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Forest Resources Survey of Shiwalik Region of Haryana & Punjab

(Ambala, Ropar Hoshiarpur And Gurdaspur Districts

INVENTORY RESULTS

FOREST SURVEY OF INDIA
NORTHERN ZONE
SHIMLA
1988

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P R E F A C E

The forest resources of the country are reducing whereas the increase in population and the process of economic growth is increasing demands on them Extreme caution and care is needed in the use of forest resources An adequate estimate of the growing stock in various forests and regeneration status is necessary to decide upon the extent of use Forest Survey of India is engaged in carrying out such inventories in various regions of the country

This report presents the forest inventory results on "Shiwalik region" of Haryana and Punjab (Ambala, Ropar Hoshiarpur and Gurdaspur districts) The inventory was carried out during the year 1985

The total geographical area of the region is 13423 km^2 Of this, 3832 km^2 lies in Ambala district of Haryana State and 9591 km^2 in Ropar, Hoshiarpur and Gurdaspur districts of Punjab State For inventory, elevation 400 metres and more above MSL was considered to form the Shiwalik region The geographical area of so determined Shiwalik region is 2125 65 km^2, of which 710 80 km^2 lies in Haryana and 1414 85 km^2 is in Punjab Out of the total geographical area of 2125 65 km^2 of the Shiwalik region, 1346 80 km^2 i e 63 36% is forest Although this percentage is adequate in accordance with the National Forest Policy norms the forest area has decreased during

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the last two decades i.e. from 1966 to 1985 by about 10%. Of the 1346.80 km^2 forest existing in the year 1966, 141.18 km^2 (10.49%) has been deforested and diverted to other uses such as agriculture, habitation etc.

Accessible forest area of the region is 1072.62 km^2, of which only 1.50% (16.68 km^2) is having a canopy density of 70% and above, 51.92% (548.28 km^2) is having canopy density of 30% to 69% and 46.50% (491.06 km^2) is having canopy density of 5% to 29%. The situation regarding regeneration is sad. Regeneration over the entire accessible tree forest area is either absent or inadequate. 748.24 km^2 (63.37% of total) of accessible forest and scrub area is subject to heavy or moderate soil erosion. Erosion intensity on the balance 432.48 km^2 (36.63%) forest area is mild.

The survey reveals that Chir, Hardwood mixed with Conifers, Sal, Khair and Miscellaneous forest types found in the region contain an average of 193, 142, 240, 77 and 97 stems per hectare respectively; The per hectare volume is 62.466, 19.812, 84.862, 3.946, 7.642 m^3 respectively. The accessible tree forest area has an estimated total growing stock of 1.5 million cubic meters comprising 11.7 million stems.

A heartening fact revealed by the survey is that an area of 323.80 km^2 shown as scrub in the topographical maps of 1966 have improved in tree stocking and are now in a position to be categorised as forest.

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Apart from the inventory, information on strip plantations raised by the Forest Departments in the four districts of Shiwalik region has also been collected and compiled from the Working Plans of the State Forest Departments. The total area under strip plantations in these four districts is 17913.36 hectares, of which 53.97% (9667.58 ha) is along canals, 34.46% (6172.32 ha), along roads, and 11.57% (2073.46 ha), along railway lines. The strip forests in the districts of Shiwalik region have a total growing stock of 0.45 million m^3 comprising 1.05 million stems.

The report has been compiled by Shri R.K. Sood, Dy. Director under the guidance of Shri S.C. Joshi, Joint Director, and with the assistance of S/Shri M.S. Mehta, STA, Jai Gopal Sharma, JTA and K.K. Dhunna, Dy. Ranger of Northern Zone, Shimla. The hardwork put in by the above named officers of North Zone is appreciated.

It is hoped that the report will be of help to the State Forest Departments and organisations engaged in the management of forest resources in the region.

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SUMMARY

1. The forest inventory survey has been carried out in Shiwalik region of Haryana and Punjab States falling within Ambala, Ropar, Hoshiarpur and Gurdaspur districts during 1985. The objectives of survey were to monitor change in land and forest resources to focus attention on its critical aspects, thereby helping in its development planning.

2. Total geographical area of the four districts of the region is 13423 km^2 Out of this area 3832 km^2 falls in Ambala district of Haryana State and 9591 km^2 in Ropar, Hoshiarpur and Gurdaspur districts of Punjab State. Forest inventory survey has been carried out in Shiwalik region of these two States and for the purpose of this survey, area above 400 meter altitude has been considered to form the Shiwalik region. The geographical area of Shiwalik region (calculated from SOI toposheets) is 2125.65 km^2 of which 710.80 km^2 lies in Haryana Shiwalik and 1414.85 km^2 is in Punjab Shiwalik. For the purpose of forest inventory areas shown by green wash and those marked as scrub on S.O.I. toposheets have been taken to constitute as forest area. Out of the total 2125.65 km^2 geographical area of Shiwaliks 1346.80 km^2 is forest area as per Survey of India toposheets (taking 1966 as reference year for monitoring the changes) which is 63.36% of the total geographical area.

3. During the past 19 years period (1966-1985) 10.40% (141.18 km^2) of the 'forest area' (1346.80 km^2) has been deforested and diverted for other uses such as agriculture, habitation etc.. Currently 8.03% (108.10 km^2 of the forest area surveyed is under scrub. Out of the remaining 1097.52 km^2 area only 24.90 km^2 being inaccessib 1072.62 km^2 is accessible tree covered area.

4. 1.50% (16.68 km^2) of accessible tree forest area is having canopy density cover of 70% and above. 51.92% (548.28 km^2) area is having canopy density cover of 30 to 69 percent and 46.50% (491.06 km^2) area is having canopy density cover of 5 percent to 29 percent.

5. Regeneration over the entire accessible tree forest area is either absent or inadequate.

6. 773.42 km^2 area being 65.50 percent of total accessible forest and scrub area has been assessed as potentially plantable.

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7. 748.24 km^2 area being 63.37% of total accessible forest and scrub area is subjected to heavy to moderate erosion and remaining 432.48 km^2 (36.63%) area is under mild erosion.

8. As a result of protection measures taken out of 323.90 km^2 of scrub area 43.56% (141.10 km^2) has been converted to dense to moderately dense tree forest and 48.74% (157.86 km^2) to open tree forest which is a positive sign of improvement in the status of the scrub areas.

9. Total area, per hectare estimated volume and number of stems in various forest types of the accessible tree forest area have been found to be as under:-

	Forest type					
	Chir	Khair	Sal	Hardwood mixed with conifers	Miscellaneous	All forest type comb
A. Haryana Zone of Shiwalik region						
1. Area (ha)	-	9174	6672	1668	22518	40032
2. No. of stems/ha	-	76.36	240.00	150.00	128.80	136.2
3. Vol./ha (m^3)	-	3.892	84.862	24.898	11.123	22.33
B. Punjab Zone of Shiwalik region						
1. Area(ha)	4980	7470	-	1660	53120	67230
2. No. of stems/ha	193.30	80.00	-	140.00	83.900	92.97
3. Vol./ha(m^3)	42.466	4.011	-	14.700	6.166	8.82
C. Entire Shiwalik region of Haryana & Punjab						
1. Area (ha)	4980	16644	6672	3328	78638	107269
2. No. of stems/ha	193.30	77.99	240.00	142.01	97.30	109.1
3. Vol./ha(m^3)	42.466	3.946	84.862	19.812	7.642	13.86

Growing-stock varies from maximum 84.862 m^3/ha. in Sal forest type which occurs only in Haryana Shiwaliks and minimum 3.946 m^3/ha. in Khair forest type. Number of stems/ha. varies from maximum 240.000 in Sal forest type and minimum 77.996 in Khair forest type. Chir Occurs in Punjab Shiwaliks only.

10. Accessible tree forest area has total growing-stock of 1.487 million cubic meters and 11.705 million stems.

Apart from the inventory survey carried out in Shiwalik region of Haryana and Punjab States information on strip plantations raised by the State Forest Departments in the four districts covering Shiwalik region has also been collected and compiled from the Working Plans of the State Forest Departments.

(i) The total area under strip plantations in four districts is 17913.36 hectares of which 53.97% area (9667.58 ha.) is along canals, 34.46% (6172.32 ha.) is along roads and 11.57% area (2073.46 ha.) along railway lines. Amongst the districts Gurdaspur accounts for 41.56% of the strip forest area followed by Ambala 35.27%, Hoshiarpur, 11.64% and Ropar 11.53% of strip forest area.

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(ii) The strip forests in the districts of Shiwalik region have total growing stock of 0 45 million cubic meters and 1 05 million stems. Distribution of number of stems and volume by major species for the region in Haryana and Punjab zone is as under:

Sl No.	Species	Haryana Zone (Ambala Distt)	%	Punjab Zone (Ropar Hoshiarpur & Gurdaspur Distts.)	%	Total for the region	
1.	Shisham						
	No of stems	110105	22 45	218101	38.83	328206	31
	Vol. in m^3	55458, 12	41 60	176642 02	55 20	232100 14	51
2.	Kikar						
	No. of stems	155876	31 78	67544	12 02	223420	21
	Vol in m^3	22557 92	16 92	25771 39	8 06	48329 31	10
3.	Eucalyptus						
	No of stems	163665	33 37	217383	38 70	381048	36
	Vol in m^3.	32935.95	24 70	52642 19	16 45	85578 14	18
4.	Fruit trees						
	No of stems	1803	0 37	15739	2 80	17542	1
	Vol in m^3	2730.34	2 05	31917 67	9.97	34648 01	7
5.	Miscellaneous						
	No of stems	58962	12 03	42966	7 65	10192 8	9
	Vol in m^3	19631 01	14 73	33023 07	10.32	52654 08	11
	Total						
	No of stems	490411	100	561733	100	1052144	1
	Vol. in m^3	133313 34	100	319996 34	100	453309 68	1

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(iii) The strip forests are divided into five Working Circles namely Eucalyptus WC, Shisham WC Kikar WC Khair WC and the Un-regulated Working Circle 89% of the strip forest area is allotted to Eucalyptus WC Shisham WC and Kikar WC each accounting for almost 30% of the area Khair Working Circle is very small in extent (0 67%) Rest of the area has been allotted to the Un-regulated Working Circle

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Chapter 1

THE BACKGROUND

1.1 Introduction

The Forest Survey of India has been set up with the aim of monitoring over a ten year cycle the dynamics of change relating to forest resources and to present data focussing attention of the planners on critical aspects of forest resources in the country. The Expenditure Finance Committee Memo (No.6-33/79-F.II) stresses that the activities of Forest Survey of India would be directed towards supplying data for Regional, State and National level planning. The following are the objectives of the Forest Survey of India (FSI) relevant to the Inventory Survey undertaken by this Zone.

i) to monitor periodically (on a ten year cycle) the changing situation of land and forest resources and to focuss attention of National planners on critical aspects of forestry.

ii) to collect the data necessary for developmental planning.

The field inventory methodology necessary to fulfil the above objectives was formulated with the assistance of the Central Statistical Organisation(CSO). The present data is in readily useable form for the National/State level planning. The design for field inventory has been kept uniform for the entire country.

This report deals with the result of the Survey conducted in Shiwalik region of Haryana and Punjab States comprising of the districts of Ambala, Ropar, Hoshiarpur and Gurdaspur. The Inventory Survey was undertaken during the period between April, 1985 to July, 1985.

1.2 Location & area

The Survey area is situated between 30°-0 and 32°-45 North latitude and 76° -45' and 77°-45' East longitude

Total geographical area of the four districts of the region is 13423 km^2 . Out of this area 3832 km^2 falls in Ambala district of Haryana State and 9591 km^2 in Ropar, Hoshiarpur and Gurdaspur districts of Punjab State. Forest inventory survey has been carried out in Shiwalik region of these two States and for the purpose of this survey, area above 400 meter altitude has been considered to form the Shiwalik region. The geographical area of Shiwalik region (calculated from SOI toposheets) is 2125.65 km^2 of which 710.80 km^2 lies in Haryana Shiwalik and 1414.85 km^2 is in Punjab Shiwalik.

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1.3 Climate

Shiwalik Zone is sub-tropical region. The summer is fairly severe with high temperature in day time. It is characterised by hot winds and dust storms in May & June. Winter is severe in December and January. Proximity of hills in North of the region influences the local climatic conditions. On the whole the summer and winter are more severe in Southern parts compared to the Northern reaches. The average rainfall is 1323 mm in Ambala district, 712 mm in Ropar district, 874 mm in Hoshiarpur district and 896 mm in Gurdaspur district. The minimum winter temperature varies from 2°C to 9°C and maximum summer temperature varies between 44°C to 48°C in the region.

1.4 Physical features

The features of the region are variable and can be distinguished in three different formations viz. Shiwalik, foothills and plains. Shiwalik hills rise upto 1600 metres in Ambala, 540 metres in Ropar, 744 metres in Hoshiarpur and 959 metres in Gurdaspur districts. The main Shiwalik range is divided into series of transverse ridges and spurs running in all directions and further spread out in numerous subsidiary spurs resulting in a broken steep and precipitous terrain. The foothills consist of elevated lands, which are in fact, the extension of outer Shiwaliks. These hills are moderately sloping and ultimately merge with the plains in the form of undulating ground. Beyond the foothills the rest of the region is plain, with flat to gentle slope. Various rivers and streams pass through this region while Shiwalik hills are drained by large number of Chos(seasonal streams). The region includes parts of the alluvial plains in Eastern, Central and Western parts where the rivers Yamuna, Sutlej, Beas and Ravi pass through. The soils of the Shiwalik hills are unstable and prone to heavy erosion.

1.5 Socio-economic conditions of the people

The Survey area consists of four districts viz. Ambala district of Haryana and Ropar, Hoshiarpur and Gurdaspur districts of Punjab. Socio-economic conditions of the people vary from district to district. Although 75% of the area of Ambala district is under cultivation, agriculture, in the area is backward, the fertility of the soil being poor and the land mostly unirrigated. After agriculture, another important occupation of the tract is anumal husbandry. It has also not developed on scientific lines as yet. People

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keep large number of un-economic cattle a mere burden on the forests. The requirement of the people living near the forests in respect of timber, wood for agricultural implements, fuel and fodder are met with from Govt. forests and partly from village common lands.

Forests of Ropar district belong to Government and are free from rights. People of the nearby villages in plains depend on forests for grazing their cattle, as due to intensive cultivation practically no private lands are left for grazing. The poorer section of rural population also collects dry and fallen twigs of trees and bushes and even cuts Ipomea and root suckers of Shisham and, lops Shisham, Kikar and other species for fuelwood specially during winter months. In the Shiwalik hills of this district fodder trees are lopped though grazing and collection of fuelwood is mostly confined to private forests. There is a big demand for timber for building construction, furniture and agricultural implements throughout the district in general and in the rural areas in particular.

In Hoshiarpur district the forests are situated both in hills and plains. In the hills of this district the Govt. forest areas are interspersed with huge tract of private lands belonging both of Panchayats and individuals. Since there are no rights in the Govt. forests, agricultural and other domestic needs of the population are generally met from the private lands. Agriculture, as compared to Ropar district is much developed in this district and hence livlihood of the population depends on agriculture. The people living near the Govt. forests however depend on forests for meeting their demands of fuelwood etc..

The people of Gurdaspur district are predominently dependant upon agriculture and animal husbandry for their earning and livlihood. Overwhelming population lives in villages while only a small percentage is inhabiting in towns and cities. The people living in cities are engaged mainly in trade, commerce, industries and general business. Agricultural occupation has been favoured with irrigation facilities in form of canals tube-wells and artisian wells which have encouraged the introduction of intensive and developed agriculture during the past two decades.

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Although agricultural wastage or residues do provide substantial quantities of fuelwood substitutes, nevertheless the demand for fuelwood, small timber and constructional timber is quite heavy and is continuously on the increase. In the face of such huge demands, the requirements for forest produce cannot be met with from local resources. Thus major part of wood etc. used locally is transported from adjoining States of Himachal Pradesh, Jammu & Kashmir or from far off places situated in U.P., M.P., and Maharashtra. The forests in Shiwalik zone of Gurdaspur are mostly Govt. owned.

1.6 Forests

Classification of forests into types has been done on the basis of occurance of species. The following forest types were found in the Survey area:

1. Chir - forests in which Chir trees constitute more than 50% of stand,
2. Hardwood mixed with conifers - forests in which broad leaved and coniferrous species occur in more or less in same proportion.
3. Sal - forests in which Sal trees constitute more than 20% of the stand.
4. Khair - forests in which Khair trees constiture more than 50% of the stand.
5. Miscellaneous forests - forests which cannot be classified in any of the above types.

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Chapter 2

DESIGN AND METHODOLOGY OF THE SURVEY

2.0 To monitor the change in forest cover, thematic maps prepared by interpretation of latest aerial-photographs were to be used. Such thematic maps were to form the basis for collection of growing-stock data. However, thematic maps were not available due to constraints beyond control of the organisation. Therefore, the 'forest areas' marked on 1:50,000 scale topographic map sheets prepared by the Survey of India were used as the basis of forest inventory. The year of topographic survey and publication of maps used in the survey area are given in Appendix I.

2.1 Definition of 'Forest Area'

The following are treated as 'Forest areas' for carrying out the forest inventory.

(i) All those areas shown in green wash on the survey of India toposheets.

(ii) All such areas in which words such as thick jungle, thick forest, dense jungle, open forest, bamboos etc. are printed.

(iii) All areas shown as 'scrub' in the Shamlaji region and given a 'brown wash' on the topo sheet.

Unless explicitly stated otherwise, 'Forest Area' in this report shall henceforth mean areas of the categories mentioned above.

2.2. Sampling Design

Each of the 1:50,000 Survey of India topographic sheets falling in the survey area was divided into 36 grids of 2½'x 2½' of latitudes and longitudes. In each of such grid, two sample points were marked. The inventory data was

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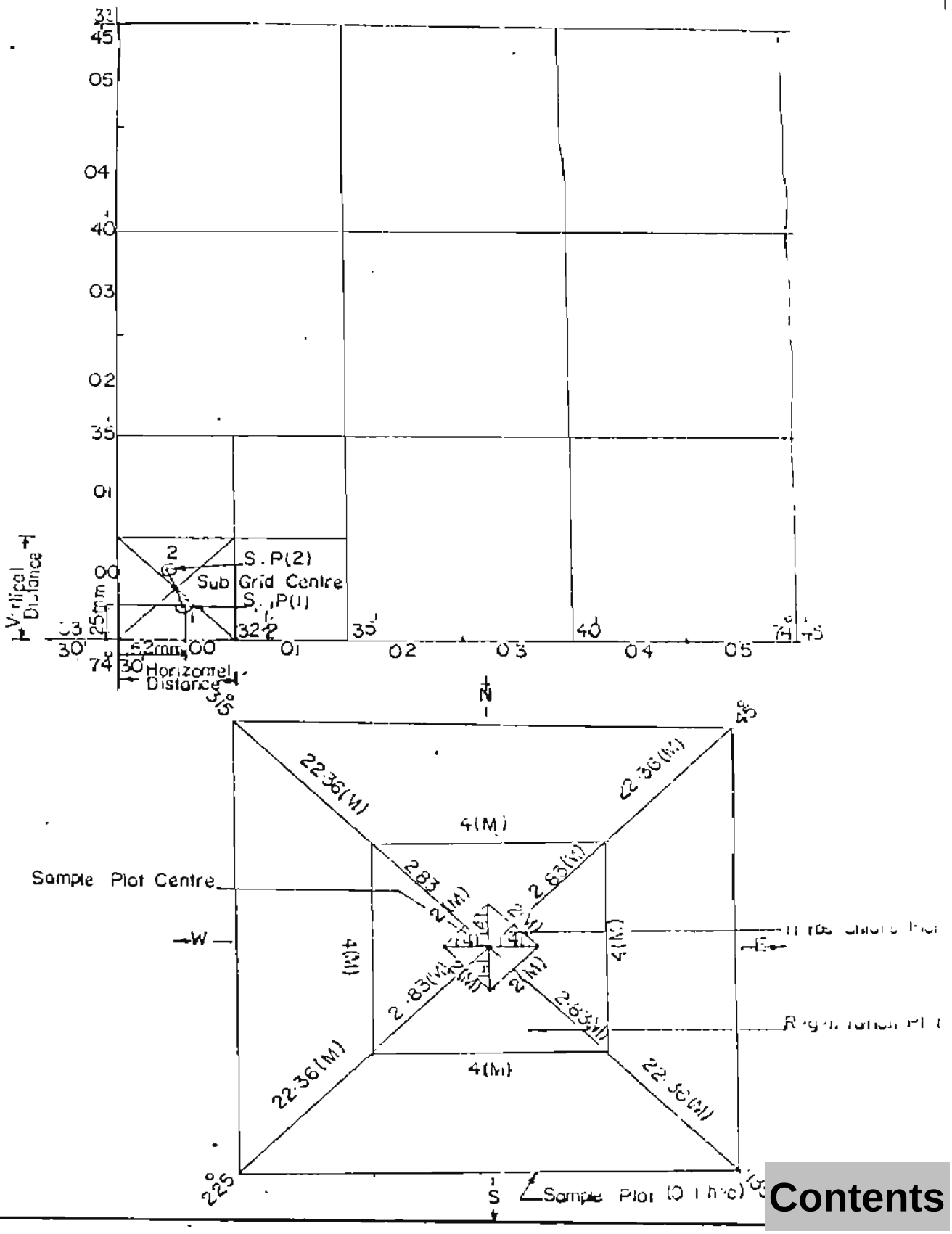
SKETCH SHOWING SAMPLING DESIGN AND LAYOUT OF PLOTS



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collected from a square plot of 0.1 hectare laid out at each of these sample points on the ground. The method of marking the sample point on the map is described below:-

One side of the square plot (which is 31.62 metres on the ground) measures 0.6 mm to the nearest first decimal of mm on the above topographic map. The length and width of each grid is measured to the first decimal in millimetres. From this length, 0.6 mm is deducted so as to prevent the plot centre from falling on the origin or on the peripheries of the sampled grid. Suppose the measurable length and width of a grid along its X & Y axes are 83.5 mm and 92.5 mm respectively, after deducting 0.6 mm, the reduced length and width are 82.9 mm and 91.9 mm respectively. A three digit random number is selected from the random number table for each axis separately. If the selected random numbers are less than 829 and 919 respectively then they are retained as such, otherwise the next random number is considered. Suppose the random numbers selected are 144 and 161 respectively then these numbers will correspond to 14.4 mm and 16.1 mm lengths along the X & Y axis respectively. To these lengths viz. 14.4 mm and 16.1 mm, 0.3 mm is added (being half the measurable side on a topographic map used). Now 14.7 mm and 16.4 mm become the co-ordinates of the first sample point in the grid. Taking SW corner of this grid as origin and measuring 14.7 mm and 16.4 mm along X & Y axis respectively the centre of the plot is marked. The centre of the first plot is then joined by a straight line to the grid centre and this line is extended further beyond the grid centre. On this extended line, the second point is marked at a distance equal to the distance of first point from grid centre. This point is the centre of the second plot. All sample points falling in 'forest areas' are located on the ground and quantitive data is collected from the sample plots and qualitative data from the surrounds of the plot. The co-ordinates of the plot centres inventoried and the relevant data pertaining to these plots are given in Appendix II.

