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REPORT

ON

FOREST RESOURCES SURVEY

OF

SAMBALPUR DISTRICT

OF

ORISSA STATE

FOREST SURVEY OF INDIA
CENTRAL ZONE
NAGPUR

1996

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CHAPTER I

INTRODUCTION

1.Ø GENERAL

Sambalpur District is located in the North-West of Orissa State and infact, its North-Western boundary forms the State boundary with Madhya Pradesh. The District lies between 2Ø°34' and 22°11'North latitudes and 82°39' and 85°15'East longitudes. Sambalpur District is bounded in the North by Sundargarh District of Orissa and Raigarh District of Madhya Pradesh. On its east and south are Dhenkanal and Bolangir Districts of Orissa respectively and Raipur District of Madhya Pradesh, forms West and North West District and State boundary. The stretch of the district along the latitudes is more than double its breadth along the longitudes and has irregular shape. The District forms a part of catchment of two major rivers i.e. Mahanadi and Brahmni. The famous Hirakud dam is one of the longest in the country and was built in 1956 to harness the waters of the mighty Mahanadi river for irrigation, and is located in the District and has revolutionised the traditional agriculture. It has a huge gross capacity of 8,14,11Ø ha.metre (66ØØ ØØØ acre - feet). The District is rich in mineral wealth, producing in bulk quantities valuable minerals like coal and limestone. Fire clay, graphite, china clay etc. are also mined.

A Five Year Plan for taking up inventory work from 1991-92 onwards in the Central Zone was prepared by the Joint Director, Forest Survey of India in consultation with PCCFs of Orissa, Madhya Pradesh and Maharashtra. After discussions with the PCCF, Orissa and his officers, in March, 1991, it was decided to take up forest inventory work in Sambalpur District on priority. Accordingly, on conclusion of Forest Resources Survey of Lohit District of Aruanchal Pradesh in April, 1991, field crews were deployed in Sambapur District from May, 1991 for carrying out forest inventory work. The field work in the District was carried out in two working seasons: May, 1991 to June, 1991 and Nov; 1991 to March, 1992.

1.1 AREA AND POPULATION.

Geographical area of sambalpur District is 17516 km^2, out of the total area of 155707 km^2 of the State of Orissa, reckoning to 11.25%. The population of the District is 2 688 395, as against the total population of 31512070 of the State, accounting to 8.5% of the total population (1991 census). Thus it can be seen that as against the average density of 202.38 persons per km^2 of the State, Sambalpur District has a lesser density of population of 153.48 persons per km^2.

1.2 ADMINISTRATIVE UNITS.

The District administration located at Sambalpur administers and implements government policies through seven sub-divisions, with headquarters at Sadar, Jharsuguda, Baragarh, Padmapur, Kuchinada, Devgarh and Rairakhol. These sub-divisions are further subdivided in to 29 C.D. blocks. There are 15 Tahsils in the District . For maintenance of law and order, the District Superintendent of Police at Sambalpur has 44 Police stations in the District. There are 368 Gram Panchayats for a total number of 3436 inhabited villages and six municipalities for a total number of ten towns.

1.3 FOREST AREA.

The total forest area of Sambalpur District is 6201 km^2, reckoning to 35.40% of the geographical area of the District i.e. 17516 km^2. Total forest area of the State is 57183.57 km^2 and hence the District shares 10.84% of the forest area of the State.

The area figure of 6201 km^2 which has been adopted for this survey report is based on the area figures communicated by the office of the PCCF, Orissa. However, as per the legal classification, after deducting forest areas diverted for other uses, the latest area figures for 91-92 as provided by the C.F. Sambalpur are as below:

PREFACE

Forest Inventory of Sambalpur District of Orissa covering a geographical area of 17516 km^2 (11.25% of the State area) was undertaken by the Forest Survey of India,Central Zone, Nagpur between May, 1991 to March, 1992.

The District is endowed with a forest area of 62Ø1 km^2 reckoning to 35.4Ø% of the geographical area. According to classification of legal status of the forest area, Reserved Forests occupy 3362.221 km^2 while Declared Protected Forests extend over 717.83Ø km^2, Undeclared Protected Forests over 1498.68Ø km^2, Unclassed Forests being 1.761 km^2 and Village Forests sharing an area of 45Ø.ØØØ km^2. The District represents two main forest types viz; (i) 3C - North Indian Tropical Moist Deciduous Forests and (ii) 5B - Northern Tropical Dry Deciduous Forests. The Inventory results reveal 54.45% area under dense and moderately dense forests, 14.97% under open forests, Ø.25% scrub forests, 1.42% Bamboo brakes, Ø.25% shifting cultivation, 11.23% under Young Plantations, 2.33% under young crop, while non-forestry plantations, grass lands, cultivation, water bodies, habitation and inaccessible area occupy the balance.

The findings of the survey exhibit two definite forest strata i.e. Sal forests extending over 268Ø.43 km^2 constituting 51.22% and Miscellaneous forests occupying an area of 2552.41 km^2 constituting in all 48.78% of the forest crop. The total vegetated area of the District is 5232.84km^2.

The inventory results reveal a total growing stock of 31.91 million m^3 out of which Sal alone contributes 19.28 million m^3 while Miscellaneous forests contribute 12.63 million m^3. Bamboo is found in overlapping form alongwith tree vegetation which is estimated at 2ØØØ.32 km^2. The estimated green stock of bamboo in the survey area accounts for Ø.543 million MT corresponding to Ø.326 million MT of dry bamboo stock.

