



Standing stock of thorny bamboo [*Bambusa bambos* (L.) Voss] in the homegardens of Thrissur, Kerala

B.M. Kumar*, K.G. Sudheesh and G. Rajesh

Department of Silviculture and Agroforestry, College of Forestry, Kerala Agricultural University, KAU PO, Thrissur 680 656, Kerala

Received 14 November 2005; received in revised form 30 November 2005; accepted 1 December 2005

Abstract

Standing stock of rural bamboo in Thrissur district was assessed through a two-stage stratified random scheme in which 330 homegardens in 10 *panchayaths* (rural) and one peri-urban area were sampled. The total growing stock of thorny bamboo in the homegardens of Thrissur district was estimated as 32,344 clumps or 22,86,305 culms, having a total dry weight of 28,659 Mg. In general, medium and large-sized holdings were having more bamboo clumps. Such gardeners also felled more bamboo and generated higher cash returns compared to the owners of small holdings. Average cash income generation per farmer through bamboo sale during the period from 1999 to 2004 was, however, modest; Rs. 62, 188 and 199 per garden per year respectively for small, medium and large holdings.

Keywords: Bamboo felling, holding size, rural bamboo, sample survey

Introduction

The homegardens are often perceived as an important source of bamboo in Kerala. Although Kumar (1997) reported that rural bamboo in Kerala is declining, the central districts of Kerala still have a substantial bamboo presence (P.K. Muraleedharan, pers. comm., 2005). Yet no accurate state- or district-wise estimates of bamboo growing stocks are available; hence a survey was conducted in the homegardens of Thrissur district to assess the standing stock of thorny bamboos. Additional objectives included gathering information on the socio-economic factors that determine the occurrence and abundance of bamboos in the homegardens, the rate at which “bamboo growers” harvest this resource and the extent of cash income generation through its sale.

Materials and methods

The survey was conducted from September 2004 to January 2005 and the methodology involved a two-stage

stratified random sampling scheme in which about 10% of the *panchayaths* and peri-urban areas (municipalities) in Thrissur district were sampled. That is, from the 99 *panchayaths* in this district (KSLUB, 1995), 10 were randomly selected. In addition, one peri-urban area also was randomly chosen from six such localities. In the first stage, a reconnaissance of the selected 11 localities was performed to identify the “bamboo growers”. This was followed by a more detailed household survey in which 30 households per locality were randomly selected (total 330). Girth at breast height (GBH) of all clumps of thorny bamboo [*Bambusa bambos* (L.) Voss] in the selected homegardens was carefully measured after removing the overhanging thorns. Information on holding size, bamboo felling, net revenue generated through bamboo sale during the five year-period from 1999 to 2004 and other socio-economic parameters were also gathered from the respondents through a questionnaire survey. Based on size, the holdings within a locality were also subdivided into three categories, for further interpretations [small (<0.4 ha), medium (0.4 to 2 ha) and large (>2 ha)].

*Author for correspondence: Phone +91 487 237 0050; Fax +91 487 237 1040; E-mail <bm Kumar53@yahoo.co.uk>

Mean number of bamboo clumps per household was estimated using the formula for sub-sampling (Chacko, 1965; Eq. 1 to 5) with *panchayath*/peri-urban area as the first-stage unit and household as the second-stage unit. The number of first- and second-stage units selected was 11 (n) and 30 (m) respectively.

$$\text{Estimate of the population mean, } \hat{Y} = \bar{y} = \frac{1}{nm} \sum_{i=1}^n \sum_{j=1}^m y_{ij} \quad [\text{Eq. 1}]$$

where y_{ij} is the total number clumps per household.

Assuming that the finite population correction (fpc) is unity, the estimate of variance of the population mean was taken as,

$$\hat{V}(\hat{Y}) = \hat{V}(\bar{y}) = \frac{S_b^2}{n} \quad [\text{Eq. 2}]$$

$$\text{where } S_b^2 = \frac{1}{n-1} \sum_{i=1}^n (\bar{y}_i - \bar{y})^2 \quad [\text{Eq. 3}]$$

\bar{y}_i is the mean of the clumps in i th first stage unit (*panchayath*) and \bar{y} is the estimate of the population mean.