2.3 Methodology

The field data is collected by a crew consisting one Junior Technical Assistant (Crew Leader), assisted by a Deputy Ranger, two to three

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Fieldmen, Khalasi and labour hired locally wherever necessary. The Crew Leader is provided with a list of sample plots to be surveyed by his crew during the season alongwith a set of toposheets with sample points already marked. A set of measuring instruments viz. Silva Compass, Haga/Blume Leiss hypsometer, Callipers, measuring tapes and ranging rods etc. are provided.

After deciding the plot and the grid number to be surveyed on a particular day from a camping spot, the Crew Leader reaches a prominent physical feature (also called starting reference point as near to the sample point as possible) which is depicted on the map and can also be identified on the ground. Usually the following features are selected as reference points:

i) Bench marks;
ii) Triangulation points;
iii) Village trijunction points;
iv) Old bridges and culverts;
v) Old temples, mosques and churches;
vi) Crossing of rail track with roads, rivers, streams;
vii) Junctions of rivers or streams and roads;
viii) Junction of streams;
ix) Junction of roads;
x) Prominent bends in roads, rivers, streams
xi) Old ponds and wells;
xii) Springs;
xiii) Prominent topographical features in hilly region such as spurs, knolls etc.
xiv) Mile stones or kilometer stones;
xv) Boundary pillars (of international, State, district and forest boundaries).

Having located a prominent physical feature (reference point) both on the ground as well as on the map, the distance and bearing of the sample point from this physical feature is measured from the map. The bearing is measured with the help of a protrector or the Silva Compass. At this reference point the Crew Leader records details of the reference feature used, the bearing and distance ofthe sample point from the reference feature, the name of the camping spot, the time taken to complete the work etc.,

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in 'Plot Approach Form'. Information in this form is used in time and cost study for the inventory and helping to relocate the point at a future date. Specimen of this Form is given in Appendix III. From the reference point, Crew Leader traverse the distance in the direction as measured on the map to reach the sample point. A wooden peg is fixed at this location which is the centre of the sample plot. After reaching at sample point, a square sample plot of 0.1 hectare with diagonals measuring 44.72 metres in NE-SW and NW-SE directions is laid out on the ground by marking its four corners by thin poles. Regeneration data is collected from a plot measuring 4 m x 4 m and herb-shrub data from a plot of 2 m x 2 m size laid out around the plot centre. Sampling design and layout of the sample plots is explained in the sketch on page 6.

After laying out the plots, the Crew Leader with the help of other crew members collects the inventory data in the following field Forms:

(i) Plot Description Form;
(ii) Plot Enumeration Form;
(iii) Sample Tree Form;
(iv) Bamboo Enumeration form (clump forming);
(v) Bamboo Enumeration Form (non-clump forming);
(vi) Bamboo weight Form;
(vii) Herbs and Shrubs data Form.

The specimen of above field Forms may be found in Appendix III. Their brief description is as under:-

(i) Plot Description Form(PDF)

Qualitative data such as land use, crop composition of tree crop and its density, erosion in the area, fire and grazing incidence, regeneration status etc. are recorded in this Form. The basis of assessments is occular by examining a surrounding area of about 2 hectares around the plot centre.

(ii) Plot Enumeration Form(PEF)

In this Form trees 0.1 hectare plot are enumerated and recorded with the name of species and diameter at breast height. Total number of bamboo clumps occuring in the plot are also recorded.

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(iii) Sample Tree Form (STF)

The data in this Form are collected from the northern quarter of the sample plot. Name of the species, diameter at breast height, twice bark thickness, dominance status, length of the clear bole and height of each tree enumerated in this quadrant are recorded. The data from this Form helps in developing local volume equations for the species in the survey area. Under bark volume is also derived from the local volume equations with the help of bark thickness data.

(iv) & (v) Bamboo Enumeration (Clump and Non-clump Forming) Forms

These forms are used wherever bamboo clumps are encountered in the sample plots. Data such as culms in each clump, their size, maturity condition, length etc. are recorded.

(vi) Bamboo Weight Form

For determining the co-relation between green and dry weight of the utilizable length of bamboo culm, data on weight are recorded in this Form.

(vii) Herbs and Shrubs Data Form:

In this Form, names and other details of all identifiable speices of herbs and shrubs are recorded. In case of species that could not be identified in the field, the number of such species only are noted.

The above is a brief description of the design and survey methodology. For details 'The Manual of Instructions" for field inventory' of Forest Survey of India may be referred whose copy can be had from the Director, Forest Survey of India, 25-Subhash Road, Dehradun or Joint Director, Forest Survey of India, Northern Zone, Shimla (H.P.).

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Chapter-3

3.0 DATA COMPILATION

After the completion of field work, the field Forms (i to vii) of the region surveyed are consolidated. The data contained in the field Forms are checked for inconsistencies and coding mistakes and then compiled.

3.1 Area Computation

The area of forest land' on the 1:50,000 scale. topographical maps was calculated using dot grid template. The zonewise 'forest area' was totaled and on the basis of number of plots falling in each zone (Punjab zone, Haryana zone) the area weightage of each plot was computed. Further distribution of forest area under various classes such as land use, forest type, soil erosion status, grazing incidence etc. was arrived at proportionately using ratio estimator. However it may be noted that area tables are based on very few sample points and therefore, should be considered as indicative only and used with due caution.

3.2 Volume estimation

The tree enumeration Forms for the region were studied to select species for which separate local volume tables were to be developed. On the basis of intensity of occurrance the following species were selected:

i) Acacia catechu
ii) Shorea robusta
iii) Boswellia serrata
iv) Anogeissus latifolia
v) Lannea coromendelica
vi) Dalbergia sissoo
vii) Pinus roxburghii

Since the collection of felled tree data by zones for developing general volume equations has been discontinued, the general volume equations developed from felled tree data, by this organisation in the past for other project areas, were perused. Considerations for selecting the general volume equation from the various project areas have been the contiguity/ closeness of the project area with the current survey area and the similarity in the forest types.

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The following are the general volume equations selected from the project areas for the various species:

	Species	Project area	Equations
i)	Acacia catechu	U.P.	$V = 0.00817 + 0.29886\ D^2H$
ii)	Shorea robusta	North Zone	$V = 0.1180 + 0.2570\ D^2H$
iii)	Boswellia serrata	Rajasthan	$V = 0.382544\ D^2H - 0.000751$
iv)	Anogeissus latifolia	U.P.	$V = 0.00817 + 0.29886\ D^2H$
v)	Lannea coromendelica	Rajasthan	$V = 0.377131\ D^2H - 0.004511$
vi)	Dalbergia sissoo	U.P.	$V = 0.00817 + 0.29886\ D^2H$
vii)	Pinus roxburghii (Chil)	Rajgarh Nahan	$V = 0.034529 + 0.284662\ D^2H$
viii)	Miscellaneous Species	U.P.	$V = 0.00817 + 0.29886\ D^2H$

From these general volume equations, the local volume tables were derived using graphical method (see appendix iv)

The local volume tables are given below:

Acacia catechu

Diameter (mtrs.)	0.15	0.25	0.35	0.45	0.55	0.65	0.75
Volume (m^3)	0.05	0.13	0.24	0.43	0.66	0.89	1.14

Dalbergia sissoo

Diameter (mtrs.)	0.15	0.25	0.35	0.45	0.55	0.65	0.75
Volume (m^3)	0.06	0.26	0.56	0.96	1.44	2.02	2.69

Anogeissus latifolia

Diameter (mtrs.)	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95
Volume (m^3)	0.06	0.16	0.33	0.56	0.88	1.24	1.62	2.04	2.48

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Lannea coromendilica

Diameter (mtrs.)	0.15	0.25	0.35	0.45
Volume (m^3)	0.055	0.225	0.535	0.912

Boswellia serrata

Diameter (mtrs.)	0.15	0.25	0.35	0.45
Volume (m^3)	0.057	0.165	0.325	0.520

Pinus roxburghii (Chil)

Diameter (mtrs.)	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95
Volume (m^3)	0.075	0.25	0.525	0.95	1.5	2.1	2.85	3.60	4.50

Shorea robusta(Sal)

Diameter (mtrs.)	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95
Volume (m^3)	0.18	0.32	0.68	0.94	1.84	2.64	3.54	4.56	5.64

Rest of the species

Diameter (mtrs.)	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95
Volume (m^3)	0.03	0.16	0.36	0.58	0.86	1.17	1.52	1.90	2.33

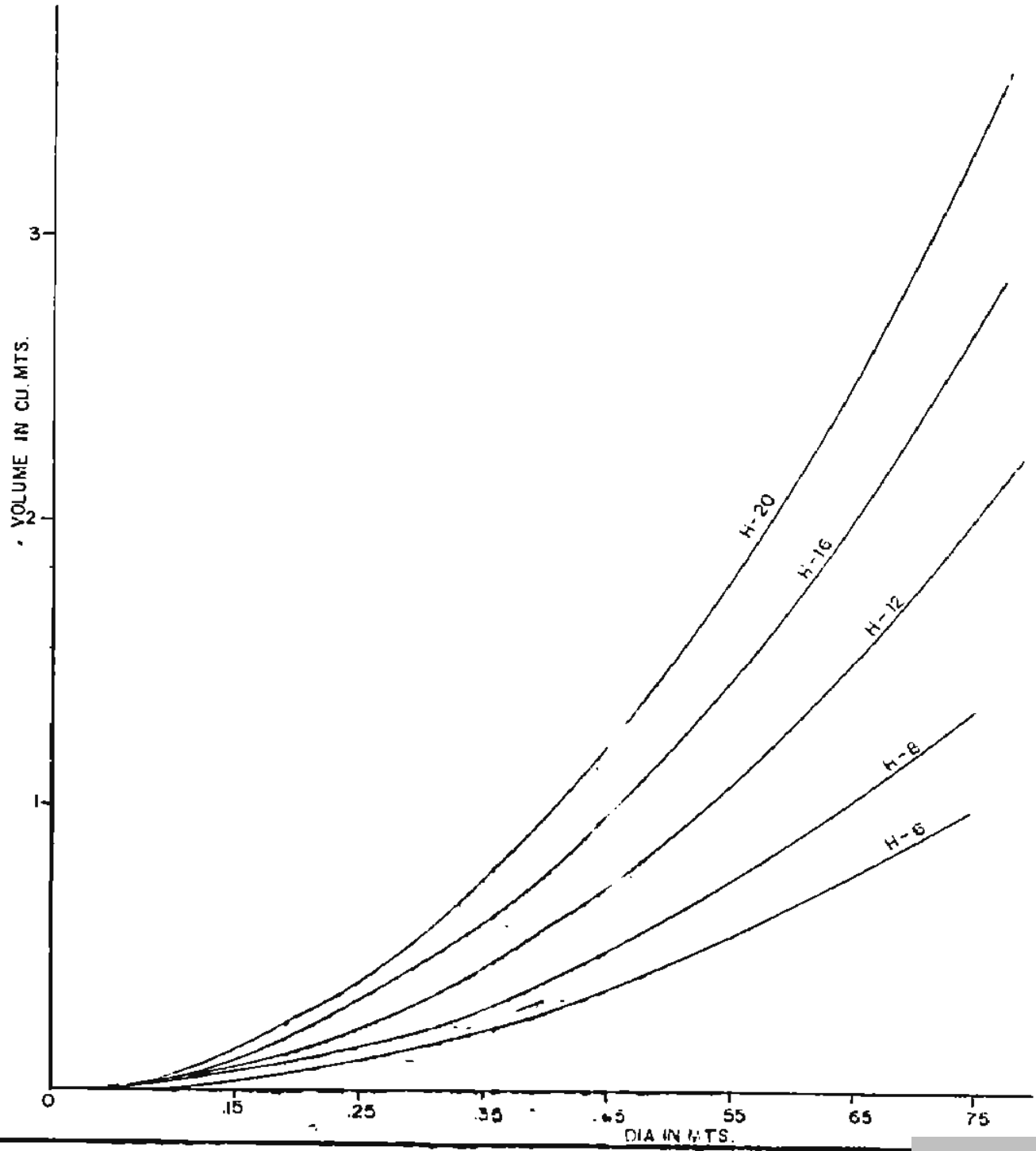
3.3 Stand & stock tables

The volume of each enumerated tree of a species was estimated from the local volume tables by reading the volume against the 'diameter class' of the tree. Estimates of number of stems and volume per hectare and total by species and diameter classes were obtained for different strata i.e. district, forest types etc.

Contents

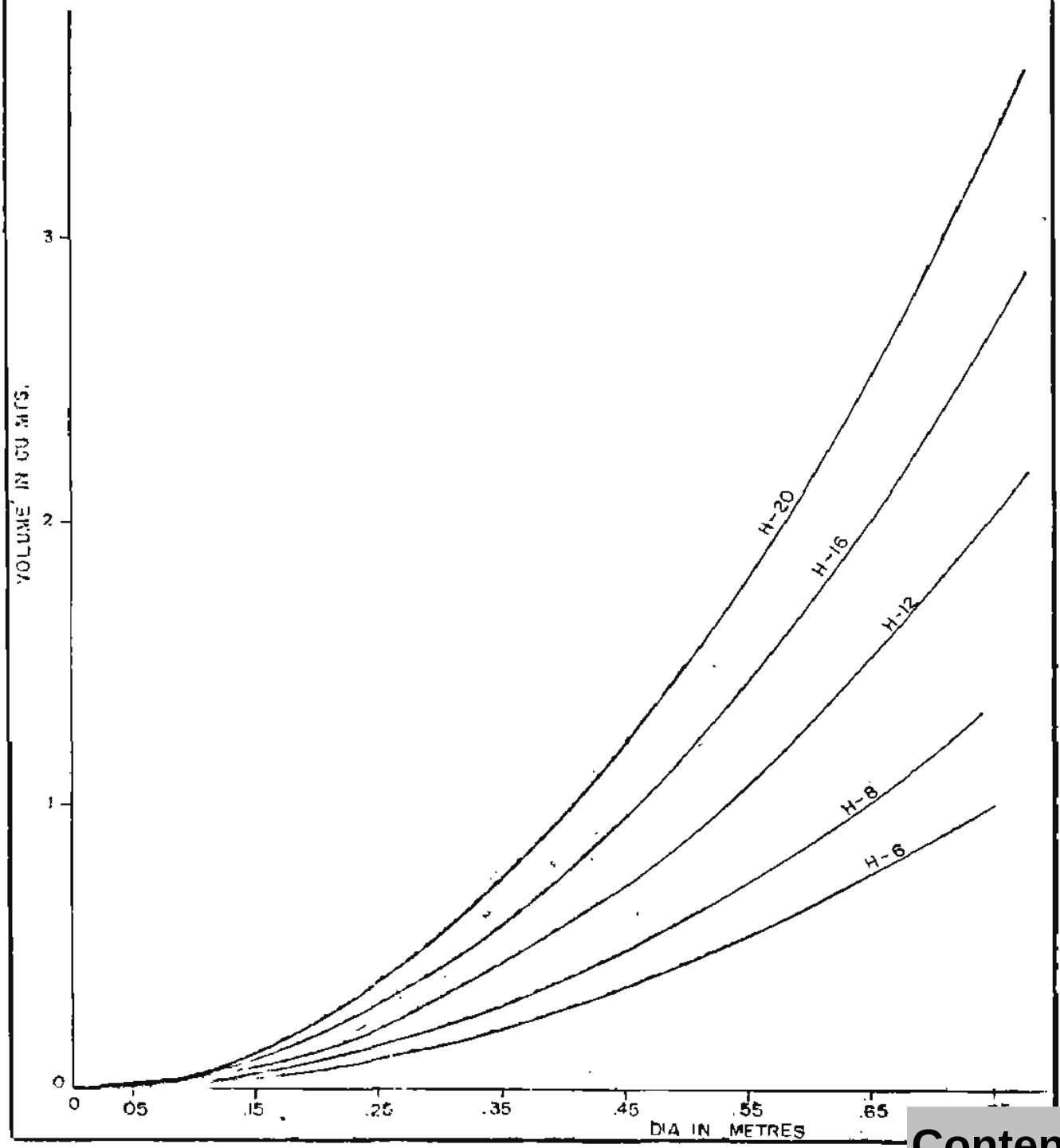
DIAMETRE - VOLUME (LOCAL) CURVE OF ACACIA CATECHU DERIVED BY GRAPHICAL METHOD USING GENERAL VOLUME EQUATION

$V = 0.00817 + 0.29886\ D^2H$ (U.P)



Contents

DIAMETRE – VOLUME (LOCAL) CURVE OF D. SISSOO DERIVED BY GRAPHICAL METHOD USING GENERAL VOLUME EQUATION
$V = 0.00817 + 0.20386\ D^2H$ (U.P.)



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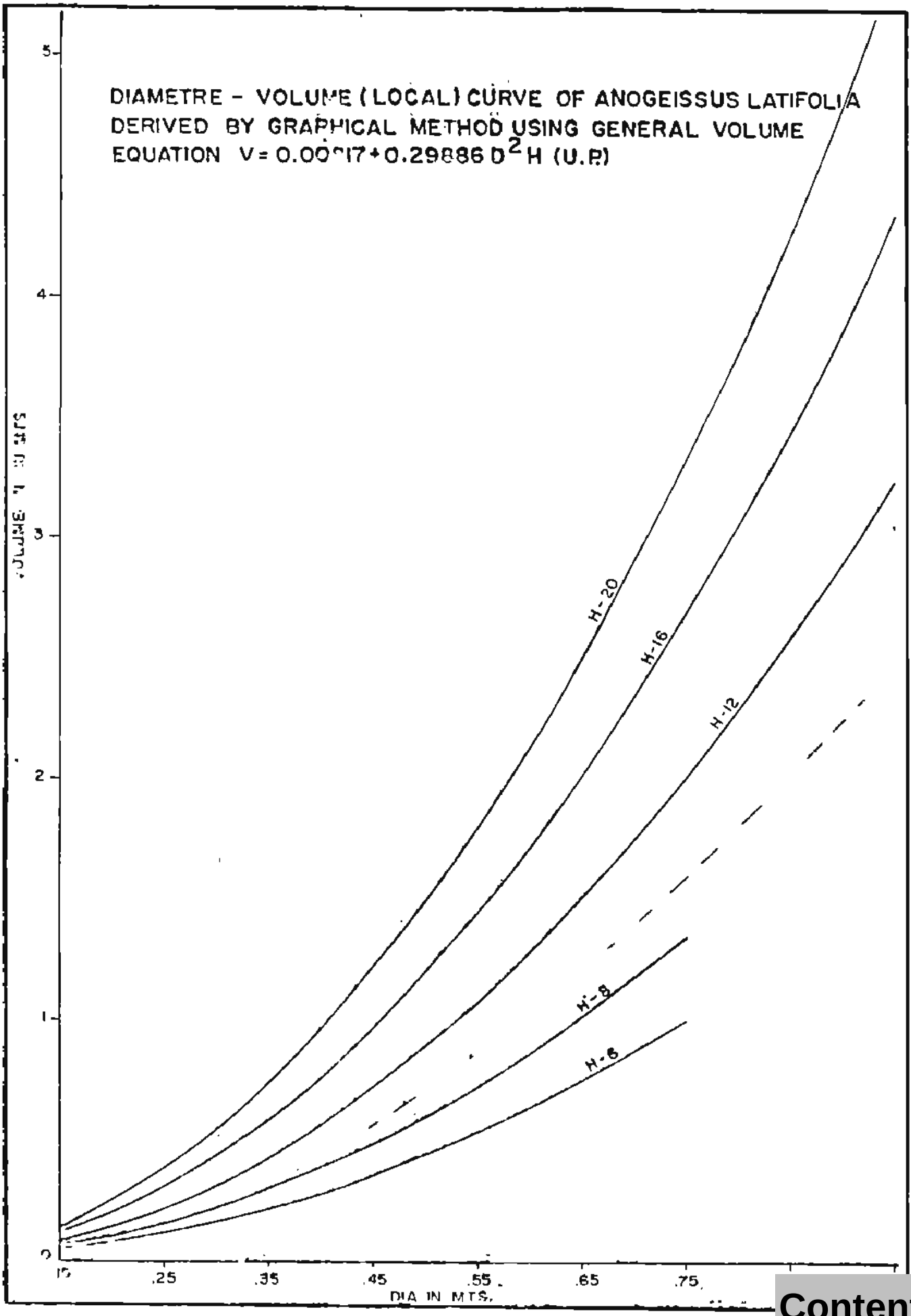
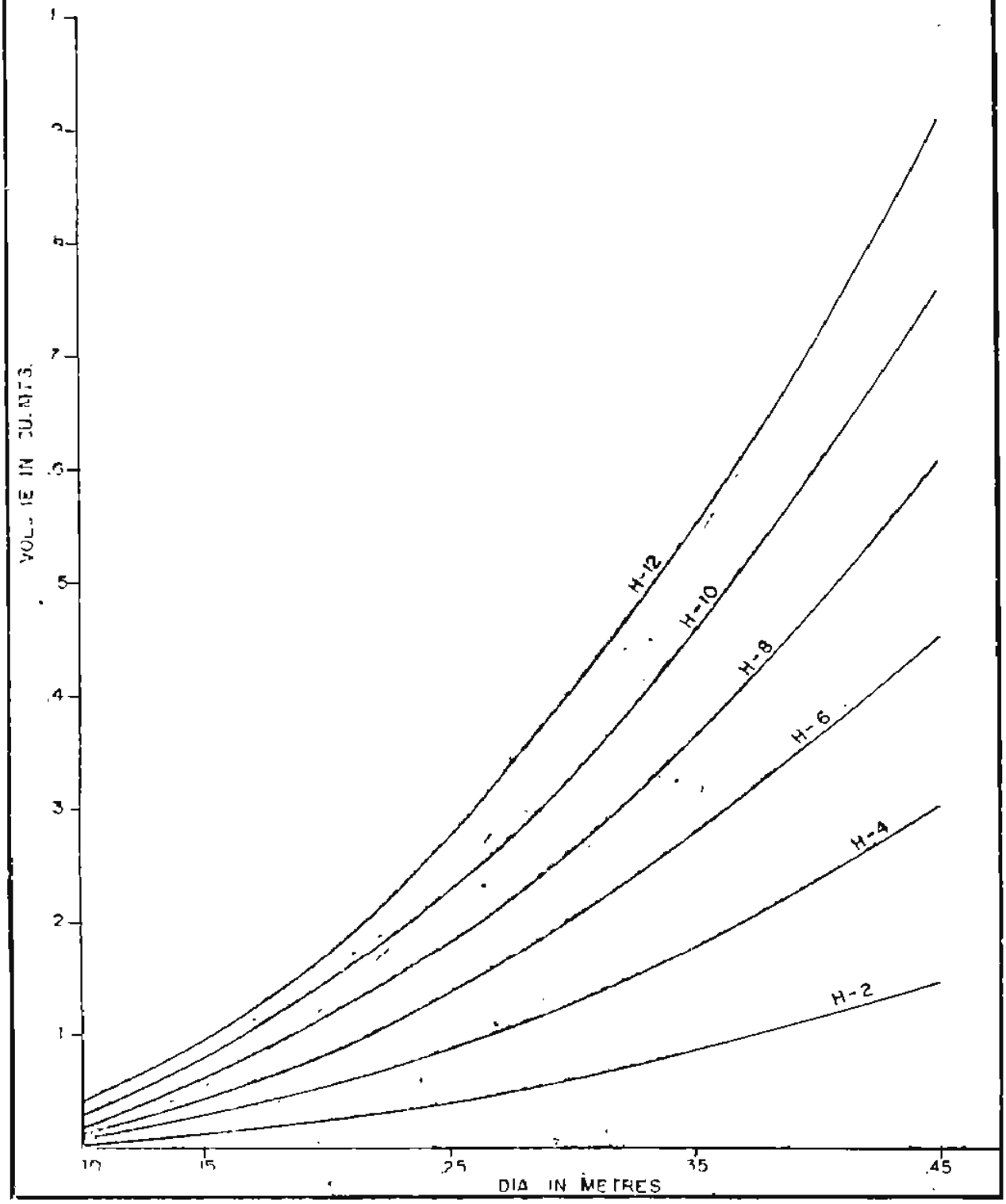

DIAMETRE - VOLUME (LOCAL) CURVE OF ANOGEISSUS LATIFOLIA
DERIVED BY GRAPHICAL METHOD USING GENERAL VOLUME
EQUATION V = 0.00017 + 0.29886 D2 H (U.P)
H-20
H-16
H-12
H-8
H-6
5
4
3
2
1
0
.15
.25
.35
.45
.55
.65
.75
DIA IN MTS.

