BAMBOO UTILIZATION IN SOUTHERN INDIA

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Introduction

Bamboo, a dependable source of woody raw-material, is closely related to cultural ethos of rural and urban India. It also has religious sanctity because of its use in Hindu customs especially for carrying dead bodies. As such bamboo is rarely burnt for fuelwood purpose. Man understood the form of the bamboo culm and made use of it for various purposes even without having the backup of scientific data. Apart from its association with religious customs, it has a number of uses, since ancient times, especially in the rural sector. However, with the advancement of science, bamboo started finding multifarious uses on a large scale based on culm form and quality parameters *vis-à-vis* strength properties.

Bamboo is represented by 23 genera and 125 species and constitutes 12.8% of the total forest in India (Solanki, 2003). India is second to China in bamboo production (approximately 4.5 million tonnes). Although the highest growing stock is from North-East states of India (66.6%), the other states also have small to considerable growing stock of bamboo like Madhya Pradesh (12%), Orissa (7%), Maharashtra and Karnataka (5% each), Andhra Pradesh (2%) and other states 5% (Solanki, 2003).

Dendrocalamus strictus and *Bambusa bambos* are major genera occurring throughout Southern India. Another genus, *Ochlandra,* is used extensively in Kerala for making mats, boards and artifacts.

The over-exploitation of timber resources throughout the world, including India and restrictions laid on tree felling resulted in more focused research on bamboo production, cultivation and utilization in recent times. Many traditional uses of bamboo not only need documentation but also scientific acceptance before large scale plantation activities are envisaged. The importance of bamboo needs no over emphasis for the following reasons :

- Bamboo yields 6 times more cellulose than fast growing trees.
- Bamboo is used worldwide by approximately 2.5 billion people.
- One billion people are living in bamboo houses.
- The form and properties of the culm make bamboos unique and with use of minimum number of simple tools, many products can be made.
- In India, about 432 million workdays

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are generated annually, because of Bamboo. It is a good substitute of wood in panel form.

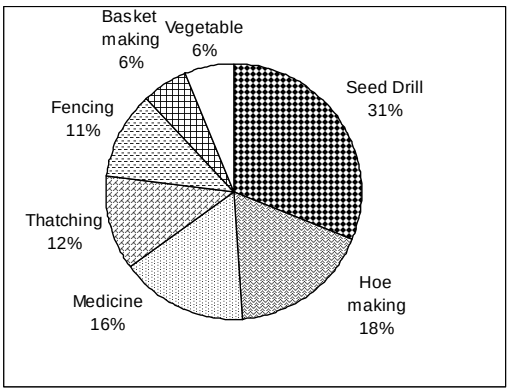
- The largest consumer of bamboo is paper and pulp industry followed by handicraft and agricultural sector.

Apart from many routine uses of bamboo which are known, the present paper describes a few other specialized uses of bamboo in aquatic environment, agriculture and socio-religious functions which are traditionally carried out in some states of Southern India besides recent developments in bamboo products. The paper further highlights the need to generate research data on other genera not investigated including bamboo improvement. The need for training and experience of Institute of Wood Sscience & Technology, Bangalore (Karnataka) is also touched upon.

