

# Taxonomical Diversity, Socioeconomic and Ethnomedicinal Significance of *Bambusa* Schreber 1789 (Poaceae: Bambusoideae) in Forest Research Institute (FRI), Dehradun (Uttarakhand), India

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## ABSTRACT

Bamboo is a renewable and versatile resource, characterized by high strength and low weight, and is easily worked using simple tools. It is widely recognized as one of the most important non-timber forest resources due to the high socio-economic benefits from bamboo based products. Bamboo is the world's fastest growing woody plants with more than three times faster growth. There are about 100 genera and more than 1642 species of bamboo all over the world. In India there are 20 genera and 25 species documented so far. Bamboos are the members of the natural subfamily Bambusoideae, family Poaceae (grass family) under the class Monocotyledonae. Bamboos (the Giant members of the Grass family) are geographically distributed in the tropical and subtropical regions of the world with tall, erect and woody arborescent habits. The present study carried out in the New Forest, Forest Research Institute (FRI), Dehradun (Uttarakhand), India which have immense diversity in genus *Bambusa* Schreber. Sum of 10 species of *Bambusa* Schreber were recorded during investigations. The socioeconomic and ethnomedicinal survey reflected that, these contain antibacterial, anticancer and other profound pharmacological properties to cure several diseases. The largest culm sheath was observed in *Bambusa bambos* (12-30cm), while the smallest culm sheath in *Bambusa multiplex* (4-5cm). The present study will be an elementary platform to glimpse the wild and cultivated diversity with socioeconomic value of bamboo from a single geographical locality.

**Key words:** *Bambusa* sp., Bamboo, Poaceae, Taxonomical diversity, New Forest, FRI, Socioeconomic, Ethnomedicine, Culm sheath.

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## INTRODUCTION

Retzius in Sweden and Schreber in Germany recognize bamboo as a distinct genus in 1789, the former calling it *Bambos* and the latter *Bambusa*.<sup>[1]</sup> These are commonly called as Bamboo.<sup>[2]</sup> Bamboos are the giant member of the grasses belongs to Bambusoideae, family Poaceae

(grass family) under the class Monocotyledonae.<sup>[3-5]</sup> It varies in height from dwarf plant (30cm) to giant timber bamboos and can grow to over 100 feet (30m).<sup>[6]</sup> Bamboo is integral part of forestry but it is also widely spread outside forest including farmlands, riverbanks, roadsides and urban area.<sup>[7]</sup> Bamboo is naturally distributed in the tropical and subtropical belt and most commonly found in Africa, Asia, Central and South America as well.<sup>[8,9]</sup> Due to its essential uses it is called Bamboo Culture, Green Gold, Poor Man Timber, Bamboo Friend of the People.<sup>[10,11]</sup> Bamboos are known to be as tall, erect and woody arborescent grasses and considered as giant members of the grass family.<sup>[12]</sup> A well developed

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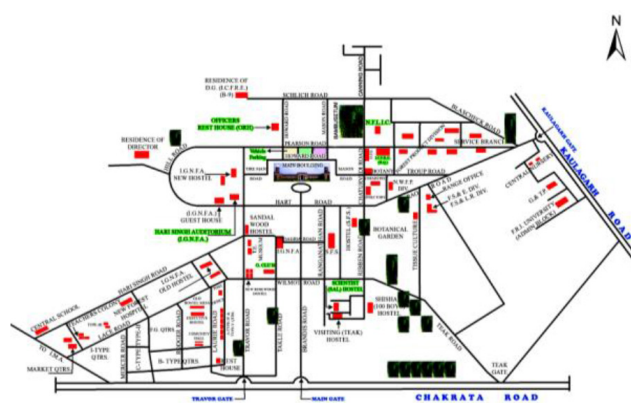
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rhizome system which supports the aerial portions, woody culms bearing the branch complements, petioles of the leaf-blade, the culm sheaths covering the new shoots and buds and the peculiar flowering and seeding behavior are some of the important morphological characters of bamboos.<sup>[13-15]</sup> The lodicules of bamboos are well developed. Single columned style with one, two, three or more stigmas, the presence of fusoid cells surrounded by strongly lobed, armed cells in the mesophyll are important features which separate bamboos from other grasses.<sup>[16-18]</sup> There is a characteristic mechanism of flowering in bamboo and most of the bamboos flower only once in their lifetime. The life span may vary from 7 years to 120 years.<sup>[19,20]</sup>