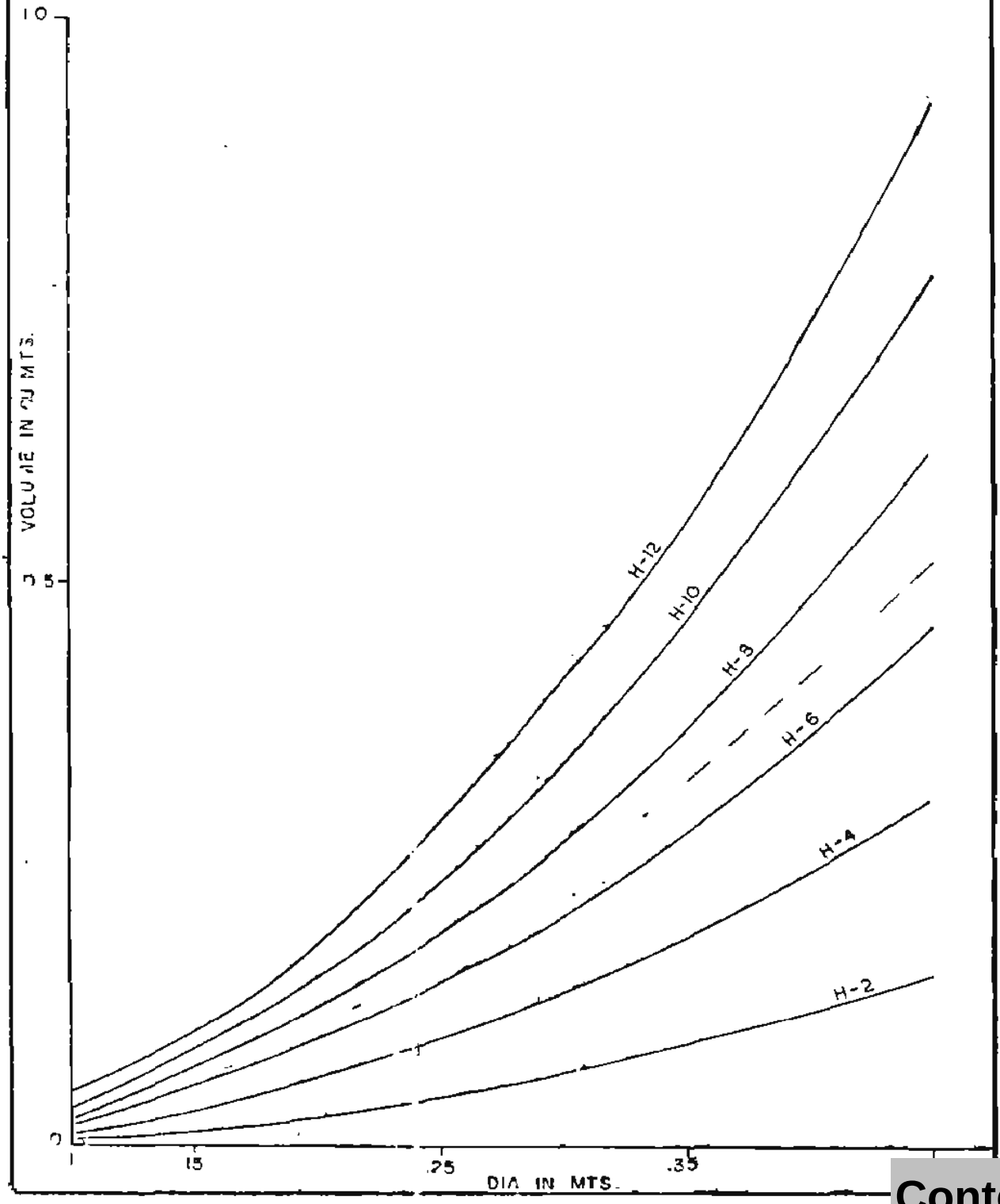
Contents

DIAMETRE-VOLUME (LOCAL) CURVE OF LANNEA COROMANDELICA DERIVED BY GRAPHICAL METHOD USING GENERAL VOLUME EQUATION $V = 0.377131\ D^2H - 0.00431$ (RAJASTHAN)



Contents

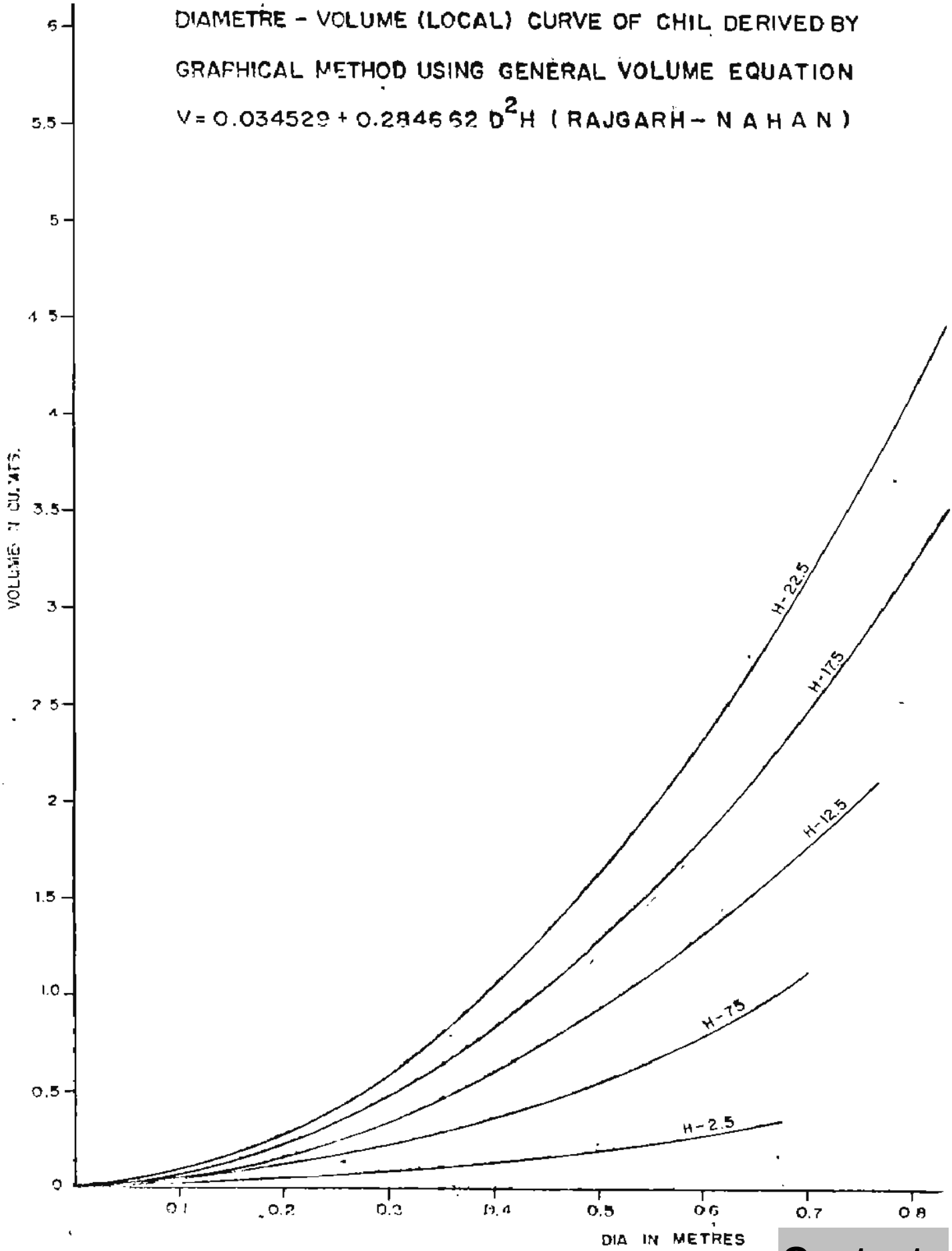
DIAMETRE - VOLUME (LOCAL) CURVE OF BOSWELLIA SERRATA DERIVED BY GRAPHICAL METHOD USING GENERAL VOLUME EQUATION $V = 0.382544\ D^2H - 0.000751$ (RAJASTHAN)



Contents

DIAMETRE - VOLUME (LOCAL) CURVE OF CHIL DERIVED BY GRAPHICAL METHOD USING GENERAL VOLUME EQUATION

$V = 0.034529 + 0.284662\ D^2H$ (RAJGARH - N A H A N)



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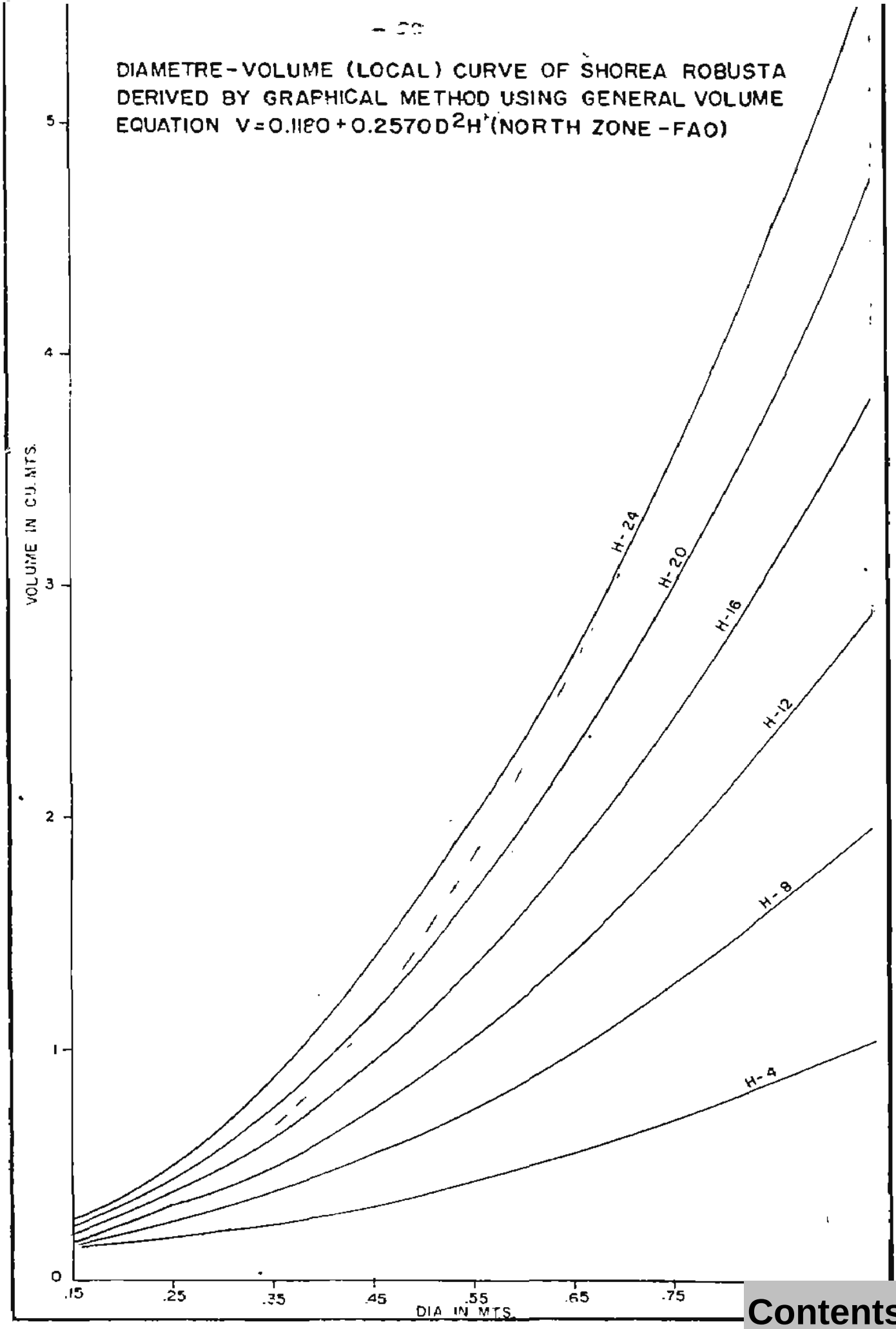
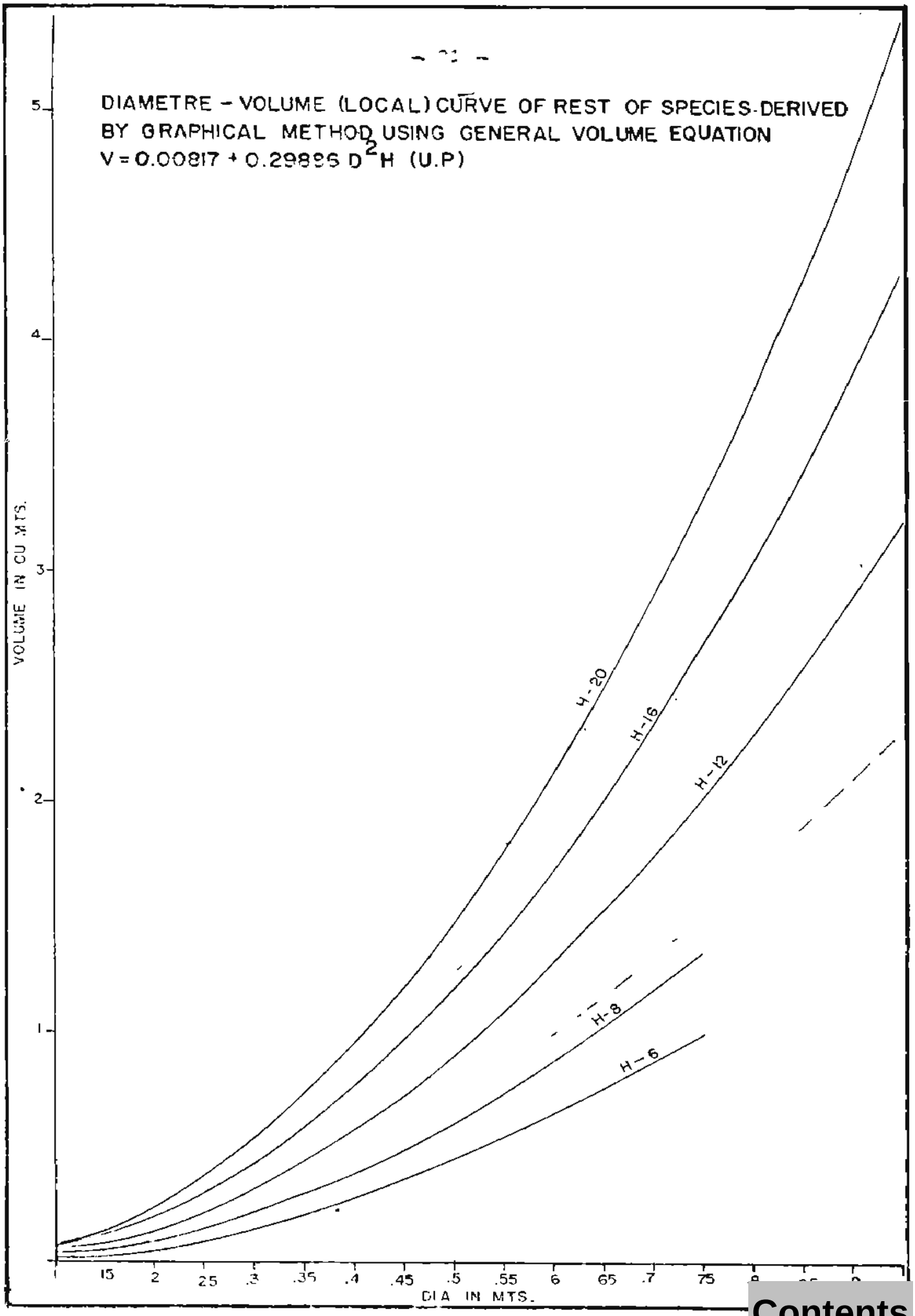
DIAMETRE-VOLUME (LOCAL) CURVE OF SHOREA ROBUSTA DERIVED BY GRAPHICAL METHOD USING GENERAL VOLUME EQUATION $V = 0.1180 + 0.2570 D^2 H$ (NORTH ZONE - FAO)



Contents


DIAMETRE - VOLUME (LOCAL) CURVE OF REST OF SPECIES-DERIVED BY GRAPHICAL METHOD USING GENERAL VOLUME EQUATION
V = 0.00817 + 0.29895 D2H (U.P)
VOLUME IN CU MTS.
5
4
3
2
1
H-20
H-16
H-12
H-8
H-6
15
2
25
.3
.35
.4
.45
.5
.55
6
65
.7
75
DIA IN MTS.

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Chapter 4

FOREST INVENTORY RESULTS

4.0 In this Chapter, the results of forest inventory and the critical aspects of forest resources as evident therefrom in the survey area are presented. This is a very low intensity survey (0.01 percent). Its results are therefore, reliable and valid for the region as a whole. However, Zonewise (Shiwalik Zone of Haryana comprising of Ambala district and Shiwalik Zone of Punjab comprising of Ropar, Hoshiarpur and Gurdaspur districts) information of some attributes has also been given which may be considered as indicative only.

4.1 Forest Area

'Forest area' has already been defined in Chapter 2. Forest Inventory Survey comprises of two components, namely information with regard to area under forest cover (forest area) which is computed from maps and estimation of growing stock by ground sampling in such areas. Within the Shiwaliks all 'vegetated areas' or 'green wash areas' on topo sheets have been sampled. The areas shown as 'scrub' above 400 meter altitude have also been included in the 'forest area' for the purpose of inventory.

The survey area is covered by 19 topo sheets of 1:50,000 scale viz: 43 P/11,15 44 M/9,13,14 53 A/2,3,7,8,12 53 B/9,13,14 53 F/1,2,3,7,8 & 11 which were used as the basis of inventory. These topo sheets were surveyed by Survey of India during the period 56-57 to 1971-72 (see appendix I). From the distribution pattern of the sheets surveyed over the years, 1966 has been taken as base year for monitoring the changes in the 'forest area' subsequently till 1985, when field inventory was done. The following table gives the Zone-wise 'forest area' computed by dot grid method, and number of sample plots falling therein (table No.4.1).

Table No.4.1

Table showing 'forest area' number of sample plots and weighted average.

Sl. No.	Name of Shiwalik Zone	Name of District	No. of plots	Sample area km^2	Weighted average km^2	%
1.	Haryana Zone	Ambala	55	458.70	8.34	34
2.	Punjab	Ropar	23	217.58	9.46	
		Hoshiarpur	61	536.20	8.79	
		Gurdaspur	23	134.32	5.85	
		Punjab Zone	107	888.10	8.30	66
		Total	162	1346.80		

Distribution of area in all the tables that follow has been worked out on the basis of Zonal weighted average on ratio estimator method.

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4.1.1 Distribution of forest area by land use classes

Total 'forest area' surveyed is 1346.80 km^2 of which 34% (458.70 km^2) is in Haryana Zone and 66% (888.10 km^2 is in Punjab Zone. In the Punjab Haryana Shiwaliks, Out of the 1346.80 km^2 'forest area' surveyed, 87.66%(1180.72 km^2) is accessible forest area and 10.49% (141.18 km^2) is deforested or diverted for other uses and 1.85% (24.90 km^2) is inaccessible due to difficult terrain. The zonewise distribution of the 'forest area' by land use classes is given in the table No.4.1.1. On examination of the data therein, following critical aspects about the state of forest resources in the area are evident:

(a) 63.36% (1346.80 km^2) of the total geographical area of 2125.65 km^2) in the region was under vegetative cover in the year 1966 (base year for survey).

(b) During the past 19 years period (1966 to 1985) 10.49% (141.18 km^2) of the forest area (1346.80 km^2) has been deforested and diverted for other uses such as agriculture, habitation etc. Currently 8.03%(108.10 km^2) of the forest area surveyed is under scrub.

(c) Pure bamboo forest has not been found to occur in Shiwaliks of Punjab & Haryana. However, as an under storey it occurs in 2.47% (33.24 km^2) of the forest area surveyed. Only one sample plot was sampled for bamboo in Haryana and 3 plots were sampled in Punjab. Since the number of plot are very small no further analysis has been done for bamboo. The bamboo occurring in the region is Dendrocalamus strictus.

(Table No.4.1.1 on next page)

Contents

Table No.4.1.1

Sl. No.	Landuse	Haryana zone			Punjab Zone			Total of the region		
		No. of S.P.	Area	%	No. of S.P.	Area	%	No. of S.P.	Area	%
01	Tree forest area	48	400.32	87.27	79	655.70	73.83	127	1056.02	78.40
02	Plantation	-	-	-	02	16.60	1.87	02	16.60	1.23
03	Scrub forest	05	41.70	9.09	08	66.40	7.48	13	108.10	8.03
04	Agricultural land	02	16.68	3.64	13	107.90	12.15	15	124.58	9.25
05	Non-forestry plantation	-	-	-	01	8.30	0.93	01	8.30	0.62
06	Habitation	-	-	-	01	8.30	0.93	01	8.30	0.62
07	Inaccessible	-	-	-	03	24.90	2.81	03	24.90	1.85
	Total	55	458.70	100	107	888.10	100	162	1346.80	100
a)	Accessible forest area (01 to 03)	53	442.02	96.36	89	738.70	83.18	142	1180.72	87.66
b)	Accessible tree forest area (01&02)	48	400.32	87.27	81	672.30	75.70	129	1072.62	79.63
c).	Forest area degraded to scrub land (03)	05	41.70	9.09	08	66.40	7.48	13	108.10	8.03
d)	Forest area deforested or diverted for other uses. (04 to 06)	02	16.68	3.64	15	124.50	14.02	17	141.18	10.49
e)	Overlapping bamboo area	01	8.34	1.82	03	24.90	2.81	04	33.24	2.47

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4.1.2 Zonewise distribution of accessible forest area by soil depth classes.

Total accessible forest area is 1180.72 km^2 (table 4.1.1)

42.90 percent of the area has soil depth of 90 cms or more and 40.86 percent area has soil depth between 30-90 cms. Area with shallow and very shallow soil is mostly confined to Haryana Zone. Distribution of accessible forest area by soil depth classes is given in Table No.4.1.2.

