

bamboo potential survey

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For long term industries like the Paper Mills, the need for a guaranteed material on sustained basis hardly requires any stress. For this it is highly imperative that accurate data is collected for determination of the latent potentialities after field survey of bamboo forests, the main raw material used at present by the Paper Mills. This paper deals with the procedure adopted by the author for determining potentiality of bamboo forests of J. K. Paper Mills, Orissa. It is hoped that in the absence of any standard practice on the subject, it may prove of some use to others for meeting identical ends.

FIELD SURVEY

(a) Procedure :

Actual field stock mapping has to be done in convenient density and quality classes. Thereafter some percentage of enumeration of bamboo clumps per unit area in each density class has to be undertaken for determining the growing stock and the extent of culms available for felling under the bamboo felling rules, prescribed for proper exploitation with due regard to the sustained annual increment of bamboo culms. For a planned stock mapping, keeping in view its objects based upon the maximum possible accuracy coupled with practical feasibility of its application on the field and the types of forests dealt with, the following five density classes have been adopted for *Dendrocalamus strictus* :—

	Density class	Clumps per acre	Corresponding average spacing of clumps in feet
(i)	Blank ...	0-10	Over 63
(ii)	Scanty ...	1-50	31-63
(iii)	Inadequate	51-80	24-30
(iv)	Adequate ...	81-110	20-23
(v)	Gregarious ...	111 and over	1-19

In vast bamboo forests, it is not practicable to count the number of clumps per acre and then fill up the density classes. Ocular estimate of inter-clumps-espacement after a couple of days actual measuring is sure to give quite satisfactory results for facilitating stock mapping rapidly.

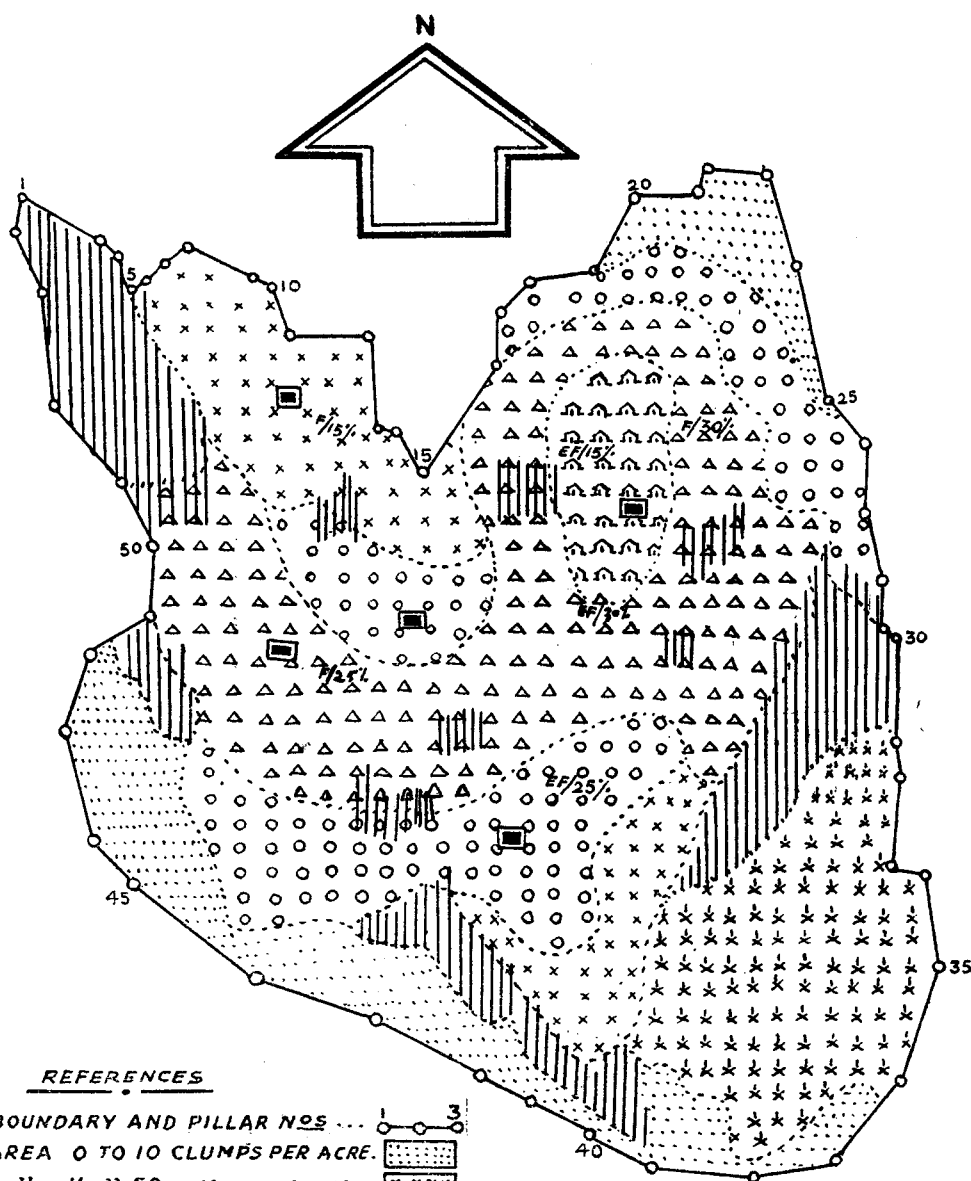
In order to make the field work convenient for execution through untrained staff with not much of forestry background, the bamboo areas have not been differentiated into quality classes depending upon height of bamboos. But the deficiency is compensated by filling up "History Sheet Form" as given below, wherein a provision has been made for recording average height and girth of different bamboo forests under survey.