There are three large genera (*Bambusa*, *Dendrocalamus* and *Ochlandra*) of bamboos in India with more than 10 species of each on the basis of Gamble's monumental work *Bambuseae of British India*.<sup>[20,21]</sup> Apart from classical taxonomy many workers emphasised the importance of anatomy of leaf, culm, etc. in bamboo systematic.<sup>[22-23]</sup> These characters can be considered as supporting evidence for generic and specific delimitations. Epidermal anatomy of culm, leaves and nodal anatomy can also be used for the purpose of bamboo classification.<sup>[24,25]</sup> In India, bamboos account for around 12.8% of the total forest cover and are one of the largest bamboo resources in the world.<sup>[26,27]</sup> About 18 amino acids are present in bamboo when the shoot is boiled, cooled with salt gives high rich nutrition.<sup>[28,29]</sup> *Bambusa bambos* help in digestion and its buds of have estrogenic activity and antifertility activity in rats.<sup>[30,31]</sup> Their soft shoots of help in birth control and leaf extract use in bacterial diseases.<sup>[32,33]</sup> Their different parts contain oxalic acid, lysine, nuclease, riboflavin, thiamine, methionine and protein.<sup>[34-36]</sup> The Present study is based on the thorough examination of *Bambusa* sp. morphological and morphometrical attributes *viz.* plant height, culm sheath, blade length, ligule length, presence or absence of auricle, petiole length, inter-nodal length and leaf dimensions as well as socioeconomic and ethnomedicinal values at New Forest, Forest Research Institute (FRI), Dehradun (Uttarakhand), India.

## MATERIALS AND METHODS

Present study of diversity and distribution of *Bambusa* sp. Schreber (Family Poaceae, Subfamily Bambusoideae) based on survey done at New Forest, Forest Research Institute (FRI), Dehradun (Uttarakhand) India (Figure 1). Vegetation is deciduous and evergreen spread over more than 1100 acre area situated between N30°20'31.56" Latitude and Longitude E77°59'50.28" having expansion

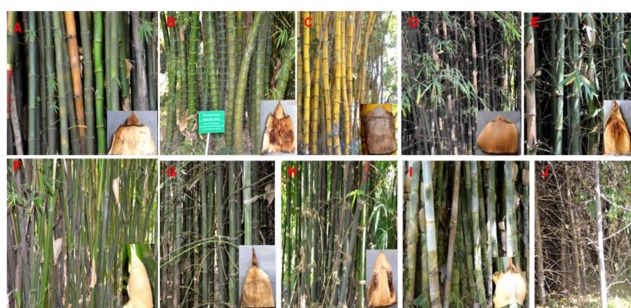


**Figure 1: Map showing site of investigation to workout phytodiversity of *Bambusa* sp. Schreber in Forest Research Institute (FRI), Dehradun (Uttarakhand), India.**

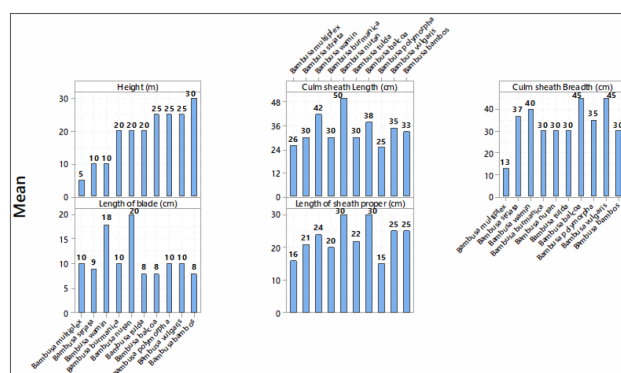
stretch up to 4.45km<sup>2</sup>. The climate is marked by hot summer, well distributed rainfall (360mm) during South-West monsoons and cold winter with less winter rain. During investigation overall campus thoroughly surveyed *viz.* Bambusetum, Botanical garden, Beeson Road, Canning Road, Chaturvedi Road, Circular Road, Parker Road, Takle Road, Hospital Road, Howard Road, Tierman Road, Lace Road, Teak Road, Trevor Road, Troup Road, Shalich Road and Rao Road. The wild as well as planted species of bamboos have been considered for study however, majority of bamboo species are planted only. For each species, detail morphology, morphotaxometry, phenology (literature based) having key taxonomic significance along the socio-economic and ethnomedicinal importance tabulated. The species was identified through relevant key literature and herbarium specimens housed in Systematic Botany Discipline, Forest Research Institute (FRI), Dehradun (Uttarakhand) India.

