KFRI RESEARCH REPORT NO. 543

ISSN 0970-8103

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(Final Technical Report of the Project KFRI RP 681.3/2014)

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Abstract of Project Proposal

Code	**KFRI RP 681.3/2014**
Title	**Monitoring of productivity in bamboo plantations**
Objectives	To monitor the productivity of different species of bamboo planted by different agencies and farmers in the State.
Project period	June 2014- June 2015
Funded by	National Bamboo Mission under its Project `Bamboo Technical Support Group – KFRI'
Scientific personnel	U.M. Chandrashekara V.P. Ravindran

CONTENTS

Abstract

The study was aimed to monitor the productivity of different species of bamboo planted in Kerala by the Forest Department and farmers. The survey conducted in 1107 ha of bamboo plantations raised by the Forest Department indicated that B*ambusa bambos* is planted in comparatively a large area (776 ha) followed by *Dendrocalmus strictus* (188 ha), *Dendrocalmus sikkimensis* (96 ha) and *Bambusa bambos* var. *gigantea (*47 ha). On hectare basis, the estimated number of culms in plantations of four species ranged between 3,146 and 25,209 (*B. bambos*: 10,840 ha^{-1}, *D. strictus*: 25,209 ha^{-1}, *D. sikkimensis:* 3,146 $ha^{-1}$and *B. bambos* var. *gigantea:* 4,844 ha^{-1}). In these plantations, the estimated of number of new culms per ha ranged from 506 to 3,338 (*B. bambos*: 3,338 ha^{-1}, *D. strictus*: 2,748 ha^{-1}, *D. sikkimensis:* 506 ha^{-1} and *B. bambos* var. *gigantea:* 765 ha^{-1}). In the State, 57 farms where 26 species of bamboos are planted were surveyed. *B. vulgaris* was the most preferred species for planting in farms (34 farms) followed by *B.vulgaris* cv. *wamin* (30 farms) and *Bambusa tulda* (27 farms). The estimated total green weight per clump ranged from 24.22 kg to 1767.3 kg with highest value in *Bambusa longispiculata* and lowest in *D. sikkimensis*. Similarly, the clumps of *B.longispiculata* produced more quantity of green weight in the form of new culms (229.2 kg per clump). In order to compare different species planted in a given year for parameters like total green weight of a clump and annual green weight production in a clump, 22 species planted in the year 2011 were selected. Values for both the parameters were significantly high ($P \leq 0.05$-0.01) in *B. bambos* followed by *D. strictus* and low in *Dendrocalamus membranaceus.* The present study also indicated that the stock of bamboo in plantations of the State is showing a decreasing trend. Certain management options for enhancing and sustaining the bamboo resource availability in the State are discussed. In farms in private and government sectors, the bamboo species that are preferred for cultivation may differ. This suggests that planting of bamboo in certain farms is mainly for ornamental purpose and with less commercial interest. On the other hand in some other farms, one or few species are cultivated extensively for commercial purpose. The need of assessment of bamboo species preferred by farmers and quantity of propagules required by them so as to generate them in adequate quantities is highlighted

1 Introduction

Bamboo is an important natural resource in the tropical, subtropical and temperate regions of the world. It is considered as a viable replacement for wood, is an industrial raw material for traditional and modern sectors, an important source of food, medicine and integrally involved in culture and arts (INBAR, 1997). Thus, bamboo has been regarded as the premier natural resource for human use and a sustainable material of the future. In a majority of Indian states, bamboo is the most versatile among minor forest produce and has multiple uses.

It is estimated that in India, about 10.03 million hectares of land area comprising 12.8 per cent of total forests in the country is occupied by bamboo with uneven distribution based on the annual precipitation, altitude, soil conditions and temperature (FSI, 2011). In Kerala, over 11,126 km^2 of forest area is covered by bamboo with stock (dry weight) of about 2,630,446 tonnes (Nair et al., 2001). It is also reported that total standing crop of bamboo in homesteads in Kerala is around 13.61 million culms and its green weight is 0.331 million tonnes (Muraleedharan et al., 2006)

It is a well known fact that, for sustaining and improving the bamboo based activities in the State, more focus should be given to address bamboo resource requirement and value addition (Kerala Forest Department, 2010). Thus, the Kerala Forest Department (KFD) has taken the issue of bamboo depletion seriously and has taken steps to popularize bamboo plantations in a large scale. The present study was aimed to monitor the productivity of bamboo in such plantations of the KFD.

It has also recognised that the scope of bamboo plantation has to go beyond forest jurisdiction to non-forest lands as a viable business operation. Thus, many government and non-government agencies and farmers started planting different species of bamboo. The Kerala Forest Research Institute, has been lending support to stakeholders by providing both propagules and technical guidance for cultivating and managing bamboos. The present study was also focused to monitor the productivity of different species of bamboo planted by different agencies and farmers in the State.

2 Methodology

Twenty six bamboo plantations raised by the Kerala Forest Department (Table 1) and located in the Central, Eastern and High Range Forest Circles of Kerala as well as fifty nine bamboo plantations which come under private and public holdings and are distributed in ten districts of the State (Table 2) were visited and basic information collected such as species planted, spacing, age of the stand, average number of culms per clump and average culm girth.

Based on data available with the landholders and based on field observation, total number clumps in each plantation were recorded. In each plantation, bamboo clumps were randomly selected all live culms in each clump were enumerated and culm girth at middle of the second inter-node from the bottom recorded.

For estimating weight of green bamboo, culms were categorized into five culm-diameter classes namely; a) very small: below 5 cm, small: 5 to 7.5 cm, medium: 7.5- 10 cm, big: 10 to 12.5 cm, and very big: above 12.5 cm. The following regression equation developed by Nair *etal.* (2001) was used to estimate the fresh weight of green culms in each clump.

$$\ln (W) = 1.718 + 0.440\, D^{1/2} - 0.007\, D$$

where W: Fresh weight (in kg) of green culms in the clump and D: culm diameter (in cm)

Thus weight of culms in each clump was calculated and then weights of all clumps in the plot were also arrived at.

On the basis of culm colour and presence or absence of leaf sheath (Khan, 1962; Chandrashekara, 1996), the bamboo culms can be classified into four age groups namely, 1-, 2-, 3- and more than 3 year old culms. In the present study, for estimating the productivity of bamboo, at least five clumps per species were selected and the number of 1-year old culms counted. Diameter of each culm was measured and the above mentioned regression equation applied to calculate weight of 1- year old culms in each clump. The mean of weight of 1- year old culms in total number of clumps sampled represented the annual productivity of each clump.

Table 1. List of bamboo plantations raised the Central, Eastern and High Range Forest Circles of Kerala by the Kerala Forest Department

Bambusa bambos (L.) Voss							
No.	Plantation Name	Forest Circle	Forest Division	Forest Range	GPS readings	Extent of plantation (ha)	Year of plantation establishment
1	Puthoor	Central	Thrissur	Pattikkad	10^0 29.23.11 N; 76^0 17.15.79E	62	1980
2	Akamala	Central	Thrissur	Wadakkanchery	10^0 41.20.00 N; 76^0 15.59.09E	20	1986
3	Pokayilappara	Central	Vazachal	Vazachal	10^0 18.01.29 N; 76^0 36.26.59E	60	1986
4	Thavalakuzhyppara	Central	Vazachal	Sholayar	10^0 17.17.84 N; 76^0 41.13.31E	53	1987
5	Pambatty	Central	Thrissur	Pattikkad	10^0 33.08.88N; 76^0 19.55.63E	70	1994
6	Olakkayam	Central	Thrissur	Pattikkad	10^0 28.53.65N; 76^0 21.31.49E	90	2006
7	Iyinikkal	Central	Malayatoor	Kodanad	10^0 09.43.08N; 76^0 38.06.82E	20	1981
8	Punnamudy	Central	Malayatoor	Kodanad	10^0 09.57.07N; 76^0 37.20.42E	20	1981
9	Kalladikode	Eastern	Palakkad	Olavakode	10^0 55.14.10N; 76^0 34.21.31E	15	1982
10	Ramanchetty	Central	Thrissur	Machad	10^0 38.10.67 N; 76^0 24.10.99 E	110	1985
11	Kuthiran	Central	Thrissur	Peechi Vazhni WLS	10^0 34.51.96 N; 76^0 22.55.38E	80	1986
12	Palathadam	Central	Thrissur	Machad	$10^0$41.55.72N; 76^0 17.52.00E	73	1986
13	Poongodu	Central	Thrissur	Wadakkanchery	10^0 42.16.40 N; 76^0 12.35.60E	30	1986
14	Urakkad	Central	Thrissur	Machad	10^0 36.48.13 N; 76^0 16.29.31 E	16	1986
15	Manjapetty	Eastern	Nilambur	Kalikavu	11^0 12.26.62 N; 76^0 18.45.65E	11	1994
16	VSS-Cherumala	Eastern	Mannarkkad	Mannarkkad	10^0 54.27.08N; 76^0 33.00.39E	6	2006
***Bambusa bambos var. gigantea* Bennet and Gaur**							
No.	Plantation Name	Forest Circle	Forest Division	Forest Range	GPS readings	Extent of plantation (ha)	Year of plantation establishment
1	Karanthodu	Central	Vazhachal	Vazhachal	10^0 21.01.48N; 76^0 37.53.76E	15.16	1972
2	Chapilakodu	Central	Thrissur	Machad	10^0 39.28.42N; 76^0 16.33.90E	20.12	1986

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Table 1 (cont'd). List of bamboo plantations raised the Central, Eastern and High Range Forest Circles of Kerala by the Kerala Forest Department

***Dendrocalamus sikkimensis* Gamble ex Oliv.**							
No.	Plantation Name	Forest Circle	Forest Division	Forest Range	GPS readings	Extent of plantation (ha)	Year of plantation establishment
1	Nedumpparathanii	Central	Malayatoor	Kuttampuzha	10^0 11.29.24N; 76^0 46.37.88E	31.2	2012
2	Neriyamagalam	High Range	Kothamangalam	Neriyamagalam		65.0	2012
***Dendrocalamus strictus* (Roxb.) Nees**							
No.	Plantation Name	Forest Circle	Forest Division	Forest Range	GPS readings	Extent of plantation (ha)	Year of plantation establishment
1	Kozhikunnu	Central	Thrissur	Wadakkanchery	10^0 42.52.47N; 76^0 10.06.37E	25	1989
2	Vellarampadam	Central	Chalakudy	Vellikulangara	10^0 25.04.97N; 76^0 20.57.14E	40.6	1992
3	Pazhavoor	Central	Thrissur	Wadakkanchery	10^0 39.43.92N; 76^0 10.57.41E	63	2001
4	Puthuruthy	Central	Thrissur	Wadakkanchery	10^0 39.07.24N; $76^0$11.32.37E	10	2006
5	Edakunni	Central	Thrissur	Wadakkanchery	10^0 39.54.96N; $76^0$10.20.17E	10	2007
6	Irippankunnu	Central	Thrissur	Wadakkanchery	10^0 39.34.43N; 76^0 10.57.86E	19	2007
7	Mulakuvallam	Eastern	Mannarkad	Mannarkad	11^0 01.53.49N; 76^0 22.56.59E	10	1995
8	Nattukal	Eastern	Mannarkad	Mannarkad	10^0 57.21.41N; 76^0 19.33.04E	10	1998