COUPE/BLOCK HISTORY SHEET FORM

1. Name of forest Block/Coupe :
- 2.(a) Total area in acres :
- (b) Total bamboo area in acres :
3. Division :
4. Range :
5. Name of felling series if formed :
6. Blocks included (in case more than one block in a coupe) :
7. Compartments if constituted :
8. Legal statue of forest i.e. Reserved/Proposed/Notified/Protected-Unreserved/Demarcated/undemarcated :
9. Estimated growing stock : Nos.....Tonnes.....

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APPENDIX No 3 **MODEL BAMBOO STOCK MAP** SCALE: 4" = 1 MILE



REFERENCES

BLOCK BOUNDARY AND PILLAR NOS ...	1	3
BLANK AREA 0 TO 10 CLUMPS PER ACRE.		
SCANTY " 11 " 50 " " "		
INADEQUATE 51 " 80 " " "		
ADEQUATE 81 " 110 " " "		
GREGARIOUS III & OVER " " "		
BAMBOO REGENERATION		
PODU (SHIFTING) CULTIVATION		
ENUMERATION PLOT		
BAMBOO DENSITY DEMARCATION LINE		
INCIDENCE OF FLOWERING (IN TERMS OF PERCENTAGE OF EXISTING CROP) F/15%	} WITH SEPARATE BOUNDARY-LINES.	
EXPECTED INCIDENCE OF FLOWERING SHORTLY EF/20%		
SAY WITHIN NEXT 3 TO 4 YEARS (IN TERMS OF PERCENTAGE OF EXISTING CROP)		

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10.(a) Total available yield for felling of bamboos per feeling cycle Nos.....Tonnes.....

(b) Average available yield for felling of bamboos per year : Nos.....Tonnes.....

(c) Average yield for felling per year per acre of total area : Nos.....Tonnes.....

(d) Average yield for felling per year per acre of bamboo area : Nos.....Tonnes.....

11. Extraction route starting from forest :

(a) Dragging upto..... Meters

(b) Road lead to..... Katcha.....K.M.

Pacca.....K.M.

(c) Rail lead from..... To Paper Mills.....K.M.

12. Headquarters of field staff :

13. Surrounding villages, population with economic conditions :

14. Topography :

15. Soil :

16. Slope :

17. Past history :

18. Vegetation :

19. Description of bamboos with special reference to :

- (i) Average length & girth :
- (ii) Regeneration conditions :
- (iii) Flowering incidence :

20. Special references—like podu (shifting cultivation) old plantation and their results etc. :

21. Project if any in the area :

22. Opinion of surveyor :

23. Remarks—such as illicit fellings, extraction facilities, permanent sources of water, nearby market, places, market days, daily wage rates etc. :

However, for *Dendrocalamus strictus*, the main species occurring in M.P., Orissa and Bihar forests, the following quality classes can be made :—

Quality class	Average height in feet.	Corresponding Approximate No. of Air dry bamboos per metric tonne.
I	Over 35	250
II	Over 28-35	300
III	Over 21-28	350
IV	Upto 21	400 and over