## RESULTS

The findings of the present work reflected that New Forest, Forest Research Institute (FRI), Dehradun is a rich source of bamboo *i.e.* *Bambusa* sp. Schreber. During investigation and thorough survey of the selected sites, about 10 species of *Bambusa* were spotted including *Bambusa vulgaris*, *B. wamin*, *B. striata*, *B. burmanica*, *B. balcoa*, *B. multiplex*, *B. nutan*, *B. tulda*, *B. polymorpha* and *B. bambos* (Figure 2). The findings were documented in the morphological and morphotaxometric attributes *viz.* plant height, culm sheath, blade length, ligule length, presence or absence of auricle, petiole length, internodal length, leaf dimensions against each species individually and well summarized in Table 1. The maximum leaf size 30x3 cm<sup>2</sup> was recorded in *B. striata*, however



**Figure 2: *Bambusa* sp. with culm sheath from FRI, Dehradun (Uttarakhand): (A) *B. vulgaris*, (B) *B. wamin*, (C) *B. striata*, (D) *B. burmanica*, (E) *B. balcoa*, (F) *B. multiplex*, (G) *B. nutan*, (H) *B. tulda*, (I) *B. polymorpha* and (J) *B. bambos* (culm sheaths not recorded as dead post gregarious flowering couple of year back).**



**Figure 3: Variation of critical parameters among species of bamboo at Forest Research Institute (FRI), Dehradun (Uttarakhand), India.**

**Table 1: Morphological and morphotaxometric attributes of different *Bambusa* sp. Schreber from Forest Research Institute (FRI), Dehradun (Uttarakhand), India. (Where: L, Length; B, Breadth; m, Meter; cm, Centimeter; mm, millimeter)**

S.No.	Botanical name	Height of culm (m)	Culm sheath					Inter-node (L) cm	Leaf	
			Culm sheath (LxB) cm <sup>2</sup>	Blade (L) cm	Sheath proper(L) cm	Ligule (mm)	Auricles		Leaf (LxB) cm <sup>2</sup>	Petiole (mm)
1.	<i>Bambusa vulgaris</i>	20-25	35x45	10	25	6-8	Two auricles, subequal	25-30	25x2	5-8
2.	<i>Bambusa wamin</i>	8-10	42x40	18	24	5-8	Two auricles, ciliated	10-15	25x3	5-7
3.	<i>Bambusa striata</i>	8-10	30x37	9	21	5-7	Two auricles, subequal	20-25	30x3	5-7
4.	<i>Bambusa burmanica</i>	10-20	30x30	10	20	4-5	Two auricles, ciliated	25-40	20x2	1-2
5.	<i>Bambusa balcoa</i>	20-25	38x45	8	30	5-7	Very small auricles	30-35	25x5	1-2
6.	<i>Bambusa multiplex</i>	4-5	26x13	10	16	1-2	Small auricles	20-45	25x3	1-2
7.	<i>Bambusa nutan</i>	15-20	50x30	20	30	1	Two unequal auricles, fringed	40-45	25x3	1
8.	<i>Bambusa tulda</i>	15-20	30x30	8	22	1	Small auricles	48-50	21x2	1-2 (hairy)
9.	<i>Bambusa polymorpha</i>	16-25	25x35	10	15	1	Two unequal auricles, continuous with blade	40-60	18x2	2-3
10.	<i>Bambusa bambos</i>	12-30	33x30	8	25	5-8	Not observed *	20-40	30x2	1-2

\*As the *Bambusa bambos* present in FRI is dead post gregarious flowering couple of year back. However other observations viz. height, culm sheath, leaves and internode length were measured from the dead remains.

the minimum leaf size 18x2 cm<sup>2</sup> documented in *B. polymorpha* (Figure 3). Mean while the height of culm was enumerated maximum in *B. vulgaris*, *B. balcoa* (20-25 m) while minimum in *B. multiplex* (4-5 m) (Figure 3). The peak culm sheath size was observed in case of *B. wamin* (42x40 cm<sup>2</sup>), on contrary minimum in

*B. multiplex* (26x13 cm<sup>2</sup>). The length of blades and leaf sheath proper were greatest 20 cm and 30 cm respectively in case of *B. nutan* (Figure 3). The internode length was maximum (40-60 cm) noticed in *B. polymorpha*. The socioeconomic survey reflected that golden bamboo was considered in many traditions across Asia to have

medicinal and cultural values. The study revealed that bamboo used for mat board preparation, flooring, basket making, fibers making, house constructions etc. as a source of income. The ethnomedicinal importance was assessed through personal interaction with the populace living in the local area and validated by the available literature as well. It was noticed that the bamboos stem used as a traditional remedy for rheumatism, abscesses and malaria. However, bark and leaves could be employed to treat heart problems, fevers and decoction aid the expulsion of the afterbirth also. The boiled leaves used by tribals as a hot tea that promoted perspiration and cure haematuria as well.