Bamboo Utilization in Southern India

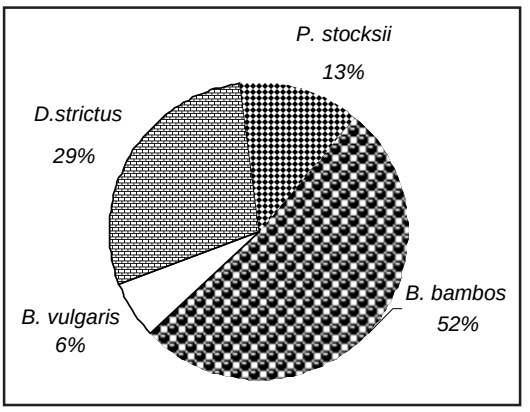
Agricultural sector : About 40% of bamboo is consumed for housing and other rural uses. In rural construction, bamboo apart from palm is used as scaffolding and rafters. Generally, the bamboo culms are coated with mud and dung as a preventive measure against attack by biological agencies. Apart from housing, certain quantity of bamboo goes into making of agricultural implements. According to Krishna (pers. comm.) based on a survey made in North Kanara Circle of Karnataka, 49% of bamboo is used for making agricultural implements whereas the remaining 51% is used for other purposes as shown in Fig. 1a. *Bambusa bambos* (*B. arundinacea*) is the most preferred species by farmers (big farmers - 26%, marginal farmers - 39% and small farmers - 35%) followed by *Dendrocalamus strictus, Pseudoxytenanthera stocksii* and *Bambusa vulgaris* (Fig. 1b). Fig. 1c and 1d show species preference for seed drills and hoe making. While *D. strictus* is the most preferred species (55%) for hoe making, *B. bambos* (59%) used for making seed drills. No specific reason has been attributed for species selection with reference to agricultural implements. A model of agricultural implement used in North Kanara is shown in Plate 1 (a). Scientific data has to be generated on these

Fig. 1a



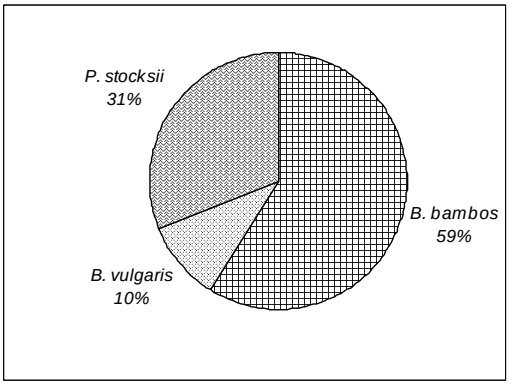
Different uses of Bamboo

Fig. 1b



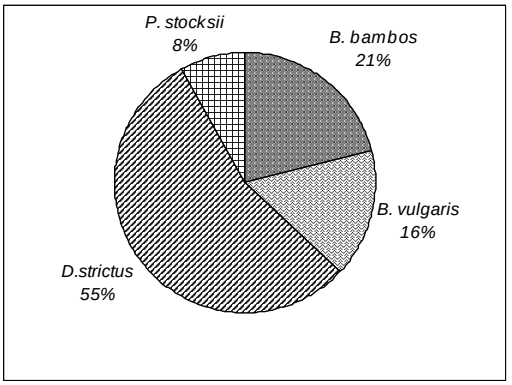
Farmers' preference for bamboo species

Fig. 1c



Species preference for seed drills

Fig. 1d



Species preferred for Hoe making

aspects not only on the genera mentioned above but also on other genera from other parts of the country.

Bamboo in Aquatic Environment : India is bestowed with vast coastline and also gifted with long stretches of rivers apart from canals and wetlands. Although, a variety of timbers are used as a means of transport like boats, ships catamarans and canoes etc., bamboos are also used as oars and mast. In Andhra Pradesh, the Kolleru (16°32' - 16°57' N, 81°5' - 81°2' E) lake ecosystem is unique with a water spread of 674 km² having considerable, economic, cultural, scientific and recreational value. It supports a population of 2 lakh people in its 46 bed (island) and 76 belt (bordering) villages. The prime occupation of people in the 'bed' villages is fishing having scope for aquaculture.

The fishing community utilizes bamboo for items like fishing traps, fishing nets, fishing rods, float for nets, rafts and flag poles. In Kolleru lake system bamboos are mostly used for basket fish traps (called in Telugu 'mavulu') for trapping fishes. About 6 lakh bamboos were required per annum (Rao *et al*., 1992). Another use of bamboo is 'bamboo screens'. The fishermen of 'bed' villages construct huge fence like bamboo screens locally called 'dadikattus' which may run from 100 m to 5-10 km at a stretch, to differentiate and demarcate community-wise and village-wise boundaries. This is a unique method followed where bamboo form is used in aquatic condition as it is not possible to draw physical demarcation in a water system. About 12 lakh numbers of bamboos are required for this purpose annually. Apart from the above uses, about 10 lakh bamboos were also used for making baskets to transport fish to different destinations and about 3 lakh bamboos were used for making watchmen sheds. In this area alone about 31 lakh bamboos were annually required, out of which 18 lakh were used entirely for under water purposes (Rao *et al*., 1992). *D. strictus* was the widely used species although *D. hamiltonii* and *Bambusa bambos* were occasionally used. Most of these bamboos are used without proper treatments. As such frequent replacements were common (Rao *et al*., 1992). The Kolleru lake system was thus

