladder	*B. tulda, P. mannii Gamble*	210/unit	100(26.31)	220(0.52)
Honey collecting basket	*P. mannii Gamble*	100-150/unit	50(13.15)	161(0.38)
Winnowing tray	*B. tulda*	150-200/unit	380(100)	28(0.07)
Grain storing basket	*B. tulda*	500-800/unit	328(86.31)	266 (0.63)
Sub total				1350 (3.21)
Total				42062(100)

Note: Figures in the parentheses indicate percentage to total; *Source:* Field Survey (2020-21)

Table 5. Food and other uses of bamboo

Uses	Species	Market price (Rs)	F	No. of bamboo culms
Raw bamboo shoot	*B. balcoa, M. baccifera*	20-30/shoot	120 (31.5)	390(0.93)
Fermented Bamboo shoot	*B. balcoa, M. baccifera*	150/kg	100(26.31)	337 (0.80)
Bamboo shoot pickle	*B. balcoa, M. baccifera*	100/150gm	95(25.00)	163(0.39)
Sub total				890 (2.11)
Musical instruments				
Flute	*D. strictus*	500/unit	17(4.47)	17(0.04)
Gogona (Assamese traditional)	*B. tulda*	150-300/unit	30(7.89)	3(0.01)
Total				42062(100)

Note: Figures in the parentheses indicate percentage to total; *Source:* Field Survey (2020-21)

CONCLUSION

Bamboo being one of the most important NTFP in the livelihood of the rural people of the NER of India was found to be used in more for the construction purposes. The study revealed that use of bamboo for engineered products and value-added high-quality products along with traditional products were negligible despite rising global demand for it. Therefore, it is recommended that the artisans/ stakeholders need to get acquainted to the demand for value added products in the global market especially the youth to be encouraged to produce and market it to have a better income and living. Alongside, hands on training for product development, use of new machines and tools, information on market linkages at global level need to be taken into consideration by the state governments of the NER.

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