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Apart from Forest Inventory, a study on the trend of wood consumption in the District was also undertaken. The results of the Wood consumption study indicate an average consumption of 1.219 m^3 per capita for construction of house. For house construction miscellaneous timber is generally preferred. Per capita annual consumption of wood for furniture and agricultural implements was estimated at Ø.Ø35 m^3 and Ø.Ø41 m^3 respectively, while the annual per capita consumption of fuel wood was estimated to be 2731.45 kg.

The draft of the report was prepared by Shri S.B. Elkunchwar, IFS, Deputy Director under the guidance of Shri P.V. Savant, IFS, Joint Director, Forest Survey of India, Central Zone, Nagpur and with the help of Shri B.R. Pandey, S.T.A. and Shri J.N. Mishra, J.T.A. The data processing was done at the Headquarter under the guidance of Shri S.K. Chakravarty, Deputy Director.

The text part of the report has been typed by Smt. Gressamma Varghese, Jr.Steno and tables have been typed by Shri D.N.Kadu, Jr.Steno. The co-operation and services rendered by all those associated in the work is appreciated.

Sincere thanks are expressed to the officers and staff of Orissa Forest Department for their valuable co-operation extended to our field parties during the survey work.

I trust that the report gives a thorough insight to acquaint with the status of forests in the District covering important aspects and also throws light for improvement in the critical areas.

Dehradun
Date: 21.Ø8.1996

Dr. S.N.Rai
Director

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FOREST SURVEY OF INDIA
CENTRAL ZONE, NAGPUR

ACKNOWLEDGEMENT

This organisation expresses its gratitude and sincere thanks to Conservator of Forests, Deputy Conservator of Forests and their field staff who provided their valuable cooperation to the field parties of our organisation during the survey work without which it was not possible for them to complete the survey work in stipulated time.

(Devendra Kumar)
Joint Director

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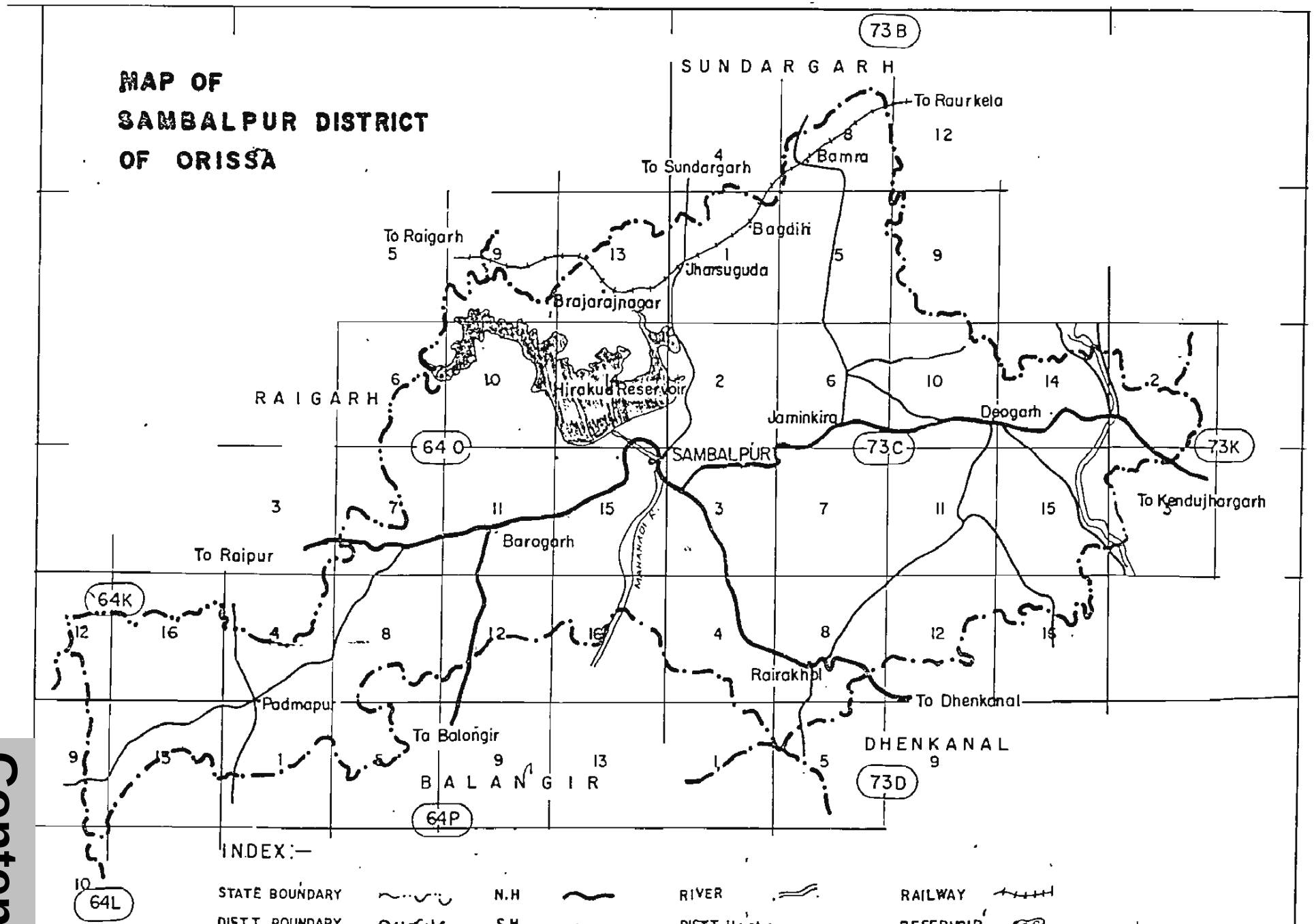
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TABLE NO 1.1