unique in using bamboo for different purposes (Plate 1 B & C).

Bamboo use in socio-religious functions : Bamboo weaving community makes bamboo ladders ranging from different sizes for domestic and industrial purposes. There is no statistics on the exact number of ladders made and the quantum of requirement of raw material. Apart from making baskets the weaving community also make a product locally called 'mora' in Kannada, 'chaata' in Telugu, 'muram' in Tamil and Malayalam, 'sup' in Marathi and Hindi (Plate 1D). This item is extensively used in rural India for separating husk/seed/seed coat/small stones/debris from food grains or grams or condiments. Huge quantity of these plates is used in many parts of India. The special importance in Karnataka, Maharashtra, Andhra Pradesh and Tamil Nadu during festive seasons like 'Swarna Gowri', 'Ganesha Chaturthi', which fall in the month of Bhadrapada of the Hindu calendar year (August-September), is that the plate along with cereals, bangles and jaggery are offered to ladies as a token of respect and prosperity. Thousands of such plates, an income generating activity to the weaving community, are exchanged during this season. The plate is made from bamboo slivers and the tradition is very ancient. Even to day the tradition is followed in most of the parts of Southern India.

Bamboo use in Sericulture and Agarbathi Industry : Bamboo is extensively used in sericulture sector in South India. Woven baskets called 'thatte' for gathering mulberry leaves, circular trays for feeding living larvae, mounts for production of cocoons, trays called as 'chandrika' for cocoon storage, stifling baskets for steaming of cocoons and woven mats are the main uses of bamboo apart from minor uses in the production of silk (Plate 2A). About 1.4 million man days per year in extracting and transporting bamboos, leading to earning revenue of Rs. 933 million per year by manufacturers of bamboo products are some of the statistical data available for this sector (Adkoli, 2002).

The State of Karnataka is also famous for manufacture of agarbathi using bamboo sticks which is a source of employment for thousands of people under cottage industry (Plate 2B). Although, ingredients like fragrance, binding material, charcoal powder are used from local source, bamboo sticks are obtained from North-eastern states of India. The industry in India is estimated to provide income to 0.5 million people on contract or sub-contract basis and expected to generate approximately Rs. 7.1 billion. National Council of Applied Economic Research (NCAER) based on a market survey showed that the country had produced 147 billion sticks valued at around Rs. 7 billion (Hanumappa, 1996).

Bamboo products : Although bamboo has the potential to be used in furniture making, because of certain Hindu customs, has not become popular. However, bamboo along with plantation grown hardwoods can be tried for making furniture as suggested by Sastry (2000). Institute of Wood Science and Technology, Bangalore experimented on this concept and fabricated a wooden sofa where plantation grown *Acacia auriculiformis* was used in making legs and seat and round culms of *B. bambos* were used as hand rests and back rest (Plate 2C). This hybrid furniture has tremendous potential and can be used as an alternative to traditionally used timbers for furniture. Any replacement

with bamboo will bring ethnic touch and reduces the use of hardwoods and cost.

Use of traditional hardwood veneers has in recent times got reduced drastically due to non-availability of raw material from natural forests and also use of low quality plantation grown timbers. Bamboo Mat Board (BMB) and Bamboo Mat Veneer Composites (BMVC) made from the woven slivers developed by IPIRTI, Bangalore which is cost effective has been found to be a good replacement for plywood. This sector is expanding and generating more than 2.5 million man days annually and likely to generate 16.7 million days of work each year. BMB has potential uses in house construction, transportation, packing cases, storage bins, furniture etc. It is a good source to pre-fabricate houses for use during disasters (Anon., 1998). In recent times IPIRTI has come out with floor tiles using bamboo strips for flooring. Again it is a good substitute for solid wood (Thanigai *et al.,* 2007).