An estimate of total number of clumps in the district was derived as $\hat{Y} = N\hat{Y}$ [Eq. 4]

where N is the total number of bamboo growing households in the district.

Estimate of the standard error of the estimated total was $SE(\hat{Y}) = N\hat{V}(\hat{Y})$ [Eq. 5]

Number of culms, dry weight of live culms and total dry weight per clump were estimated based on the clump diameter at breast height (DBH in m)—derived from GBH measurements, and using the following prediction equations (Kumar et al., 2005). The prediction variances at the household-level were ignored and thereby the variances of such variables are slightly underestimated.

$$\text{Total biomass per clump (kg), } Y = -3225.8 + 1730.4 \text{ DBH} \quad [\text{Eq. 6}]$$

$$\text{Live culm dry weight (kg), } \ln Y_l = 4.298 + 2.647 \ln(\text{DBH}) \quad [\text{Eq. 7}]$$

$$\text{No. of culms, } Y = -12.23 + 37.281 \text{ DBH} \quad [\text{Eq. 8}]$$

Results and discussion

Standing stock of bamboo in the homegardens of Thrissur

Estimates of the population mean and its descriptive statistics are presented in Table 1. It indicates that the mean number of bamboo clumps and culms per home-garden in Thrissur district are 1.56 and 111 respectively and the total dry weight, 1470 Mg. Using these estimates, the standing stock of bamboo culms in Thrissur district (for 99 *panchayaths* and six municipalities; KSLUB, 1995) was estimated as $32,344 \pm 859$ clumps or $22,86,305 \pm 62,495$ culms with a total dry weight of $28,659 \pm 1,150$ Mg (Table 2). Average number of bamboo growing homegardens (per locality) being 197 (Table 3), the total number of bamboo growing households in the district (105 *panchayaths*/peri-urban

Table 1. Estimate of the population mean, standard error of the estimate and relative standard error of the estimate of number of clumps, culms, dry weight of live culms and dry weight of live and dead culms together per household in Thrissur district of Kerala

Parameter	Mean number of clumps	Mean number of culms	Dry wt. of live culms (Mg)	Total dry wt. (Mg)
Population mean	1.56	110.5	1368	1470
Standard error of the estimate (\pm)	0.04	3.02	52.6	55.6
Relative standard error of the estimate	2.66	2.73	3.85	3.78
Lower limit	1.48	105.6	1265	1361
Upper limit	1.65	116.5	1471	1579

areas) was estimated as 20,685. Previous estimates on rural bamboo stocks of Thrissur are not available; hence it is impossible to make any comparative assessments.

An evaluation of the data in Table 3, however, shows that bamboo is present only in a relatively small fraction of the total homegardens in Thrissur district (2.2 to 4.6%). Furthermore, the number of bamboo growers, average number of bamboo clumps per household and the standing stock of bamboo are highly variable. Mean number of clumps per household was 1.61 ± 0.06 , with a mean culm number of 121.98 ± 3.39 . Although highlands adjoining forest areas (e.g., Athirappilly; Table 3) had relatively more bamboo clumps per holding, the total number of gardens with bamboo and the standing stock of bamboo in the homegardens, were generally low there. Conversely, the coastal (e.g., Mullassery) and midlands zones (e.g., Kadangode and Poyya) had relatively fewer number of clumps per household than other zones. Soil type of the bamboo growing area and the socio-economic factors may play a vital role in this respect; but it is impossible to deduce any concrete relationships in the absence of more detailed studies.

Holding size: a determinant of bamboo abundance

Within a locality, bamboo occurrence and abundance are strongly dependent on the size of holdings (Table 4). As expected, medium and large holdings had more clumps than small gardens. Such gardeners also felled more clumps; and through that accrued relatively more cash returns. Yet the mean cash income generation per respondent for the five preceding years (1999 to 2004) on account of bamboo sale was, rather modest with the small, medium and large holders getting Rs. 62, 188 and 199 per garden per year respectively.

