



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

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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)].

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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 ± 859 clumps or 22,86,305 ± 62,495 culms with a total dry weight of 28,659 ± 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 (±) | 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”.

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