DIVISION WISE AND LEGAL STATUSWISE FOREST AREAS IN KM^2

Name of division	R.F	DPF	UPF	UCF	VF	Total
Sambalpur	1012.950	51.060	392.070	0.280	-	1456.360 (24.15%)
Rairakhol	1013.391	100.960	510.000	0.511	450.000	2074.862 (34.41%)
Deogarh	612.970	185.260	169.640	0.020	-	967.890 (16.05%)
Bamra	722.910	380.550	426.970	0.950	-	1531.380 (25.39%)
Total ..	3362.221	717.830	1498.680	1.761	450.000	6030.492

RF = Reserved Forests, DPF = Declared Proteoted Forests,
UPF= Undeclared Protected Forests, UCF = Unclassed Forests
VF = Village Forests

Thus it is seen that out of the four territorial Forest Divisions, Rairakhol has the maximum area of 2074.862 km^2, followed by Bamra - 1531.380 km^2 and Sambalpur 1456.360 km^2, while Devgarh Forest Division has the least area of 967.890 km^2.

There are three Wildlife Sanctuaries (WLS) in the District. Debrigarh WLS in Sambalpur Division occupies 346.90 km^2 area, Ushakothi WLS in Bamra Division is spread over 308.03 km^2 area and Khalasuni WLS encompasses 116.00 km^2 area.

1.4 CLIMATE AND RAINFALL.

Not considering local variations, the climate of Sambalpur Distriot is hot in the summer followed by rainy season, mainly from middle of June to middle of October and a distinct winter season from November to January. The average rainfall of Sambalpur District is 1545 mm having 70 rainy

days. The mean maximum temperature is 35.5°c and the mean minimum temperature is 22.5°c. However, during high summer in May the mercury crosses 42°c for some days. Winters are not very cold with the minimum being 14°c in December. Frost is usually absent.

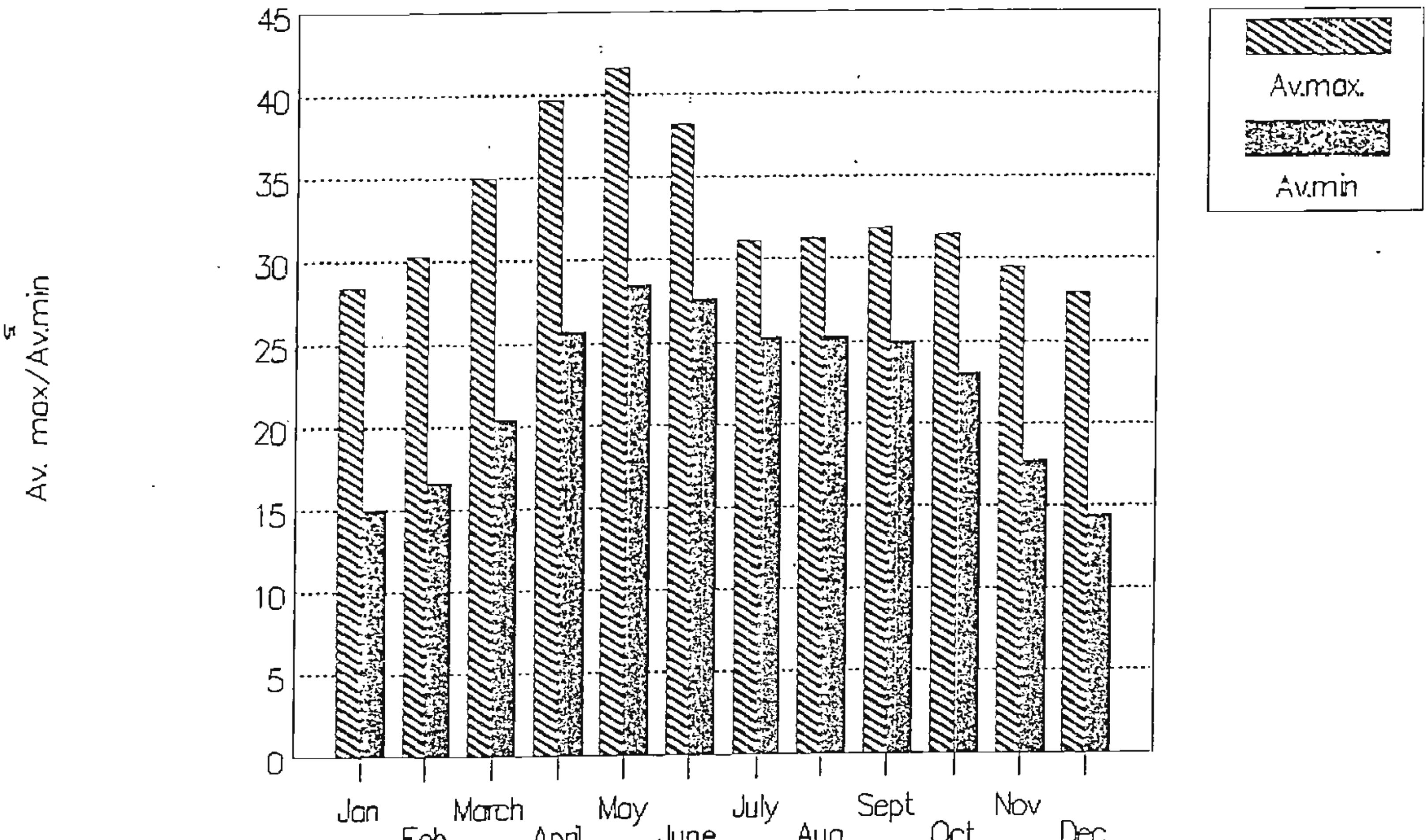
A bar diagram appended at page 5 & 6 depicts mean monthly variation of temperature and rainfall in Sambalpur, based on 1Ø-25 years.