Table No.4.1.2

Total area = 1180.72 km^2
Total sample plots = 142
Unit = km^2

Soil depth	Haryana Zone		Punjab Zone		Total	
	Area	%	Area	%	Area	%
No Soil	-	-	-	-	-	-
Very shallow	25.02	5.66	-	-	25.02	2.12
Shallow	141.78	32.08	24.90	3.37	166.68	14.12
Medium	208.30	47.17	273.90	37.08	482.40	40.86
Deep	66.72	15.09	439.90	59.55	506.62	42.90
Total:	441.82	100	738.70	100	1180.72	100

4.1.3 Zonewise distribution of accessible forest area by soil texture classes.

As is evident from table No.4.2.3, 57.02 percent of the area has sandy loam soil 7.03 percent has loamy soil, 32.43 percent has clayey loam and remaining 3.52 percent area has clayey and sandy soil. Thus the region does not have significant areas requiring specific treatment or choice of species from point of view of soil texture. Zonewise distribution of area by soil texture classes is given in table No.4.1.3.

Contents

Table No.4.1.3

Total area : 1180.72 km^2
Total sample plots : 142
Unit : km^2

Soil texture	Haryana Zone Area	%	Punjab Zone Area	%	Total Area	%
Clayey	8.34	1.89	-	-	8.34	0.71
Clayey loam	241.96	54.72	141.10	19.10	382.96	32.43
Loam	-	-	83.00	11.24	83.00	7.03
Sandy loam	191.82	43.39	481.40	65.17	673.22	57.02
Sandy	-	-	33.20	4.49	33.20	2.81
No soil	-	-	-	-	-	-
Total:	442.02	100	738.70	100	1180.72	100

4.1.4 Zone-wise distribution of accessible forest area by soil erosion classes.

Out of the total accessible forest area 31.68 percent has heavy erosion, 31.69 percent is under moderate erosion class and remaining 36.63 percent is under mild erosion class. The area under moderate to heavy erosion class is almost two third of total area which needs special attention from soil conservation point of view so as to prevent further degradation of soil and forests. All kinds of fellings in such areas also need to be regulated. Besides intensive soil conservation measures are to be adopted. Zonewise distribution of forest area by soil erosion classes is given in table No.4.1.4..

Table No. 4.1.4

Total area : 1180.72 km^2
Total sample plots : 142
Unit : km^2

Soil erosion status	Haryana Zone Area	%	Punjab Zone Area	%	Total Area	%
Mild erosion	183.48	41.51	249.00	33.71	432.48	36.63
Moderate erosion	133.44	30.19	240.70	32.58	374.14	31.69
Heavy erosion	125.10	28.30	249.00	33.71	374.10	31.68
Total:	442.02	100	738.70	100	1180.72	100

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4.1.5 Zonewise distribution of accessible forest area by grazing incidence classes.

Incidence of heavy grazing has been observed in 19.71 percent of the area and incidence of medium grazing in 35.91 percent of the area. In 28.18 percent of the area, grazing incidence is light while there is no grazing in 16.20 percent of the area. Grazing in 55.62 percent of the area where it is medium to heavy needs to be checked. Zonewise distribution of forest area by grazing incidence classes is given in table No.4.1.5.

Table No. 4.1.5

Total area : 1180.72 km^2
Total sample plots : 145
Unit : km^2

Grazing incidence	Haryana Zone Area	%	Punjab Zone Area	%	Total Area	%
Heavy grazing	58.38	13.21	174.30	23.60	232.68	19.71
Medium grazing	133.44	30.19	290.50	39.32	423.94	35.91
Light grazing	150.12	33.96	182.60	24.72	332.72	28.18
No grazing	100.00	22.64	91.30	12.36	191.38	16.20
Total:	442.02	100	738.70	100	1180.72	100

4.1.6 Zonewise distribution of accessible forest area by fire incidence classes.

There is no incidence of very heavy fire. 3.52% of the area has incidence of frequent fires, 28.16 percent of the area has incidence of occasional fires while there is no incidence of fires in 68.32 percent of the area. Zonewise distribution is given in table No. 4.1.6.

Table No. 4.1.6

Total area : 1180.72 km^2
Total sample plots : 142
Unit : km^2

Intensity of fire	Haryana Zone Area	%	Punjab Zone Area	%	Total Area	%
Very heavy fire	-	-	-	-	-	-
Frequent fire	8.34	1.89	33.20	4.49	41.54	3.52
Occasional fire	100.00	22.64	232.40	31.46	332.40	28.16
No fire	333.68	75.47	473.10	64.05	806.70	68.32
Total:	442.02	100	738.70	100	1180.72	100

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4.1.7 Zonewise distribution of accessible forest area by plantation potential

65.50 percent of total accessible forest area has scope for afforestation or augmentation of stocking by enrichment plantation. Only 0.70 percent area has been assessed as un-plantable while 33.80 percent of the area needs no further stocking by way of plantation. Zonewise distribution is given in table No.4.1.7.

Table No.4.1.7

Total area : 1180.72 km^2
Total sample plots : 142
Unit : km^2

Plantation potential	Haryana Zone Area	Haryana Zone %	Punjab Zone Area	Punjab Zone %	Total Area	Total %
Plantable	316.92	71.70	456.50	61.80	773.42	65.50
Unplantable	-	-	8.30	1.12	8.30	0.70
Not applicable	125.[illegible]	28.30	273.90	37.08	399.00	33.80
Total:	442.[illegible]	100	738.70	100	1180.72	100

Explanatory Note:-

Plantation potential was assessed only at those sample plots having tree crown cover density of less than 30%. Plantation potential was determined by giving due consideration to aspect, soil depth, drainage, crop in surrounding area and other biotic and climatic factors. The maximum permissible slope upto which plantation can be raised was kept as 40° and minimum soil depth 20 cms. Sample plots having crown density of 30% or more were catagorised as not applicable since plantation potential of such area from the point of view of afforestation is not of any significance.

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4.1.8 Zonewise distribution of accessible tree forest area by forest types:

The accessible tree forest area is 1072.62 km^2 (table No. 4.1.1)

As is evident from table No.4.2.8, miscellaneous forest type is predominant in the region accounting for 70.52 percent of the total tree forest area. Chir forest type occurs in Punjab Zone only accounting for 7.41 percent in Punjab Zone and for 4.64 percent in the region on the whole. Similar is the case with Sal which occurs in Haryana Zone only and accounts for 16.67 percent in Haryana while it accounts for 6.52 percent in the region as a whole. Other forest types occur are Khair and Hardwood mixed with conifers which accounts for 15.52 percent and 3.10 percent respectively. Zonewise distribution is given in table No.4.1.8.

Table No. 4.1.8

Total area : 1072.62 km^2
Total sample plots: 129
Unit : km^2

Forest type	Haryana Zone		Punjab Zone		Total	
	Area	%	Area	%	Area	%
Chir	-	-	49.80	7.41	49.80	4.64
Hardwood mixed with conifers	16.68	4.16	16.60	2.47	33.28	3.10
Sal	66.72	16.67	-	-	66.72	6.22
Khair	91.74	22.92	74.70	11.11	166.44	15.52
Miscellaneous	225.18	56.25	531.20	79.01	756.38	70.52
Total:	400.32	100	672.30	100	1072.62	100

Explanatory note:

Species comprising more than 50% of crop was recognised as pure forest type of that species. Hardwood mixed with conifers was the type in which conifers and broad leaved species occur in more or less in same proportion.

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4.1.9 Zonewise distribution of accessible tree forest area by size class

As is evident from table No.4.1.9, pole crop is predominantly found in the region. Other size classes are almost equally distributed over the area. Zonewise distribution is given in table No.4.1.10.

Table No.4.1.10

Total area : 1072.62 km^2
Total sample plots: 129
Unit : km^2

Size class	Haryana zone Area	%	Punjab Zone Area	%	Total Area	%
Regeneration	[illegible].34	[illegible].08	74.70	11.11	83.04	7.74
Pole crop	[illegible].52	58.34	481.40	71.60	714.92	66.65
Small timber	[illegible].36	8.33	74.70	11.11	108.06	10.08
Big timber	[illegible].02	6.25	41.50	6.18	66.52	6.20
Mixed size class	[illegible].08	25.00	-	-	100.08	9.33
Total	[illegible].32	100	672.30	100	1072.62	100

Explanatory Note -

Regeneration: crop below 10 cms diameter predominating.

Pole crop : crop between 10 to less than 20 cms diameter predominating.

Small timber: Crop 10 cms to under 30 cms diameter predominating.

Big timber : Tree with diameter 30 cms and over predominating.

Mixed size : Tree crop with no marked diameter of any size class.

4.1.10 Zonewise distribution of accessible tree forest area by regeneration status

Regeneration is completely absent over 89.91 percent area and inadequate over rest of the area. This indicates that area cannot be relied upon for natural regeneration. Zonewise distribution is given in table No.4.1.10.

Contents

Table No.4.1.10

Total area : 1072.62 km^2
Total sample plots: 129
Unit: km^2

Regeneration status	Haryana Zone Area	Haryana Zone %	Punjab Zone Area	Punjab Zone %	Total Area	Total %
Profuse	-	-	-	-	-	-
Adequate	-	-	-	-	-	-
Inadequate	58.38	14.58	49.80	7.41	108.18	10.09
Absent	341.94	85.42	622.50	92.59	964.44	89.91
Total:	400.32	100	672.30	100	1072.62	100

Explanatory note:-

Adequate regeneration: Means where 8 or more than 8 seedlings (having diameter between 2 cms to less than 10 cms at breast height), of economically important species were found in a regeneration plot of 16 sq.meter area.

Inadequate regeneration: Means where less than 8 seedlings (having diameter between 2 cms to less than 10 cms at breast height), of economically important species were found in regeneration plot of 16 sq. meter area.

4.1.11 Zonewise distribution of accessible tree forest area by injuries to the crop

35.60 percent area is subjected to man made/Unnatural injuries, 1.53 percent to natural injuries and the remaining 62.77 percent area is free of injuries. Injuries to crop reduce growth of the timber produced, retard the growth of trees and at times lead to mortality of the trees. Zonewise distribution is given in table No. 4.1.11.

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Table No. 4.1.11

Total area : 1072.62 km^2
Total sample plots : 129
Unit : km^2

Type of injury	Haryana Zone Area	Haryana Zone %	Punjab Zone Area	Punjab Zone %	Total Area	Total %
Natural	8.34	2.08	8.30	1.23	16.64	1.55
Man made/ Un-natural	191.82	47.92	190.90	28.40	382.72	35.68
Absent	200.16	50.00	473.10	70.37	673.26	62.77
Total:	400.32	100	672.30	100	1072.62	100

Explanatory note:-

Injury was judged by occular estimation in 2 ha area around the centre of plot, provided the affected trees formed at least 10 percent of the crop.

Natural injury: Means injury by wind/snow or flood, climber, lightening, wildlife borer attack, leaf defoliator or other pests.

Man-made/Un-natural: Injury by girdling/illicit felling, scarring/fire, lopping.

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Zonewise distribution of accessible tree forest area by forest types and canopy density classes

Out of 1072.62 km^2 of accessible tree forest area, 16.60 km^2 of area falls under 'plantation' landuse class. This area has not been categorized in canopy density classes. Thus the break up of 1056.02 km^2 area represented by 177 sample plots is given in table No.4.1.12.

Only 1.58 percent (16.68 km^2) area has canopy density greater than 70 percent. 51.92 percent (548.28 km^2) area has canopy density between 30 percent to 69 percent and 46.50 percent (491.06 km^2) area is below the canopy density of 30 percent. Forest typewise density is highest in Sal forest type (50.00 percent) and Chir forest type has least canopy density of 17.00 percent. It may be mentioned here that forest type Sal occurs in Haryana Zone only while Chir forest type is found in Punjab Zone. The canopy density in miscellaneous forest type is 35 percent which is equal to the overall canopy density of Shiwalik region. The overall Zonewise canopy density is 39.5 percent for Punjab Shiwalik area 28.1 percent for Haryana Shiwalik.

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Table No. 1.1.12

Total area : 1072.62 km^2
Total sample plots : 129
Unit : km^2

Survey zone	Hardwood mixed with conifers: Sair 70% & above	Sair 30% to 69%	Sair 5% to 29%	Sal 70% & above	Sal 30% to 69%	Sal 5% to 29%	Khair 70% & above	Khair 30% to 69%	Khair 5% to 29%	Miscellaneous 70% & above	Miscellaneous 30% to 69%	Miscellaneous 5% to 29%	Total 70% & above	Total 30% to 69%	Total 5% to 29%	Total Area
Haryana	-	-	-	-	8.34	3.34	16.68	33.36	16.68	-	8.34	83.40	-	50.04	175.14	16.68	100.08	283.56	400.32
Punjab	-	-	49.80	-	-	-	-	-	-	-	66.40	8.30	-	381.80	149.40	-	448.20	207.50	655.70
Total	-	-	49.80	-	8.34	8.34	16.68	33.36	16.68	-	71.74	91.70	-	431.84	324.54	16.68	548.23	491.06	1056.02
Density % (Forest typewise)	17.00			33.50			50.50			31.82			35.34						
%area under different density classes																1.58	51.92	46.50	
Overall density percent																	35.21		

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4.1.13 Changes in the Status of Scrub Areas.

During reconnaisance the areas shown as scrub on topo sheets were found to have forest growth and therefore were included under the category of forest area. The Shiwalik region includes 323.90 km^2 of scrub area out of the total 1346.80 km^2 of forest area surveyed. Area attributes of the forest area including scrub have been dealt with in paras 4.1.1 to 4.1.12. It would be of interest to study the changes in the land-use pattern during the last 19 years i.e. from 1966 to 1985 in the scrub area surveyed.

Present land-use of the scrub area in the Shiwalik region

Sl. No.	Land-use	Haryana Zone (Ambala Distt.)	Pun-jab Zone (Ropar, Hoshiarpur & Gurdaspur Districts	Entire Shiwalik Region
		km^2	km^2	km^2
1.	Dense tree forest	-	33.20	33.20
2.	Moderately dense tree forest	-	107.90	107.90
3.	Open tree forest	33.36	124.50	157.86
4.	Scrub	8.34	8.30	16.64
5.	Habitation	-	8.30	8.30
	Total	41.70	282.20	323.90

It would thus be seen that as a result of protection measures taken up in Shiwalik region the land-use pattern of scrub area has been changed which shows positive signs of improvement. 43.56% of scrub area has been converted to dense to moderately dense tree forest and 48.74% to open tree forest. Status remains static only in 5.14% of area whereas 2.56% of scrub area has been diverted for habitation.

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Stand and stock tables

Distribution of volume per hectare (stock table) and stems per hectare (stand table) by species and diameter classes in accessible tree forest area of the zones are given forest type wise from table No.4.2.1 to 4.2.16.. The zone wise stand and stock tables (all forest types combined) are given in table No.4.2.17 to 4.2.20.

The gist of these tables is given below:

Zone	Forest type	Area	Vol/ha m^3	Stems/ha
Haryana Shiwalik	1. Khair	9174	3.892	76.36
	2. Sal	6672	84.862	240.00
	3. Hardwood mixed with conifers	1668	24.898	150.00
	4. Miscellaneous	22518	11.123	128.80
	All forest types combined	40032	22.330	136.25
Punjab Shiwalik	1. Chir	4980	42.466	193.30
	2. Khair	7470	4.011	80.00
	3. Hardwood mixed with conifers	1660	14.700	140.00
	4. Miscellaneous	53120	6.166	83.900
	All forest types combined	67230	8.826	92.970

4.2.1 Status of the growing-stock in forest types

Stand and stock tables of various forest types occuring in the region for Haryana and Punjab Zones have been presented in Table Nos. 4.2.1 to 4.2.16. Table No. 4.1.12 gives the canopy density classes distribution by forest types for Haryana and Punjab Zones as well as for the Shiwalik region. On the basis of stand, stock and canopy data, growing-stock status of various forest types occuring in the region is given below:

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(i) Khair forest type:- This forest type occurs both in Haryana and Punjab Shiwalik over an area of 9174 ha and 7470 ha respectively. The volume per hectare in Haryana and Punjab are very low and comparable, being 3.892 m^3 and 4.011 m^3 respectively. Similarly, the stems per hectare are 76.36 and 80 respectively in Haryana and Punjab. The basal area and crop dia for Khair forest type in Haryana Shiwalik is 1.46 m^2 and 15.62 cm while in Punjab Shiwalik it is 1.48 m^2 and 15.35 cm. Hence, there is practically no difference between the structure of Khair forest type in Punjab and Haryana. The canopy cover in Khair forest type in the region is 31.82 percent. The proportion of Khair trees by volume is 69.9% in Haryana and 70.0% in Punjab. Other species occuring in Khair forest type are Dalbergia sissoo, Salai, Anogeissus species etc.

(ii) Sal forest type:- This forest type occurs in Haryana Shiwaliks over an area of 6672 ha. and has not been found to occur in Punjab Shiwaliks. The canopy density in this forest type is 50.50%. The volume per hectare is 84.862 m^3 of which 88.8% is Sal. Other species found associated with Sal are Sandan, Khair, Sain, Tendu Semal etc. Per hectare stems in Sal forest type are 240. The basal area for the crop is 13.47 m^2 and crop dia is 25.73 cm. The Sal forests of this region are of site quality II/III and are being worked under "Coppice with standard system". The coppice rotation being 30 years and standards are retained for 120 years. Hence the stocking is not comparable with the stocking given in the yield tables.

(iii) Hardwood mixed with conifers:- This forest type occurs both in Haryana and Punjab over an area of 1668 ha and 1660 ha respectively. The volume per hectare in Haryana is 24.898 m^3 and vol/ha in Punjab is 14.700 m^3. The stems per hectare are 150 and 140 in Haryana and Punjab respectively. The basal area and the crop dia in Haryana is 5.71 m^2 and 22 cm. The basal area and the crop dia in Punjab is 3.97 m^2 and 19 cm. The basal area figures are not comparable. The over all canopy density is 33.5 percent. The conifer associated with the hardwoods is Chir pine. Other species occuring in this forest type are Dalbergia sissoo, Lannea coromandelica, Salai, Eucalyptus, Anogeissus species Acacia catechu, Tendu etc.

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(iv) Chir forest type:- This forest type occurs over an area of 4980 ha in Punjab Shiwalik and has not been found to occur in Hareyana Shiwalik. The abundance of Chir in the over wood differentiates this forest type from 'Hardwood mixed with conifers'. The canopy density is 17.0%. The volume per hectare is 42.466 m^3 and stems per hectare are 193. The basal area is 8.91 m^2 and crop dia is 24.22 cm. The contribution of Chir in the volume is 77.1%. Other species occuring in this forest type are Semal, Khair, Tendu, Shisham etc. The volume per hectare is 42.4 m^3 and stems per hectare are 193.

(v) Miscellaneous forest type:- This type is the most abundant in the region occuring over an area of 22518 ha in Haryana and 53120 ha in Punjab Shiwalik, thus accounting for 70.52 percent of the tree forest area (107262 ha). The canopy density is 35.84 percent. The basal area in Haryana Shiwalik is 3.45 m^2 and the crop dia is 18.46 cm. The basal area in Punjab Shiwalik is 2.06 m^2 and the crop dia is 17.68 cm. Some of the species occuring in this type are Khair, Eucalyptus, Shisham, Sain, Sandan, Tendu, Salai, Chir, Semal etc. The per hectare volume is 11.1 m^3 in Haryana and 6.2 m^2 in Punjab. The stems per hectare in Haryana and Punjab are 129 and 84 respectively.

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4.2.2 Total growing stock

The whole of accessible tree forest area of Haryana Shiwalik has total growing stock of 893927 m^3 and the number of stems are 5454360. The growing stock in Punjab Shiwaliks is 593398 m^3 and the number of stems are 6250400. Thus in comparison the Haryana Shiwalik is better stocked having stocking of 22.33 m^3/ha while Punjab Shiwalik has very low stocking of 8.826 m^3/ha. The number of stems/ha in Haryana and Punjab are 136 and 93 respectively. In tabular form the growing stock is given below:

Zone	Area ha	Growing stock m^3	Number of stems
Haryana Shiwalik	40032	893927	5454360
Punjab Shiwalik	67230	593398	6250400
Total region	107262	1487325	11704760

Thus the per hectare growing stock for the region is 13.866 m^3/ha and the number of stems are 109

Data in stand, stock tables and foregoing analysis of same indicates that crop in various forest types is understocked to varying degree when compared with ideal normal stocking. Overall canopy density of crop varies from 17 percent in Chir type to 50 percent in Sal forest type. Overall canopy cover in the area is about 35 percent (table No.4.1.12). Open forests are less productive as well as more susceptible to soil erosion thus leading to further degradation of site. Such forests cannot afford full protection to area and maintain ecological balance. Hence greater attention is needed in future to such open areas to improve production, their productivity and to check their further degradation.

4.3 Sampling error

Standard error percent of volume is given below:

Zone	SE%	
Punjab Shiwalik	19.23	(81)
Haryana Shiwalik	31.93	(48)
Overall region	20.72	(129)

Number in brackets indicate the number of observations on which the error is based.

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Table No. 4.2.1

Distribution of total volume by species and diameter classes and volume/ha by diameter classes in accessible tree forest area.

Stratum : Acacia catechu

Region : Shiwalik zone of Haryana
Area : 9174 ha.
Unit : '000' m^3

S.No.	Species	DIAMETER CLASSES (in cms)									
		10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Acacia catechu	21.684	3.253	-	-	-	-	-	-	24.937	69.9
2.	Anogeissus spp.	2.002	-	-	-	-	-	-	-	2.002	5.6
3.	Dalbergia sissoo	0.500	-	-	-	-	-	-	-	0.500	1.4
4.	Lannea coromandelica	0.917	1.876	-	-	-	-	-	-	2.793	7.8
5.	Boswellia serrata	0.475	-	-	-	-	-	-	-	0.475	1.3
6.	Eucalyptus	0.250	-	-	-	-	-	-	-	0.250	0.7
7.	Misc.	4.754	-	-	-	-	-	-	-	4.754	13.3
	Total:-	30.582	5.129	-	-	-	-	-	-	35.711	100.0
	Volume/ha (m^3/ha)	3.333	0.559	-	-	-	-	-	-	3.892	-
	%	85.6	14.4	-	-	-	-	-	-	-	100.0

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Table No. 4.2.2

Distribution of total volume by species and diameter classes and volume/ha by diameter classes in accessible tree forest area.

Stratum : Shorea robusta

Region : Shiwalik zone of Haryana

Area : 6672 ha.

Unit : '000' m^3

S.No.	Species	DIAMETER CLASSES (in cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Shorea robusta	91.573	82.733	158.793	86.235	61.382	22.017	-	-	502.733	88.8
2.	Buchnania latifolia	1.501	2.669	-	-	-	-	-	-	4.170	0.7
3.	Bombax ceiba	0.500	-	-	-	-	-	-	-	0.500	0.1
4.	Diospyros melanoxylon	1.501	2.669	3.002	-	-	-	-	-	7.172	1.3
5.	Ougeinia Dalbergioides	2.252	6.672	-	4.837	-	-	-	-	13.761	2.4
6.	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	6.755	1.2
7.	Terminalia tomentosa	0.751	2.669	3.002	4.837	-	-	-	-	11.259	2.0
8.	Misc.	-	-	-	-	7.172	-	12.677	-	19.849	3.5
	Total:-	102.665	99.580	164.797	95.909	68.554	22.017	12.677	-	566.199	100.0
	Volume/ha (m^3/ha)	15.387	14.925	24.700	14.375	10.275	3.300	1.900	-	84.862	-
	%	18.1	17.6	19.1	16.9	12.1	4.0	2.2	-	-	100.0

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Table No. 1.2.1

Distribution of total volume by species and diameter classes and volume/ha by diameter classes in accessible tree forest area.