Although Krishnankutty (2004) concluded that bamboo in the Kerala homegardens has the potential to be the second most profitable crop, our observations indicate that the average returns generated through sale of bamboo in the homegardens of Thrissur district is relatively small. Furthermore, bamboo felling in the homegardens of Thrissur was rather patchy; indeed, many gardeners (73%) did not report any felling activity during the past five years, while some of the gardeners indicated extensive clearing. The number of respondents, who felled 1, 2, 3, 4, 5, 6 and 7 clumps, during the period from 1999 to 2004, was 43, 17, 11, 8, 6, 3 and 1 respectively. The net returns generated was also correspondingly variable; the highest being Rs. 9000/- with a frequency of one over a five year period and the number of individuals who earned up to Rs 1000, 1001 to 2000, 2001 to 3000, 3001 to 4000, 4001 to 5000, 5001 to 6000, 6001 to 7000 and 7001 to 8000 was 12, 35, 12, 13, 3, 8, 3 and 2 respectively. It may be noted that our data-set excludes those gardens from where bamboo has been completely exterminated in the past.

The reasons for elimination of bamboo clumps from the homegardens are also seemingly promiscuous, but fragmentation of the holdings and urbanization is seemingly important (Kumar, 1997). There is also a tacit assumption that the profusely growing surface (fibrous) root systems of bamboo may out-compete the field/tree crops grown in association (Kumar and Divakara, 2001). Indeed, a large number of other species including woody perennials were encountered in the sampled gardens (data not presented), implying interspecific competition as a cardinal reason for the decimation of the home-garden bamboo clumps.

Overall, the present estimates suggest that the standing

Table 2. Estimates of bamboo growing stock in Thrissur district, Kerala, India.

Parameter	No. of bamboo clumps	No. of bamboo culms	Dry wt. of live culms (Mg)	Total dry wt. (Mg)
Growing stock	32,344	22,86,305	26,665	28,659
Standard error of the estimate (\pm)	859	62,495	1,088	1,150
Relative standard error of the estimate	2.66	2.73	3.85	3.78
Lower limit	30,659	21,63,816	26,162	26,534
Upper limit	34,028	24,08,794	30,427	32,664

Table 3. Total number of households, bamboo growers and estimates of the mean no. of clumps, culms, dry weight of live culms and total dry weight of culms in selected *panchayaths*/peri-urban areas of Thrissur district, Kerala

Locality	Predominant soil type†	Natural regions	Total households (no.)	Bamboo growers (no.)	Relative proportion of bamboo growers (%)	Mean parameters (per garden)			
						No. of bamboo clumps	No. of culms	Culm dry wt. (kg)	
								Live	Total
Athirappilly	Oxic Humitropepts	H	2456	74	3.01	2.03	115.5	2156	2290
Avinissery	Typic Dystropepts	M	5240	219	4.18	1.60	126.8	2613	2763
Kadangode	Ustic Kandihumults	M	6121	276	4.51	1.57	121.0	2459	2601
Kandanassery	Typic Kanhaplustults	M	5625	178	3.16	1.50	119.1	2439	2580
Kunnamkulam*	Typic Dystropepts	M	10276	229	2.23	1.57	116.4	2143	2280
Mullassery	Typic Trophaquepts	L	5157	208	4.03	1.37	105.0	2067	2190
Nenmanikkara	Ustic Haplohumults	M	5511	184	3.34	1.37	113.4	2502	2637
Padiyur	Typic Kanhaplustults	M	4091	161	3.94	1.50	113.1	2215	2347
Poyya	Typic Dystropepts	M	6180	210	3.40	1.67	139.9	3084	3251
Punnayurkkulam	Typic Kanhaplustults	M	5223	143	2.74	1.83	138.3	2961	3122
Thiruvilwamala	Typic Ustropepts	H	6237	284	4.55	1.70	133.3	2751	2908
Mean	-	-	5647	197	3.49	1.61	122	2490	2634
Standard error (\pm)	-	-	1796	57	-	0.06	3.39	102	106