Research needs

Considering the species diversity of bamboo in India the amount of data generated on anatomical and strength properties of different species is scanty (Tewari, 1992; Chauhan *et al*., 2000; Rao *et al*., 2005). Similar to other forestry species, bamboos also have low productivity in India. While research is required to be carried out to understand variation in bamboo quality in general, it is equally important to evaluate the culm quality of selected species of bamboos based on species improvement programme which may form future source for massive plantation activity. Keeping the points mentioned above work was initiated on *Pseudoxytenanthera stocksii* a species which is extensively used in Karnataka and Maharashtra and Candidate Plus Clumps (CPCs) of *B. bambos* and *D. strictus* at Institute of Wood Science and Technology (IWST), Bangalore (Rao *et al.,* 2004). The studies revealed that certain properties of *P. stocksii* were better than *B. bambos* and *D. strictus* (Table 1) and can be used roofing for huts, tent poles, walking sticks, umbrella handles, javelin poles and basket weaving (Rao *et al. ,* 2005).

Table 1

Comparative strength properties of P. stocksii with other bamboos

Species	Basic density (gm/cm^3)	MOR (kg/cm^2)	MOE ($1000kg/cm^2$)	MCS (kg/cm^2)
Pseudoxytenanthera stocksii	0.7 (0.61-0.83) a	620 (210- 900) a	98.6 a	386 (193- 660) a
Oxytenanthera abyssinica	-	836 c	150 c	466 c
Bambusa bambos	0.60 b, 0.56c	583 c, 655 b	39.5 c, 53 b	353c, 523 b
Bambusa nutans	0.630 c	529 c	66.2 c	456 c
Dendrocalamus strictus	0.69b, 0.63 c	734 c, 936 b	120 c, 123 b	359 c, 635 b

Sources : a = Rao *et al*., 2005; b = Chauhan *et al*., 2000; c = Rajput *et al*., 1992.

For bamboo improvement programme, a number of criteria have been identified for the selection of candidate plus clumps keeping the end use in view (Mohinder Pal, Pers. comm.). Preliminary results obtained on selected CPCs of 2 year old *B. bambos* based on selected criteria showed that among the mechanical properties tested (Table 2), CPC 110 for FS at EL, CPC 111 for MOR and CPC 3 for MOE have the highest values and the corresponding lower values were found in CPC 7 and CPC 111 for MOE. The best specific gravity values were found for CPC 110 and the CPC 3 and the lowest was found for CPC 66. A comparison of mechanical properties of CPC with published data of non-CPC (Table 3) indicated that wide variations in both the categories, which may be due to factors such as locality, age, external diameter, culm wall thickness, position within the culm and moisture content as was indicated by Rajput *et al*. (1992). Considering the classification adopted by Rajput *et al*. (1994) for structural purposes on the basis of MOR and MOE, in green condition, the CPCs fall under Group I. In general, the mechanical properties of certain young CPCs were better than non-CPC culms. Extensive research is required in selection of CPCs of bamboo genera and generate data on strength properties as indicated in the present work so that future

Table 2

Physical and mechanical properties of CPCs of Bambusa bambos

Property	CPC No.					Remarks
	3	7	66	110	111	
Specific gravity	0.679	0.555	0.521	0.688	0.550	*
FS @ EL (kg/cm^2)	539.000	389.000	456.000	787.000	622.000	*
MOR (kg/cm^2)	827.000	591.000	609.000	945.000	985.000	*
MOE (1000 kg/cm^2)	172.800	100.400	117.100	156.100	98.100	*

* Significant at 5% probability; Source: Rao *et al*. (2005)

Table 3

Comparative strength properties of CPCs with culms of non-CPC of Bambusa bambos as tested from different localities*