(Source: Revised working plan for Sambalpur 197Ø-9Ø by SG Panda)

1.5 TOPOGRAPHY.

The topography of Sambalpur is predominantly extension of plains of Chhattisgarh. The river Mahanadi bifurcates the district into two major physical divisions viz; west of Mahanadi and east of Mahanadi. The eastern part of the district, in particular the area confined to the Deogarh Forest Division, forms the catchment of Brahmani River and its tributories. The famous Hirakud dam on the Mahanadi exists in the north of Sambalpur. The dam has played a major role in economic upliftment of the agrarian society of Sambalpur District. Mahanadi crosses the district from north to south by entering the border from west. The Mahanadi has its catchment over Bamra, Sambalpur and Rairakhol forest divisions.

In the western part of Mahanadi, important tahsils of Bargarh Padmapur and Attabira fall. The important tahsils on the eastern side of Mahanadi are Sambalpur, Jharsuguda, Kuchinada, Rairakhol and Deogarh. The plains of the District are gently sloping, thickly populated and extensively cultivated and almost devoid of forests. The plains extend upto Bamra in the north. The western and north western parts of the District are hilly. Entire areas of Bamra and Deogarh Forest Divisions are hilly and are interspersed with valleys. Khalasuni and Kansar blocks have a compact hill range in Rairakhol division; its physiography divided into three distinct zones by the river Tikira and National Highway going to Cuttuck.



DIA.SHOWING DISTRIBUTION OF TEMPERATURE

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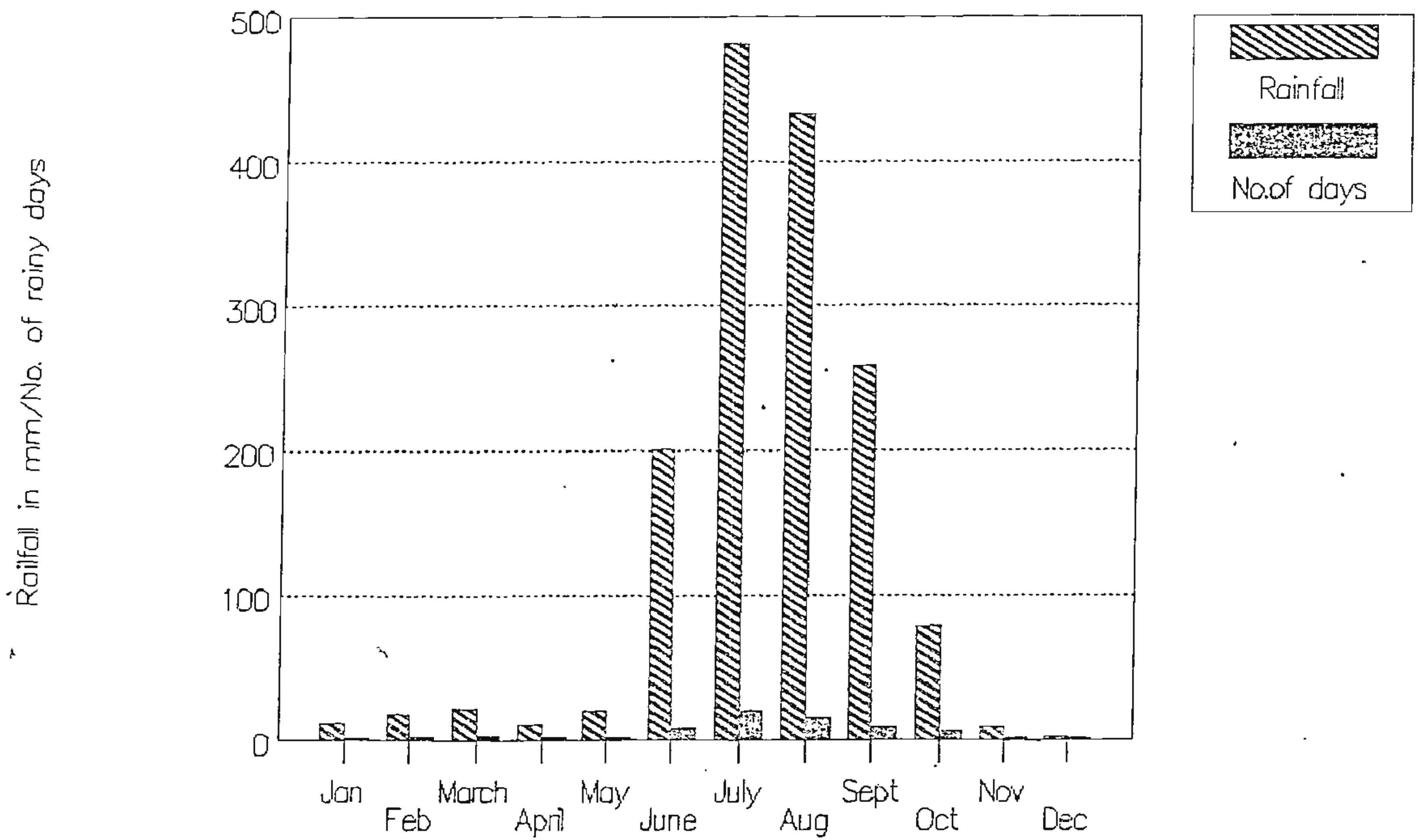