Table 2. List of bamboo plantations raised in private and public lands in Kerala

No	Plantation Name	District	Latitude	Longitude	Year of planting
1	Lakshmananchalla	Palakkad	10°34'13.84"N	76°43'26.12"E	2007
2	Kozhippara	Palakkad	10°47'23.40"N	76°50'03.08"E	2005
3	Kanjikode	Palakkad	10°47'33.67"N	76°43'40.61"E	2003
4	Mulaythiri	Palakkad	10°46'03.13"N	76°42'52.16"E	2006
5	Vilayanoor	Palakkad	10°40'46.72"N	76°37'23.69"E	2006
6	Akathethara	Palakkad	10°48'03.26"N	76°39'03.91"E	2010
7	Thrikangode	Palakkad	10°45'58.67"N	76°21'07.89"E	2011
8	Pattambi	Palakkad	10°48'40.58"N	76°11'13.58"E	2010
9	Chundampatta	Palakkad	10°54'24.63"N	76°12'49.71"E	2010
10	Dhoni	Palakkad	10°50'01.15"N	76°37'24.48"E	2008
11	Kulangarakad	Palakkad	10°39'35.59"N	76°31'48.07"E	2008
12	Anapady	Palakkad	11°02'51.03"N	76°45'34.74"E	2007
13	Kathikudam	Thrissur	10°15'34.99"N	76°19'33.15"E	2003
14	Chitethukkara	Ernakulam	9°59'34.59"N	76°21'20.62"E	2005
15	Puthen Cruz	Ernakulam	9°58'14.22"N	76°25'10.05"E	2008
16	Chmmanad	Ernakulam	9°57'29.62"N	76°24'47.33"E	2008
17	Munakkal Beach	Thrissur	10°10'59.06"N	76°09'44.35"E	2008
18	SN Puram	Thrissur	10°15'15.72"N	76°08'47.77"E	2010
19	Kuttaneloor	Thrissur	10°30'10.30"N	76°15'17.10"E	2012
20	Aralam Farm	Kannur	11°27'23.38"N	75°46'27.83"E	2011
21	Alanallore	Palakkad	11°00'21.23"N	76°21'19.67"E	2008
22	Beemanad	Palakkad	10°59'58.81"N	76°22'18.36"E	2012
23	Kootala	Thrissur	10°32'38.50"N	76°18'13.46"E	2002
24	Kodanad	Ernakulam	10°11'42.31"N	76°31'40.25"E	2011
25	Manjapra plantation	Ernakulam	10°13'17.19"N	76°27'06.34"E	2007
26	CBF	Thrissur	10°17'59.10"N	76°25'59.81"E	2007
27	Pothupara	Pathanamthitta	9°09'08.85"N	76°54'47.36"E	2005
28	Pambadi	Kottayam	9°35'04.96"N	76°36'14.07"E	2007
29	St.Joseph Cathedral	Kottayam	9°35'25.24"N	76°32'36.04"E	2009
30	Contour Jungle Resort, Changanassery	Kottayam	9°25'59.69"N	76°31'42.49"E	2010
31	Thekkepatta	Palakkad	10°38.'22.50"N	76°25'40.57"E	2007
32	St.Basil granites, Poovanchira	Thrissur	10°34'38.79"N	76°21'33.43"E	2007
33	Nallathanny	Idukki	9°33'01.51"N	76°57'48.96"E	2011
34	Kumali	Idukki	9°38'00.79"N	77°08'43.79"E	2011
35	Periyar Tiger Reserve	Idukki	9°36'05.48"N	77°10'00.60"E	2011
36	Madayilkonam	Thrissur	10°22'64.51"N	76°12'50.04"E	2009
37	Dhoni	Palakkad	10°51'15.12"N	76°37'39.46"E	2011
38	Desamangalam	Thrissur	10°44'34.39"N	76°14'11.35"E	2010
39	Perintalmanna	Malappuram	10°18'26.10"N	76°23'56.54"E	2012
40	Athirapally	Thrissur	11°00'30.92"N	76°13'34.60"E	2005
41	Nadathara	Thrissur			2011
42	Keezhumad	Ernakulam	10°06'31.45"N	76°23'20.49"E	2011
43	FDA, Karakad	Ernakulam	10°13'18.02"N	76°28'34.18"E	2012
44	Melukavu	Kottayam	9°44'10.53"N	76°46.10.20"E	2010
46	Karad	Malappuram	11°12'32.40"N	76°52'57.00"E	2010
47	Mupliyar	Kozhikode	10°24'37.61N	76°19'57.47"E	2010

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Table 2 (cont'd). List of bamboo plantations raised in private and public lands in Kerala

No	Plantation Name	District	Latitude	Longitude	Year of planting
48	Kakkad	Kozhikode	11°29'58.31"N	75°58'19.15"E	2007
49	Olamanna	Kozhikode	11°14'32.52"N	75°49'47.10"E	2011
50	Thalikulam	Thrissur	10°25'54.95"N	76°04'38.65"E	2011
51	Neriyamangalam	Idukki	10°03'04.70"N	76°51'16.08"E	2010
52	Kallar	Idukki	10°02'45.18"N	76°57'35.82"E	2010
53	Munnar	Idukki	10°01'50.58"N	77°09'40.63"E	2011
54	Lake Resort, Munnar	Idukki	10°08'89.12"N	77°05'95.01"E	2005
55	Kakavayal	Kozhikode	11°59' 86.21"N	76°09'14.12"E	2010
56	Kasargod	Kasargod	12°43' 87.16"N	75°02'12.03"E	2007
57	Mathaipara	Idukki	9°43'50.99"N	76°59'16.82"E	2007

3. Results and discussion

3.1. Bamboo plantations raised by the Kerala Forest Department

In the present study, culm density, total green weight, total dry weight and annual productivity of *B.bambos*, *B.bambos* var. *gigantea*, *D. sikkimensis* and *D. strictus* in plantations raised by the Forest Department were studied. Out of 1107 ha of bamboo plantations surveyed, those of *B. bambos* covering 776 ha area was predominant followed by *D. strictus* (188 ha), *D. sikkimensis* (96 ha) and *B. bambos* var. *gigantea* (Table 1).

The estimated number of clumps in 776 ha of plantation of *B. bambos* is 2,30,975 with a total 84,12,310 culms (Table 3; Appendix 1) . About 46% of total green weight of *B. bambos* was contributed by plantations established in 1985 and 1986. On the other hand, only around 6% of total green weight stock is available in the plantations that were established in 2006.

The production of new culms in plantations of different age ranged between 1,100 and 7,200 culms per ha (Table 4), with an average of 3,338 culms ha. Similarly a wide variation in the stock (green and dry) of 1-yr old clumps was recorded. The average green weight and dry weight of 1-year old culms was 176.8 tonne/ha and 92.0 tonne/ha respectively amounting to around 24% of total stock.

Only two plantations of *B. bambos* var. *gigantea* covering 47.16 ha area in the Central Forest Circle were recorded. Around 60% of total number of clumps and around 80% of total number of culms estimated are from the plantation that was established in the year 1972. Similarly, around 65% of bamboo stock (green and dry stock) is available from the same plantation (Table 5; Appendix 2).

Table 3. Details of number of clumps, culms and stock (green and air-dry) of *Bambusa bambos* in plantations located in Central, Eastern and High Range Forest circles of Kerala.

Year of planting	Area of plantations (ha)	Total number of clumps	Total number of culms	Total Green weight (tonnes)	Total Dry weight (tonnes)
1968	40	16,000	5,05,600	27,495	16,497
1980	62	24,800	11,40,800	64,147	38,488
1981	40	16,000	12,48,000	69,880	41,928
1982	15	9,375	4,05,938	34,959	20,976
1985	110	11,000	5,56,600	47,433	28,460
1986	279	82,800	30,26,880	1,94,597	1,16,758
1987	53	21,200	6,21,796	21,303	12,782
1994	81	11,400	3,38,304	31,316	18,789
2006	96	38,400	5,68,392	30,828	18,497
Total	**776**	**2,30,975**	**84,12,310**	**5,21,958**	**3,13,175**

Table 4. Details of 1-year old culms of *Bambusa bambos* in plantations located in Central, Eastern and High Range Forest circles of Kerala.

Year of planting	Total number of 1-yr old culms per ha	Total green weight (tonnes) of 1-yr old culms per ha	Total dry weight (tonnes) of 1-yr old culms per ha
1968	5600	243.6	126.7
1980	3600	161.9	84.2
1981	7600	340.4	177.0
1982	6250	430.6	223.9
1985	1100	75.0	39.0
1986	2517	118.0	61.3
1987	2800	76.7	39.9
1994	2900	99.0	51.5
2006	1400	46.3	24.1

Table 5. Details of number of clumps, culms and stock (green and air-dry) of *Bambusa bambos* var. *gigantea* in plantations located in the Central Forest Circle of Kerala.

Year of planting	Area of plantations (ha)	Total number of clumps	Total number of culms	Total Green weight (tonnes)	Total Dry weight (tonnes)
1972	15.16	6064	181920	2,758	1,643
1986	32.00	3200	45760	1,464	873
Total	47.16	9264	227680	4,222	2,516

The production of new culms in the plantation established in 1972 was much higher (1380 culms per ha per year) than in the plantation established in 1986 (150 culms per ha per year).

Consequently, annual green bamboo production was more in the plantation established in 1972 (Table 6). It was also noticed that around 32% of total number of culms and around 29% of total bamboo stock in these plantations are from 1-year old culms.

Table 6. Details of 1-year old culms of *Bambusa bambos* var. *gigantea* in plantations located in the Central Forest Circle of Kerala.

Year of planting	Area of plantations (ha)	Total number of 1-yr old culms per ha	Total green weight (tonnes) of 1-yr old culms per ha	Total dry weight (tonnes) of1-yr old culms per ha
1972	15.16	1,380	20.9	12.5
1986	32.00	150	4.8	2.9

The plantations of *D. sikkimensis* established in 2012 are located one each in Central and High Range Forest Circles, covering total area of 96.2 ha area. Despite the fact that total number of culms in the plantation located in High Range Forest Circle was comparatively less than that in the plantation at Central Forest Circle, bamboo stock (green and dry) was higher in that plantation (Table 7).

Table 7. Details of number of clumps, culms and stock (green and air-dry) of *Dendrocalmus sikkimensis* in plantations located in Central and High Range Forest Circles of Kerala. Year of planting: 2012.

Plantation Name	Area of plantations (ha)	Total number of clumps	Total number of culms	Total Green weight (tonnes)	Total Dry weight (tonnes)
Nedumpparathanii	31.2	12480	187200	471.0	254.3
Neriyamagalam	65.0	26000	115440	1023.5	552.7
Total	96.2	38480	302640	1494.5	807.0

Number of new culms of *D. sikkimensis* produced was more in the plantation of Central Circle (Table 8). However, total green weight and dry weight of culms were greater in the plantation of High Range Circle.

Plantations of D. *strictus* covering about 187.6 ha are distributed in the Central and Eastern Forest Circles of the State. The plantations established during 2006 were more in area followed by those established during 1992 (Table 9; Appendix 3). However, total number of culms and culm stock (green and dry weight) were greater in old plantations.

Table 8. Details of 1-year old culms of *Dendrocalmus sikkimensis* in plantations located in the Central and High Range Forest Circle of Kerala. Year of planting: 2012.

Plantation Name	Area of plantations (ha)	Total number of 1-yr old culms per ha	Total green weight (tonnes) of 1-yr old culms per ha	Total dry weight (tonnes) of 1-yr old culms per ha
Nedumpparathanii	31.2	780	61.2	33.1
Neriyamagalam	65.0	231	133.1	71.9

Table 9. Details of number of clumps, culms and stock (green and air-dry) of *Dendrocalmus strictus* in plantations located in Central and Eastern Forest Circles of Kerala.

Plantation year	Area (ha)	Number of clumps	Total number of culms	Total green wt (in tonnes)	Total dry wt in tonnes
1992	60.6	33375	3424450	88439.4	50410.5
1989	25	2500	217500	7836.1	4466.6
2006	83	51875	907500	19746.9	11255.7
2007	19	11875	190000	4600.7	2622.4
Total	187.6	99625	4739450	120623.1	68755.2

Total number of 1-year old culms was more in the 1992 plantation followed by 2006 plantations. Similarly, green weight and dry weight of 1-year old bamboo culms were also greater in 1992 plantations (Table 10).

Table 10. Details of 1-year old culms of of *Dendrocalmus strictus* in plantations located in Central and Eastern Forest Circles of Kerala.

Year of planting	Area of plantations (ha)	Total number of 1-yr old culms per ha	Total green weight (tonnes) of 1-yr old culms per ha	Total dry weight (tonnes) of 1-yr old culms per ha
1992	60.6	7911	204.3	103.2
1989	25	896	32.3	17.9
2006	83	1214	26.4	14.6
2007	19	970	23.5	13.1

3.2. Bamboo plantations raised in private and public lands

A total of 26 species of bamboo (Table 11) were planted in 57 farms of the State. Among 26 species *B.vulgaris* was planted in more number of farms (34 farms) followed by *B. vulgaris* cv. *wamin* (30 farms) and *B.tulda* (27 farms) (Table 12). On the other hand, species such as *B.longispiculata* and *D. membranaceus* were found to be planted only in two farms each. However, species such as *D.sikkimensis*, *B. tulda* and *D. asper* were represented well with a total of more than 1,000 clumps when *B. longispiculata* and *D. membranaceus* were poorly represented with a total of less than 10 clumps. Average number of culms per clump ranged from 4 to 51 with maximum value in *M. baccifera* and minimum in *G. atroviolacea* . It was also recorded that though *D.sikkimensis* represented well with highest number of clumps, total number of culms in the species was comparatively less probably due to its poor growth and culm recruitment in the study sites.