Property	Dehra Dun* Uttarakhand	Haldwani* Uttarakhand	Kerala*	W. Bengal*	Sirsi, Karnataka**
Specific gravity	0.623	0.579	0.579	0.592	0.521 - 0.688
FS@EL (kg/cm^2)	441.000	818.000	275.000	210.000	389 -787
MOR (kg/cm^2)	805.000	1268.000	778.000	582.000	591 - 985
MOE (x1000 kg/cm^2)	98.280	161.500	53.700	37.600	98.1 - 172.8

* Source: Shukla *et al.* (1988). Original data of non-CPC culms was recast after adjustments to 12% moisture content for comparison with the present study.
**Rao *et al.* (2005)

plantations of bamboo will have improved productivity and quality.

Interface between R&D Institute, GoI, resource dependent community for improvement in product development through training : Angamally cluster is unique in Kerala where semi-literate and highly skilled persons in large numbers by training or by tradition depend on their livelihood for making bamboo mats and handicrafts. More than 25,000 artisans are involved in bamboo mat weaving and craft using basic raw material of *B. bambos* and *Ochlandra travancorica* which are available in plenty and supplied by Bamboo Corporation (Mallikarjunaiah, pers. Comm.). In order to make Angamally bamboo cluster potential for export oriented quality products, a unique approach was made where the Office of the Development Commissioner, Handicrafts (Ministry of Textiles, GoI) sponsored a training programme in 2003 conducted by Institute of Wood Science & Technology, Bangalore an R&D organization, required to the artisans on application of scientific methods to bring awareness for efficient utilization of raw material. These artisans are semi-literate and the scientists were highly technical. Using an interpreter who could translate the scientific content into user-friendly local language, the science part of bamboo processing and utilization was conveyed. The programme was a big success and Office of the Development Commissioner was appreciative of transferring technology to user agency (Plate 2 D, E). These types of training are required for bamboo dependent community in order to sensitize the importance of application of science to semi-literate community for making quality products.

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SUMMARY

Bamboo occupies a prominent place in the socio-economic and cultural life of Indians. It has been a source of number of uses since ancient times. India is the second largest in bamboo production with the highest growing stock concentrated in the North-East states. This paper outlines the consumption pattern of different species of bamboo in various sectors like agriculture, aquatic environment, socio-religious functions, sericulture, agarbathi industry and furniture. It also emphasizes the importance of research on bamboo improvement programme to produce better quality material in terms of physico-mechanical properties and the role of training in efficient utilization of this unique raw material.

Key words **: Bamboo, utilization, R&D, training, Southern India.**

दक्षिणी भारत में बांसों का उपयोजन

आर० विजेन्द्र राव, एस०सी० गैरोला, एस० शशिकला व ए०के० सेठी

सारांश

बांसों को भारतीयों के समाजार्थिक और सांस्कृतिक जीवन में प्रधान स्थान मिला हुआ है। प्राचीन काल से ही यह अनेक उपयोगों का स्रोत बना चला आ रहा है। भारत बांसों का दूसरा सबसे बड़ा उत्पादकता है और

इसकी वर्धनशील संनिधि सबसे ज्यादा उत्तरपूर्वी राज्यों में संकेन्द्रित है। इस अभिपत्र में विभिन्न सेक्टरों जैसे कृषि, जलीय पर्यावरण, समाजधार्मिक कार्यों, रेशम कीटपालन, अगरबत्ती उद्योग और उपस्कर निर्माण में विभिन्न बांस जातियों के उपायोग की रूपसज्जा की रूपरेखा बताई गई है। इसमें भौतिक–संधारी विशेषताओं की दृष्टि तथा इस विलक्षण कच्चे माल को दक्षतापूर्वक उपयोग करने के लिए प्रशिक्षण की भूमिका को ध्यान में रख, श्रेष्ठतर गुणवत्ता वाली सामग्री उपलब्ध कराने में बांस परिष्कार कार्यक्रमों में अनुसन्धान कार्य कराने के महत्व पर भी बल दिया गया है।

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