DIGRM. SHOWING DISTRIBUTION OF RAINFALL

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The height variation in the entire tract ranges from 368 m to 822 m above mean sea level.

1.6 DRAINAGE.

The catchments of Mahanadi and Brahmini rivers encompass the entire district. Mahanadi is the principal river flowing North to South for about 110 km, and carries immense volume during the monsoons, average width being 1 km. After rains the flow is regulated by the Hirkud dam. The river Bhrahmini also flows mightily during monsoons. The main tributory of Mahanadi is the Ib river which enters from Sundargarh District. The river Ong coming from Madhya Pradesh drains in Mahanadi near sonepur. North and north eastern parts drain into the river Bhrahmini through rivers Tikra and Aunhjor.

1.7 GEOLOGY AND ROCKS.

The geology and rock system prevailing in the District may be divided into Archaean, Cuddapah and lower Gondwana (Talcher series). The petrological sub-groups in their decreasing antiquity and with their extent are given below:

Petrological groups	Places of occurrence
A. Archaean	A. 1(a) and (b)
1. Granite group	Dumerduca - Mundher Jaduloisingh- Gunjghara
(a) Grey augengneiss with magnetite veins(rare)	Kendrapat, Bandher, Budharaja, Tabla,
(b) Granitoid gneiss, granular granite, granite with biotite.	Lachhmidongri and Bireingh Blocks.

2. Quartzite group :-	A. 2 (a)
(a) Quartzite and its variations quartz felspar schist and at places and traversed by quartz veins.	Hills in Kulcher, Moghpal, Kusamura, Charbahali and Parsalikhaman and Basiapara blocks, Baighara, Moulabhan and West Jharghatti - Garpatti, Desar and Motijharan blocks.
(b) Micaceous and hornblende schist and phylitic schists, pink schistose gneiss, sandy schists, granular quartzite, dolerite and Koalinised gneiss.	A. 2 (b) Plains of Kulcher, Kusamura Charbahali, Parsalikhaman, Basiapara and Sangramal Blocks. Chhamunda, Beheramal parts of Hatibari, Chichamura, Phulghar, G-Jarmal, Lamaljunan, Landungri, Adhapara and Ramenda blocks.
(c) Khondalite, amphibolite schistose and granulitic gneiss.	A.2 (c) Tabloi, Deogaon Larasara, Goinpura, East Jharghatti, Sunaridungri, Rampaluga and hills of Sangramal blocks.
(d) Rocks as in (b) but altered by contact metamorphism.	A 2 (d) : as in A 2 (b).
3. Granite - Quartzite group:-	A 3 (a) : Brahminidungri
(a) Quartzite, amphibolite and granitoid gneiss, quartz, granite and hypersthene gneiss.	and part of Hatibari blocks.
(b) Banded porphyritic gneiss.	A 3 (b): Labdera block.
Lower Gondwana (Talcher series) 1. Sandstone	1: Bhowarkhol block, Nimgir border of Belpahar.
B. Cuddapah formation	B1 : Throughout the plains

1. Red and purple rocks.		of Lakhanpur, Prakashpur.
2. Calcarious shales (with intercalation of lime stones)lime stones.		Ambabhona and Kanagaon.
	B2 :	Dungri, Dalipali and Loharabehara.
3.Gritty quartzite and slightly metamorphosed ferrogeneous sand stone.	B3 :	Dechua hills and Hulsari dungri.

Most of the district in east and north are covered by Archaean rocks. However, Cuddapah formation is also seen in Barapahar and south of Mahanadi river. Lower Gondwana is found in isolated patches in Thowari khol block in the north of the District bordering Sundergarh.

1.8 SOILS.

Soils form the basic support system to the forest resources. Variety, health, luxuriance and productivity of the forest resources largely depend upon the type of soils available in the tract. Sambalpur is characterised by the three main rock systems viz; Archaean, Cuddapah and Lower Gondwana. Accordingly, soil formations also vary at places and are characterised by their parent rock systems and metamorphic changes. The chief type of soil is derived out of Archaean group followed by Cuddapah formation and lower Gondwana in descending order of their occurrence.