Table 11. List of bamboos supplied by KFRI and planted in private and government farms in Kerala.

No.	Species	No.	Species
1	*Bambusa balcooa* Roxb.	14	*Dendrocalamus hamiltonii* Nees & Arn. ex Munro
2	*Bambusa bambos* (L.) Voss	15	*Dendrocalamus longispathus* (Kurz) Kurz
3	*Bambusa longispiculata* Gamble	16	*Dendrocalamus membranaceus* Munro
4	*Bambusa multiplex* (Lour.) Raeusch. ex Schult.	17	*Dendrocalamus sikkimensis* Gamble ex Oliv.
5	*Bambusa nutans* Wall. ex Munro	18	*Dendrocalamus strictus* (Roxb.) Nees
6	*Bambusa polymorpha* Munro	19	*Gigantochloa atroviolacea* Widjaja
7	*Bambusa tulda* Roxb.	20	*Gigantochloa rostrata* K.M.Wong
8	*Bambusa vulgaris* cv. *wamin* McClure	21	*Guadua angustifolia* Kunth
9	*Bambusa vulgaris* Schrad. ex Wendl.	22	*Melocanna baccifera* (Roxb.) Kurz
10	*Bambusa wamin* E.G.Camus	23	*Pleioblastus fortunei* (Van Houtte) Nakai
11	*Dendrocalamus asper* (Schult.) Backer	24	*Pseudoxytenanthera stocksii* (Munro) T.Q.Nguyen
12	*Dendrocalamus brandisii* (Munro) Kurz	25	*Schizostachyum dullooa* (Gamble) R.B.Majumdar
13	*Dendrocalamus giganteus* Munro	26	*Thyrsostachys oliveri* Gamble

Among the species studied, *B. longispiculata* recorded highest total green weight per clump (1767.3 kg per clump) when *D. sikkimensis* recorded the lowest value (24.22 kg per clump) (Table 12). Similarly, the clumps of *B. longispiculata* produced more quantity of green weight in the form of new culms (229.2 kg per clump) when *D. sikkimensis* annually produced comparatively a lower quantity of green weight (3.0 kg per clump).

Table. 12. Details of bamboos supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

Species	Number of farms	Total number of clumps	Total number of culms	Total Green weight (tonnes)	Total Dry weight (tonnes)
Bambusa balcooa	22	245	2,600 (697)	69.85 (17.58)	41.11 (10.01)
Bambusa bambos	5	87	1,659 (193)	42.38 (4.96)	25.22 (2.95)
Bambusa longispiculata	2	4	159 (21)	7.07 (0.92)	4.11 (0.53)
Bambusa multiplex	9	21	712 (108)	2.89 (0.40)	1.69 (0.23)
Bambusa nutans	15	67	859 (132)	23.84 (3.60)	13.85 (2.09)
Bambusa polymorpha	4	15	413 (50)	11.57 (1.39)	6.86 (0.82)
Bambusa tulda	27	1495	38,180 (3,941)	429.71 (43.75)	214.43 (21.83)
Bambusa vulgaris cv. *wamin*	30	358	7,171 (909)	319.11 (38.26)	190.11 (22.78)
Bambusa vulgaris	34	957	17,232 (2,514)	599.18 (91.2)	321.21 (48.80)
Bambusa wamin	14	40	760 (95)	12.93 (1.99)	7.59 (1.17)
Dendrocalamus asper	23	1193	25,965 (3,376)	608.12 (80.04)	365.29 (48.08)
Dendrocalamus brandisii	23	164	3,229 (388)	94.16 (10.96)	55.109 (6.41)
Dendrocalamus giganteus	22	49	523 (103)	35.49 (7.21)	21.58 (4.39)
Dendrocalamus hamiltonii	8	61	588 (67)	9.85 (1.10)	6.00 (0.67)
Dendrocalamus longispathus	16	150	2,571 (291)	35.76 (3.94)	20.47 (2.26)
Dendrocalamus membranaceus	2	8	352 (30)	13.86 (1.07)	8.19 (0.63)
Dendrocalamus sikkimensis	12	1903	8,945 (1,104)	46.09 (5.65)	27.90 (3.42)
Dendrocalamus strictus	14	177	2,833 (414)	31.83 (4.27)	20.43 (2.74)
Gigantochloa atroviolacea	5	11	42 (11)	0.84 (0.20)	0.44 (0.11)
Gigantochloa rostrata	9	145	1,726 (129)	11.74 (0.78)	6.31 (0.42)
Guadua angustifolia	4	21	217 (42)	1.89 (0.38)	1.12 (0.22)
Melocanna baccifera	6	48	2,465 (2,830)	39.40 (4.28)	23.21 (2.52)
Pleioblastus fortunei	6	70	529 (73)	2.60 (0.33)	1.46 (0.19)
Pseudoxytenanthera stocksii	11	37	483 (75)	10.30 (1.73)	5.60 (0.94)
Schizostachyum dullooa	4	67	321 (53)	2.18 (0.34)	1.25 (0.20)
Thyrsostachys oliveri	17	866	19,528 (2,823)	509.97 (67.90)	284.16 (37.87)

Since the number of bamboo species planted in different years varied with maximum number of species (24) planted in the year 2011 and only eight species planted in the year 2012, only bamboo planted in the year 2011 were selected, for the comparison of total green weight of a clump and green weight produced in a year in a clump. Among the 24 species, 22 species had 3 or more planted and three clumps per species were selected as replicates for statistical comparison. Statistical difference between 22 species for each of the two parameters (total green weight of a clump and total green weight of 1-year old culms of a clump) studied were examined through analysis of variance (ANOVA). If the ANOVA value was found to be significant ($P \leq 0.05$-0.01), the parameter means were compared using Fisher's least significant difference (LSD) test. The mean green weight per clump varied from 1.3 kg to 547.7 kg with significantly high value ($P \leq 0.05$-0.01) and the mean green weight of 1-year old culms in a clump varied from 0.4 kg to 72.7 kg. Values for both the parameters were significantly high ($P \leq 0.05$-0.01) in *B. bambos* followed by *D. strictus* and low in *D. membranaceus.*

In the Appendix 3, important features and uses of all 26 species of bamboo (Source: Seethalakshmi and Kumar, 1998) and individual Tables (Table 13 to 37) showing density of clumps and culms, green and dry weight of all culms and 1-year old culms of each species in different farms are provided.

4. Conclusion

For the bamboo plantations of Kerala Forest Department, *B. bambos* seems to remain as the most preferred species. However, the stock of bamboo, even of this species, in plantations of the State showing a decreasing trend. For instance, in the present study the total weight (green and dry) of *B. bambos* in plantations covering a total of 776 ha area was estimated. It was found that about 46% of total weight (green/dry) of this species is contributed by plantations established in 1985 and 1986. On the other hand, only around 6% of bamboo culm stock (green/dry) is available in the plantations that were established in 2006. One possible reason being that lack of management would result in drop in new culm recruitment. At the same time, in order to enhance and sustain the bamboo resource availability in the State, new plantations need be established every year

In Private and public farms, the bamboo species that are preferred for cultivation may differ. For instance, when 57 farms where bamboos were planted with the supply of propagules from the Kerala Forest Research Institute were considered, *B. vulgaris, B. vulgaris* cv.

wamin and *B. tulda* found to be the most sought species as they were planted in 34 farms, 30 farms and 27 farms respectively. However, comparatively more number of clumps of *D. sikkimensis* followed by *B. tulda* and *D. asper* were planted in farms where they are introduced. This suggests that planting of bamboo in certain farms is mainly for ornamental purpose and with less commercial interest. On the other hand in some other farms, one or few species are cultivated extensively for commercial purpose. Thus, prior to the supply of bamboo propagules, the supplying agency/ies will have assess the species preferred by farmers and the quantity of propagules required by them.

5. References

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Bambusa balcooa Roxb.

Bambusa balcooa, indigenous to the North-Eastern India is being cultivated in different states of the Country. Culms of this species of bamboo are 12-20 m high and 8-15 cm in diameter, grayish green, thick-walled, the diameter of the cavity about one-third of that of the culm; nodes thickened with a whitish ring above, hairy below; internodes 20-40 cm long; branches from the lower nodes leafless and hard, mostly spreading sometimes thorn-like; young shoots blackish-green, green with yellow, brown or tinged culm-sheath, clothed sparsely with dark brown hairs. *Bambusa balcooa* is known as the best and strongest species for building purposes much used for scaffolding. This is also used for agarbathi sticks and in bamboo wood chip industry.

Table. 13. Details of *Bambusa balcooa* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Kootala	2002	5	60 (9)	1,806.0 (258.7)	1,080.0 (149.7)
2.	Kathikudam	2003	1	75 (12)	2,475.0 (354.3)	1,480.1 (201.4)
3.	Chitethukkara	2005	3	72 (13)	4,068.0 (703.2)	2,432.7 (402.3)
4.	Mulaythiri	2006	8	192 (43)	11,174.4 (2,404.7)	6,682.3 (1,356.9)
5.	Vilayanoor	2006	30	300 (36)	2496.0 (276.4)	1492.6 (161.3)
6.	Lakshmananchalla	2007	42	756 (295)	25,099.2 (9,435.3)	14,733.2 (5,417.5)
7.	Anapady	2007	3	39 (9)	1,279.2 (276.3)	750.9 (150.2
8.	Kasargod	2007	1	8 (1)	436.0 (45.8)	255.9 (27.4)
9.	Mathaipara	2007	10	80 (7)	2,888.0 (232.6)	1,695.3 (132.2)
10.	Puthen Cruz	2008	1	15 (3)	394.5 (70.1)	231.6 (41.3
11.	Pattambi	2010	58	464 (164)	4,918.4 (1,598.3)	2,847.8 (899.2)
12.	Chundampatta	2010	3	24 (2)	381.6 (29.3)	220.9 (15.9)
13.	Mupliyar	2010	7	154 (23)	8,978.2 (1,212.3)	5,198.4 (668.3)
14.	Kallar	2010	2	19 (5)	609.9 (157.2)	353.1 (84.7)
15.	Thrikangode	2011	5	25 (6)	380.0 (89.2)	221.5 (47.9)
16.	Aralam farm	2011	22	110 (27)	462.0 (109.3)	269.3 (68.3)
17.	Nallathanny	2011	30	78 (23)	109.2 (30.9)	63.7 (17.2)
18.	Kumali	2011	1	7 (0)	84.7 (0)	49.4 (0)
19.	Dhoni	2011	1	3 (0)	5.4 (0)	3.1 (0)
20.	Keezhumad	2011	3	18 (4)	502.2 (107.3)	292.8 (59.3)
21.	Munnar	2011	3	83 (13)	1,262.3 (189.1)	735.9 (104.2)
22.	Kuttaneloor	2012	6	18 (2)	39.2 (4.2)	22.9 (2.3)
	Total		245	2,600 (697)	69,849.4 (17,584.5)	41,113.3 (10,007.5)

Bambusa bambos (L.) Voss

Bambusa bambos, native to South-East Asia and widely introduced and cultivated throughout the tropics, is a very densely tufted bamboo, producing large dense clumps of closely packed culms. Culms hollow, dark green-coloured, up to 30 m tall, 15-18 cm diameter, the walls very thick with a lumen; branching at all nodes, those from the lower nodes recurved and bent downward towards the ground with the upper branches arching and producing a fan like plume, the upper leafy branches bearing small spines. Nodes slightly swollen and few lower nodes produce short aerial roots.

Important use of this bamboo is as a raw material for pulp, paper and panel products. Other uses include scaffoldings, rafters, thatching and roofing, basket making, bows and arrows, furniture, floating timber and rafting, cooking utensils and fencing. Shoots and seeds are edible. The leaves are used as fodder and medicine.