Stratum : Hardwood with conifers

Region : Shiwalik zone of Haryana

Area : 1668 ha.

Unit : '000' m^3

S.No.	Species	DIAMETER CLASSES (in cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Acacia catechu	0.117	1.084	-	-	-	-	-	-	1.501	3.6
2.	Anogeissus spp.	1.501	1.334	-	-	-	-	-	-	2.835	6.8
3.	Dalbergia sissoo	[illegible]	2.085	[illegible]	-	[illegible]	-	-	-	[illegible]	[illegible]
4.	Ougeinia dalbergioides	0.500	-	-	-	-	-	-	-	0.500	1.2
5.	Nyctanthus arbortristis	0.751	-	-	-	-	-	-	-	0.751	1.8
6.	Bombax ceiba	-	1.334	-	-	-	-	-	-	1.334	3.3
7.	Lannea coromandelica	0.458	-	4.462	-	-	-	-	-	4.920	11.8
8.	Terminalia tomentosa	0.500	1.334	-	-	-	-	-	-	1.834	4.4
9.	Misc.	0.751	-	-	-	-	-	-	-	0.751	1.8
	Total:-	8.631	7.171	13.219	-	12.510	-	-	-	41.531	100.0
	Volume/ha (m^3/ha)	5.174	4.299	7.925	-	7.500	-	-	-	24.898	
	%	20.8	17.3	31.8	-	30.1	-	-	-	-	100.0

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Table No. 2.

Distribution of total volume by species and diameter classes and volume/ha by diameter classes in accessible area forest area.

Stratum : Miscellaneous

Region : Shivalik zone of Haryana

Area : 22518 ha.

Unit : '000' m^3

S.No.	Species	DIAMETER CLASSES (In cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Acacia catechu	22.935	6.505	-	-	-	-	-	-	29.140	11.7
2.	Eucalyptus	0.500	5.337	-	-	-	-	-	-	5.837	2.3
3.	Dalbergia sissoo	0.500	-	-	-	-	-	-	-	0.500	0.2
4.	Anogeissus spp.	31.025	3.005	2.752	-	-	-	-	-	41.783	16.7
5.	Lannea coromandelica	10.091	22.518	22.309	-	-	-	-	-	54.918	21.9
6.	Terminalia tomentosa	0.751	4.003	-	-	-	-	-	-	4.754	1.9
7.	Dugeinia dalbergioides	0.500	1.334	-	-	-	-	-	-	1.834	0.7
8.	Diospyros melanoxylon	2.502	1.334	3.002	-	-	-	-	-	6.838	2.7
9.	Boswellia serrata	9.508	2.752	5.421	-	-	-	-	-	17.681	7.1
10.	Pinus roxburghii	-	-	-	23.769	-	-	-	-	23.769	9.5
11.	Bombax ceiba	-	1.334	-	-	-	-	-	-	1.334	0.5
12.	Buchnania latifolia	1.501	2.669	-	-	-	-	-	-	4.170	1.7
13.	Misc.	23.258	25.353	9.007	-	-	-	-	-	57.628	23.1
	Total:-	103.081	81.145	42.491	23.769	-	-	-	-	250.486	100.0
	Volume/ha (m^3/ha)	4.578	3.603	1.887	1.055	-	-	-	-	11.123	-
	%	41.2	32.4	17.0	9.4	-	-	-	-	-	100.0

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Table No. 4.2.5

Distribution of total volume by species and diameter classes and volume/ha by diameter classes in accessible tree forest area.

Stratum : Pinus roxburghii

Region : Shiwalik zone of Punjab

Area : 4980 ha.

Unit : '000' m^3

S. No.	Species	DIAMETER CLASSES (in cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Pinus roxburghii	11.827	14.525	30.502	31.540	74.700	-	-	-	163.094	77.1
2.	bombax ceiba	0.249	-	-	-	-	-	-	-	0.249	0.1
3.	Acacia catechu	7.470	-	-	-	-	-	-	-	7.470	3.5
4.	Diospyros melanoxylon	0.996	-	5.976	-	-	-	-	-	6.972	3.3
5.	Dalbergia sissoo	0.498	-	-	-	-	-	-	-	0.498	0.2
6.	Misc.	9.462	16.600	-	-	7.138	-	-	-	33.200	15.6
	Total:-	30.502	31.125	36.478	31.540	81.838	-	-	-	211.483	100.0
	volume/ha (m^3/ha)	6.125	6.250	7.325	6.333	16.433	-	-	-	42.466	-
	%	14.4	14.7	17.2	14.9	38.8	-	-	-	-	100.0

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Table No. 4.2.6

Distribution of total volume by species and diameter classes and volume/ha by diameter classes in accessible tree forest area.

Stratum : Acacia catechu

Region : Shiwalik zone of Punjab

Area : 7470 ha.

Unit : '000' m^3

S.No.	Species	DIAMETER CLASSES (in cms)									
		10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Acacia catechu	21.995	1.079	-	-	-	-	-	-	23.074	77.0
2.	Dalbergia sissoo	0.498	2.158	-	-	-	-	-	-	2.656	8.9
3.	Anogeissus spp.	0.498	-	-	-	-	-	-	-	0.498	1.6
4.	Misc.	3.735	-	-	-	-	-	-	-	3.735	12.5
	Total	26.726	3.237	-	-	-	-	-	-	29.963	100.0
	Volume/ha (m^3/ha.)	3.578	0.433	-	-	-	-	-	-	4.011	-
	%	89.2	10.8	-	-	-	-	-	-	-	100.0

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Table No. 4.2.7

Distribution of total volume by species and diameter classes and volume/ha by diameter classes in accessible tree forest area.

Stratum : Hardwood with conifers

Region : Shiwalik zone of Punjab

Area : 1660 ha.

Unit : '000' m^3

S.No.	Species	DIAMETER CLASSES (in cms)									
		10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Acacia catechu	2.075	-	1.992	-	-	-	-	-	4.067	16.7
2.	Pinus roxburghii	4.980	4.150	8.715	-	-	-	-	-	17.845	73.1
3.	Diospyros melanoxylon	0.747	-	-	-	-	-	-	-	0.747	3.1
4.	Misc.	1.743	-	-	-	-	-	-	-	1.743	7.1
	Total	9.545	4.150	10.707	-	-	-	-	-	24.402	100.0
	Volume/ha (m^3/ha)	5.750	2.500	6.450	-	-	-	-	-	14.700	
	%	39.1	17.0	43.9	-	-	-	-	-	-	100.0

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Table No. 4.2.8

Distribution of total volume by species and diameter classes and volume/ha by diameter classes in accessible tree forest area.

Stratum : Miscellaneous

Region : Shiwalik zone of Punjab

Area : 53120 ha.

Unit : '000' m^3

S.No.	Species	DIAMETER CLASSES (in cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Lannea coromandelica	30.129	46.687	13.321	15.139	-	-	-	-	105.276	32.1
2.	Ougeinia dalbergioides	4.980	1.245	-	-	-	-	-	-	6.225	1.9
3.	Acacia catechu	30.295	4.316	1.992	-	-	-	-	-	36.603	11.2
4.	Diospyros melanoxylon	3.735	1.328	-	-	-	-	-	-	5.063	1.5
5.	Bombax ceiba	1.743	2.656	-	-	-	-	-	-	4.399	1.3
6.	Dalbergia sissoo	13.446	21.580	13.944	-	-	-	-	-	48.970	15.0
7.	Terminalia belerica	0.490	-	-	-	-	-	-	-	0.490	0.1
8.	Ficus roxburghii	-			-	12.450	-	-	-	12.450	3.8
9.	Eucalyptus	0.249	-	-	-	-	-	-	-	0.249	0.1
10.	Anogeissus spp.	3.984	-	-	-	-	-	-	-	3.984	1.2
11.	Misc.	57.519	33.200	5.976	-	7.138	-	-	-	103.833	31.7
	Total:-	146.578	111.012	35.233	15.139	19.588	-	-	-	327.550	100.0
	Volume/ha (m^3/ha)	2.759	2.090	0.663	0.285	0.369	-	-	-	6.166	
		44.7	33.9	10.8	4.6	6.0	-	-	-	-	100.0

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Table No. 4.2.9

Distribution of total stems by species and diameter classes and stems/ha by diameter classes in accessible tree forest area.

Stratum : Acacia catechu

Region : Shiwalik zone of Haryana
Area : 9174 ha.
Unit : '000' stems

S.No.	Species	DIAMETER CLASSES (in cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Acacia catechu	433.68	25.02	-	-	-	-	-	-	458.70	65.5
2.	Anogeissus spp.	33.36	-	-	-	-	-	-	-	33.36	4.7
3.	Dalbergia sissoo	8.34	-	-	-	-	-	-	-	8.34	1.2
4.	Lannea coromandelica	16.68	8.34	-	-	-	-	-	-	25.02	3.6
5.	Boswellia serrata	8.34	-	-	-	-	-	-	-	8.34	1.2
6.	Eucalyptus	8.34	-	-	-	-	-	-	-	8.34	1.2
7.	Misc.	158.46	-	-	-	-	-	-	-	158.46	22.6
	Total:-	667.20	33.36	-	-	-	-	-	-	700.56	100.0
	Stems/ha.	72.73	3.63	-	-	-	-	-	-	76.36	
	%	95.2	4.8	-	-	-	-	-	-	-	100.0

Basal area: 1.40 m^2
Crop dia : 15.62 c

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Table No. 4.2.10

Distribution of total stems by species and diameter classes and stems/ha by diameter classes in accessible tree forest area.

Stratum : Shorea robusta

Region : Shiwalik zone of Haryana
Area : 6672 ha.
Unit : '000' stems

S.No.	Species	DIAMETER CLASSES (in cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Shorea robusta	508.74	258.54	233.52	91.74	33.36	8.34	-	-	1134.24	70.8
2.	Buchnania latifolia	50.04	16.68	-	-	-	-	-	-	66.72	4.2
3.	Bombax ceiba	16.68	-	-	-	-	-	-	-	16.66	1.0
4.	Diospyros melanoxylon	50.04	16.68	8.34	-	-	-	-	-	75.06	4.7
5.	Dugeinia dalbergioides	75.06	41.70	-	8.34	-	-	-	-	125.10	7.8
6.	[illegible]	91.74	16.68	-	-	-	-	-	-	108.42	6.8
7.	Terminalia tomentosa	25.02	16.68	8.34	8.34	-	-	-	-	58.36	3.6
8.	Misc.	-	-	-	-	8.34	-	8.34	-	16.68	1.0
	Total:-	817.32	366.96	250.20	108.42	41.70	8.34	8.34	-	1601.28	100.0
	Stems /ha.	122.50	55.00	37.50	16.25	6.25	1.25	1.25	-	240.00	
	%	51.1	22.9	15.6	6.8	2.6	0.5	0.5	-	-	100.0

Basal area : 3.47 m^2
Crop dia : 26.7 cm

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Table No. 4.2.11

Distribution of total stems by species and diameter classes and stems/ha by diameter classes in accessible tree forest area.

Stratum : Hardwood with conifers

Region : Shiwalik zone of Haryana

Area : 1668 ha.

Unit : '000' stems

S.No.	Species	DIAMETER CLASSES (in cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Acacia catechu	8.34	8.34	-	-	-	-	-	-	16.68	6.7
2.	Anogeissus spp.	25.02	8.34	-	-	-	-	-	-	33.36	13.3
3.	Lannea roxburghii	50.04	8.34	16.68	-	8.34	-	-	-	83.40	33.3
4.	Ougeinia dalbergioides	16.68	-	-	-	-	-	-	-	16.68	6.7
5.	Nyctanthus arbortristis	25.02	-	-	-	-	-	-	-	25.02	10.0
6.	Bombax ceiba	-	8.34	-	-	-	-	-	-	8.34	3.3
7.	Lannea coromandelica	8.34	-	8.34	-	-	-	-	-	16.68	6.7
8.	Terminalia tomentosa	16.68	8.34	-	-	-	-	-	-	25.02	10.0
9.	Misc.	25.02	-	-	-	-	-	-	-	25.02	10.0
	Total:-	175.14	41.70	25.02	-	8.34	-	-	-	250.20	100.0
	Stems/ha.	105.00	25.00	15.00	-	5.00	-	-	-	150.00	
	%	70.0	16.7	10.0	-	3.3	-	-	-		100.0

Basal area: [illegible] m^2

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Table No. 4.2.12: Distribution of total stems by species and diameter classes and stems/ha by diameter classes in accessible tree forest area

Stratum : Miscellaneous

Region : Shiwalik zone of Haryana
Area : 22518 ha.
Unit : '000' stems.

S.No.	Species	DIAMETER CLASSES (in cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	
1.	Acacia catechu	458.70	50.04	-	-	-	-	-	-	508.74	17.6
2.	Eucalyptus	16.68	33.36	-	-	-	-	-	-	50.04	1.7
3.	Dalbergia sissoo	8.34	-	-	-	-	-	-	-	8.34	0.3
4.	Anogeissus spp.	517.08	50.04	8.34	-	-	-	-	-	575.46	20.0
5.	Lannea coromandelica	183.48	100.08	41.70	-	-	-	-	-	325.26	11.2
6.	Terminalia tomentosa	25.02	25.02	-	-	-	-	-	-	50.04	1.7
7.	Ougeinia dalbergioides	16.68	8.34	-	-	-	-	-	-	25.02	0.9
8.	Diospyros melanoxylon	83.40	8.34	8.34	-	-	-	-	-	100.08	3.4
9.	Boswellia serrata	166.80	16.68	16.68	-	-	-	-	-	200.16	6.7
10.	Pinus roxburghii	-	-	-	25.02	-	-	-	-	25.02	0.9
11.	Bombax ceiba	-	8.34	-	-	-	-	-	-	8.34	0.3
12.	Buchnania latifolia	50.04	16.68	-	-	-	-	-	-	66.72	2.3
13.	Misc.	775.62	158.46	25.02	-	-	-	-	-	959.10	33.0
	Total:-	2301.84	475.38	100.08	25.02	-	-	-	-	2902.32	100.0
	Stems/ha.	102.2	21.1	4.44	1.1	-	-	-	-	128.8	
	%	79.3	16.4	3.4	0.9	-	-	-	-	-	100.0

Basal area : 3.45 m^2 Crop. dia : 18.46 cm

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Table No. 4.2.13

Distribution of total stems by species and diameter classes and stems/ha by diameter classes in accessible tree forest area.

Stratum : Pinus roxburghii

Region : Shivalik Zone of Punjab

Area : 4980 ha.

Unit : '000' stems

S. No.	Species	DIAMETER CLASSES (in cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Pinus roxburghii	157.7	58.1	58.1	33.2	49.8	-	-	-	356.9	37.1
2.	Bombax ceiba	8.3	-	-	-	-	-	-	-	8.3	0.9
3.	Acacia catechu	149.4	-	-	-	-	-	-	-	149.4	15.5
4.	Diospyros melanoxylon	33.2		16.6	-	-	-	-	-	49.8	5.2
5.	Dalbergia sissoo	8.3	-	-	-	-	-	-	-	8.3	0.8
6.	Misc.	315.4	66.4	-	-	8.3	-	-	-	390.1	40.5
	Total:-	672.3	124.5	74.7	33.2	58.1	-	-	-	962.8	100.0
	Stems/ha (Nos)	135.0	25.0	15.0	6.6	11.7	-	-	-	193.3	
	%	69.8	12.9	7.8	3.4	6.1	-	-	-	-	100.0

Basal area : 8.91 m^2
Crop dia: 24.219 cm.

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Table No. 4.2.14

Distribution of total stems by species and diameter classes and stems/ha by diameter classes in accessible tree forest area.

Region : Shiwalik zone of Punjab
Area : 7470 ha.
Unit : '000' stems.

Stratum : Acacia catechu

S.No.	Species	DIAMETER CLASSES (in cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Acacia catechu	439.9	8.3	-	-	-	-	-	-	448.2	75.0
2.	Dalbergia sissoo	8.3	8.3	-	-	-	-	-	-	16.6	2.8
3.	Anogeissus spp.	8.3	-	-	-	-	-	-	-	8.3	1.4
4.	Misc.	124.5	-	-	-	-	-	-	-	124.5	20.8
	Total:-	581.0	16.6	-	-	-	-			[illegible]	100.0
	Stems/ha. (nos)	77.8	2.2	-	-	-	-	-	-	80.0	
	%	97.3	2.7	-	-	-	-	-	-	-	100.0

Basal area : 1.68 m^2
Crop dia : 15.35 cm.

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Table No. 4.2.15

Distribution of total stems by species and diameter classes and stems/ha by diameter classes in accessible tree forest area.

Stratum : Hard wood with conifers

Region : Shiwalik zone of Punjab

Area : 1660 ha.

Unit : '000' stems

S. No.	Species	DIAMETER CLASSES (in cms)									
		10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Acacia catechu	41.5	-	8.3	-	-	-	-	-	49.8	21.4
2.	Pinus roxburghii	66.4	16.6	16.6	-	-	-	-	-	99.6	42.9
3.	Diospyros melanoxylon	24.9	-	-	-	-	-	-	-	24.9	10.7
4.	Misc.	58.1	-	-	-	-	-	-	-	58.1	25.0
	Total:-	190.9	16.6	24.9	-	-	-	-	-	232.4	100.0
	Stems/ha (Nos)	115.0	10.0	15.0	-	-	-	-	-	140.0	
	%	82.1	7.2	10.7	-	-	-	-	-		100.0

Basal area : 3.97 m^2
Cr. dia : [illegible]

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Table No. 4.2.16

Distribution of total stems by species and diameter classes and stems/ha by diameter classes in accessible tree forest area.

Stratum : Miscellaneous

Region : Shiwalik zone of Punjab
Area : 53120 ha.
Unit : '000' stems

S.No.	Species	DIAMETER CLASSES (in cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Lannea coromandelica	547.8	207.5	24.9	16.6	-	-	-	-	796.8	17.9
2.	Ougeinia dalbergioides	166.0	41.5	-	-	-	-	-	-	207.5	4.6
3.	Acacia catechu	605.9	33.2	8.3	-	-	-	-	-	647.4	14.5
4.	Diospyros melanoxylon	124.5	8.3	-	-	-	-	-	-	132.8	3.0
5.	Bombax ceiba	56.1	16.6	-	-	-	-	-	-	74.7	1.[illegible]
6.	Dalbergia sissoo	224.1	83.0	24.9	-	-	-	-	-	332.0	7.4
7.	Terminalia belarrica	16.6	-	-	-	-	-	-	-	16.6	0.4
8.	Pinus roxburghii	-	-	-	-	8.3	-	-	-	8.3	0.2
9.	Anogeissus spp.	66.4	-	-	-	-	-	-	-	66.4	1.5
10.	Eucalyptus	8.3	-	-	-	-	-	-	-	8.3	0.2
11.	Misc.	19[illegible]	207.5	16.6	-	8.3	-	-	-	2166.8	48.6
	Total:-	3752.1	597.6	74.7	16.6	16.6	-	-	-	4457.6	100.0
	Stems/ha. (Nos)	70.7	11.2	1.4	0.3	0.3	-	-	-	83.9	
	%	84.3	13.3	1.6	0.4	0.4	-	-	-	-	100.0

Basal area : [illegible] m²
Crown : [illegible] c

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Table No. 4.2.17

Distribution of total volume by species and diameter classes and volume/ha by diameter classes in accessible tree forest area.

Stratum : All forest types

Region : Shiwalik zone of Haryana
Area : 40032 ha.
Unit : '000' m^3

S.No.	Species	DIAMETER CLASSES (in cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Acacia catechu	49.623	13.010	-	-	-	-	-	-	62.633	7.0
2.	Anogeissus spp.	34.528	9.340	2.752	-	-	-	-	-	46.620	5.2
3.	Buchnania latifolia	3.002	5.338	-	-	-	-	-	-	8.340	0.9
4.	Bombax ceiba	0.500	2.668	-	-	-	-	-	-	3.168	0.4
5.	Boswellia serrata	9.983	2.752	5.421	-	-	-	-	-	18.156	2.0
6.	Dalbergia sissoo	1.000	-	-	-	-	-	-	-	1.000	0.1
7.	Diospyrus melanoxylon	4.003	4.003	6.004	-	-	-	-	-	14.010	1.6
8.	Eucalyptus	0.750	5.337	-	-	-	-	-	-	6.087	0.7
9.	Lannea coromandelica	11.466	24.394	26.771	-	-	-	-	-	62.631	7.0
10.	Nyctanthus arbortristis	0.751	-	-	-	-	-	-	-	0.751	0.1
11	Ougeinia dalbergioides	3.252	8.006	-	4.837	-	-	-	-	16.095	1.8
12.	Pinus roxburghii	3.753	2.085	8.757	23.769	12.510	-	-	-	50.874	5.7
13.	Shorea robusta	91.573	82.733	158.793	86.235	61.382	22.017	-	-	502.733	56.2
14.	Terminalia tomentosa	2.002	8.006	3.002	4.837	-	-	-	-	17.847	2.0
15.	Misc.	28.773	25.353	9.007	-	7.172	-	12.677	-	82.982	9.3
	Total:-	244.959	193.025	220.507	119.678	81.064	22.017	12.677	-	893.927	100.0
	Volume/ha (m^3/ha)	6.119	4.822	5.508	2.989	2.025	0.550	0.317	-	22.330	
	%	27.4	21.6	24.7	13.4	9.1	2.4	1.4	-	-	100.0

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Table No. 4.2.18

Distribution of total stems by species and diameter classes and stems/ha by diameter classes in accessible tree forest area.

Stratum : All forest types

Region : Shiwalik zone of Haryana
Area : 40032 ha.
Unit : '000' stems

S.No.	Species	DIAMETER CLASSES (in cms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Acacia catechu	992.46	100.08	-	-	-	-	-	-	1092.54	20.0
2.	Anogeissus spp.	575.46	58.38	8.34	-	-	-	-	-	642.18	11.8
3.	Buchnania latifolia	100.08	33.36	-	-	-	-	-	-	133.44	2.4
4.	Bombax ceiba	16.68	16.68	-	-	-	-	-	-	33.36	0.6
5.	Boswellia serrata	175.14	16.68	16.68	-	-	-	-	-	208.50	3.8
6.	Dalbergia sissoo	16.68	-	-	-	-	-	-	-	16.68	0.3
7.	Diospyros melanoxylon	133.44	25.02	16.68	-	-	-	-	-	175.14	3.2
8.	Eucalyptus	25.02	33.36	-	-	-	-	-	-	58.38	1.1
9.	Lannea coromandelica	208.50	108.42	50.04	-	-	-	-	-	366.96	6.7
10.	Nyctanthus arbortristis	25.02	-	-	-	-	-	-	-	25.02	0.5
11.	Ougeinia dalbergioides	108.42	50.04	-	8.34	-	-	-	-	166.80	3.1
12.	Pinus roxburghii	50.04	8.34	16.68	25.02	8.34	-	-	-	108.42	2.0
13.	Shorea robusta	508.74	258.54	233.52	91.74	33.36	8.34	-	-	1134.24	20.8
14.	Terminalia tomentosa	66.72	50.04	8.34	8.34	-	-	-	-	133.44	2.4
15.	Misc.	959.10	158.46	25.02	-	8.34	-	8.34	-	1159.26	21.3
	Total:-	3961.50	917.40	375.30	133.44	50.04	8.34	8.34	-	5454.36	100.0
	Stems/ha.	98.958	22.917	9.375	3.334	1.250	0.208	0.208	-	136.25	
	%	72.6	16.8	6.9	2.4	0.9	0.2	0.2	-	-	100.0

Basal area : 4.798 m^2

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Table No. 4.2.19

Distribution of total volume by species and diameter classes and volume per hectare by diameter classes in accessible tree forest area.