The Archaean rocks with sub-group of granite, quartzite and combination of the two have given rise to coarse sandy soils. They change frequently to calcarious loams. On the hill slopes generally the soils are shallow with little sub-soil but in the valleys these are deep and fertile. In small valleys they are neither deep nor fertile and on the lower hill slopes the soils are deep but with light texture and are unfertile. Mixed deciduous forests generally with high percentage of bamboos in the vegetation cover are found standing on such soils. The quartzite metamorphosed rocks

turn into reddish sandy loam to clayey loam, usually rich in iron and alumina. These types of soils occur in the east and north of Mahanadi river. Forest reserves on such soils are composed of mainly Sal crop with scattered teak. Bamboo also occurs sporadically on such soils. The granite and quartzite together have given rise to sedimentary coarse textured soils. These soils are more sandy and less clayey and tend to lower the average fertility of the soils. The forest supported on such soils consists of sal (Shorea robusta) quality III and IV. Often on drier slopes the crop turns into mixed forests. The areas covered under such soils are spread over hills in Kulcher, Moghpal to West Jharghatti - Garpatti and Motijharan blocks.

The petrological cuddapah formation has given rise to sand stone formation. Limestones are also found on such formations. The soils yielded on such rocks are loamy to clayey with much calcium contents and less amount of sand grains. The occurrence of such soils is limited to valleys and plains and they are less fertile. The Bamboos and mixed deciduous forest are the characteritic features of vegetation of such soils. The tracts of Brahmini dungri and part of Hatibari blocks support this system of soil and vegetation. The lower Gondwana (Talcher series) has fertile soil. The occurrence is confined to convex slopes distinguished with characteristic of pisolitic laterite which is easy to handle when wet but hard when dry. The extent of such soils are seen in Bhowar khol reserved forest block supporting a vegetation of Shorea robusta with Dendrocalamus strictus bamboo and mixed forest.

1.9 MINERALS

The District produces variety of minerals of which coal is the most important. Following table gives the relevant information about the mineral position in the District. The information is for the year 1990.

S.No.	Mineral	No. of mines	Area in ha	No. of workers employed.	Output in MT	Value (Rs lakhs)
1.	Fine clay	5	416	81	6,515	4.ØØ
2.	Lime stone	3	1Ø47	622	5,Ø4,2Ø7	445.ØØ
3.	Graphite	16	82Ø	869	9,729	41.ØØ
4.	Quartz and quartizite	4	382	28	1,152	3.ØØ
5.	Coal	12	5979	1Ø641	5,7ØØ,773	11701.ØØ
6.	China clay	4	146	57	2381	2.ØØ
7.	Soap stone	2	9	17	25	-
	Total ..	46	8799	12315	62,24782	12,196.ØØ

Thus, it is seen that valuewise, coal contributes to 95.94% of the revenue obtained through minerals. Substantial population is employed in mining activity. (Source District Statistical handbook 199Ø-91).

1.1Ø LANDUSE PATTERN

PATTERN OF LAND UTILISATION IN THE DISTRICT

(Area in 'ØØØ' Hect)

S.No.	Items	1985-86	1986-87	1987-88	1988-89	1989-9Ø
1	2	3	4	5	6	7
1.	Geographical	17.49	17.49	17.49	17.49	17.49
2.	Forest area	632	639	639	639	62Ø
3.	Barren and Uncultivable land	54	54	54	54	54

4. Land put to non agricultural use	68	68	68	68	68
5. Cultivable waste	88	88	88	88	88
6. Permanent pasture & grazing land	95	95	95	95	95
7. Misc. tree crops and included in net area sown	101	101	101	101	120
8. Current Fallows	20	27	37	21	21
9. Other Fallows	30	23	7	23	23
10. Net area sown	661	654	660	660	660
11. Gross cropped area including fruits	895	877	879	899	910
12. Area sown more more than once excluding fruits	234	223	219	239	250
13. Cropping intensity	125	134	133	136	138

As seen from the table, the forest area forms 35.40% (being 6201 km^2) of the total geographical area of 17516 km^2. Gross cropped area is 9100 km^2, i.e. 51.95%. Barren and uncultivable land is 540 km^2, (3.08%), land put to non agriculture use is 680 km^2 (3.88%), Cultivable wastes are 880 km^2 (5.02%) Permanent pastures and grazing lands are 950 km^2 (5.42%), Fallow lands are 230 km^2 (1.31%) and Misc. tree crops not included in area sown area are 1200 km^2 (6.85%).

1.11 SOCIO-ECONOMIC CONDITIONS.

The total population of Sambalpur District is 26.88 lakh, male and female ratio being 1:1. The District is rural based as about 85% population resides in rural area. The literacy percentage is 42%.

Out of the gross cropped area of 9100 km^2, 3532 km^2 agriculture land is irrigated through mainly Hirakud and other irrigation projects, i.e. 38.81% cultivable land is irrigated. This has improved the agriculture sector to a great extent. Consumption of fertilizers of 54.1 kg per ha is highest in the state, the average for which is 21.7 kg per ha. This is reflected in per capita production of food grains which is 316 kg per ha as against 256 per ha for the state. Rice is the main crop that is grown and forms bulk of the food grain production, i.e. 166.36 lakh MT out of total of 203.19 lakh MT of food grains. However, number of marginal farmers below 1 ha holding is quite large i.e. 1,42,600 out of 3,30,900 (43.09%), small farmers with holdings from 1.00 to 2.00 ha are 9,10,00(27.50%), semi medium holdings of 2 to 4 ha are 67,600 (20.43%), medium holdings of 4 to 10 ha are 25,900 (7.83%) and large holdings of 10 ha and above are 3800 (1.15%). The tribal and scheduled caste population as well as landless people fare the same miserable fate as that of their brotheren elsewhere in the country. Total population of live stock is 18.35 lakh out of which cattle are 11.77 lakhs, buffaloes are 1.23 lakh, sheep and goats are 5.23 lakhs and rest are mostly pigs (1982 census).