Table. 14. Details of *Bambusa bambos* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Kanjikode	2003	4	24 (3)	1228.8 (148.8)	738.5 (89.4)
2.	Chitethukkara	2005	22	616 (74)	31539.2 (3721.3)	18698.6 (2206.2)
3.	Vilayanoor	2006	48	768 (86)	6835.2 (740.2)	4107.9 (444.9)
4.	Akathethara	2010	10	200 (23)	1140 (131.1)	696.3 (80.1)
5.	Periyar Tiger Reserve	2011	3	51 (7)	1637.1 (218.2)	974.1 (129.8)
Total			87	1659 (193)	42380.3 (4959.6)	25215.4 (2950.4)

Bambusa longispiculata Gamble

***Bambusa longispiculata* is** found in Mizoram (India), Bengladesh, Thailand and Myanmar growing up to an altitude 1000 m. Culms of this species are 10-15 m high, 7-10 cm in diameter, green in fairly open clumps. Internodes 30-70 cm long. Young shoots greyish green with dark brown hairs; blades leathery, acute.

Table. 15. Details of *Bambusa longispiculata* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Kootala	2002	3	129 (17)	6166.2 (804.3)	3588.7 (468.1)
2.	Vilayanoor	2006	1	30 (4)	903.0 (112.5)	525.5 (65.5)
Total			4	159 (21)	7069.2 (916.8)	4114.3 (533.6)

Bambusa multiplex (Lour.) Raeusch. ex Schult.

A thickly growing bamboo with culms usually 2-4 m high, 1.5-2.5 cm in diameter, glabrous, smooth, green when young, yellowish on aging, hard, much branched from the base; nodes prominently thickened; internodes usually 20-40 cm long. This species is indigenous to China and Japan and now cultivated in many countries mainly in Asian countries such as India, Sri Lanka, Myanmar, Malaya and Bangladesh. This reed-like bamboo is largely used for hedges. It is also used for construction purposes, basket making and handicrafts.

Table. 16. Details of *Bambusa multiplex* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	CBF	2007	4	152 (21)	380.0 (47.7)	225.0 (28.2)
2.	Pambadi	2007	1	30 (7)	111.0 (23.1)	65.7 (13.7)
3.	Kakkad	2007	1	15 (2)	57.0 (5.7)	33.7 (3.4)
4.	Alanallore	2008	1	8 (2)	5.8 (1.3)	3.5 (0.8)
5.	Madayilkonam	2009	1	35 (6)	203.0 (30.2)	118.1 (17.6)
6.	Contour Jungle Resort, Changanassery	2010	8	320 (47)	1312.0 (175.6)	763.6 (102.2)
7.	Kakavayal	2010	1	29 (4)	107.3 (13.2)	62.4 (7.7)
8.	Dhoni	2011	1	3 (0)	7.5 (0)	4.4 (0)
9.	Keezhumad	2011	3	120 (19)	708.0 (103.2)	412.1 (60.1)
Total			21	712 (108)	2891.6 (400.0)	1688.5 (233.6)

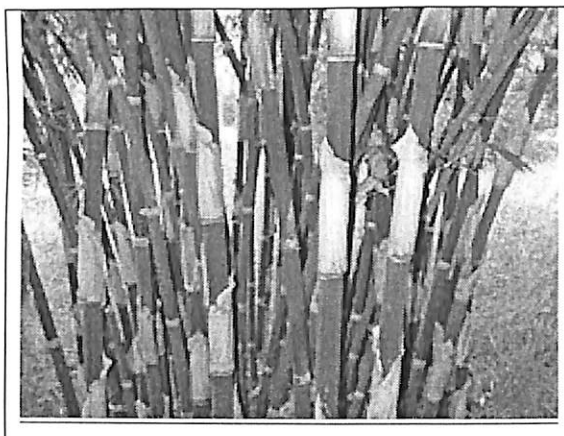
Bambusa nutans Wall. ex Munro

Bambusa nutans is a medium sized graceful bamboo with culms 6-15 m high, 5-10 cm in diameter, loosely clumped, much branched above, usually unbranched below. Internodes usually 25-45 cm long, thick-walled. It is commonly cultivated in North-West India especially in and around Dehra Dun; extensively cultivated in Orissa and West Bengal. *Bambusa nutans* is one among the six species commonly used in Indian paper industry. The culm is good, strong, straight and used locally for various purposes, mainly as poles. Being a graceful bamboo, *Bambusa nutans* is also grown as an ornamental plant.

Table. 17. Details of *Bambusa nutans* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Kootala	2002	2	62 (13)	1,866.2 (345.3)	1,086.1 (201.0)
2.	Munnar	2005	1	40(7)	528.0 (89.3)	307.3 (52.0)
3.	Lakshmananchalla	2007	1	2 (0)	26.4 (0)	15.4 (0)
4.	Anappady	2007	12	48 (7)	484.8 (67.3)	282.2 (39.2)
5.	Manjapra plantation	2007	1	20 (3)	666.0 (87.2)	387.6 (50.8)
6.	CBF	2007	4	220 (47)	6,006.0 (1211.2)	3,495.5 (704.9)
7.	Thekkepatta	2007	2	45 (7)	1,674.0 (243.4)	974.3 (141.7)
8.	Kasargod	2007	6	144 (17)	2,174.4 (238.2)	1,265.5 (138.6)
9.	Kallar	2010	5	90 (13)	7,911.0 (1076.4)	4,604.2 (626.5)
10.	Thrikangode	2011	25	150 (13)	2,175.0 (198.2)	1,246.3 (113.6)
11.	Nallathanny	2011	2	6 (0)	60.6 (0)	34.7 (0)
12.	Periyar Tiger Reserve	2011	1	10 (2)	132.0 (24.8)	75.6 (14.2)
13.	Dhoni	2011	1	3 (0)	27.6 (0)	15.8 (0)
14.	Olamanna	2011	3	17 (2)	94.1 (16.2)	53.9 (9.3)
15.	Thalikulam	2011	1	2 (0)	10.4 (0)	6.0 (0)
			67	859 (132)	23,836.5(3,597.5)	13,850.3 (2,091.6)

Bambusa polymorpha Munro



Bambusa polymorpha is a large evergreen, densely tufted bamboo; sometimes leaf-shedding in dry season. Its culms 16-25 m high, 8-15 cm diameter and with internodes 40-60 cm long. This bamboo is indigenous to India, Bengladesh and Myanmar. *Bambusa polymorpha* is used for house building, production of pulp and paper, agarbathi sticks and fibre boards. The young shoots of this species is edible with a distinctly sweet taste. It is also a graceful species suitable for landscaping.

Table. 18. Details of *Bambusa polymorpha* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Kootala	2002	7	182 (20)	7207.2 (792.0)	4302.6 (472.8)
2.	Chitethukkara	2005	3	78 (7)	959.4 (86.1)	573.2 (51.4)
3.	Manjapra plantation	2007	1	13 (2)	436.8 (67.2)	254.6 (39.2)
4.	Contour Jungle Resort, Changanassery	2010	4	140 (21)	2968.0 (445.2)	1730.3 (259.5)
Total			15	413 (50)	11571.4 (1390.5)	6860.7 (823.0)

Bambusa tulda Roxb.

Bambusa tulda is a tufted, gregarious bamboo with culms usually 7-23 m high, 5-10 cm in diameter and with internodes 40-70 cm long. In India, it is found in the states of Assam, Bihar, Meghalaya, Mizoram, Nagaland and Tripura and cultivated in Arunachal Pradesh, Uttar Pradesh, Karnataka and Bengal. This is one the five quick-growing species of bamboos preferred for raising plantations in India. It can be used as reinforcement in cement concrete. The succulent shoots are rich in phytosterols and the fermented shoots can be used for production of sterol drugs.

Table. 19. Details of *Bambusa tulda* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Kozhippara	2005	13	221 (10)	707.2 (32.0)	312.7 (14.2)
2.	Vilayanoor	2006	23	943 (138)	9147.1 (1338.6)	4558.0 (667.0)
3.	Manjapra plantation	2007	7	245 (28)	9604.0 (1097.6)	4830.3 (552.0)
4.	CBF	2007	52	6240 (832)	78624.0 (10483.2)	39335.6 (5244.7)
5.	Pothupara	2007	6	390 (72)	2613.0 (482.4)	1287.5 (237.7)
6.	Pambadi	2007	2	20 (4)	144.0 (28.8)	72.4 (14.5)
7.	Thekkepatta	2007	3	75 (9)	540.0 (64.8)	271.2 (32.5)
8.	St.Basil granites, Poovanchira	2007	16	464 (39)	1995.2 (167.7)	987.6 (83.0)
9.	Kasargod	2007	100	1500 (221)	10050.0 (1480.7)	4913.3 (723.9)
10.	Dhoni	2008	1	12 (3)	102.0 (25.5)	51.3 (12.8)
11.	Kulangarakad	2008	31	775 (87)	8060.0 (904.8)	4012.2 (450.4)
12.	Munakkal Beach	2008	5	95 (9)	361.0 (34.2)	181.3 (17.2)
13.	St.Joseph Cathedral	2009	3	18 (3)	57.6 (9.6)	28.3 (4.7)
14.	Madayilkonam	2009	76	1900 (228)	16530.0 (1983.6)	8304.6 (996.6)
15.	Chundampatta	2010	1	45 (9)	400.5 (80.1)	158.5 (31.7)
16.	Contour Jungle Resort, Changanassery	2010	2	60 (8)	606.0 (80.8)	305.2 (40.7)
17.	Desamangalam	2010	70	1855 (85)	20961.5 (960.5)	10445.6 (478.6)

Table. 19 (Cont'd). Details of *Bambusa tulda* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
18.	Melukavu	2010	5	25 (6)	107.5 (25.8)	54.1 (13.0)
19.	Karad	2010	10	50 (11)	220.0 (48.4)	110.5 (24.3)
20.	Aralam Farm	2011	6	78 (9)	156.0 (18.0)	78.5 (9.1)
21.	Kodanad	2011	1000	22000 (1984)	264000.0 (23808.0)	131765.3 (11882.8)
22.	Nallathanny	2011	12	144 (14)	244.8 (23.8)	123.1 (12.0)
23.	Kumali	2011	10	150 (23)	645.0 (98.9)	324.4 (49.7)
24.	Periyar Tiger Reserve	2011	8	32 (5)	54.4 (8.5)	27.4 (4.3)
25.	Dhoni	2011	5	20 (4)	62.0 (12.4)	31.2 (6.2)
26.	Nadathara	2011	23	747.5 (91)	3214.3 (391.3)	1604.4 (195.3)
27.	Keezhumad	2011	5	75 (9)	502.5 (60.3)	252.3 (30.3)
Total			1495	38179.5 (3941)	429709.6 (43750.3)	214426.8 (21829.3)

Bambusa vulgaris cv. *wamin* McClure (green)

Bambusa vulgaris cv. *wamin* is a moderate sized bright green bamboo with culms 8-20 m high, 5-10 cm in diameter and internodes up to 45 cm long. This species is cultivated extensively in many parts of the word, in India mainly in North-East and also in many other parts of the country. It is used for paper-making, scaffolding, construction, poles, curios and handicrafts in different parts of India. Occasionally cultivated in Malaysia for its edible shoots. It can be planted on slopes to control erosion.