Stratum : All forest types

Region : Shiwalik zone of Punjab

Area : 67230 ha.

Unit : '000' m^3

S. No.	Species	DIAMETER CLASSES (in cms)									
		10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Acacia catechu	61.835	5.395	3.984	-	-	-	-	-	71.214	12.0
.	Anogeissus spp.	4.482	-	-	-	-	-	-	-	4.482	0.7
.	Bombex ceiba	1.992	2.656	-	-	-	-	-	-	4.648	0.8
.	Dalbergia sissoo	14.442	23.738	13.944	-	-	-	-	-	52.124	8.8
5.	Diospyrus melanoxylon	5.470	1.328	5.976	-	-	-	-	-	12.782	2.2
6.	[illegible]calyptus	0.249	-	-	-	-	-	-	-	0.249	-
[illegible]	[illegible]ea coroma[illegible]	30.129	46.687	13.321	15.139	-	-	-	-	105.276	17.7
	[illegible]nus [illegible]lbergiodes	4.980	1.245	-	-	-	-	-	-	6.225	.1
	[illegible]nus roxburghii	16.807	18.675	39.217	31.540	87.150	-	-	-	193.[illegible]	[illegible].6
[illegible]	[illegible]nalia belarica	0.498	-	-	-	-	-	-	-	0.498	0.1
.	[illegible]sc.	72.459	49.800	5.976	-	14.270	-	-	-	142.511	[illegible]
	[illegible]	213.351	149.524	82.41[illegible]	[illegible].679	[illegible].420	-	-	-	593.398	100.
	olume/ha.	3.173	2.224	1.226	0.694	1.509	-	-	-	8.82[illegible]	-
	[illegible]	[illegible]	2.[illegible]	[illegible]	[illegible].9	[illegible]	-	-	-	-	[illegible]0.

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Table No. 4.2.20

Distribution of total stems by species and diameter classes and stems/ha by diameter classes in accessible tree forest area.

Stratum : All forest types

Region : Shiwalik zone of Punjab

Area : 67230 ha.

Unit : '000' stems

S.No.	Species	DIAMETER CLASSES (incms) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80+	Total	%
1.	Acacia catechu	1230.7	41.5	16.6	-	-	-	-	-	1296.8	20.7
2.	Anogeissus spp.	74.7	-	-	-	-	-	-	-	74.7	1.2
3.	Bombax ceiba	66.4	16.6	-	-	-	-	-	-	83.0	1.3
4.	Dalbergia sissoo	240.7	91.3	24.9	-	-	-	-	-	356.9	5.7
5.	Diospyrus melanoxylon	182.6	8.3	16.6	-	-	-	-	-	207.5	3.3
6.	Eucalyptus	8.3	-	-	-	-	-	-	-	8.3	0.1
7.	Lannes coromendélico	547.8	207.5	24.9	16.6	-	-	-	-	796.8	12.8
8.	Ougeinia dalbergiodes	166.0	41.5	-	-	-	-	-	-	207.5	3.3
9.	Pinus roxburghii	224.1	74.7	74.7	33.2	58.1	-	-	-	464.8	7.4
10.	Terminalia belarica	16.6	-	-	-	-	-	-	-	16.6	0.3
11.	Misc.	2432.4	273.9	16.6	-	16.6	-	-	-	2739.5	43.9
	Total:-	5196.3	755.3	174.3	49.8	74.7	-	-	-	6250.4	100.0
		77.291	11.235	2.593	0.740	1.111	-	-	-	92.970	-
		83.1	12.1	2.8	0.8	1.2	-	-	-	-	100.0

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Chapter 5

STRIP PLANTATIONS

5.1 Area

The previous chapters deal with the block forests of Shiwaliks in Punjab and Haryana. During the last two decades there has been a rapid rise in the strip plantations along the sides of roads, Canal and railways lines. This chapter gives the [illegible] of strip plantation in the districts of Ambala, Ropar, Hoshiarpur and Gurdaspur based upon compilation from the working plans. The area statement is given in table No.5.1 given on the next page. The total area under strip plantations in four districts is 17013.36 hectares. 53.97% of the strip plantation area is along the canals and bunds (9667.58) hectares. 17[illegible].3[illegible] hectares are along the roads accounting for 7[illegible].1[illegible] of the total strip plantation area. 11.57%(2073.46 ha) [illegible] covered along the railway lines. Amongst the districts, Gurdaspur accounts for 41.56% of the strip forest area (7444.72 ha) followed by Ambala 35.27% (6313.38 ha), the Hoshiarpur 11.64%(2084.91 ha) closely followed by Ropar 11.53%(2065.35 ha) strip forest area.

The strip forests are divided into five working Circles, namely. Eucalyptus W.C., Shisham Working Circle, Kikar Working Circle, Khair Working Circle and Unregulated Working Circle. It can be seen from table No.5.1 that almost 39% of the strip forest area is allotted to Eucalyptus W.C., Shisham W.C., and Kikar W.C each accounting for almost 30% of the area. Khair Working Circle is very small in extent of [illegible]. Rest of the area has been allotted to the Unregulated Working Circle.

5.2 Stocking

The district wise volume and number of stems are given below:

District	Volume m^3	No. of stems
Ambala	133313.34	490411
Ropar	57377.90	131568
Hoshiarpur	98033.35	168323
Gurdaspur	164585.09	261842
Total	453309.68	1052144

The distribution of the volume and stems of each district, specieswise and working circle wise are given in table No.5.2.1 to table No.5.2.13. The Working Circle wise distribution with respect to the stocking in Ambala district is not available. Table No.5.2.14 [illegible] species wise breakup of Volume and number of stems by districts for the region.

Contents

Table No. 5.1

Distribution of area of strip forests in the region

Stratum: Shiwalik region of Haryana & Punjab — Area in hectares: 17913.36

District	Name of Working Circle	Description of strips: Railway lines	Roads	Canals & Bunds	Total	%
Ambala	1. Eucalyptus WC	553.67	1402.01	477.97	2433.65	
	2. Shisham "	91.67	1117.56	744.66	1953.89	35.27
	3. Kikar "	-	923.99	365.38	1289.37	
	4. Overlapping "	4.00	492.04	145.43	641.47	-
	Total Ambala	649.34	3935.60	1733.44	6318.38	
Ropar	1. Eucalyptus WC	35.29	171.07	397.87	604.23	
	2. Shisham "	78.07	113.26	339.44	530.77	
	3. Kikar "	35.13	76.09	475.86	587.08	11.53
	4. Khair "	1.76	-	117.15	118.91	
	5. Unregulated "	83.63	57.41	83.32	224.36	
	Total Ropar	233.88	417.83	1413.64	2065.35	
Hoshiarpur	1. Eucalyptus WC	18.42	327.01	203.56	548.99	
	2. Shisham "	214.53	409.81	417.33	1041.67	
	3. Kikar "	24.81	68.71	223.97	317.49	11.64
	4. Unregulated "	51.05	125.71	-	176.76	
	Total Hoshiarpur	308.81	931.24	844.86	2084.91	
Gurdaspur	1. Eucalyptus WC	183.36	242.26	1449.78	1875.40	
	2. Shisham "	95.51	228.12	1398.90	1722.53	41.56
	3. Kikar "	372.12	265.95	2348.74	2986.81	
	4. Unregulated "	230.44	151.32	478.22	859.98	
	Total Gurdaspur	881.43	887.65	5675.64	7444.72	
Total of the region	1. Eucalyptus WC	790.74	2142.35	2529.18	5462.27	30.49
	2. Shisham "	479.78	1868.75	2900.33	5248.86	29.30
	3. Kikar "	432.06	1334.74	3413.95	5180.75	28.92
	4. Khair "	1.76	-	117.15	118.91	0.67
	5. Unregulated "	369.12	826.48	706.97	1902.57	10.62
	Total	2073.46	6172.32	9667.58	17913.36	100
	%	11.57	34.46	53.97	100	

Source: Working Plans of Ambala, Ropar, Hoshiarpur & Gurdaspur Forest Divisions.

Contents

Table No. 5.2.1

Distribution of total stems and volume by species and diameter classes in strip forests

Stratum : All working circles combined. District : Ambala

(diameter in cms) Area : 6318.38 ha.

Species	No/Vol.	Diameter classwise number of stems and volume in m^3								
		10-19	20-29	30-39	40-49	50-59	60-69	70+	Total	%
Shisham	No.	18572	36975	33134	16068	4090	846	420	110105	22.45
	Vol.	1109.32	5176.50	19086.38	18156.74	8098.20	2394.18	1436.80	55458.12	41.60
Kikar	No.	104883	38114	8786	2977	806	192	118	155876	31.78
	Vol.	6292.97	5335.96	5008.02	3364.01	1595.88	543.36	417.72	22557.92	16.92
Eucalyptus	No.	100216	52486	9921	863	134	25	20	163665	33.37
	Vol.	11424.62	16375.63	4510.50	517.80	80.40	15.00	12.00	32935.95	24.71
Fruit trees	No.	129	363	190	427	268	158	268	1803	0.38
	Vol.	7.74	50.82	262.77	482.51	530.64	447.14	948.72	2730.34	2.05
Misc.	No.	12795	31815	7029	4177	1632	575	939	58962	12.02
	Vol.	767.70	1934.10	4006.53	4720.01	3231.36	1647.25	3394.06	19631.01	14.72
Total:-	No.	236595	159753	59060	24512	6930	1796	1765	490411	100
	%	48.24	32.58	12.04	5.00	1.41	0.37	0.36	100	
	Vol.	19672.35	28873.01	32874.20	27241.07	13536.48	5046.93	6139.30	133313.34	100
	%	14.76	21.66	24.66	20.43	10.15	3.79	4.61	100	

Working circle : 1. Shisham W.C., 2. Kikar W.C., 3. Eucalyptus W.C.
4. Un-regulated F.C.

Source : D.F.O. working plan Ambala.

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Table No. 5.2.2

Distribution of total stems and volume by species and diameter classes in strip forests

Stratum : Eucalyptus working circle. District : Ropar

(diameter in cms) Area : 604.23 ha.

Species	No./vol	Diameter classwise number of stems and volume m^3								
		10-19	20-29	30-39	40-49	50-59	60-69	70+	Total	%
Shisham	No.	-	3768	2977	1875	820	244	110	9794	13.89
	Vol.	-	565.20	1637.35	2062.50	1640.00	683.20	385.00	6973.25	31.49
Kikar	No.	-	3380	1050	443	149	35	6	5063	7.18
	Vol.	-	507.00	577.50	487.30	298.00	98.00	21.00	1988.80	8.98
Eucalyptus	No.	19255	25217	5320	764	75	4	2	50637	71.83
	Vol.	962.75	3752.55	2926.00	840.40	150.00	11.20	7.00	8679.90	39.20
Fruit	No.	-	216	222	251	161	96	145	1091	1.55
	Vol.	-	32.40	122.10	276.10	322.00	268.80	507.50	1528.90	6.90
Misc.	No.	-	1519	1078	775	357	93	93	3915	5.55
	Vol.	-	227.85	592.90	852.50	714.00	260.40	325.50	2973.15	13.43
Total:-	No.	19255	34100	10647	4108	1562	472	356	70500	100
	%	27.31	48.37	15.10	5.83	2.22	0.67	0.50	100	
	Vol.	962.75	5115.00	5855.85	4510.60	3124.00	1321.60	1246.00	22144.00	100
	%	4.3	23.10	26.44	20.40	14.11	5.97	5.63	100	

Source : Working plan of Ropar Forest Division.

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Table No. 5.2.3

Distribution of total stems and volume by species and diameter classes in strip forests

Stratum : Shisham working circle — District : Ropar

(diameter in cms) — Area : 530.77 ha.

Species	No/Vol.	Diameter classwise number of stems and volume in m^3								
		10-19	20-29	30-39	40-49	50-59	60-69	70+	Total	%
Shisham	No.	-	8584	7766	4869	1321	374	175	23089	67.65
	Vol.	-	1287.60	4271.30	5335.90	2642.00	1047.20	612.50	15216.50	69.35
Kikar	No.	-	1307	922	688	267	49	11	3244	9.51
	Vol.	-	196.05	507.10	756.80	534.00	137.20	38.50	2169.65	9.89
Eucalyptus	No.	627	2858	390	32	-	-	-	3907	11.45
	Vol.	31.35	428.70	214.50	35.20	-	-	-	709.75	3.23
Fruit	No.	-	298	234	233	153	94	152	1164	3.41
	Vol.	-	44.70	128.70	256.30	306.00	263.20	532.00	1530.90	6.98
Misc	No.	-	960	745	566	249	104	100	2724	7.98
	Vol.	-	144.00	409.75	622.60	498.00	291.20	350.00	2315.55	10.55
Total:-	No.	627	14007	10057	6388	1990	621	438	34128	100
	%	1.84	41.04	29.47	18.72	5.83	1.82	1.28	100	
	Vol.	31.35	2101.05	5531.35	7026.80	3980.00	1738.80	1533.00	21942.35	100
	%	0.14	9.58	25.21	32.02	18.14	7.92	6.99	100	

Note:- Excludes all trees of 10-19 cm dia class of all species except Eucalyptus sp.

Source :- Working plan of Ropar Forest Division.

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Table No. 5.2.4

Distribution of total stems and volume by species and diameter classes in strip forests

Stratum : Kikar working circle. District : Ropar

(diameter in cms) Area : 587.08 ha.

Species	No./vol.	Diameter classwise number of stems and volume m^3								
		10-19	20-29	30-39	40-49	50-59	60-69	70+	Total	%
Shisham	No.	-	1976	1386	681	153	40	32	4268	21.99
	Vol.	-	296 40	762.30	749.10	306.00	112.00	112.00	2337.80	27.12
Kikar	No.	-	4879	2086	851	251	27	14	8108	41.78
	Vol.	-	731.85	1147.30	936.10	502.00	75.60	49.00	3441.85	39.93
Eucalyptus	No.	1361	2762	631	40	6	2	-	4802	24.74
	Vol.	68.05	414.30	347.05	44.00	12.00	5.60	-	891.00	10.34
[illegible]	No.	-	78	38	58	49	56	119	398	2.05
	Vol.	-	11.70	20.90	63.80	98.00	156.80	416.50	767.70	8.91
Miscl.	No.	-	827	552	280	89	34	49	1831	9.44
	Vol.	-	124.05	303.60	308.00	178.00	95.20	171.50	1180.35	13.70
Total:-	No.	1361	10522	4693	1910	548	159	214	19407	100
	%	7.02	54.22	24.18	9.84	2.82	0.82	1.10	100	
	Vol.	68.05	1578.30	2581.15	2101.00	1096.00	445.20	749.00	8618.70	100
	%	0.7[illegible]	18.31	29.95	24.38	12.72	5.16	8.69	100	

Source: [illegible] of Forest Ropar + Division.

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Table No. 5.2.5

Distribution of total stems and volume by species and diameter classes in strip forests.

Stratum : Un-regulated working circle. District : Ropar

(diameter in cms) Area : 224.36 ha.

Species	No/Vol	Diameter classwise number of stems and volume in m^3								
		10-19	20-29	30-39	40-49	50-59	60-69	70+	Total	%
Shisham	No.	-	1653	1322	618	190	65	00	3914	51.96
	Vol.	-	247.95	727.10	679.80	392.00	182.00	210.00	2438.85	52.19
Kikar	No.	-	451	234	135	43	5	2	870	11.55
	Vol.	-	67.65	128.70	148.50	86.00	14.00	7.00	451.85	9.67
Eucalyptus	No.	263	759	114	15	1	-	-	1152	15.29
	Vol.	13.15	113.85	62.70	16.50	2.00	-	-	208.20	4.46
Fruit	No.	-	141	119	60	64	43	96	523	6.94
	Vol.	-	21.15	65.45	66.00	128.00	120.10	336.00	736.70	15.77
Misc.	No.	-	466	293	153	70	33	59	1074	14.26
	Vol.	-	69.90	161.15	168.30	140.00	92.40	205.50	837.25	17.91
Total:-	No.	263	3470	2082	981	374	146	217	7533	100
	%	3.49	46.06	27.64	13.02	4.97	1.94	2.88	100	
	Vol.	13.15	520.50	1145.10	1079.10	748.00	408.50	758.50	4672.85	100
	%	0.28	11.14	24.51	23.09	16.01	8.74	16.23	100	

Source : Working pl. of I. Forest Division

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Table No.5.2.6

Distribution of total stems and volume by species and diameter classes in strip forests

Stratum: Eucalyptus Working Circle

District: Hoshiarpur

Area : 548.99 ha

Species	No./ Vol.	10-19	20-29	30-39	40-49	50-59	60-69	70+	Total	%
Shisham	No.	2109	3420	2979	1267	447	323	449	10994	16.58
	Vol.	105.45	513.00	1638.45	1393.70	894.00	904.40	1571.50	7020.50	27.99
Kikar	No.	672	779	413	116	46	10	7	2043	3.08
	Vol.	33.60	116.85	227.15	127.60	92.00	28.00	24.50	649.70	2.59
Eucalyptus	No.	11863	21760	12291	2449	334	58	25	48780	73.55
	Vol.	593.15	3264.00	6706.05	2693.90	668.00	162.40	87.50	14229.00	56.73
Frait	No.	51	102	134	91	103	134	360	[illegible]	[illegible]
	Vol.	2.55	15.45	73.70	100.10	206.00	375.20	1231.00	2054.00	8.19
Misc.	No.	1680	1042	457	176	85	25	50	3524	5.31
	Vol.	84.00	156.30	251.35	193.60	170.00	70.00	190.00	1127.25	4.50
Total	No.	16375	27103	16274	4099	1018	550	903	66323	100
	%	24.69	40.87	24.54	6.18	1.53	0.83	1.36	100	
	Vol.	818.75	4065.60	8950.70	4508.9	2030.00	1540.60	3100.50	25000.45	100
	%	3.2	16.21	35.68	17.98	8.12	6.14	12.60	100	

Source: Extracts fr[illegible]

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Table No.5.2.7

Distribution of total stems and volume by species and diameter classes in strip forests.

Stratum: Shisham Working Circle

District : Hoshiarpur

Area : 1041.67 ha

Species	No. Vol.	10-19	20-29	30-39	40-49	50-59	60-69	70+	Total	%
Shisham	No.	3987	9050	16905	12194	3947	1674	1677	49434	72.55
	Vol.	199.35	1357.50	9297.75	13413.40	7894.00	4087.20	5869.50	42718.70	70.92
Kikar	No.	1119	957	1235	838	408	120	47	4725	6.93
	Vol.	55.95	142.55	679.80	921.80	816.00	336.00	164.50	3117.60	5.62
Eucalyptus	No.	1790	2459	1396	476	115	19	9	6266	9.20
	Vol.	89.50	368.85	767.80	525.80	230.00	53.20	31.50	2066.65	3.72
Fruit	No.	85	167	201	221	184	240	692	1890	2.64
	Vol.	4.25	25.05	110.55	254.10	368.00	672.00	2422.00	3855.95	6.94
Misc.	No.	1400	2081	1110	560	266	139	55	5617	8.69
	Vol.	70.00	312.15	613.80	616.00	532.00	389.20	124.50	3775.65	6.80
Total	No.	[illegible]	14714	20854	14301	4920	2192	2780	68162	100
		[illegible]	[illegible]	[illegible]	[illegible]	7.2[illegible]	3.[illegible]	4.[illegible]	100	
	Vol.	[illegible]	2207.[illegible]	11460.7[illegible]	15731.1	46.[illegible]	6117.[illegible]	[illegible]	55534.5[illegible]	
		[illegible]	3.[illegible]	[illegible]	28.3[illegible]	17.[illegible]	11.[illegible]	17.52	1[illegible]	

[illegible] from [illegible] Hoshiarpur [illegible] Circle

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Table No. 5.2.8

Distribution of total stems and volume by species and diameter classes in strip forests

Stratum: Kikar working Circle. District: Hoshiarpur

Area : 317.49 ha

Species	No. Vol.	10-19	20-29	30-39	40-49	50-59	60-69	70+	Total	%
Shisham	No.	482	878	582	362	141	65	57	2567	10.53
	Vol.	24.10	131.70	320.30	398.20	282.00	182.00	199.50	1537.60	25.10
Kikar	No.	6095	8492	2662	376	85	14	-	17724	72.72
	Vol.	304.75	1273.80	1464.10	413.60	170.00	39.20	-	3665.45	59.83
Eucaly-ptus	No.	936	1559	488	51	1	-	-	3035	12.45
	Vol.	46.80	233.85	268.40	56.10	2.0	-	-	607.15	9.91
Fruit	No.	1	23	11	7	6	4	11	63	0.26
	Vol.	0.05	3.41	6.05	7.70	12.00	11.20	38.50	78.95	1.29
Misc.	No.	577	224	125	30	5	6	1	5	4.[illegible]
	Vol.	28.85	33.60	68.75	40.70	10.00	15.80	38.50	237.20	3.87
Total	No.	8[illegible]	11176	[illegible]	[illegible]	2[illegible]	89	79	24374	100
	[illegible]	[illegible]	45.85	15.85	3.42	[illegible]	0.36	0.32	100	
	[illegible]	[illegible]	[illegible]	2127.[illegible]	[illegible]	[illegible]	[illegible]	27[illegible]	6126.[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.07	4.[illegible]	100	1[illegible]

Source: [illegible] Forest [illegible]

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Table No. 5.2.9

Distribution of total stems and volume by species and diameter classes in strip forests

Stratum: Un-regulated Working Circle. District: Hoshiarpur

Area : 176.76 ha

Species	No. Vol.	10-19	20-29	30-39	40-49	50-59	60-69	70+	Total	%
Shisham	No.	162	1099	1029	613	347	276	391	3917	41.30
	Vol.	8.10	164.85	565.95	674.30	694.00	772.60	1368.50	4248.50	37.62
Kikar	No.	26	85	114	86	34	13	4	362	3.82
	Vol.	1.30	12.75	62.70	94.60	68.00	36.40	14.00	289.75	2.57
Eucalyptus	No.	396	899	283	83	25	8	3	1697	17.89
	Vol.	19.80	134.85	155.65	91.30	50.00	22.40	10.50	484.50	4.29
Fruit	No.	41	144	149	193	248	311	932	2018	21.28
	Vol.	2.05	21.60	81.95	212.30	496.00	870.80	3262.00	4946.70	43.81
Misc.	No.	227	527	271	162	79	53	171	1490	15.71
	Vol.	11.35	79.05	149.05	178.20	158.00	148.40	599.50	1322.55	11.71
Total	No.	852	2754	1846	1137	733	661	1501	9484	100
	%	8.98	29.04	19.46	11.99	7.73	6.97	15.83	100	
	Vol.	42.60	413.10	1015.30	1250.70	1466.00	1850.80	5253.50	11292.00	
	%	0.38	3.66	8.99	11.08	12.98	16.39	46.52	100	100

Source: Extracts from Working Plan of Hoshiarpur and Garhshankar Forest Divisions.

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Table No. 5.2.10

Distribution of total stems and volume by species and diameter classes in strip forests.

