

## PRISM SAMPLING BY COMPARTMENTS IN MIXED CONIFEROUS FORESTS

by

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## Summary

*To assess the accuracy and average deviation percent of prism sampling vis-a-vis total enumeration in the mixed temperate coniferous forests, seven compartments (390 hectares) of varying density, varying slope and species composition of Kaghan Reserved Forests, were sampled, by prism of B.A.F. 20 and also enumerated totally. This paper is confined to the discussion of conifers only. The deviation of Basal Area varies from 13 to 29% for different compartments. The compartmentwise variation between total number of trees and total volume with prism sampling and total enumeration ranged from 12 to 46% and 11 to 28% respectively. The variation between stand tables (5 centimetres diameter classes) prepared with prism sampling and those derived from total enumeration was much wider. The volume estimates with prism sampling for all area, varied from the volume estimates of the total enumeration by minus 12% i.e., the prism sampling estimates were on lower side. It was concluded that prism sampling technique may be used for basal area and volume estimates with a permissible deviation of 20%, in the mixed temperate coniferous forests, but it will not be advisable to use it for the preparation of the stand tables, unless acceptable accuracy is achieved by improving the application of point sampling in all its ramifications.*

## Introduction

This study was undertaken to test the accuracy of prism sampling against total enumeration in the mixed coniferous forests. The work was carried out in Malkandi Compartments 2 (ii) 3(i), 7, Nuri 2, Kamalban 8, Battal 4 and Naran 8 of Kagan Reserved Forests, total area 390 hectares. The area bears pure and mixed crops of the blue pine, deodar, fir, spruce and broad leaved species of density varying from below 10% to over 70%. The slope varies from 10 to over 100%. The present discussion is confined to conifers only.

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### Method of Data Collection

The growing stock was estimated through prism sampling, using B.A.F. 20 prism. The sampling design adopted was systematic with random start, without stratification. Stand and stock tables were prepared by compartments and then totalled for the whole area. A sampling intensity of one plot per 4 hectares was taken in the first instance with a minimum of 14 points for a single compartment. After collecting data over the compartment in this manner, the co-efficient of variation was calculated for basal area. The required number of plots was then calculated on the basis of coefficient of variation for achieving a basal area estimate within 20% of the mean at 80% probability. Where the number of plots calculated for the required degree of dependability was more than the number of plots already taken, additional plots distributed at random over the compartment were taken to complete the required number.

### Observation recorded on each plot

D.b.h. of all 'in' trees was measured, except those which were more than 50% rotten. No readings were recorded for plots falling in a blank of more than 2 hectares. Zero reading was recorded for plots falling in blanks less than 2 hectares in area.

For determining centre to centre distance between the plots, and line to line spacing, the acreage of a compartment was divided by the required number of plots and the resultant acreage was converted into square metres and then its square root was found which is the desired distance. As in the first instance one plot per 4 hectares was to be taken, therefore, plot to plot and line to line distance in this case worked out to be 200 metres. This distance was measured by pacing, taking one step, equal to 6 metres of 330 steps for 200 metre. Care was taken to avoid bias. The starting point was identifiable on the ground as well as on the compartment map. As the compartment boundaries are formed by permanent features, therefore, in most cases the corner points of these boundaries were used for this purpose. The centre of the first plot was taken 30 metres inside the compartment from the selected point and subsequent distance between the plot centres and lines was taken equal to that determined for the compartment. D.b.h. was measured by steel callipers and recorded by 2.5 cm. diameter class. For comparison, the total enumeration of the area was carried out by adopting the standard procedure practised for such enumeration.

### Computation of Data

For computational works, Preliminary Working Plan Report for Revision of Working Plan for Kagan Reserved Forests, by Mr. S.M. Ayyaz, was followed. For calculation of volumes, stand tables were converted to stock tables, using Azam's volume tables of 1970.

## RESULTS

### Basal area

The basal areas per hectare for different compartment, by the two methods are compared in Table 1 below:



TABLE 1

## Comparison of Basal Areas per acre

Compartment No.		Basal Area (square metres) per hectare by total enumeration	Basal Area (square metres) per hectare by prism sampling	Deviation from total enumeration	Deviation % as of the total enumeration
Malkandi	2(ii)	26.17	21.35	-4.82	-18
„	3(i)	21.35	15.15	-6.20	-29
„	7	17.68	22.04	-4.36	+25
Nuri	2	29.85	25.48	-4.37	-15
Kamalban	8	35.13	30.54	-4.59	-13
Battal	4	20.43	23.65	+3.22	+16
Naran	8	31.68	27.09	-4.59	-14
Total		182.29	165.30	-16.99	-9.3

The deviation is over 20% for two compartments only, whereas in all other cases including total, it is below 20%.