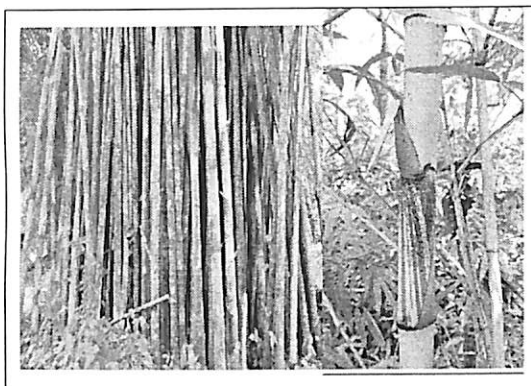
Table. 20. Details of *Bambusa vulgaris* cv. *wamin* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1	Kanjikode	2003	23	874 (129)	28929.4 (3258.2)	17226.4 (1940.1)
2	Kathikudam	2003	48	768 (94)	31641.6 (3854.3)	18743.2 (2283.1)
3	Kozhippara	2005	25	500 (74)	16550.0 (2409.9)	9824.3 (1430.5)
4	Chitethukkara	2005	2	42 (5)	1709.4 (199.6)	1011.3 (118.1)
5	Lake Resort, Munnar	2005	32	1888 (158)	98553.6 (8209.6)	59087.2 (4922.0)
6	Vilayanoor	2006	30	390 (58)	18291.0 (2718.2)	10743.2 (1596.5)
7	Anapady	2007	10	120 (19)	3816.0 (604.2)	2216.4 (350.9)
8	Manjapra plantation	2007	7	154 (19)	7438.2 (903.2)	4412.9 (535.8)
9	Pambadi	2007	7	53 (6)	2378.3 (254.3)	1410.3 (150.8)
10	Thekkepatta	2007	1	55 (8)	4191.0 (602.3)	2503.2 (359.7)
11	St.Basil Granites, Poovanchira	2007	5	65 (6)	715.0 (59.3)	412.3 (34.2)
12	Kasargod	2007	5	105 (9)	3276.0 (280.6)	1965.6 (168.4)
13	Kulangarakad	2008	2	42 (9)	1369.2 (292.4)	811.3 (173.3)
14	Munakkal Beach	2008	29	174 (27)	2244.6 (329.3)	1312.3 (192.5)
15	Alanallore	2008	1	3 (0)	5.7 (0)	3.4 (0)
16	St.Joseph Cathedral	2009	1	10 (2)	521.0 (99.8)	312.6 (59.9)
17	Madayilkonam	2009	21	609 (59)	23872.8 (2309.4)	14123.7 (1366.3)
18	Akathethara	2010	1	34 (5)	683.4 (89.3)	402.3 (52.6)
19	SN Puram	2010	5	80 (7)	336.0 (27.3)	198.2 (16.1)
20	Contour Jungle Resort, Changanassery	2010	9	207 (23)	16808.4 (1858.3)	10012.2 (1106.9)
21	Karad	2010	14	119 (24)	1332.8 (250.3)	786.3 (147.7)
22	Mupliyar	2010	30	450 (85)	37440.0 (7013.0)	22565.8 (4226.9)
23	Kallar	2010	12	168 (22)	8971.2 (1160.3)	5312.3 (687.1)

Table. 20 (cont'd). Details of *Bambusa vulgaris* cv. *wamin* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
24	Thrikangode	2011	17	136 (32)	4610.4 (1076.8)	2666.2 (622.7)
25	Nallathanny	2011	1	3 (0)	12.6 (0)	7.6 (0)
26	Kumali	2011	3	21 (3)	277.2 (33.9)	166.3 (20.3)
27	Periyar Tiger Reserve	2011	10	30 (18)	243.0 (142.9)	143.8 (84.6)
28	Dhoni	2011	2	6 (2)	25.2 (8.4)	15.1 (5.0)
29	Thalikulam	2011	3	9 (2)	108.9 (24.2)	65.3 (14.5)
30	Munnar	2011	2	56 (4)	2755.2 (189.7)	1653.2 (113.8)
			358	7171 (909)	319107.1 (38259.0)	190114.2 (22780.5)

Bambusa vulgaris Schrad. ex Wendl. (yellow)



Bambusa vulgaris, popularly known as yellow bamboo is native to Indochina and to the Province of Yunnan in southern China. This is a densely tufted bamboo with culms 10–20 m high, 4–10 cm diameter and internodes 20–45 cm long. It grows well mostly on river banks, road sides, wastelands, and open ground, generally in the low altitudes. Culms are used for fencing and construction as well as to make furniture, basketry, windbreakers, flutes, fishing rods, tool handles and stakes. *Bambusa vulgaris* is also cultivated as ornamental solitary or as border hedge.

Table. 21.. Details of *Bambusa vulgaris* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1	Kanjikode	2003	25	1400 (282)	82460.0 (16408.2)	44238.3 (8802.7)
2	Kathikudam	2003	60	1500 (231)	84450.0 (12978.3)	45208.2 (6947.6)
3	Kozhippara	2005	78	1950 (236)	114855.0 (13800.2)	61221.5 (7356.0)
4	Chitethukkara	2005	23	736 (103)	40627.2 (5624.3)	21938.7 (3037.1)
5	Pothupara	2005	4	68 (9)	3617.6 (458.9)	1923.3 (244.0)
6	Athirapally	2005	5	170 (47)	9741.0 (2689.3)	5260.1 (1452.2)
7	Lake Resort, Munnar	2005	35	1068 (177)	60740.8 (10066.7)	32199.5 (5336.5)
8	Anapady	2007	6	60 (5)	2034.0 (169.5)	1088.3 (90.7)
9	Pambadi	2007	1	10 (2)	372.0 (74.4)	200.1 (40.0)
10	Thekkepatta	2007	3	65 (14)	3554.5 (765.7)	1896.3 (408.5)
11	Kakkad	2007	1	20 (3)	54.0 (8.1)	29.2 (4.4)
12	Kasargod	2007	3	15 (4)	469.5 (125.2)	246.3 (65.7)
13	Mathaipara	2007	10	140 (16)	7798.0 (891.2)	4201.9 (480.2)
14	Munakkal Beach	2008	44	572 (65)	21049.6 (2393.2)	11370.7 (1292.8)
15	St.Joseph Cathedral	2009	6	42 (4)	474.6 (43.2)	256.3 (23.3)
16	Madayilkonam	2009	7	144 (19)	12862.6 (1697.2)	6897.3 (910.1)

Table. 21 (cont'd). Details of *Bambusa vulgaris* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
17	Akathethara	2010	4	160 (23)	5472.0 (765.1)	2854.9 (399.2)
18	Chundampatta	2010	1	25 (4)	1472.5 (229.3)	768.2 (119.6)
19	SN Puram	2010	1	12 (2)	398.4 (66.4)	225.2 (37.5)
20	Contour Jungle Resort, Changanassery	2010	16	384 (62)	12134.4 (1943.2)	6543.6 (1047.9)
21	Melukavu	2010	2	70 (17)	3976.0 (965.6)	2133.4 (518.1)
22	Mupliyar	2010	20	310 (78)	16492.0 (4149.6)	8905.3 (2240.7)
23	Kallar	2010	8	156 (23)	8611.2 (1247.6)	4650.1 (673.7)
24	Kakavayal	2010	1	9 (2)	281.7 (62.7)	153.1 (34.1)
25	Thrikangode	2011	2	18 (3)	37.8 (6.3)	20.4 (3.4)
26	Aralam Farm	2011	8	40 (5)	1144.0 (132.2)	608.3 (70.3)
27	Kodanad	2011	500	7500 (998)	87000.0 (11436.8)	46980.2 (6175.9)
28	Periyar Tiger Reserve	2011	5	15 (3)	109.5 (21.9)	59.1 (11.8)
29	Dhoni	2011	41	102 (28)	1045.5 (277.9)	564.6 (150.1)
30	Nadathara	2011	4	28 (5)	386.4 (69.3)	208.7 (37.4)
31	Keezhumad	2011	22	209 (19)	8213.7 (736.2)	4435.4 (397.5)
32	Olamanna	2011	3	9 (2)	6.3 (1.4)	3.4 (0.8)
33	Thalikulam	2011	2	9 (2)	91.8 (20.4)	49.6 (11.0)
34	Munnar	2011	6	216 (21)	7149.6 (694.3)	3867.2 (375.5)
			957	17,232 (2,514)	5,99,183.2 (91,019.8)	321206.7 (48796.4)

Bambusa wamin E.G.Camus

Bambusa wamin is a medium-sized graceful bamboo. Culms usually 4-8 m high, loosely tufted, usually arching at the top, dark green, shining and glabrous; internodes 10-15 cm long, rarely longer, much swollen (pitcher shaped) in the lower half; the swollen part 10-12 cm diameter. *Bambusa wamin* is grown in many gardens as an ornamental bamboo mainly in the subtropical regions including India. Culms of this species are used for handicrafts.

Table. 22. Details of *Bambusa wamin* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1	Kanjikode	2003	1	7 (1)	208.6 (27.3)	124.3 (16.3)
2	Pambadi	2007	1	2(0)	31.4 (0)	18.7 (0)
3	Thekkepatta	2007	1	5 (1)	149.0 (27.2)	88.8 (16.2)
4	Kakkad	2007	8	16 (4)	193.6 (42.1)	112.9 (24.5)
5	Mathaipara	2007	2	42 (7)	2301.6 (376.3)	1341.8 (219.4)
6	St.Joseph Cathedral	2009	1	5 (1)	44.5 (8.2)	26.5 (4.9)
7	Madayilkonam	2009	1	5 (0)	47.5 (0)	28.3 (0)
8	Contour Jungle Resort, Changanassery	2010	1	35 (8)	3143.0 (709.3)	1873.2 (422.7)
9	Melukavu	2010	1	9 (2)	250.2 (53.8)	145.9 (31.4)
10	Kallar	2010	1	18 (3)	941.4 (150.3)	548.8 (87.6)
11	Periyar Tiger Reserve	2011	1	2 (0)	11.4 (0)	6.8 (0)
12	Keezhumad	2011	1	10 (3)	121.0 (35.2)	70.5 (20.5)
13	Olamanna	2011	3	9 (2)	14.4 (3.2)	8.4 (1.9)
14	Thalikulam	2011	17	595 (63)	5474.0 (559.8)	3191.3 (326.4)
			40	760 (95)	12931.6 (1992.7)	7586.4 (1171.8)

Dendrocalamus asper (Schult.) Backer

Dendrocalamus asper is a tall bamboo with culms 15–20 m high, 6–10 cm diameter; internodes 30–50 cm long. Culms trumpet-shaped with lowest diameter thicker than from breast height up. Culm internodes of lower culm completely covered with velvety greenish to brown hairs. This species is cultivated throughout tropical Asia, from lowlands up to about 1,500 m altitude for shoot for food, culms for construction, for making chop-sticks and tooth-picks, and for pulp.

Table. 23. Details of *Dendrocalamus asper* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1	Kozhippara	2005	13	208 (34)	10233.6 (1612.8)	6060.6 (955.1)
2	Chitethukkara	2005	5	40 (4)	588.0 (55.3)	353.4 (33.2)
3	Vilayanoor	2006	16	96 (2)	1228.8 (25.6)	726.9 (15.1)
4	Anapady	2007	95	1140 (89)	18126.0 (1408.2)	10883.9 (845.6)
5	Manjapra plantation	2007	1	25 (5)	2132.5 (412.7)	1263.8 (244.6)
6	Pambadi	2007	4	20 (3)	246.0 (36.8)	148.1 (22.2)
7	Thekkepatta	2007	3	9 (2)	758.7 (160.4)	434.2 (91.8)
8	Mathaipara	2007	10	20 (4)	72.0 (14.4)	43.2 (8.6)
9	Puthen Cruz	2008	116	4756 (579)	126985.2 (15256.2)	76134.5 (9146.9)
10	Chmmanad	2008	360	15120 (2154)	400680.0 (56106.2)	241109.8 (33762.0)
11	St.Joseph Cathedral	2009	3	45 (6)	1210.5 (159.3)	726.3 (95.6)
12	Akathethara	2010	2	4 (0)	115.6 (0)	69.7 (0)
13	Pattambi	2010	6	78 (12)	101.4 (14.9)	61.0 (9.0)
14	SN Puram	2010	9	99 (9)	2950.2 (268.2)	1776.1 (161.5)
15	Contour Resort, Changanassery	2010	4	38 (7)	1098.2 (198.1)	661.2 (119.3)
16	Kakavayal	2010	11	528 (83)	3801.6 (567.3)	2276.5 (339.7)
17	Thrikangode	2011	11	55 (1)	374.0 (6.8)	224.3 (4.1)
18	Aralam Farm	2011	6	30 (4)	216.0 (28.8)	130.2 (17.4)
19	Kodanad	2011	500	3500 (358)	35700.0 (3513.3)	21321.4 (2098.3)
20	Nallathanny	2011	4	92 (11)	846.4 (101.2)	502.3 (60.1)
21	Periyar Tiger Reserve	2011	5	30 (4)	372.0 (49.7)	223.4 (29.8)
22	Dhoni	2011	5	20 (3)	256.0 (38.4)	143.2 (21.5)
23	Olamanna	2011	4	12 (2)	28.8 (4.8)	17.3 (2.9)
Total			1193	25965 (3376)	608121.5 (80039.4)	365291.3 (48084.1)

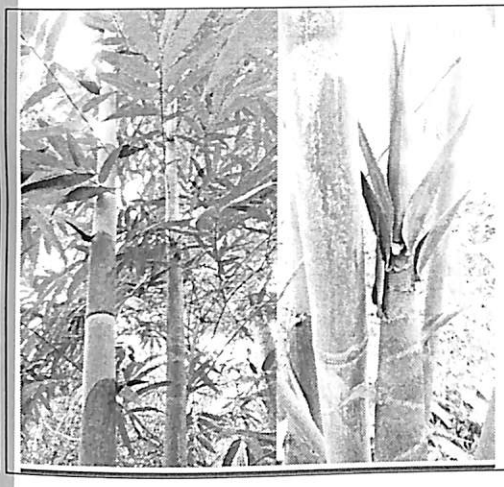
Dendrocalamus brandisii (Munro) Kurz

Dendrocalamus brandisii is a very large evergreen tufted bamboo. Culms ashy-gray to greenish-gray, 19-33 m high and 13-20 cm diameter, nodes slightly swollen and internodes 30-38 cm long. The species is found growing in the tropical forests, chiefly on calcareous rocks up to an altitude of 1300 m. This speices is cultivated in Manipur, Andamans, Karnataka and Kerala for using its culms for house building, baskets and decorative. Young shoots are edible.