1.12 INFRASTRUCTURE.

Sambalpur District is laced with a network of roads of different kinds. National Highway no. 6 - Mumbai to Howrah passes through Sambalpur and has a length of 329.50 km in the District. Total road length in the District is 26,614 km and its distribution is as below:

	Category of Road		Length in km
1.	National Highway	-	329.50
2.	State Highway	-	241.20
3.	Major District roads	-	1038.00
4.	Other Dstrict roads	-	334.69
5.	Classified village roads	-	476.00

6.	Municipal roads	1146.ØØ
7.	Forest roads -	1Ø43.ØØ
8.	Irrigation roads -	57Ø.62
9.	O.S.E.B. roads -	22.18
1Ø.	Panchayat samiti roads -	2668.2Ø
11.	Grampanchayat roads -	18745.ØØ
	Total ..	26614.39

Apart from National and State highways and District and municipal roads other roads are either metalled or unsurfaced roads.

Two broad guage railway lines pass through the district i.e. Mumbai-Howrah (via Nagpur) app. 1ØØ km and Jharsuguda-Titlagarh about 115 km.

1.13 FOREST PRODUCE AND FOREST BASED INDUSTRIES.

Sal is the most important timber tree species of the District. Poles, Bamboos and fire wood are the main forest produce. The important minor forest produce are Kendu leaves, Charcoal, Sal seed, Tassar, Sabairope, Mahua flower and seed, gums, Myrobalans and fibres obtained from the forest area. Thatch grass as well as other varieties of grasses for fodder and brooms are also obtained from the forest area. Medicinal plants, soap nuts and honey etc. are also produced in the forest.

Forest based industries in the District comprise Saw mills, Furniture marts, Katha product mills and paper mill. Orient paper mill in Brajrajnagar is the major Forest based industry in the District.

A list of Names and number of registered forest based industries supplied by the District Industries office, Sambalpur is below:-

Type of Industry	No. of units
Saw mills	24
Furniture mart (wooden)	27
Kath. Wood product industry	1
Paper mill	1
Poly leaf press	2
Shutter, door works,Bullock cart	5
Wooden Reels, Packing box	2
Wooden cable drums	1
Khus products & Bamboo products	1
Wooden frame looms	1

Source : Sambalpur Industries office.

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CHAPTER II

THE FORESTS

2.0 GENERAL DESCRIPTION.

The forests of Sambalpur District lie in the northern tropical zone and far away from the sea with a rainfall averaging about 1500 mm per year. Climatically the tract comes within northern tropical moist deciduous zone, but due to prolonged dry season with a short monsoon period, poor moisture retention capacity of soils, low relative humidity and regualr fires, large areas support dry forests. In general, on the eastern side of Mahanadi, forest areas have preponderence of Sal and on the western side the crop is Miscellaneous in nature. The quality of Sal varies according to locality factors and biotic interference. Moist sal occurs in moist pockets in valleys and nalla banks and lower slopes of hills showing site quality II and rarely even I. Dry Sal occurs in the rest of the area. Bamboos (Dendrocalamus strictus) occur in both Sal and Miscellaneous forests. Where Sal forests have not been able to withstand biotic pressures, bamboo brakes have taken over, as is typically found in Kansar and Gogua blocks of Bamra Forest Division. Natural teak occurs only in Lachmidugri block in association with Miscellaneous species and also in a small area of Khesra forests of Tabdakud.

2.1 FOREST TYPES.

Two broad forest types occurring according to the revised classification of Champion and Seth are: (i) 3C - North Indian Tropical Moist Deciduous Forests and (ii) 5 B Northern Tropical Dry Deciduous Forests.

The Forests are further subdivided on the lines of the said classification:-

Forest type/sub type

I. (1) 3C/c2 e(i)-
Moist Peninsular High level Sal

(2) 3C/c2 e(ii)
Moist Peninsular low level Sal

(3) 3C/c2 e (iii)
Moist Peninsular valley Sal

II.(4) 5B/ C/E
Dry Peninsular Sal

(5) 5B/C2
Dry Mixed Deciduous Forests

III. 5 E9 Dry Bamboo brakes

I. MOIST PENINSULAR SAL.

Moist peninsular Sal is confined to sheltered valleys with deep sandy loam soils, where water table does not go too deep during summer. The quality varies from II to III in valley Sal (27-33 m and 21-27m) to III, IV and V (21 to 27m, 15-21m, below 15m) in lower level sal and IV to V in high level sal. Important species found in High level Sal forests are: Gmelina arborea, Adina cordifolia, Bombax ceiba, Pterocarpus marsupium in the top storey. Middle storey consists of Bursera serrata, Careya arborea, Ougeinia oojeinensis, Bauhinia retusa, Cassia fistula, Screbera switenioides, Dillenia pentagyna, Bridelia retusa etc.

In low level Sal, in the top canopy Mitragyna parviflora, Hymenodictyon excelsum are also found in addition to species in high level sal whereas in the middle storey Syzigium cuminii, Diospyros melanoxylon, Dalbergia latifolia, Cleistanthus collinus, Mallotus philipinensis are found.