Stratum : Eucalyptus working circle

District : Gurdaspur

Area : 1875.40 ha.

(diameter in cms)

Species	No/Vol.	Diameter classwise number of stems and volume in m^3								
		10-19	20-29	30-39	40-49	50-59	60-69	70+	Total	%
Shisham	No.	357	7498	5505	1973	849	626	892	17700	14.67
	Vol.	28.56	2999.20	4624.20	2860.85	1884.78	1978.16	3799.92	18175.67	34.96
Kikar	No.	1963	589	298	156	60	23	35	3124	2.59
	Vol.	157.04	235.60	250.32	226.20	133.20	72.68	149.10	1224.14	2.35
Eucalyptus	No.	57992	26984	4392	384	55	25	32	89864	74.48
	Vol.	6379.12	10253.92	3513.60	614.40	159.50	103.75	163.20	21187.49	40.76
Fruit	No.	68	654	595	406	331	212	617	2883	2.39
	Vol.	5.44	621.60	499.80	588.70	734.82	669.92	2628.42	5748.70	11.06
Misc.	No.	1940	2274	1527	583	303	151	309	7087	5.87
	Vol.	155.20	909.60	1276.68	845.35	672.66	477.16	1316.34	5652.99	10.87
Total:-	No.	62320	37999	12317	3502	1598	1037	1885	120658	100.0
	%	51.65	31.49	10.21	2.90	1.33	0.86	1.56	100	
	Vol.	6725.36	15019.92	10164.60	5135.50	3584.96	3301.67	8056.98	51988.99	100.0
	%	12.94	28.88	19.55	9.88	6.90	6.35	15.50	100	

Source : Working plan of Gurdaspur Forest Division.

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Table No. 5.2.11

Distribution of total stems and volume by species and diameter classes in strip forests.

Stratum : Shisham working circle. District : Gurdaspur

(diameter ib cms) Area : 1722.53 ha.

Species	No/vol.	Diameter classwise number of stems and volume in m^3								
		10-19	20-29	30-39	40-49	50-59	60-69	70+	Total	%
Shisham	No	2089	35751	26264	7475	2189	949	960	75677	81.11
	Vol.	167.12	14300.40	22061.76	10812.65	4858.58	2998.84	4089.60	59289.95	79.89
Kikar	No.	1275	975	779	240	68	13	15	3365	3.61
	Vol.	102.00	390.00	654.36	348.00	150.96	41.08	63.90	1750.30	2.36
Eucalyptus	No.	1010	1252	1083	171	19	6	4	3551	3.81
	Vol.	111.76	475.76	866.40	273.60	55.10	24.90	20.40	1827.92	2.46
Fruit	No.	74	543	451	265	204	211	596	2344	2.51
	Vol.	5.92	217.20	378.84	384.25	452.88	666.76	2538.96	4644.81	6.26
Misc.	No.	451	4062	2508	761	241	143	199	8365	8.96
	Vol.	36.08	1624.80	2106.72	1103.45	535.02	451.88	847.76	6705.71	9.03
Total:-	No.	4905	42583	31085	8912	2721	1322	1774	93302	100.0
	%	5.26	45.64	33.31	9.55	2.92	1.42	1.90	100	
	Vol.	422.88	17008.16	26068.08	12921.95	6053.54	4183.46	7560.62	74218.69	100.0
	%	0.57	22.92	35.12	17.40	8.16	5.64	10.19	100	

Source : Working plan of Gurdaspur Forest Division.

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Table No. 5.2.12

Distribution of total stems and volume by species and diameter classes in strip forests

Stratum : Kikar working circle. District : Gurdaspur

(diameter in cms) Area : 2986.81 ha.

Species	No/Vol	Diameter classwise number of stems and volume in m^3								
		10-19	20-29	30-39	40-49	50-59	60-69	70+	Total	%
Shisham	No.	203	2772	3205	1045	436	270	495	8426	26.14
	Vol.	16.24	1108.80	2692.20	1515.25	967.92	853.20	2108.70	9262.31	47.26
Kikar	No.	10647	4754	1710	931	339	86	20	18487	57.35
	Vol.	851.76	1901.60	1436.40	1349.95	752.50	271.76	85.20	6649.17	33.93
Eucalyptus	No.	939	1550	241	37	8	-	1	2776	8.61
	Vol.	103.29	589.00	192.80	59.20	23.20	-	5.10	972.59	4.96
Fruit	No.	54	114	87	47	22	14	112	450	1.40
		4.32	45.60	73.00	68.15	48.84	44.24	477.12	761.35	3.89
Misc.	No.	193	889	574	211	62	48	118	2095	6.50
	Vol.	15.44	355.60	483.00	305.95	137.72	151.68	502.60	1952.07	9.96
Total:-	No.	12036	10079	5817	2271	867	418	746	32234	100.0
	%	37.34	31.27	18.05	7.05	2.68	1.30	2.31	100	
	Vol.	991.05	4000.60	4877.48	3298.50	1930.18	1320.88	3178.80	19597.49	100
	%	5.06	20.41	24.89	16.83	9.85	6.74	16.22	100	

Source : Working plan of Gurdaspur Forest Division.

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Table No. 5.2.13

Distribution of total stems and volume by species and diameter classes in strip forests

Stratum : Un-regulated working circle. District : Gurdaspur

(diameter in cms) Area : 859.98 ha.

Species	No/Vol.	Diameter classwise number of stems and volume in m^3								
		10-19	20-29	30-39	40-49	50-59	60-69	70+	Total	%
Shisham	No.	1136	3414	2007	777	401	212	374	8321	53.16
	Vol.	90.88	1365.60	1685.88	1126.65	890.22	669.92	1593.24	7422.39	39.52
Kikar	No.	44	140	131	81	24	5	4	429	2.74
	Vol.	3.52	56.00	110.04	117.45	53.28	15.80	17.04	373.13	1.99
Eucalyptus	No.	102	484	208	51	10	6	55	916	5.85
	Vol.	11.22	183.92	166.40	82.10	29.00	24.90	280.50	778.04	4.14
Fruit	No.	39	198	274	299	225	174	814	2023	12.93
	Vol.	3.12	79.20	230.16	433.55	499.50	549.84	3467.64	5263.01	28.03
Misc.	No.	84	951	1279	937	339	183	186	3959	25.30
	Vol.	6.72	380.40	1074.36	1358.65	752.58	578.28	792.36	4943.35	26.32
Total:-	No.	1405	5187	3899	2145	999	580	1433	15648	100
	%	8.98	33.15	24.92	13.71	6.38	3.71	9.15	100	
	Vol.	115.46	2065.12	3266.84	3118.40	2224.58	1838.74	6150.78	18779.92	100
	%	0.61	11.00	17.40	16.60	11.85	9.79	32.75	100	

Source : Working plan of Gurdaspur Forest Division.

Contents

Table No. 5.2.14

Statement showing No. of stems and volume (m^3) by species of strip forests in Ambala, Ropar, Hoshiarpur and Gurdaspur Districts

Sl. No.	Species		Haryana Zone Ambala	%	Punjab Zone Ropar	Hoshiarpur	Gurdaspur	Total of 6+7+8	%	Grand Total	%
1	2	3	4	5	6	7	8	9	10	11	12
1.	Shisham	No.	110105	22.45	41065	66912	110124	218101	38.83	328206	31.19
		Vol.	55458.12	41.60	26966.40	55525.30	94150.32	176642.02	55.20	232100.14	51.20
2.	Kikar	No.	155876	31.78	17285	24954	25405	67544	12.02	223420	21.23
		Vol.	22557.92	16.92	8052.15	7722.50	9996.74	25771.39	8.06	48329.31	10.66
3.	Eucalyptus	No.	163665	33.37	60493	59773	97107	217383	38.70	381048	36.22
		Vol.	32935.95	24.70	10488.85	17387.30	24766.04	52642.19	16.45	85578.14	18.88
4.	Fruit trees	No.	1803	0.37	3176	4863	7700	15739	2.80	17542	1.67
		Vol.	2730.34	2.05	4564.20	10935.60	16417.87	31917.67	9.97	34648.01	7.64
5.	Miscellaneous	No.	58962	12.03	9544	11916	21506	42966	7.65	101928	9.69
		Vol.	19631.01	14.73	7306.30	6462.65	19254.12	33023.07	10.32	52654.08	11.62
	Total	No.	490411	100	131568	168323	261842	561733	100	1052144	100
		Vol.	133313.34	100	57377.90	98033.35	164585.09	319996.34	100	453309.68	100
	Volume per tree		0.272		0.436	0.582	0.629	0.570		0.431	

Contents

APPENDIX -I

Year of Survey and publication of Survey of India topo sheets used for forest inventory in Shiwalik region of Punjab & Haryana

Sl.No. 1	Map sheet No. 2	Year of survey 3	Year of publication 4
1	43 L/16	1910-58	1975
2	43 P/4	1965-66	1973
3	43 P/7	1966-67	1975
4	43 P/8	1972-73	1978
5	43 P/11	1967-68	1977
6	43 P/12	1967-69	1973
7	43 P/14	1962-63	1975
8	43 P/15	1956-57	1976
9	43 P/16	1956-57	1969
10	44 I/13	1956-57	1978
11	44 M/1	1970-72	1977
12	44 M/2	1971-72	1977
13	44 M/5	1971-72	1977
14	44 M/6	1971-72	1977
15	44 M/9	1967-68	1968
16	44 M/10	1957-58	1961
17	44 M/11	1957-58	1961
18	44 M/13	1956-57	1961
19	44 M/14	1957-58	1963
20	44 M/15	1957-58	1960
21	53 A/2	1964-65	1974
22	53 A/3	1964-65	1967
23	53 A/4	1964-65	1973
24	53 A/7	1964-65	1974
25	53 A/8	1964-65	1968
26	53 A/11	1964-65	1974
27	53 A/12	1964-65	1970
28	53 B/5	1964-65	1970
29	53 B/6	1964-65	1969

Contents

1	2	3	4
30	53 B/9	1964-65	1970
31	53 B/10	1964-65	1975
32	53 B/11	1965-66	1969
33	53 B/12	1965-66	1969
34	53 B/13	1967-68	1968
35	53 B/14	1967-68	1971
36	53 B/15	1965-66	1974
37	53 B/16	1965-66	1967
38	53 F/1	1965-66	1968
39	53 F/2	1965-66	1968
40	53 F/3	1965-66	1970
41	53 F/4	1965-66	1970
42	53 F/7	1965-66	1969
43	53 F/8	1965-66	1970
44	53 F/11	1965-66	1969
45	53 F/12	1965-66	1967

Contents

APPENDIX II

LOCATION OF CENTRE OF SAMPLE PLOTS VISITED FOR FOREST INVENTORY

STATE : HARYANA

District : AMBALA

Map sheet covering : 53 B/13,14

53 F/1,2,3,7,8,11

S. No.	Longitude Latitude of plot centre			E N	Forest Division code	Land use code	Forest type code	No. of trees enumerated in sample plot of 0.1 ha.	Volume (m^3) in sample plot of 0.1 ha.
	Degree	Minutes	Seconds						
	1				2	3	4	5	6
					Map sheet No. 53 B/13				
1	76	50	55	EL	01	03	17	001	0.03
	30	46	28	NL					
2	76	51	37	EL	01	02	20	013	1.04
	30	45	58	NL					
3	76	57	38	EL	01	02	17	032	1.48
	30	46	04	NL					
4	76	51	31	EL	01	02	20	023	1.315
	30	49	43	NL					
5	76	49	47	EL	01	03	17	008	0.35
	30	50	30	NL					
6	76	50	25	EL	01	03	17	003	0.23
	30	51	31	NL					
7	76	46	35	EL	01	03	17	001	0.05
	30	54	04	NL					
8	76	47	56	EL	01	03	17	005	0.27
	30	53	25	NL					
9	76	55	16	EL	01	03	20	008	0.60
	30	53	06	NL					
					Map sheet No. 53 B/14				
10	76	54	40	EL	01	03	17	008	0.430
	30	42	07	NL					
11	76	55	41	EL	01	03	20	008	0.475
	30	41	52	NL					
12	76	57	02	EL	01	03	20	000	000
	30	43	46	NL					
13	76	55	29	EL	01	03	20	013	0.911
	30	43	43	NL					

Contents

1				2	3	4	5	6
					Map sheet No.53 F/1			
14	77 30	00 32 47 19	EL NL	01	03	20	007	0.365
15					Map sheet No. 53 F/2			
15	77 30	08 09 34 32	EL NL	01	03	20	011	0.572
16	77 30	05 07 36 20	EL NL	01	03	17	001	0.05
17	77 30	09 58 37 22	EL NL	01	03	20	005	0.74
18	77 30	07 29 35 10	EL NL	01	03	17	012	0.587
19	77 30	02 16 37 59	EL NL	01	04	-	-	-
20	77 30	04 19 37 38	EL NL	01	03	17	012	0.58
21	77 30	03 12 39 49	EL NL	01	02	20	032	3.810
22	77 30	05 29 39 42	EL NL	01	02	08	019	4.350
23	77 30	07 04 37 45	EL NL	01	03	20	000	000
24	77 30	08 33 38 52	EL NL	01	13	-	-	-
25	77 30	09 00 38 38	EL NL	01	02	20	019	2.340
26	77 30	00 54 40 59	EL NL	01	03	17	001	0.225
27	77 30	04 21 41 28	EL NL	01	03	20	015	2.365
28	77 30	03 09 41 01	EL NL	01	03	20	011	0.665
29	77 30	05 26 40 41	EL NL	01	03	20	017	1.740
30	77 30	07 07 41 51	EL NL	01	02	20	027	2.475
31	77 30	07 38 40 44	EL NL	01	03	08	011	0.630
32	77 30	00 18 37 59	EL NL	01	03	20	004	0.160

Contents

					Map sheet No. 53 F/2 (contd)				
33	77	04	11	EL	01	03	20	017	1.160
	30	42	56	NL					
34	77	05	26	EL	01	03	20	003	0.220
	30	43	35	NL					
					Map sheet No. 53 F/3				
35	77	14	17	EL	01	03	20	001	0.16
	30	25	02	NL					
36	77	14	49	EL	01	03	20	020	1.237
	30	28	29	NL					
					Map sheet No. 53 F/7				
37	77	25	38	EL	02	02	11	027	10.540
	30	51	53	NL					
38	77	28	16	EL	02	03	11	000	000
	30	22	27	NL					
39	77	22	59	EL	02	04	-	-	-
	30	24	03	NL					
40	77	25	40	EL	02	04	-	-	-
	30	23	02	NL					
41	77	28	54	EL	02	03	20	006	0.331
	30	22	47	NL					
42	77	21	33	EL	02	04	-	-	-
	30	26	35	NL					
43	77	22	31	EL	02	03	20	012	0.760
	30	26	23	NL					
44	77	27	14	EL	02	03	11	000	000
	30	25	51	NL					
45	77	27	29	EL	02	04	-	-	-
	30	26	44	NL					
					Map sheet No. 53 F/8				
46	77	25	14	EL	02	12	-	-	-
	30	12	51	NL					
					Map sheet No. 53 F/11				
47	77	33	14	EL	02	02	20	024	1.812
	30	19	07	NL					
48	77	31	12	EL	02	03	20	027	2.027
	30	20	56	NL					
49	77	31	19	EL	02	03	20	014	1.295
	30	31	33	NL					
50	77	34	41	EL	02	02	11	023	5.990
	30	20	44	NL					
51	77	32	49	EL	02	03	20	011	1.385
	30	21	46	NL					

Contents

Map sheet No. 53 F/11 (contd)

52	77	32	20	EL	02	01	11	027	14.610
	30	22	32	NL					
53	77	30	12	EL	02	02	11	056	12.030
	30	24	58	NL					
54	77	31	08	EL	02	02	11	021	13.140
	30	25	55	NL					
55	77	31	22	EL	02	01	11	038	13.730
	30	26	35	NL					

Total sample plots = 55

Contents

LOCATION OF CENTRE OF SAMPLE PLOTS VISITED FOR FOREST INVENTORY

STATE : PUNJAB

District : ROPAR

Map sheet coverage : 53 A/7,8,12
53 B/9,13

S. No.	Longitude E / Latitude N of plot centre: Degree	Minitus	Seconds		Forest Division code	Land use code	Forest type code	No. of trees enumerated in sample plot of 0.1 ha.	Volume (m^3) in sample plot of 0.1 ha.
	1				2	3	4	5	6
					Map sheet 53 A/7				
1	76	24	43	EL	08	04	-	-	-
	31	20	58	NL					
2	76	23	29	EL	08	15	-	-	-
	31	23	08	NL					
					Map sheet No. 53 A/8				
3	76	26	34	EL	08	03	20	011	0.33
	31	04	27	NL					
4	76	26	23	EL	08	03	20	002	0.06
	31	07	11	NL					
5	76	26	07	EL	08	03	20	003	0.160
	31	05	21	NL					
6	76	22	42	EL	08	03	20	000	000
	31	11	35	NL					
7	76	22	03	EL	08	03	20	000	000
	31	12	51	NL					
					Map sheet No. 53 A/12				
8	76	31	52	EL	08	13	-	-	-
	31	13	45	NL					
					Map sheet No. 53 B/9				
9	76	43	57	EL	08	03	20	000	000
	30	51	24	NL					
10	76	43	24	EL	08	03	20	000	000
	30	54	49	NL					
11	76	44	06	EL	08	03	20	008	0.48
	30	52	39	NL					
12	76	40	57	EL	08	03	20	000	000
	30	56	13	NL					
13	76	44	35	EL	08	03	20	000	000
	30	55	38	NL					

Contents

1					2	3	4	5	6
					Map sheet No. 53 B/9 (contd)				
14	76	42	54	EL	08	03	20	000	000
	30	56	50	NL					
15	76	37	07	EL	08	13	-	-	-
	30	59	23	NL					
16	76	38	34	EL	08	03	20	000	000
	30	58	59	NL					
17	76	38	56	EL	08	03	20	000	000
	30	58	30	NL		Map Sheet No. 53 B/13.			
18	76	47	13	EL	08	04	-	-	-
	30	49	13	NL					
19	76	48	18	EL	08	03	17	014	0.59
	30	49	18	NL					
20	76	51	00	EL	08	07	20	002	0.09
	30	47	46	NL					
21	76	46	14	EL	08	04	-	-	—
	30	50	06	NL					
22	76	46	15	EL	08	03	20	005	0.25
	30	52	24	NL					
23	76	45	38	EL	08	03	20	011	0.675
	30	53	05	NL					

Total No. of sample plots = 23

Contents

LOCATION OF CENTRE OF SAMPLE PLOTS VISITED FOR FOREST INVENTORY

STATE : PUNJAB

District : HOSHIARPUR

Map sheet coverage : 44 M/9,13,14
53 A/2,3,8

S. No.	Longitude E / Latitude N of plot centre: Degree	Minitus	Seconds		Forest Division code	Land use code	Forest type code	No. of trees enumerated in sample plot of 0.1 ha.	Volume (m³) in sample plot of 0.1 ha.
	1				2	3	4	5	6
					Map sheet No. 44 M/9				
1	75	43	29	EL	06	13	-	-	-
	31	54	27	NL					
					Map sheet No. 44 M/13				
2	75	52	05	EL	06	02	20	015	0.650
	31	45	42	NL					
3	75	54	14	EL	06	02	20	009	0.425
	31	46	54	NL					
4	75	53	14	EL	06	02	20	000	000
	31	45	34	NL					
5	75	55	22	EL	06	02	20	017	0.800
	31	46	12	NL					
6	75	57	01	EL	06	02	06	019	7.350
	31	46	15	NL					
7	75	49	22	EL	06	07	17	001	0.055
	31	49	16	NL					
8	75	50	34	EL	06	03	17	004	0.185
	31	49	06	NL					
9	75	51	54	EL	06	02	-	—	—
	31	48	24	NL					
10	75	53	21	EL	06	01	20	018	0.680
	31	48	51	NL					
11	75	54	11	EL	06	01	06	012	1.320
	31	48	42	NL					
12	75	55	46	EL	06	02	20	013	0.445
	31	49	01	NL					
13	75	49	44	EL	06	03	20	007	0.695
	31	51	37	NL					
14	75	51	48	EL	06	12	-	-	-
	31	52	10	NL					

Contents

1					2	3	4	5	6
					Map sheet No. 44 M/13 (contd)				
15	75	50	42	EL	06	03	17	003	0.150
	31	50	20	NL					
16	75	54	28	EL	06	04	-	-	-
	31	51	52	NL					
17	75	56	14	EL	06	13	-	-	-
	31	51	15	NL					
18	75	47	03	EL	06	01	20	007	0.670
	31	54	19	NL					
19	75	48	23	EL	06	01	20	033	3.352
	31	53	29	NL					
20	75	49	09	EL	06	13	-	-	-
	31	54	01	NL					
21	75	52	28	EL	06	04	-	-	-
	31	54	36	NL					
22	75	46	22	EL	06	03	20	004	0.250
	31	55	11	NL					
23	75	51	03	EL	06	03	20	002	0.967
	31	56	15	NL					
24	75	51	25	EL	06	03	20	003	0.675
	31	56	12	NL					
					Map sheet No. 44 M/14				
25	75	59	30	EL	06	01	17	006	0.210
	31	37	17	NL					
26	75	57	17	EL	06	02	20	021	1.045
	31	38	19	NL					
27	75	58	17	EL	06	02	17	020	1.190
	31	39	01	NL					
28	75	59	13	EL	06	03	17	003	0.150
	31	38	29	NL					
29	75	53	57	EL	06	03	20	003	0.09
	31	42	15	NL					
30	75	57	00	EL	06	02	-	—	—
	31	40	54	NL					
31	75	55	30	EL	06	02	20	000	000
	31	41	38	NL					
32	75	59	48	EL	06	02	08	013	1.130
	31	41	05	NL					
33	75	56	26	EL	06	01	06	026	4.280
	31	41	26	NL					
34	75	52	29	EL	06	01	20	000	000
	31	43	55	NL					
35	75	57	17	EL	06	02	06	026	2.705
	31	42	04	NL					
36	75	55	15	EL	06	02	06	014	6.545
	31	44	50	NL					

Contents

1					2	3	4	5	6
					Map sheet No. 44 M/14 (contd)				
37	75	53	06	EL	06	02	06	019	1.875
	31	43	29	NL					
					Map sheet No. 53 A/2				
38	76	04	26	EL	06	03	20	004	0.15
	31	31	49	NL					
39	76	05	25	EL	06	02	20	030	1.365
	31	31	49	NL					
40	76	01	12	EL	06	02	17	011	0.510
	31	33	37	NL					
41	76	01	27	EL	06	03	20	000	000
	31	33	52	NL					
42	76	03	09	EL	06	02	20	000	000
	31	33	13	NL					
43	76	01	12	EL	06	02	20	016	0.555
	31	35	55	NL					
44	76	01	17	EL	06	03	-	—	—
	31	36	36	NL					
45	76	02	44	EL	06	02	20	015	3.15
	31	35	52	NL					
46	76	00	06	EL	06	03	20	005	0.19
	31	38	13	NL					
					Map sheet No. 52 A/3				
47	76	11	49	EL	07	03	20	004	0.250
	31	16	21	NL					
48	76	11	53	EL	07	03	20	000	000
	31	17	34	NL					
49	76	10	36	EL	07	03	20	003	0.150
	31	19	55	NL					
50	76	08	28	EL	07	01	20	022	1.515
	31	24	52	NL					
51	76	07	14	EL	07	02	20	007	0.675
	31	26	32	NL					
52	76	08	36	EL	07	02	20	029	1.970
	31	26	05	NL					
53	76	06	57	EL	06	02	20	038	2.220
	31	29	32	NL					
					Map Sheet No. 53/8				
54	76	24	14	EL	07	03	20	009	0.405
	31	07	02	NL					
55	76	22	26	EL	07	03	20	011	1.065
	31	08	13	NL					
56	76	23	47	EL	07	03	17	010	0.500
	31	08	08	NL					