Table. 24. Details of *Dendrocalamus brandisii* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1	Kootala	2002	4	112 (11)	6328.0 (621.5)	3803.1 (373.5)
2	Kathikudam	2003	1	20 (3)	1084.0 (162.6)	651.5 (97.7)
3	Kozhippara	2005	5	60 (6)	1932.0 (193.2)	1161.1 (116.1)
4	Lake Resort, Munnar	2005	11	594 (96)	8791.2 (1420.8)	5283.5 (853.9)
5	Anapady	2007	24	288 (29)	4377.6 (440.8)	2630.9 (264.9)
6	Manjapra plantation	2007	8	264 (23)	2983.2 (259.9)	1792.9 (156.2)
7	Thekkepatta	2007	4	196 (23)	10172.4 (1193.7)	6113.6 (717.4)
8	St.Basil Granites, Poovanchira	2007	3	30 (6)	489.0 (97.8)	274.8 (55.0)
9	Kasargod	2007	2	34 (5)	931.6 (137.0)	523.6 (77.0)
10	Kulangarakad	2008	7	112 (7)	3236.8 (202.3)	1819.1 (113.7)
11	St.Joseph Cathedral	2009	3	24 (3)	698.4 (87.3)	392.5 (49.1)
12	Madayilkonam	2009	5	45 (7)	2709.0 (421.4)	1522.5 (236.8)
13	Chundampatta	2010	2	50 (7)	2560.0 (358.4)	1438.7 (201.4)
14	SN Puram	2010	7	49 (6)	759.5 (93.0)	426.8 (52.3)
15	Contour Resort, Changanassery	2010	1	30 (7)	1776.0 (414.4)	1028.3 (239.9)
16	Melukavu	2010	1	42 (9)	2368.8 (507.6)	1371.5 (293.9)
17	Karad	2010	5	10 (0)	26.0 (0)	15.1 (0)
18	Kallar	2010	6	192 (11)	9273.6 (531.3)	5369.4 (307.6)
19	Kakavayal	2010	9	270 (21)	14013.0 (1089.9)	8113.5 (631.1)
20	Nallathanny	2011	3	21 (3)	342.3 (48.9)	198.2 (28.3)
21	Thalikulam	2011	3	12 (1)	170.4 (14.2)	98.7 (8.2)
22	Munnar	2011	2	150 (21)	16515.0 (2312.1)	9562.2 (1338.7)
23	Kuttaneloor	2012	48	624 (83)	2620.8 (348.6)	1517.4 (201.8)
			164	3229 (388)	94158.6 (10956.7)	55109.0 (6414.6)

Dendrocalamus giganteus Munro



Dendrocalamus giganteus is the tallest of bamboos with close culms and slender branches. Culms 24-30 m tall, 20-30 cm diameter, usually 2-2.5 cm thick-walled, dull green, covered with white waxy crust when young and internodes 35-40 cm long. It is a native of Myanmar and cultivated in Arunachal Pradesh, Assam, Manipur, Nagaland and West Bengal; occasionally in other parts of the country. The culm is used for building purposes, boat masts, vases, buckets, and various other decorative purposes. Young shoots of this species are used for the preparation of many delicacies.

Table. 25. Details of *Dendrocalamus giganteus* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Kootala	2002	5	150 (33)	19,920.0 (4,132.6)	12,211.0 (2,533.3)
2.	Chitethukkara	2005	2	18 (4)	146.2 (31.4)	89.6 (19.3)
3.	Mulayathri	2006	2	26 (5)	220.0 (40.3)	134.8 (24.7)
4.	Lakshmananchalla	2007	2	4 (0)	6.4 (0)	3.9 (0)
5.	Anapady	2007	10	40 (5)	338.4 (40.1)	207.4 (24.6)
6.	Manjapra plantation	2007	1	28 (6)	3813.6 (806.2)	2337.7 (494.2)
7.	CBF	2007	2	70 (17)	1001.0 (232.1)	613.6 (142.3)
8.	Pambadi	2007	4	24 (5)	943.2 (187.3)	578.2 (114.8)
9.	St.Basil Granites, Poovanchira	2007	1	3 (0)	30.3 (0)	18.6 (0)
10.	Kakkad	2007	1	5 (0)	61.5 (0)	37.7 (0)
11.	Mathaipara	2007	1	3 (0)	12.6 (0)	7.7 (0)
12.	Alanellore	2008	1	3(0)	5.7 (0)	3.5 (0)
13.	Thrikangode	2009	1	5 (0)	75.0 (0)	46.0 (0)
14.	St.Joseph Cathedral	2009	1	3 (0)	33.6 (0)	19.9 (0)
15.	Chundanpatta	2010	2	80 (18)	7408.0 (1,432.3)	4392.9 (849.4)
16.	Contour Resort, Changanassery	2010	1	4 (0)	324.8 (0)	192.6 (0)
17.	Melukavu	2010	1	9 (3)	774.9 (250.1)	459.5 (148.3)
18.	Aralam farm	2011	3	12 (2)	36.1 (6.0)	21.4 (3.6)
19.	Nallathanny	2011	1	3 (0)	18.9 (0)	11.2 (0)
20.	Periyar Tiger Reserve	2011	3	12 (2)	170.4 (28.4)	101.0 (16.8)
21.	Dhoni	2011	3	18 (3)	146.2 (23.7)	86.7 (14.1)
22.	Kuttaneloor	2012	1	3 (0)	6.3 (0)	3.7 (0)
			49	523 (103)	35493.0 (7210.5)	21578.8 (4385.2)

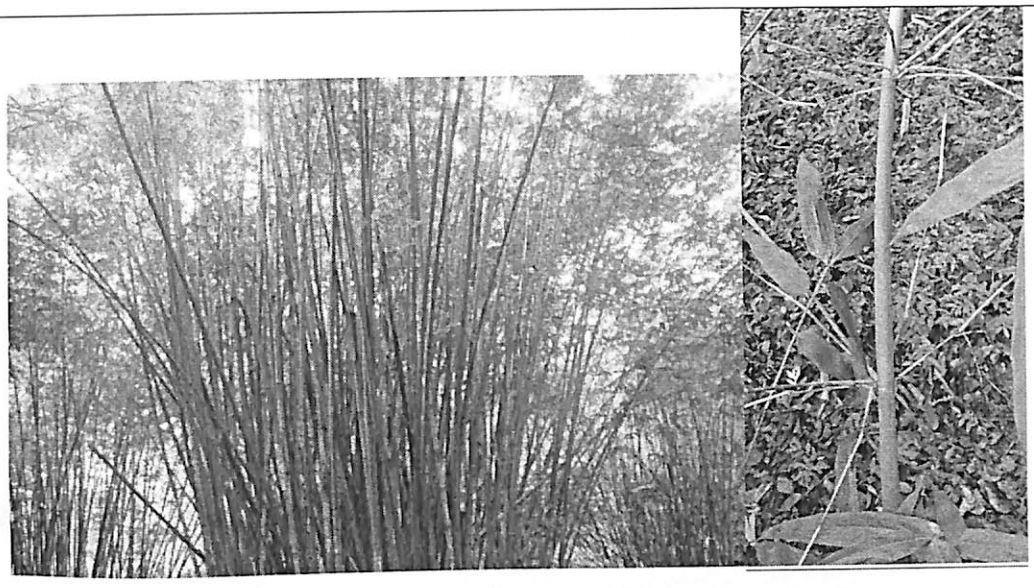
Dendrocalamus hamiltonii Nees & Arn. ex Munro

Dendrocalamus hamiltonii is a large- sized bamboo with culms 12-20 m or up to 25 m tall, 10-18.5 cm diameter, grayish-white when young with dense appressed pubescence, dull green when old and internodes 30-50 cm long. This species distributed in the North-West Himalaya, Sikkim, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura is generally cultivated in other parts of India as well. The species is used for construction purposes, basket-making, mats, water and milk vessels, fuel, floats for timber-rafts. The tribals of Arunachal Pradesh use the tender shoot for preparation of 'hiyup', a sour pickle. Recently, it was observed that the skin of this bamboo can be used in cottage industry for binding and caning of chairs.

Table. 26. Details of *Dendrocalamus hamiltonii* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Chitethukkara	2005	2	44 (7)	550.0 (83.2)	336.6 (50.9)
2.	Vilayanoor	2006	16	160 (18)	4608.0 (506.3)	2820.1 (309.9)
3.	Pattambi	2010	27	243 (21)	2478.6 (203.4)	1516.9 (124.5)
4.	SN Puram	2010	2	44 (6)	1267.2 (156.3)	764.1 (94.2)
5.	Aralam Farm	2011	3	36 (4)	327.6 (35.6)	197.5 (21.5)
6.	Nallathanny	2011	5	25 (5)	302.5 (59.6)	182.4 (35.9)
7.	Periyar Tiger Reserve	2011	3	24 (4)	242.4 (39.3)	146.2 (23.7)
8.	Olamanna	2011	3	12 (2)	69.6 (11.6)	42.0 (7.0)
Total			61	588 (67)	9845.9 (1095.3)	6005.8 (667.6)

Dendrocalamus longispathus (Kurz) Kurz

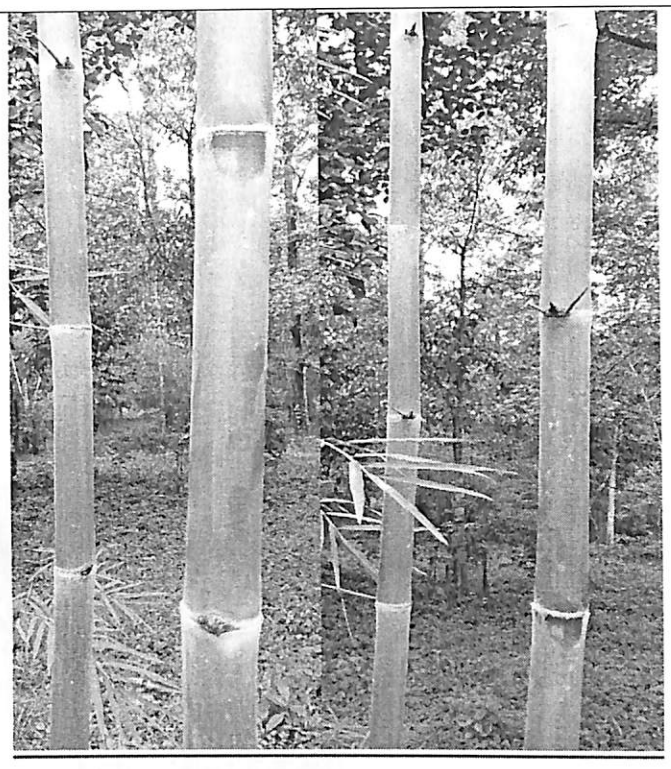


Dendrocalamus longispathus is a large tufted bamboo. Its culms usually 10-18 m high, glaucous green when young, greyish-green on maturity and internodes 25-60 cm long. This species is generally used for the manufacture of paper. It is also used for making basket and containers. *Dendrocalamus longispathus* is found as an ideal material for the manufacture of good quality tooth picks.