#### Compartmentwise number of trees

Compartmentwise total number of trees by the two methods is compared in Table 2 below:

TABLE 2

## Compartmentwise number of trees

Compartment No.			Area (hectares)	No. of trees by total enumeration	No. of trees by prism sampling	Deviation of prism sampling from total enumeration	Deviation % as of the total enumera- tion
Malkandi	2 (ii)	..	30.35	3480	2442	-1038	-30
„	3 (i)	..	77.70	6933	4754	-2179	-31
„	7	..	60.70	7069	10301	+3232	+46
Nuri	2	..	43.71	8072	10897	+2825	+35
Kamalban	8	..	77.70	14797	10479	-4318	-29
Battal	4	..	29.14	2882	4144	+1262	+44
Naran	8	..	70.01	4716	5299	+583	+12

Out of seven compartments, deviation of only one compartment (Naran 8) is within reasonable limits, whereas in case of all others, it is very high.

## Compartmentwise volume

Compartmentwise volume of the crop by the two methods is compared in Table 3 below:

TABLE 3

## Compartmentwise Volume

Compartment No.			Area (hectares)	Volume by total enumeration m <sup>3</sup>	Volume by prism sampling m <sup>3</sup>	Deviation of prism sampling from total enumeration	Deviation % as of the total enumera- tion
Malkandi	2 (ii)	..	30.35	9609	7841	-1768	-18
„	3 (i)	..	77.70	19342	13828	-5514	-28
„	7	..	60.70	11853	14064	+2211	+19
Nuri	2	..	43.71	14868	11421	-3447	-23
Kamalban	8	..	77.70	31706	28210	-3496	-11
Battal	4	..	29.14	7005	7925	+920	+13
Naran	8	..	70.01	16025	13565	-2460	-15

Deviation is above 20% in case of only two compartments, whereas in case of all others, it is below 20%.

## Stand tables

The stand tables for the area by the two methods are compared in Table 4 below:

TABLE 4

## Stand Tables

Diameter class cms.	No. of trees by total enumeration	No. of trees by prism sampling	Deviation of prism sampling from total enumeration	Deviation % as of the total enumeration
16—20	4240	4467	+ 227	+ 5
21—25	4615	5355	+ 740	+ 16
26—30	4641	6396	+ 1755	+ 38
31—35	4802	5509	+ 707	+ 15
36—40	4438	3626	— 812	— 18
41—45	3837	3481	— 356	— 9
46—50	3464	3542	+ 78	+ 2
51—55	3374	3578	+ 204	+ 6
56—60	2683	1850	— 833	— 31
61—65	2779	3115	+ 336	+ 12
66—70	1977	1772	— 205	— 10
71—75	1868	1795	— 73	— 4
76—80	1437	1286	— 151	— 11
81—85	1197	901	— 296	— 25
86—90	778	482	— 296	— 38
91—95	557	309	— 248	— 45
96—100	385	299	— 86	— 22
101—105	464	259	— 205	— 44
106—110	158	93	— 65	— 41
111—115	120	148	+ 28	+ 23
116—120	36	44	+ 8	+ 22
121—125	23	—	— 23	— 100
126—130	76	9	— 67	— 88
Total	47949	48316	+ 367	+ 0.8

Out of the total of 23 diameter classes, the deviation is within 20% in 11 classes, within 30% in 4 classes and over 30% in the remaining 8 classes. The deviation is generally higher in bigger diameter classes which have lower representation in the crop.



**Stock tables**

When the stand tables are converted into stock tables, and the volumes of diameter classes grouped into immature, sub-mature, mature and over-mature classes, the results can be compared as follows:

TABLE 5  
Comparison of Volumes

Classes (d.b.h. cms.)	Volume by total enumeration m <sup>3</sup>	Volume by prism sampling m <sup>3</sup>	Deviation of prism sampling from total enumeration	Deviation % as of the total enumeration
Immature (16—30)	5918	7004	+ 1086	+ 18
Sub-mature (30—50)	23232	21777	— 1455	— 6
Mature (50—70)	35424	34072	— 1352	— 4
Over-mature (Over 70)	45834	34001	—11833	—26
Total	110408	96854	—13554	—12.3

Table 5 shows that the estimates of volume by prism sampling vary from those by total enumeration in all size classes but these are less than 20% for the first three classes and above 20% for over-mature class only. Prism sampling has over-estimated the immature class volume and under estimated the sub-mature, the mature and the over-mature classes volumes, thus reducing the variation of total volume by prism sampling from the total enumeration to minus 12% of the latter. However, on the whole the prism sampling results are well within the permissible limits and they are on lower side, which means conservative estimation.

**Conclusion**

From this test study of prism sampling using B.A.F. 20 prism, the following conclusions are drawn:

1. The prism sampling estimates for basal area and volume (both compartment-wise and for total area) are of acceptable accuracy.

2. A deviation of 20% (plus or minus) may be permitted in prescribed yield for working plans of such areas.
3. The deviations of prism sampling from total enumeration for number of trees (compartmentwise as well as combined stand tables) are unduly large in most of the cases.
4. Because of saving in time and cost, and fair accuracy for volume estimation, the method may be used for this purpose in preference to 100% enumerations.
5. Till the method is improved further, stand tables prepared with it can only be considered as approximate.

#### REFERENCES

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