At the time of stock mapping the bamboo areas in various density classes, 1% enumeration of each of density class is carried out by laying out one acre sample plots (5 chains × 2 chains) in representative areas and the clump and culm numbers therein are recorded in the following proforma :

Name of Forest or Coupe No. & felling series.	Plot No.	Serial No. of Clump	Total No. of Culms in the clump. e. Growing Stock (G ₁)	No. of one season old culms (N ₁)	No. of two season old culms (N ₂)	Others	Availability for bamboos felling as per felling rules (N ₃)	Remarks. **
1	2	3	4	5	6	7	8	9

***"The concept of silviculture and scientific management should run together for maximising sustained yield."

(b) The enumeration plots are also roughly shown on the map to facilitate checking of the field work.

Bamboo regeneration areas, not ready for immediate exploitation, and also areas affected by Podu (shifting

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cultivation) are separately shown on the map. Similarly extent of bamboo flowering (both existing and expected within the next 3-4 years on determinable indications), is also specially recorded on the map as this phenomenon is bound to disturb the sustained supply of raw material for a pretty long time. Slumps having five or less culms in them in the unworked forests are treated as regeneration crop only, but such instances are rare. Similarly two adjacent clumps within 3 feet of each other, are counted as one clump for purposes of stock mapping. On a convenient scale of 4"=1 mile map minimum unit for mapping has been fixed as 5 acres on practical considerations.

(c) After completion of stock mapping of a particular

forest, the following information is ready with the surveyor :—

- (i) Total acreage of bamboo area density class wise
- (ii) Density class wise per acre growing stock i.e. G_1
- (iii) Number of bamboos available for felling per acre i.e. N_3 in case of unworked forest and

Mean (Average) annual increment ($\frac{N_1 + N_2}{2}$), where

N_1 and N_2 are number of one and two season old culms, in case of normal forests and areas under regular working. An illustration of bamboo enumeration in scanty type density class and a "Model stock map" are given below :

Model Bamboo enumeration plot record for the unworked bamboo Forests (*Dendrocalamus strictus*) with scanty density

Name of Forest/ or Coupe No. & Felling Series.	Plot No.	Serial No. of the clump	Total No. of clumps in the clump i.e. growingstock (G ₁)	No. of one season old culms (N ₁)	No. of two season old culms (N ₂)	Others	Availability for bamboos felling as per felling rules (N ₃)	Remarks.
1	2	3	4	5	6	7	8	9
Ratu B. F. S.	1	1	39	10	—	29	23	
		2	36	4	3	29	23	
		3	42	8	11	23	17	
		4	24	4	—	20	14	
		5	6	2	—	4	—	
		6	24	3	2	19	13	
		7	8	—	3	5	—	
		8	14	1	3	10	4	
		9	10	1	2	7	—	
		10	15	3	1	11	5	
		11	28	4	6	18	12	
		12	20	3	2	15	9	
		13	26	4	9	13	7	
		14	30	3	3	24	18	
		15	17	3	1	13	7	
		16	34	8	1	25	19	
		17	23	1	4	18	12	
		18	29	5	1	23	17	
		19	35	—	5	30	24	
		20	30	3	1	26	20	
		21	14	—	2	12	4	
		22	31	7	4	20	14	
		23	24	2	1	21	14	
		24	39	7	2	30	24	
		25	40	9	2	29	23	
		26	12	5	1	6	—	
				Total :	640	100	70	470

NOTE :—1. Bamboo Felling Rules are based upon the following considerations :—

- a. Retention of all one season and two season old culms.
 - b. Retention of atleast 6 mature culms in each clump.
 - c. Retention of a minimum of 10 culms in each clump.
2. For a better assessment of the future yield, for finding out the mean (average) annual increment, it will be more appropriate to determine it from the total recruitment of new culms for the entire felling cycle rather than two years only, after laying out sample plots for different density classes.

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(d) Calculation of yield :

From the foregoing data, total availability for each density class can be calculated as under :—

(i) In case of unworked forests :

Total availability of bamboos in any density class

= $A \times N_3$ where A is the area of a particular density class in acres.

and N_3 the number of bamboos available for felling per acre as per felling rules.