Contents

	1				2	3	4	5	6
				Map sheet No. 53/8					
57	76 31	19 10	51 46	EL	07	04	-	-	-
58	76 31	21 11	25 35	EL NL	07	03	20	000	0.000
59	76 31	21 10	02 56	EL NL	07	04	-	-	-
60	76 31	16 14	09 03	EL NL	07	03	20	005	0.615
61	76 31	20 14	25 37	EL NL	07	03	20	005	0.275

Total No. of sample plots =61

Contents

LOCATION OF CENTRE OF SAMPLE PLOTS VISITED FOR FOREST INVENTORY

STATE : PUNJAB

District : GURDASPUR

Map sheet coverage : 43 P/11,15

S. No.	Longitude E / Latitude N of plot centre: Degree	Minitus	Seconds		Forest Division code	Land use code	Forest type code	No. of trees enumerated in sample plot of 0.1 ha.	Volume (m^3) in sample plot of 0.1 ha.
					Map sheet No. 43 P/11				
1	75 32	42 20	56 50	EL NL	03	12	-	-	-
2	75 32	41 22	45 52	EL NL	03	03	20	001	0.03
3	75 32	44 25	52 15	EL NL	03	12	-	-	-
					Map sheet No. 43 P/15				
4	75 32	47 20	39 02	EL NL	02	04	-	-	-
5	75 32	49 22	52 23	EL NL	02	03	20	023	1.505
6	75 32	50 22	36 06	EL NL	02	03	20	006	0.230
7	75 32	46 24	50 36	EL NL	02	03	08	015	1.525
8	75 32	45 22	42 54	EL NL	03	03	20	010	0.325
9	75 32	49 22	33 58	EL NL	03	03	20	015	0.740
10	75 32	47 24	55 32	EL NL	02	03	20	000	000
11	75 32	51 23	03 35	EL NL	02	02	20	027	1.830
12	75 32	51 23	27 55	EL NL	02	13	-	-	-
13	75 32	52 24	38 50	EL NL	02	02	20	017	1.050
14	75 32	47 25	22 55	EL NL	02	13	-	-	-
15	75 32	45 26	06 37	EL NL	02	03	20	011	1.770

Contents

1					2	3	4	5	6
					Map sheet No. 43 P/15				
16	75 32	49 26	07 06	EL NL	02	12	-	-	-
17	75 32	48 26	21 26	EL NL	02	14	-	-	-
18	75 32	50 26	15 08	EL NL	02	03	20	006	0.685
19	75 32	52 26	13 23	EL NL	02	03	20	009	1.080
20	75 32	53 26	57 37	EL NL	02	03	20	007	0.625
21	75 32	53 25	29 50	EL NL	02	12	-	-	-
22	75 32	50 28	49 45	EL NL	02	13	-	-	-
23	75 32	51 28	39 45	EL NL	02	03	20	008	0.480

Total No. of sample plots	=	23
Total Haryana sample plots	=	55
Total Punjab sample plots	=	107
Grand total:-	=	162

Contents

Description of Codes for Forest Divisions i.e. Col.2 of appendix II.

State	Code	Name of Forest Division
Haryana	01	Morni - Pinjore
	02	Ambala
Punjab	02	Gurdaspur
	06	Hoshiarpur
	07	Garh Shankar
	08	Ropar

Contents

Description of codes for land use i.e. col. 3 of appendix II

Code	Item	Description
01	Dense tree forests	All lands with a forest cover of trees with canopy density 70% and above (canopy density is defined as the relative completeness of Canopy expressed as percentage taking closed Canopy as 100. Standing in a plot or in area around it observe the tree growth and assess the percentage of the space covered).
02	Moderately Dense-tree Forests.	All lands with a forest cover of trees. With Canopy density 30% to 69%.
03	Open tree Forests	All lands with a Forest cover of trees with Canopy density 5% to 29%
04	Scrub Forests	Inferior tree growth chiefly of small or stunted trees. With Canopy density less than 5%.
05	Bamboo brakes	Areas completely covered with Bamboo growth.
06	Shifting cultivation (Kumri)	Areas under current as well as last years shifting cultivation will come under this class. The agriculture crop may be standing or may have been harvested.
07	Young plantations of forestry species	This will include young plantations of forestry species in which average stems are above 10 cm. diameter at B.H. and the extent of such plantation is more than 0.5 ha. This will include Farm Forests, Social forestry plantations, Parts of coversion to uniform areas, plantations raised by Forest Development Corporation etc.
08	Trees in Line	This will include trees planted along canal banks, along road sides, along railway lines, wind brakes and shelter belts planted under various Social Forestry Schemes.
09	Forest roads etc.	This class will include areas under forest roads, depots, colonies, nurseries and such other forest land used in connection with forest administration.
10	Govt. Grass lands	This will include areas under natural or planted grass lands pastures etc. which are owned by Government.
11	Barren lands	This will include areas with exposed surfaces like rock sheets, sand dunes, swamps and areas without any vegetation.

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Code	Item	Description
12	Agricultural land without trees in surround	All lands under cultivation including fallow lands will come under this category. These lands will not have any tree growth along bunds or in their vicinity of 2 ha.
13	Agricultural land with trees in surround	This will include all lands under cultivation including fallow lands which are covered with trees along bunds and in their surround within 2 ha.
14	Non forestry plantations	All lands with tree growth planted primarily for purposes other than forestry such as Cashew, Coffee, gardens, parks, zoos, private grass lands etc.
15	Habitation	This will include village City sites, industrial area, grave yards, grounds, houses, Colonies etc.
16	Water bodies	Land under lakes, water courses etc.
17	Other lands	Lands which cannot be classed under any of the above categories.

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Description of codes for Forest type i.e. col. 4 of appendix II

Code	Crop composition (Forest type)	Description
01	Fir	When Fir constitute more than 50%
02	Spruce	Where Spruce constitute more than 50%
03	Fir-spruce	Where Fir & Spruce both taken together constitute more than 50%
04	Blue-pine (Kail)	Where Blue pine constitute more than 50%
05	Deodar	Where Deodar constitute more than 50%
06	Chir-pine	Where Chir-pine constitute more than 50%
07	Mixed conifers	Where all conifers taken together constitute more than 50%
08	Hardwoods mixed with conifers or Conifers mixed with hardwoods	Where the conifers & broad leaved species occur in more or less in same propositions.
09	Up-land hardwoods	Broad leaved species constitute more than 50% in the Upper Chir zone above 1500 metre altitude.
10	Teak-	Where Teak constitute more than 20%
11	Sal	Where Sal constitute more than 20% (If Sal and Teak are both more than 20% preference to be given to teak)
12	Bamboo forest	Where the crop is of almost pure bamboo.
13	Mangrove	Mangrove forests.
14	Depterocarpus (Gurjan)	Where Gurjan constitute more than 50% in the top canopy.
15	Hollong Mekai Hollong (Depterocarpus macro carpus) Shorea assamica (Mekai)	Where Hollong and Mekai individual or both taken together constitute more than 50%.
16	Khasi pine	Where Khasi pine constitute more than 50%
17	Khair forest	Where Khair trees constitute more than 50%
18	Salai forest	Where Salai constitute more than 50%.
19	Alpine pastures	Alpine pastures.
20	Miscellaneous forest	Forest which could not be classified in any of the above classes.

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APPENDIX III

Field Forms

Contents

F. S. I.

Field Form 1

PLOT APPROACH FORM

1) Plot Approach Form must be filled in while the journey is in progress.
2) While recording date, it is essential to record month and year also.
3) If a plot is visited on more than one day, a separate form for each visit shall be filled up.

1. State and Code

2. Division and Code

3. District and Code

4. Map-sheet and Code

5. Grid Code

5. (a) Plot No.

6. Crew Leader (name)

7. Name of Camp

8. Time (hrs.) at which Left the camp

9. Distance covered by vehicle (km.)

10. Time taken in journey by vehicle — Hours — Minutes

11. Name of the place up to which journey was performed by vehicle (describe in brief)

12. Conspicuous features observed during the journey by vehicle (describe in brief)

13. Time at which started on foot

14. Direction and distance covered on foot up to the reference point (km.)

15. Conspicuous features observed during the journey on foot (describe in brief)

16. Time (hrs.) at which arrived at the reference point.

17. Description of the reference point (Describe in details)

18. Compass bearing from reference point to the plot approached for commencing survey (please give the Plot No. also) if any

19. Distance of the plot Centre from reference point (Mtr) .

Contents

20	Date and time at which arrived at the Plot	1st Plot*	2nd Plot*
21.	Time (hrs) of Leaving the Plot	1st Plot*	2nd Plot*
22	Time (hrs) at which returned to the Camp.		
23.	Compassing done by		
24.	Distance measured by		
25.	Plots laid out by		
26.	Tree Enumeration done by		
27.	Height measurements taken by		
28.	B T and other measurements taken by		
29.	Bamboo enumeration done by		
30.	Bamboo Weight taken by		
31.	References in the field written by		
32.	Remarks		

Dated :

Signature of the Crew Leader

Diagrams etc.

A

B

N B. *Strike out unwanted one.

Contents

PLOT DESCRIPTION FORM

Field Form 2

Job No.	Card design	Zone	State	District	Forest Division	Map Sheet No.	Grid No.	Plot No.	Legal Status	Land Use
1–3	4–5	6	7–8	9–10	11–12	13–18	19–22	23	24	25–26

Terrain Data						Soil Data							Crop Data												Bamboo Data															
General Topography	SLOPE	Position on Slope	Altitude	Aspect	Rockiness	Humus	Soil Colour	Soil Consistency	Soil Texture	Coarse Fragments	Soil Depth	Soil Erosion	Origin of Stand	Crop. Composition	Canopy Layer or Storey	Top Height	Size Class	Intensity of regeneration	Important Species under registration	Injuries to Crop	Fire Incidence	Grazing Incidence	Presence of weeds	Presence of Grass	Bamboo density	Bamboo quality	Bamboo Flowering	Bamboo regeneration	Plantation Potential	Distance to road	Distance to Mule Path	Distance to River/stream	Kacha road Distance	Pucca road Distance	River distance to market outlet	Obstacles	Plot Status	Status of Forest
27	28-30	31	32 35	36	37	38	39	40	41	42	43	44	45	46-47	48-49	50 51	52	53	54-56	57	58	59	60	61	62	63	64	65	66	67	68	69	70 71	72 74	75 76	77	78	79

Signature of Crew Leader

Dated

Name of Crew Leader

Contents

PLOT ENUMERATION FORM

Field Form No..3

Job No.	Card design	Map Sheet No.	Grid No.	Plot No.
1—3	4—5	6—11	12—15	16

Total No. of bamboo clums	Total No. of trees
71—73	74—76

Species		Species		Species		Species		Species		Species		Species		Species		Species	
Code	Dia	Code	Dia	Code	Dia	Code	Dia	Code	Dia	Code	Dia	Code	Dia	Code	Dia	Code	Dia
17-19	20-22	23-25	26-28	29-31	32-34	35-37	38-40	41-43	44-46	47-49	50-52	53-55	56-58	59-61	62-64	65-67	68-70

Date

Signature of Crew Leader

Name of Crew Leader

Contents

Field Form No. 4

SAMPLE TREE FORM

Job No.	Card design	Map Sheet No.	Grid No.	Plot N .
1—3	4—5	6—11	12—15	16

Total No. of trees
55—56

SPECIES	Tree Serial No.	Species Code	Dominance	DBH OB (cm)	DBT (mm)	Tree Height (m)	Clear Bole (m)	Condition	Form		SPECIES	Tree Serial No.	Species Code	Dominance	DBH OB (cm)	DBT (mm)	Tree Height (m)	Clear Bole (m)	Condition	Form	
									Longitudinal	Sectional										Longitudinal	Sectional
	17-18	19-21	22	23-25	26-28	29-30	31-32	33	34	35		36-37	38-40	41	42-44	45-47	48-49	50-51	52	53	54

Date .....

Signature of Crew Leader .....

Name of Crew Leader.....

Contents

Field Form 5

BAMBOO EMUNERATION AND CLUMP ANALYSIS FORM

Job No.	Grid Design	Map Sheet No.	Grid No Inter Sectional No	Plot No
1—3	4 - 5	6—11	12—15	16

Average culm height (in dcm)		Bamboo quality
Upto 1cm top dia 72—74	Upto 2cm top dia 75—77	78

Species	Species Code	Clump Serial No.	Clump diameter (in cms.)	Clump size class	Green sound culms							Green damaged culms							Dry sound culms			Dry damaged culms			Decayed culms	Total No. of culms
					Current year's	One to two seasons old			Over two seasons old			Current year's	One to two seasons old			Over two seasons old										
						2<5 Cms	5<8 Cms	8 + Cms	2<5 Cms	5<8 Cms	8 + Cms		2<5 Cms	5<8 Cms	8 + Cms	2<5 Cms	5<8 Cms	8 + Cms	2<5 Cms	5<8 Cms	8 + Cms	2<5 Cms	5<8 Cms	8 + Cms		
	17—19	20-22	23-25	26	27—28	29-30	31-32	33-34	35-36	37-38	39-40	41—42	43-44	45-46	47-48	49 50	51-52	53 54	55-56	57-58	59 60	61-62	63-64	65 66	67—68	69—71

Signature of Crew Leader

Name of Crew Leader

Contents

BAMBOO ENUMERATION FORM (NON CLUMP FORMING)

Field Form 6

Job No.	Card Design	Map Sheet No.	Grid No.	Plot No.
1–3	4–6	6–11	12–15	16

Species Code	Green sound culms							Green damaged culms							Dry sound culms			Dry damaged culms			Decayed culms	Average culms Ht. (in decimeter)	Total No. of culms
	Current year's	One to two years old			Over two years old			Current year's	One to two year old			Over two years old											
		2<5 Cms	5<8 Cms	8 + Cms	2<5 Cms	5<8 Cms	8 + Cms		2<5 Cms	5<8 Cms	8 + Cms	2<5 Cms	5<8 Cms	8 + Cms	2<5 Cms	5<8 Cms	8 + Cms	2<5 Cms	5<8 Cms	8 + Cms			
17–19	20–22	23-25	26-28	29-30	31-33	34-36	37-38	39-41	42-44	45-47	48-49	50-52	53-55	56-57	58-60	61-62	63-64	65-67	68-69	70-71	72-73	74-76	77-80

Date .....

Signature of the Crew Leader.....

Name of the Crew Leader .....

Contents

Field Form No. 7

BAMBOO WEIGHT FORM

Job Number	Card Design
1-3	4-5

Mapsheet Number	Grid No.	Plot Number
6-11	12-15	16

Species Code	Sample No.	Green Weight of culm															Green weight of sub-sample for co-relation with dry weight		
		DIAMETER CLASS																	
		2 to under 5 cm					5 to under 8 cm					8 cm and over							
		Diameter in cm	Total length in dmt	Utilizable length in dmt		Weight in Grams	Diameter in cm	Total length in dmt	Utilizable length in dmt		Weight in Grams	Diameter in cm	Total length in dmt.	Utilizable length in dmt		Weight in Grams	Sub-sample culm 2cm & under 5cm dia	Sub sample culm 5cm & under 8cm dia	Sub-sample culm 8cm and over
				Upto 1cm top dia	Upto 2cm top dia				Upto 1cm top dia	Upto 2cm top dia				Upto 1cm top dia	Upto 2cm top dia				
17 18 19	20	21 22	23 24 25	26 27 28	29 30 31	32 33 34 35 36	37 38	39 40 41	42 43 44	45 46 47	48 49 50 51 52	53 54	55 56 57	58 59 60	61 62 63	64 65 66 67 68	69 70 71 72	73 74 75 76	77 78 79 80

Date ....

Signature of Crew Leader..................

Name of Crew Leader..................

Contents

HERBS AND SHRUBS DATA FORM

Field Form No. 8

Map Sheet No.....

Grid No.....

Plot No.....

HERBS								SHRUBS									
Name of Species	Total No.	Characteristics			Occurrence		Colour of flower if observed	Name of Spp.	Total No.	Avr. Ht.	Pattern of Branching			Occurence		Information on flowers & Fruits	
		Erect	prostrate	Creeping	Gregarious	Sporadic					Opposite	Alternate	Whorling	Gregarious	Sporadic	Clour of Flowers	Size of fruit (Small med big)

Date.....

Signature of the Crew Leader.....

Name of the Crew Leader .....

Contents

Appendix IV

Extract from 'Forest Mensuration' by A.N. Chaturvedi & L.S. Khanna giving an illustration for development of volume tables using graphical method in respect of Deodar.

Derivation of local volume table from general volume table by graphical method - The general volume table gives volume of a tree by diameter and height classes. These are generally based on data of trees collected from a wide range of distribution. For using general volume table it is necessary to measure d.b.h. and height of individual trees. Local volume table is derived from a general volume table with the help of measurement of d.b.h. and height of some standing trees in the locality. The procedure of preparation of a local volume table from general volume table is as follows:

The figures of a general volume table are plotted on a graph paper showing volumes against the middle of diameter classes for each height class separately. Thus there will be the same number of curves as the number of height classes and in order to distinguish them, they should be given a number equivalent to the middle of the height class to which it pertains. For instance, the general volume table of deodar gives the following data for different height classes:

d.b.h. (cm)	Volume (m^3) Height (m)				
	17	23	29	35	41
15	0.030	0.068	0.106		
20	0.114	0.182	0.250		
25	0.222	0.329	0.435	0.541	
30	0.355	0.508	0.661	0.814	
35	0.512	0.720	0.929	1.137	1.345
40	0.692	0.965	1.237	1.509	1.782
45	0.897	1.242	1.586	1.931	2.276
50		1.552	1.977	2.403	2.228
55		1.894	2.409	2.924	3.438
60		2.269	2.882	3.494	4.107
65		2.677	3.396	4.115	4.834
70		3.117	3.951	4.785	5.619
75			4.547	5.504	6.462
80			5.185	6.274	7.363
85			5.863	7.092	8.322
90			6.583	7.961	9.339
95			7.343	8.879	10.415
100			8.145	9.847	11.549

Contents

Thus by plotting volumes of each height class against the middle of diameter class interval, 5 curves will be obtained and they will be numbered as 17 m, 23 m, 29 m, 35 m, and 41 m as shown in Fig.
Then the diameters and heights of a sufficiently large number of trees of the locality for which local volume table is to be prepared are accurately measured and recorded. Suppose the diameters and heights of these trees are:

Diameter (cm)	Height (m)
26	18
37	22
42	24
50	26
58	28
68	34
85	40
90	41

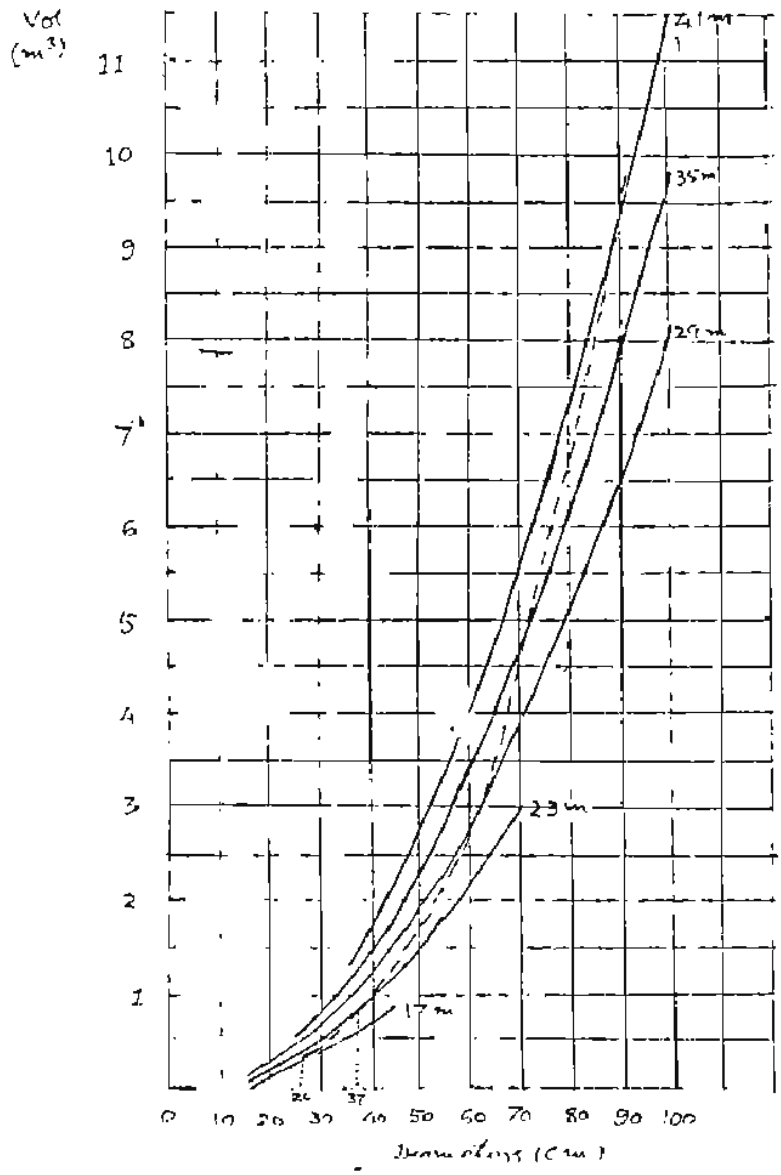

Fig. 1

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These diameter and height figures are then plotted on the same graph paper by taking the diameters along X axis and then interpolating the height against these diameters in between the height curves of general volume table. For example, the diameter of the first tree is 26 cm. After locating 26 cm mark on diameter axis, the same ordinate is followed up to locate 18 m by simple rule of proportion. The curves already drawn are for 17m and 23 m. The distance between the two on that ordinate is 2 mm. This distance represents a gap of 23 m - 17m = 6 m. Therefor 18m point should be $\frac{2}{6}$ mm above the 17 m curve. Then the diameter of the second tree is 37 cm. After locating 37 cm mark on diameter axis, the same ordinate is followed up to locate 22 m point for height. This point will also be between the 17 m and 23 m curves. The distance between the two curves on the 37 cm ordinate is 5 mm. This distance represents a gap of 23 m - 17 m = 6 m. Therefore by simple rule of proportion the 22 m mark point will be on that ordinate at $\frac{5 \times 5}{6}$ = 4.16 mm above the 17 m curve or just 0.84 mm below the 23 mm curve. Having plotted all points in this way, a smooth curve is drawn through these points. The curve so obtained is the desired local volume table curve and represents the local relationship between diameter and height. From this curve, volume may be read at the middle of diameter classes and tabulated to give diameter classes and volume. This table is then called local volume table. For instance, from the local volume table curve drawn in Fig. 1 the following volume table will be prepared:

Diameter (cm)	Volume (m^3)
30-40	0.65
40-50	1.30
50-60	2.25
60-70	3.55
70-80	5.75
80-90	8.10

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