Table. 27. Details of *Dendrocalamus longispathus* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Kootala	2002	8	144 (15)	1958.4 (198.3)	1139.8 (115.4)
2.	Kathikudam	2003	4	120 (18)	1632.0 (221.3)	949.8 (128.8)
3.	Lake Resort, Munnar	2005	48	816 (99)	8241.6 (986.3)	4796.6 (574.0)
4.	Manjapra plantation	2007	2	62 (11)	2430.4 (427.4)	1414.5 (248.7)
5.	CBF	2007	46	690 (59)	9384.0 (793.4)	5461.5 (461.8)
6.	Thekkepatta	2007	5	140 (19)	2114.0 (261.2)	1230.3 (152.0)
7.	Kakkad	2007	1	6 (1)	72.6 (12.1)	41.3 (6.9)
8.	Kasargod	2007	1	12 (1)	441.6 (35.7)	251.3 (20.3)
9.	Dhoni	2008	1	43 (8)	584.8 (103.2)	332.8 (58.7)
10.	Kulangarakad	2008	1	21 (3)	268.8 (35.4)	152.9 (20.1)
11.	Munakkal Beach	2008	10	40 (6)	520.0 (76.4)	295.9 (43.5)
12.	Madayilkonam	2009	7	259 (23)	5516.7 (468.7)	2995.6 (254.5)
13.	Contour Resort, Changanassery	2010	8	144 (17)	1742.4 (205.2)	946.1 (111.4)
14.	Desamangalam	2010	1	8 (1)	98.4 (12.3)	53.4 (6.7)
15.	Kallar	2010	5	60 (9)	732.0 (103.2)	397.5 (56.0)
16.	Olamanna	2011	2	6 (1)	18.6 (3.1)	10.1 (1.7)
			150	2571 (291)	35756.3 (3943.2)	20469.4 (2260.6)

Dendrocalamus membranaceus Munro



Dendrocalamus membranaceus is a moderate-sized, strong bamboo forming loose clump. Culms straight, 20-24m high, 6-10cm diameter; internodes 22-38 cm long; upper branches slender, leafy, drooping. This species is a native of Myanmar. This is one of the common species occurring in China and Taiwan. This species is used for building purposes, making chopsticks, shreds and paper. Young shoots edible.

Table. 28. Details of *Dendrocalamus longispathus* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Thekkepatta	2007	4	348 (29)	13850.4 (1068.2)	8185.6 (631.3)
2.	Periyar Tiger Reserve	2011	4	4 (1)	5.2 (1.0)	3.0 (0.6)
Total			8	352 (30)	13855.6 (1069.2)	8188.6 (631.9)

Dendrocalamus sikkimensis Gamble ex Oliv.

Dendrocalamus sikkimensis is a large bamboo with few culms. Culms large, 17-20 m high, 12-20 cm diameter, dark-green; internodes up to 45 cm long, rough. In Sikkim Himalaya, this is one of the largest bamboos preferred by Lepchas and Bhutias for making the 'Chungas' for carrying water and milk. In Sikkim, it is used for fencing, posts, huts, ropes, boxes, water pipes and as animal fodder. It also can be used for pulp and paper.

Table. 29. Details of *Dendrocalamus sikkimensis* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Kuttaneloor	2012	48	384 (38)	1075.2 (112.3)	637.6 (66.6)
2.	Manjapra plantation	2007	5	70 (11)	3801.0 (532.1)	2254.0 (315.5)
3.	Nallathanny	2011	20	100 (19)	1230.0 (213.2)	729.4 (126.4)
4.	Kumali	2011	7	28 (4)	98.0 (13.8)	58.1 (8.2)
5.	Periyar Tiger Reserve	2011	1	4 (0)	7.6 (0)	4.5 (0)
6.	Madayilkonam	2009	7	182 (23)	13322.4 (1633.6)	8033.4 (985.1)
7.	Perintalmanna	2012	300	2100 (211)	7560.0 (727.6)	4558.7 (438.7)
8.	Kakkad	2007	4	24 (3)	309.6 (33.5)	186.7 (20.2)
9.	Olamanna	2011	6	12 (1)	31.2 (2.5)	18.8 (1.5)
10.	Neriyamangalam	2010	1500	6000 (789)	18000.0 (2308.5)	11016.0 (1412.8)
11.	Kallar	2010	4	32 (3)	508.8 (42.2)	311.4 (25.8)
12.	Kakavayal	2010	1	9 (2)	143.1 (30.2)	87.6 (18.5)
Total			1903	8945 (1104)	46086.9 (5649.5)	27896.1 (3419.4)

Dendrocalamus strictus (Roxb.) Nees

Dendrocalamus strictus is a deciduous densely tufted bamboo. Culms 8-16 m high, 2.5-8 cm diameter; internodes 30-45 cm long, thick-walled to almost solid. This species occupies 53 per cent of total bamboo area in India.It is found suitable for reclamation of ravine land. It is extensively used as raw material in paper mills and also for a variety of purposes such as construction, agricultural implements, musical instruments, furniture etc. Young shoots are commonly used as food. Decoction of leaves and nodes and silicious matter is used in the traditional medicine.

Table. 30. Details of *Dendrocalamus strictus* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Kootala	2002	2	36 (6)	500.4 (81.2)	321.3 (52.1)
2.	Lakshmananchalla	2007	48	1,056 (134)	13,833.6 (1,703.2)	8,881.2 (1,093.5)
3.	Pambadi	2007	2	26 (5)	377 (65.8)	242.0 (42.2)
4.	St.Basil Granites, Poovanchira	2007	6	150 (19)	1,530 (178.9)	982.3 (114.9)
5.	Kakkad	2007	1	5 (0)	57.5 (0)	36.9 (0)
6.	Kasargod	2007	30	435 (79)	1,870.5 (320.2)	1,200.9 (205.6)
7.	Mathaipara	2007	10	140 (33)	1,848 (425.3)	1,186.4 (273.0)
8.	Munakkal Beach	2008	6	42 (7)	134.4 (21.3)	86.3 (13.7)
9.	Alanallore	2008	1	5 (1)	14 (2.8)	9.0 (1.8)
10.	Karad	2010	2	4 (0)	12.4 (0)	8.0 (0)
11.	Nallathanny	2011	11	385 (49)	5,582.5 (706.2)	3,584.0 (453.4)
12.	Keezhumad	2011	23	414 (51)	5,754.6 (701.2)	3,694.5 (450.2)
13.	Thalikulam	2011	5	15 (3)	94.5 (18.9)	60.7 (12.1)
14.	FDA, Karakad	2012	30	120 (27)	216 (45.7)	138.7 (29.3)
			177	2,833 (414)	31,825.4 (4,270.7)	20,431.9 (2,741.8)

Gigantochloa atroviolacea Widjaja

Gigantochloa atroviolacea is a bamboo with clumps loosely tufted. Culms 8-12 m high, 6-8 cm diameter at the base, purple on maturity; internodes usually 30-50 cm long. This species grows widely in West Java. It prefers to grow in dry areas on soil rich in limestone. The purplish colour of the culm is more prominent when it grows in dry areas. This species is used for building construction and for making furniture. It is also used for making traditional musical instruments and handicrafts.

Table. 31. Details of *Gigantochloa atroviolacea* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Chitethukkara	2005	3	12 (3)	110.4 (24.3)	59.9 (13.2)
2.	Pambadi	2007	3	13 (3)	278.2 (61.2)	151.1 (33.2)
3.	Kakkad	2007	1	5 (2)	107.0 (41.1)	54.8 (21.0)
4.	Chundampatta	2010	1	9 (2)	334.8 (72.1)	171.4 (36.9)
5.	Olamanna	2011	3	3 (1)	10.5 (3.1)	5.4 (1.6)
Total			11	42 (11)	840.9 (201.8)	442.6 (106.0)

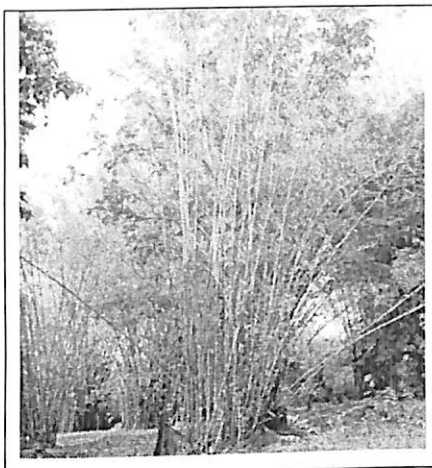
Gigantochloa rostrata K.M.Wong

Gigantochloa rostrata is a tufted dark-green bamboo with culms 5-8 m tall, 2.5-5 cm diameter. Thick-walled, slightly drooping, basal portion with yellowish stripes; internodes 20-30 cm long. It is distributed in Assam, Meghalaya, Tripura, Orissa, Bihar, Madhya Pradesh, Maharashtra and Karnataka. It is also cultivated in different parts of the country. The culms are used for building huts and making baskets. Also used as a raw material for paper industry. Seeds are used as food by the local people.

Table. 32. Details of *Gigantochloa rostrata* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Kathikudam	2003	13	39 (7)	144.3 (24.3)	80.1 (13.5)
2.	Chitethukkara	2005	1	32 (5)	326.4 (48.7)	181.2 (27.0)
3.	Kasargod	2007	21	252 (16)	3124.8 (183.2)	1734.3 (101.7)
4.	Kulangarakad	2008	1	16 (3)	72.0 (13.5)	38.3 (7.2)
5.	Pattambi	2010	53	1007 (38)	5941.3 (215.3)	3160.8 (114.5)
6.	Aralam Farm	2011	6	78 (7)	780.0 (65.2)	415.0 (34.7)
7.	Periyar Tiger Reserve	2011	1	2 (0)	5.4 (0)	2.8 (0)
8.	Olamanna	2011	1	12 (2)	46.8 (7.2)	24.5 (3.8)
9.	Kuttaneloor	2012	48	288 (51)	1296.0 (217.6)	677.8 (113.8)
Total			145	1726 (129)	11737.0 (775.0)	6314.6 (416.2)

Guadua angustifolia Kunth

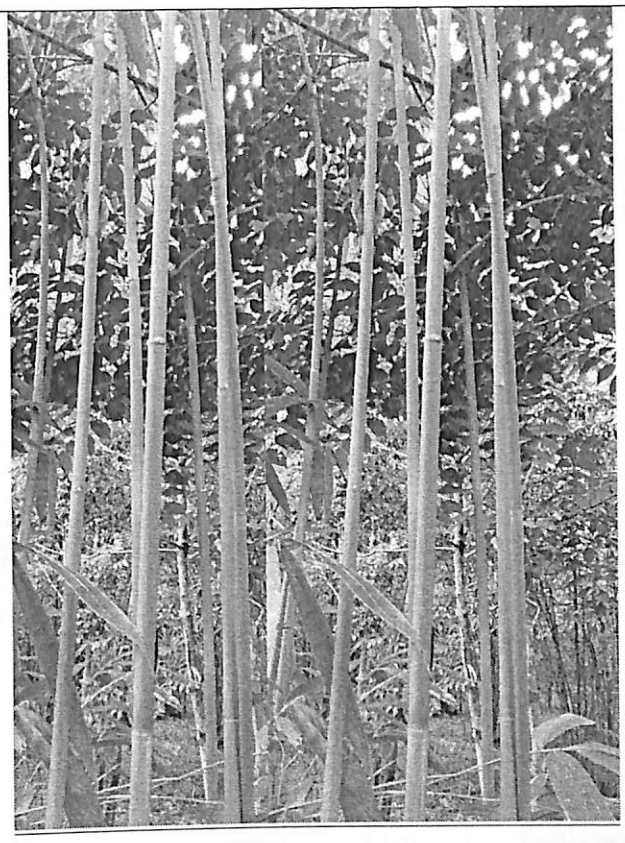


Guadua angustifolia is a bamboo with culms 20–30 m high; 10–13 cm diameter; culm-internodes terete; hollow; 20 cm long. It is the most economically important bamboo in the humid, tropical Americas; primary source of building material for urban and rural dwellings, and raw material for numerous products.