†As described in KSLUB (1995); *peri-urban area; all others are rural areas; H= highland, M= midlands and L= lowlands

Table 4. Mean number of bamboo clumps present, clumps felled and revenue generated in the sampled households in selected *panchayaths*/peri-urban areas of Thrissur district, Kerala

Locality	Clumps present per garden			Number of clumps felled per year per homegarden†			Net returns from bamboo felling (Rupees/year/homegarden)†		
	S	M	L	S	M	L	S	M	L
Athirappilly	1.2	1.3	2.1	0.04	0.2	0.14	91	282	154
Avinissery	1.0	1.5	2.3	0	0.1	0.06	0	116	89
Kadangode	1.1	1.5	2.1	0.06	0.02	0.08	69	14	95
Kandanassery	1.0	1.7	1.8	0	0.04	0.4	0	55	471
Kunnamkulam*	1.2	1.8	2.1	0.1	0.1	0.2	204	155	223
Mullassery	1.2	1.3	1.6	0.04	0.2	0.1	66	261	142
Nenmanikkara	1.0	1.5	1.6	0.04	0.2	0.2	59	304	248
Padiyur	1.0	1.5	2.0	0	0.3	0.26	0	398	366
Poyya	1.2	1.9	1.9	0.06	0.2	0.08	58	153	92
Punnayurkkulam	1.3	2.1	2.2	0.02	0.1	0.08	28	80	97
Thiruvilwamala	1.1	1.4	2.6	0.1	0.2	0.2	104	246	210
Mean	1.12	1.59	2.03	0.04	0.2	0.16	61.7	187.6	198.8
SD	0.1	0.24	0.28	0.035	0.1	0.098	56.85	113.7	118.7

*peri-urban area; all others are rural areas; S= small (<0.4 ha), M= medium (0.4 to 2 ha) and L= large (>2 ha) holdings; †average for five years (1999 to 2004)

stock of bamboo in the homegardens of Thrissur district is low to moderate. Furthermore, the available bamboo resources are being felled on account of fragmentation of the holdings, competitive interactions with the associated crops, aesthetic reasons and the like. With

increasing fragmentation of holdings especially on account of the rising population pressure and urbanization, the boundary planted bamboo clumps are likely to be the first target of destruction in any major “developmental activity”.

Acknowledgements

This research has been financed in part by a grant made by the Indian Council of Agricultural Research, New Delhi under the AP Cess Fund Schemes. Statistical assistance by Dr. C. Sunanda and the cooperation of the survey participants are gratefully acknowledged. Dr. K. Jayaraman of the Kerala Forest Research Institute, Peechi provided useful comments on a previous version of this paper.

References

- Chacko, V.J. 1965. *A Manual on Sampling Techniques for Forest Surveys*. The Manager of Publications, Delhi. 172p.
- Kerala State Land Use Board (KSLUB) 1995. Land Resources of Kerala State. Thiruvananthapuram, Kerala, 209p.
- Krishnankutty, C.N. 2004. Benefit-cost analysis of bamboo in comparison with other crops in mixed cropping homegardens in Kerala State, India. *J. Bamboo Rattan*, 3: 99-106.
- Kumar, B.M. 1997. Bamboos in the homegardens of Kerala: A shrinking resource base. *J. Non-timber For. Products*, 4 (3/4): 156-159.
- Kumar, B.M. and Divakara, B.N. 2001. Proximity, clump size and root distribution pattern in bamboo: A case study of *Bambusa arundinacea* (Retz.) Willd., Poaceae, in the Ultisols of Kerala, India. *J. Bamboo Rattan*, 1: 43-58.
- Kumar, B.M., Rajesh, G. and Sudheesh, K.G. 2005. Above-ground biomass production and nutrient uptake of thorny bamboo [*Bambusa bambos* (L.) Voss] in the homegardens of Thrissur, Kerala. *J. trop. Agric.*, (this volume).