The sum total of availability of all the density classes in a particular area will give the total felling stock of bamboos for that area. This divided by the felling cycle will give the annual yield (Y) for the first felling cycle with the presumptions that the average annual increment is balanced by the natural mortality of the oldest age class of culms and also the extent of destructive agencies would continue to be at par with the past.

Total number of bamboos for the subsequent felling cycles with proper working can be very nearly anticipated by multiplying each of the density class areas with the following constant factors (for *Dendrocalamus strictus* only), evaluated for moist and dry deciduous forests as a result of extensive enumerations.

Density class	Constant factor
Scanty	200
Inadequate	600
Adequate	950
Gregarious	1150

These constants will hold good if the density classes are representative of the average type. In case of varying and extreme cases of marginal type, (on the lowest or highest side depending upon site and biotic conditions), margin of reproduction may differ appreciably. No hard and fast rule can be laid down to arrive at the accurate and dependable results in such cases and the judgement of the man on spot will speak the best.

(ii) In case of forests under working :

$$y = A \times \frac{N_1 + N_2}{2}$$

where Y = Yield i.e. annual availability of bamboos for felling.

A = The area of a particular density class in acres.

N_1 & N_2 = Number of one and two season old culms per acre respectively for the systematically worked forests.

Thus the sum total of annual availability from all density class areas will give very nearly the annual potentiality of the area with the presumption that the destructive biotic influences will continue to play just the same role as in the past. However for the unmethodically under or over worked forests, there will be every reason to realise or conserve more respectively at the felling operations. Extent of this over removal or excess retention, as the case may be, can be determined by sample enumerations as forecited and will be added to or subtracted from the average annual increment for accurate determination of the actual yield. In that case yield for any density class may be assessed as under :

$$Y = A \times \left(\frac{N_1 \times N_2}{2} \pm X \right) \text{ with usual notations except}$$

× which will be a variant for each forest depending upon the nature of crop and extent of irregular working.

The sum total of yield from all density classes will give the annual potentiality of the area under survey.

An illustration for yield calculation is shown below :—

(a) Model bamboo yield calculation sheet for unworked forests.

Name of Forest Block or Bamboo Felling Series & Coupe.	Density class of Bamboos.	Area in acres (from actual stock mapping) (A)	Average availability per acre of density class per felling cycle (As per actual enumerations or constant factors)	Total yield per felling cycle.
1	2	3	4	5
Ratu 'A'	Scanty	150	200	30,000
	Inadequate	100	600	60,000
	Adequate	100	950	95,000
	Gregarious	100	1,150	1,15,000
	Total :	450	2,100	3,00,000

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Assuming the quality of bamboos is II i.e. 300 bamboos per ton, then the total yield for felling per felling cycle 3,00,000

in terms of tonnage will be $\frac{3,00,000}{300} = 1000$ tons.

Further assuming that the felling cycle is four years. Then annual yield will be 250 tonnes.

(b) Model bamboo yield calculation sheet for Forests under working.

Name of Forest Block or Bamboo Felling Series & Coupe.	Density class of Bamboos.	Area in acres (A)	Average annual yield per acre of density class as per actual enumerations.	Total annual yield for felling
1	2	3	4	5
Ratu 'C'	Scanty	150	50	7,500
	Inadequate	100	150	15,000
	Adequate	100	237	23,700
	Gregarious	100	288	28,800
	Total :	450	725	75,000

Assuming the quality of bamboos is II i.e. 300 bamboos per ton then the total annual yield in terms of tonnage 75,000

will be $\frac{75,000}{300} = 250$ tonnes.

(e) **Regulation of yield :** Lastly in order to exercise a cross check on the stability of yield and also for safeguarding against any further encroachment on the future yield, as a rough and thumb rule, during selection fellings of the regularly and properly worked bamboo forests, it shall be advisable to retain at least 50% of the total growing stock uniformly distributed over the clumps as far as possible, as part of the future

crop. The total growing stock can be ascertained from the enumerations forecited as under :—

$G = A \times G_1$ where G = total growing stock for a particular density class.

A = The area in acres of the same density class.

G_1 = The growing stock per acre determinant from the actual enumerations.

The sum total of growing stock of all the density classes will give the total growing stock for the forest under Survey.

(f) Last but not the least, proportionate reduction for the incidence of flowering observed must be made in each density class separately for determination of apt to creep in form clear felling the flowered clumps, future sustained yield and like wise temporary increase should be recorded separately for purposes of yield calculations.

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