## DISCUSSION

The identification of bamboo species and its longevity was not easy on the basis of floral characters only.<sup>[37-39]</sup> However, the patterns of branching helped to identification of bamboo species as most important characters, hence taken in consideration.<sup>[29,31,40]</sup> The flowering of *Bambusa bambos*, *B. tulda* was gregarious in nature as only the dead plants and parts noticed during investigation as gregarious flowering recorded couple of year back.<sup>[41,42]</sup> However the flowering in wild bamboos were uncertain and observed incidentally as well.<sup>[43,44]</sup> Because of the reports of available published reports authors emphasized the vegetative characters that played significant role in the bamboos taxonomical studies. As the bamboo (subfamily Bambusoideae) is a large clade of the family Poaceae with more than 88 genera and nearly 1,642 species worldwide, of which 28 genera and more than 120 species are herbaceous bamboo.<sup>[45]</sup> The species based variation leaf size, phenology, culms height was quite frequently corroborated to the earlier reports.<sup>[46-48]</sup> The greatest leaf size in *B. striata*, however lowest blade size in *B. polymorpha* as well as sheath proper, ligule, petiole, internode length and number of auricles also important in the taxonomical studies supported by the several reports.<sup>[49-51]</sup> The recorded erect, grassy and grassy erect characters of seedling segregation in wild nature of *B. bambos* and *B. multiplex* was remarkable as well.<sup>[52,53]</sup> During survey in term of socioeconomic values, assessment of bamboo has revealed that bamboo plantation, harvesting and processing has brought many social benefits to rural dwellers, communities and nations which commercialised its plantation.<sup>[54-56]</sup> The *B. balcoa* was used for mat board preparation, fibers making and constructions.<sup>[57]</sup> The bamboo has been used frequently for house construction, flooring, basket making, source of income and for other household utensils.<sup>[58,59]</sup> During

ethnomedicinal assessment, it was recorded that the stems used as a remedy for rheumatism while shoots applicable in the treatment of abscesses and malaria.<sup>[29,60]</sup> The bark is astringent and emmenagogue, however the leaves used to treat heart problems and malaria.<sup>[33,61]</sup> The boiled leaves used in a bath to ease fevers.<sup>[35,62]</sup> A decoction of boiled leaves is used by women as a 'clean-out' for dilation and curettage, and also to aid the expulsion of the afterbirth.<sup>[63,64]</sup> The boiled leaves used as a hot tea, which induces profuse perspiration in treating a fever and sap is used to cure haematuria.<sup>[64,65]</sup> It was reported that the water stored in golden bamboo tubes and masticated leaves used to cure of various diseases including measles and sexually transmitted diseases.<sup>[66,67]</sup>

## CONCLUSION

The findings based on the survey carried out at New Forest, Forest Research Institute (FRI), Dehradun (Uttarakhand) India. During study it has been found that the bambusetum of FRI is a rich source of *Bambusa* sp. Schreber. There were 10 species observed including *Bambusa vulgaris*, *B. wamin*, *B. striata*, *B. burmanica*, *B. balcoa*, *B. multiplex*, *B. nutan*, *B. tulda*, *B. polymorpha* and *B. bambos*. Bamboo occupied remarkable position in term of socioeconomic values viz. gardening, road side plantation, paper and rayon manufacturing, house constructions, handicrafts, food and medicines. Present study is outcome of thorough examination, detailed morphological and morphotaxometric attributes viz. height of plants culm sheath, blade length, ligule length, presence or absence of auricle, petiole length, internodal length and leaf dimensions of all 10 species in FRI campus. The study concludes that a planned, scientific and holistic approach to bamboo cultivation, processing and management using advanced technology will enhance bamboo sustainability and an alternative material for infrastructure development. Bamboo can play a significant role in the restoration and rejuvenation of rural and national economies through its cultivation. Therefore, it is an utmost need for strategic bamboo forest management for sustainable environment and development.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## ABBREVIATIONS

**FRI:** Forest Research Institute; **B:** *Bambusa*.

## SUMMARY

There were 10 species observed including *Bambusa vulgaris*, *B. wamin*, *B. striata*, *B. burmanica*, *B. balcoa*, *B. multiplex*, *B. nutan*, *B. tulda*, *B. polymorpha* and *B. bambos*. The socioeconomic and ethnomedicinal survey reflected that, these contain antibacterial, anticancer and other profound pharmacological properties to cure several diseases.

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