Table. 33. Details of *Guadua angustifolia* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Chitethukkara	2005	2	60 (13)	1002.0 (217.1)	594.2 (128.7)
2.	Mulaythiri	2006	1	7 (1)	86.1 (12.3)	51.1 (7.3)
3.	Vilayanoor	2006	13	130 (24)	754.0 (139.2)	447.1 (82.5)
4.	Aralam Farm	2011	5	20 (4)	52.0 (10.4)	28.2 (5.6)
Total			21	217 (42)	1894.1 (379.0)	1120.6 (224.2)

Melocanna baccifera (Roxb.) Kurz



Melocanna baccifera is characterised by diffse clump and culms 10-20 m high, 3-7 cm diameter, green when young, straw coloured when old; longest internodes 20-25 cm long. The species is distributed in India, Bengladesh and Myanmar, cultivated in many Asian countries. This species is used for building houses, for making woven ware and as an important source of superior paper pulp. Highly suitable for kraft paper making. The culms are strong, durable with inconspicuous nodes. Fruits are edible. The culms are used for making floats to transport wooden logs.

Table. 34. Details of *Melocanna baccifera* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Kathikudam	2003	12	540 (63)	27972.0 (3132.3)	16587.4 (1857.5)
2.	Kasargod	2007	24	1440 (128)	9504.0 (821.4)	5531.3 (478.1)
3.	Contour Resort, Changanassery	2010	1	120 (47)	432.0 (151.2)	251.4 (88.0)
4.	Kakavayal	2010	2	4 (1)	10.4 (2.2)	6.1 (1.3)
5.	Kodanad	2011	2	4 (0)	16.8 (0)	9.4 (0)
6.	Periyar Tiger Reserve	2011	7	357 (44)	1463.7 (175.4)	821.1 (98.4)
			48	2465 (2830	39398.9 (4282.5)	23206.8 (2523.2)

Pleioblastus fortunei (Van Houtte) Nakai

Pleioblastus fortunei, a bamboo native to China and japan is a small bamboo with culms 0.60 – 1.2 m high and 2 - 6mm diameter. Culm internodes 10 – 30 cm long. The plant is grown as ornamental, where it is used as a ground cover.

Table. 35. Details of *Pleioblastus fortunei* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Pothupara	2005	2	50 (11)	210.0 (41.4)	118.2 (23.3)
2.	CBF	2007	13	195 (23)	1228.5 (141.2)	691.6 (79.5)
3.	Pambadi	2007	2	20 (5)	58.0 (13.2)	32.7 (7.4)
4.	Kakkad	2007	2	10 (2)	42.0 (7.9)	23.6 (4.4)
5.	Dhoni	2011	50	250 (31)	1050.0 (125.4)	591.2 (70.6)
6.	Keezhumad	2011	1	4 (1)	12.8 (3.1)	7.2 (1.7)
Total			70	529 (73)	2601.3 (332.2)	1464.5 (187.0)

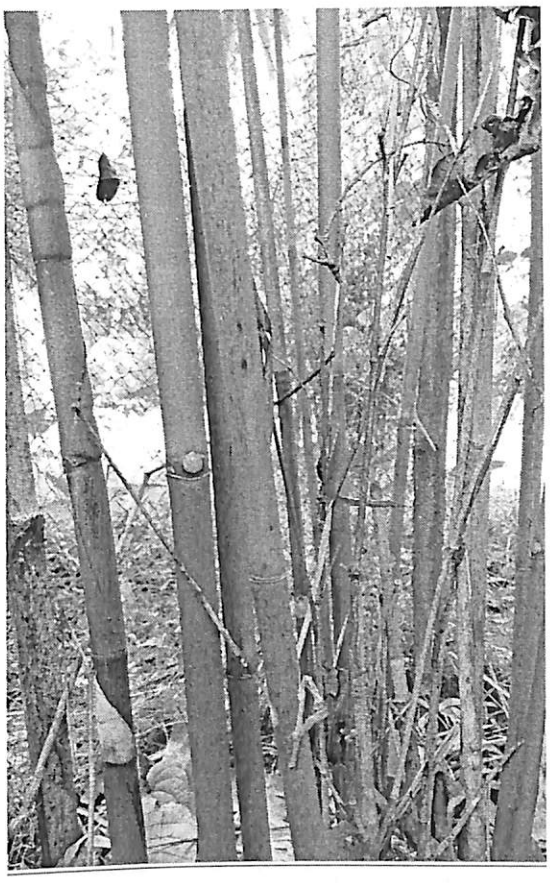
Pseudoxytenanthera stocksii (Munro) T.Q.Nguyen

Pseudoxytenanthera stocksii is a medium-sized bamboo. Culms up to 9 m tall, glabrous, when young covered with dense white or gray deciduous tomentum, internodes 15-30 cm long and 2.5-4 cm broad; branches few at the node. This bamboo is mostly confined to the banks of streams and requires a well drained deep loamy soil. The culms are used for construction purposes, umbrella handles and basket making.

Table. 36. Details of *Pseudoxytenanthera stocksii* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Chitethukkara	2005	1	60 (19)	2208 (699.2)	1174.7 (371.9
2.	Lake Resort, Munnar	2005	8	144 (17)	5443.2 (642.6)	2988.3 (352.8)
3.	Anapady	2007	18	162 (17)	1166.4 (122.4)	620.5 (65.1)
4.	Manjapra plantation	2007	1	27 (4)	426.6 (63.2)	234.2 (34.7)
5.	Pambadi	2007	1	5 (1)	156.5 (31.3)	85.9 (17.1)
6.	Kakkad	2007	3	18 (3)	183.6 (30.6)	100.8 (16.9)
7.	Dhoni	2008	1	11 (3)	114.4 (31.2)	60.9 (16.8)
8.	Kulangarakad	2008	1	26 (5)	343.2 (66.0)	182.6 (35.1)
9.	Desamangalam	2010	1	8 (1)	126.4 (15.8)	69.4 (8.2)
10.	Dhoni	2011	1	2 (0)	4.8 (0)	2.6 (0)
11.	Munnar	2011	1	20 (5)	126 (31.5)	69.2 (17.5)
			37	483 (75)	10299.1 (1733.8)	5589.1 (936.2)

Schizostachyum dullooa (Gamble) R.B.Majumdar



Schizostachyum dullooa is a moderate sized to large tufted bamboo, sometimes scandent. Culms variable in size, 6-9 m tall and 2.5-7.5 cm diameter, dark green with a few white hairs; internodes 40-75 cm, sometimes up to 1m long, with thin walls. *S. dullooa* is capable of growing on the course textured soil provided there is moisture, Used by the people of Garo Hills for carrying water and for making umbrellas. Generally used for making baskets, mats and small boxes.

Table. 37. Details of *Schizostachyum dullooa* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1.	Pambadi	2007	3	36 (7)	1062.0 (202.3)	613.8 (116.9)
2.	Nallathanny	2011	13	78 (7)	662.5 (57.1)	376.3 (32.4)
3.	Olamanna	2011	3	15 (3)	50.0 (8.9)	28.4 (5.1)
4.	Kuttaneloor	2012	48	192 (36)	403.2 (73.2)	233.0 (42.3)
			67	321 (53)	2177.6 (341.5)	1251.5 (196.7)

Thyrsostachys oliveri Gamble

Thyrsostachys oliveri is A large tufted elegant bamboo. Culms straight 15-25 m high, ca. 5 cm diameter, internodes 40-60 cm long, thin walled. This species is a native of Myanmar and now planted in many parts of India as its culms are in great demand for construction purposes, reinforcement for concrete slabs, poles, basketing and handicrafts. Young shoot is commonly used for edible purposes. This species is used for canning in Thailand for the production of steamed bamboo shoots for export.

Table. 38. Details of *Thyrsostachys oliveri* supplied by KFRI and planted in private and government farms in Kerala. Values in parentheses are for 1-year old culms.

No.	Plantation Name	Year of planting	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1	Kootala	2002	9	234 (38)	8119.8 (1145.3)	4479.6 (631.8)
2	Kanjikode	2003	4	44 (7)	664.4 (103.2)	356.7 (55.4)
3	Chitethukkara	2005	1	26 5)	408.2 (74.2)	226.5 (41.2)
4	Mulaythiri	2006	6	168 (31)	2184 (389.5)	1123.8 (200.4)
5	Lakshmananchalla	2007	1	56 (9)	840 (129.1)	459.9 (70.7)
6	Thekkepatta	2007	1	22 (4)	875.6 (153.2)	465.5 (81.4)
7	Dhoni	2008	8	720 (83)	27216 (2014.3)	14239.8 (1053.9)
8	Alanallore	2008	320	10240 (1296)	346112 (43603.2)	194322.1 (24480.7)
9	Chundmpatta	2010	380	5700 (1012)	89490 (15642.3)	49786.3 (8702.3)
10	SN Puram	2010	1	14 (2)	182 (28.1)	102.6 (15.8)
11	Melukavu	2010	1	25 (3)	845 (101.4)	469.6 (56.4)
12	Aralam farm	2011	4	16 (2)	121.6 (15.2)	68.8 (8.6)
13	Nallathanny	2011	1	1 (0)	12.3 (0)	6.9 (0)
14	Periyar Tiger Reserve	2011	2	4 (0)	4.8 (0)	2.6 (0)
15	Olamanna	2011	2	8 (0)	9.6 (0)	5.4 (0)
16	Mulaythiri	2012	25	50 (10)	105 (21.2)	58.1 (11.6)
17	Beemanad	2012	100	2200 (321)	32780 (4482.1)	17986.3 (2459.3)
Total			866	19528 (2823)	509970.3 (67902.3)	284160.5 (37869.7)

Appendix 1. Details of number clumps, culms and stock (green and air-dry) of *Bambusa bambos* in different plantations of Central and Eastern Forest circles of Kerala

No	Plantation Name	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
Central Circle					
1	Mallana,Perumthodu	16000	505600	27495	16497
2	Punnamudy	8000	560000	31366	18819
3	Iyinikkal	8000	688000	38514	23109
4	Ramanchetty	11000	556600	47433	28460
5	Palathadam	29200	1273120	108266	64960
6	Urakkad	1600	29760	1612	967
7	Puthoor	24800	1140800	64147	38488
8	Kuthiran	8000	416000	22930	13758
9	Pambatty	7000	287000	29618	17771
10	Olakkayam	36000	558000	30757	18454
11	Pokayilappara	24000	504000	16692	10015
12	Akamala	8000	552000	30989	18594
13	Poongodu	12000	252000	14107	8464
14	Thavalakuzhyppara	21200	621796	21303	12782
	Total	214800	7944676	485230	291138
Eastern Circle					
	Plantation Name	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
1	VSS-Cherumala	2400	10392	71	43
2	Manjapetty	4400	51304	1697	1018
3	Irullankunnu,Kalladikode	9375	405937	34959	20976
	Total	16175	467633	36728	22037

Appendix 2. Details of number clumps, culms and stock (green and air-dry) of *Bambusa bambos* var. *gigantea* in plantations of the Central Forest circle of Kerala

No	Plantation Name	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
Central Circle					
1	Karanthodu	6064	181920	2757907	1643161
2	Chapilakodu	3200	45760	1464320	872442
	Total	9264	227680	4222227	2515603

Appendix 3. Details of number of clumps, culms and stock (green and air-dry) of *D. strictus* in plantations located in Central and Eastern Forest Circles of Kerala.

No.	Plantation Name	Number of clumps	Total number of culms	Total Green weight (Kg)	Total Dry weight (Kg)
Central Circle					
1	Vellarampadam	25375	2791250	66179.3	37722.2
2	Kozhikunnu	2500	217500	7836.1	4466.6
3	Pazhavoor	39375	511875	10845.2	6181.8
4	Puthuruthy	6250	201875	3584.7	2043.3
5	Irippankunnu	11875	190000	4600.7	2622.4
6	Edakunni	6250	193750	5317.0	3030.7
	Total	91625	4106250	98363.0	56067.0
Eastern Circle					
1	Mulakuvallam	4000	300000	10896.3	6210.9
2	Nattukal	4000	333200	11363.8	6477.4
	Total	8000	633200	22260.1	12688.3