In valley Sal, the ground floor is covered with dense growth of Semi-evergreen shrubs. In addition to species mentioned in the top canopy, Terminalia arjuna, Alstonia scholaris and Mangifera indica are also found.

Bamboos occur in moist Sal areas as a second storey and is fairly distributed.

II. TROPICAL DRY DECIDUOUS FORESTS.

The forests of the District falling under this categqry have light upper canopy which is generally irregular and broken. Description of the sub types is given below:-

(A) Dry Peninsular Sal forests.

Dry peninsular sal forests occupy extensive areas in the District. They are found on shallow soils overlying crystalline or metamorphic rocks. It is found to be absent or very few on soils formed in situ on permanent basic granite rocks and Cuddapah. It is also found on calcarious soils. The quality of Sal is poor, generally IV and V. Unsoundness in Sal in this subtype is owing to poor soils, annual fires and uncontrolled selective fellings. Main species found in the upper storey are: Shorea robusta, Terminalia tomentosa, Anogeissus latifolia, Diospyros melanoxylon, Madhuca indica,, Lagerstroemia parviflora, Adina cordifolia, Sterculia urens, Cochlospermum religosium, Hymenodictyon excelsum etc. In the understorey, Dendrocalamus strictus occurs widely. Other species of note are Buchnania latifolia, Chloroxylon swietenia, Emblica officinalis, Terminalia bellirica, Lannea grandis, Cleistanthus collinus, Ougeinia oojeinensis etc.

(B) Dry Mixed Deciduous Forests.

This sub-type also occurs over large areas in the District and is found on soils formed in situ on Gneiss, Schists and Cuddapah. Sal is either absent or scattered or occurs in small patches along nalla banks or on northern lower slopes. The crop is more or less open and presents a desolate look in summers when trees become leafless. Main species found are: Terminlia tomentosa, Pterocarpus marsupium, Anogeissus latifolia, Diospyros melanoxylon, Cleistanthus collinus, Lagerstroemia parviflora, Buchnania latifolia, Sterculia urens, Boswellia serrata, Lannea grandis, Cochlospermum religiosum, Chloroxylon sweitenia, Cassia fistula, Gardenia latifolia, Emblica officinalis, Semicarpus anacardium etc. Chochlospermum is found on dry rocky grounds. Bamboo is scattered over the entire area.

(C) Dry Bamboo Brakes.

Bamboo brakes occur where, due to biotic pressure and annual fires and dryness, other species cannot survive. Bamboos develop rapidly after coppice fellings or clearfellings are followed by fires. Miscellaneous species occur scattered all over, especially on nalla banks.

2.2 DAMAGE TO FORESTS.

Annual fires from the beginning of March to the month of May are the main cause for serious damage being caused to the forests of Sambalpur District. Almost entire forests are affected by annual fires wreaking havoc on young regeneration and pole crop. The main reason for forest fires is probably tendu leaf trade, as it is a fact that after cut ting back tendu bushes if the area is swept by fire, the bushes sprout luxuriant flush of leaves. It is no secret that wherever tendu trade is being carried out, forest fires are a regular feature. Forest fires are also caused by people setting patches of forests on fire so that Mahua flower fall can easily be picked up on black and charred background. Graziers also set fire to vast tracts so as to get good flush of palatable grasses in the monsoons. In tribal areas the tribals set fire to forests so as to drive the game in a particular direction to trap them. General apathy on the part of public toward nature is evident here, as elsewhere in the

country, in that, they throw burning bidi, cigarette butts non-chalantly in the forest area. Annual fires are one of the main reasons for moist Sal degenerating into dry sal and dry sal getting edged out by dry deciduous forests. As has been explained above, occurrence of bamboo brakes in many parts of the district is the direct result of annual fires taking toll of tree species whereas the bamboo rhizomes remain unaffected underground.

The live stock population of the District is very large i.e. 18.35 lakhs. The forests, especially near about habitation are prone to very heavy grazing. The carrying capacity of the land is exceeded manifolds due to this large cattle population. Unrestricted grazing has resulted in compacting of the soil, thereby making natural rengeneration a difficult proposition. Whatever regeneration comes up is either grazed by the cattle or trampled.

Though the District boasts of a fairly good rainfall, normally indicative of moist vegetation, the number of rainy days are quite less in number and the spread of the rainfall is also not even. Consequently, dry period starts from the month of October and continues through to Mid-June. Given that the maximum temperature crosses 40°c mark in high summer, and also the fact that large tracts have low moisture retention capacity, the drought has played its role in degrading probably the moist Sal forests of the District.

Moist valleys and pockets are heavily infested with climbers like Bauhinia vahilii, Milletia auriculata, Smilax species, Butea superba etc. The Loranthus also attacks Sal poles and trees here and there.

Injury to crop by illicit felling and encroachments is not very serious in the District but its occurrence is seen on and off especially in the plain areas.

2.3 RIGHTS AND CONCESSIONS

In A class reserved forests no rights and concessions have been allowed but forest materials can be reserved from the annual coupes of B class Reserved forest on payment of shedule rates, fixed by the administration, for bonafide domestic needs by villagers.

Grazing is allowed even in reserved forest though, at very nominal rates to the villagers. People living in villages adjoining reserved forests have been granted permission to collect free of charge minor forest produce like edible roots, fruits, flowers, leaves and grass for their bonafide domestic use. All the tribal villagers are permitted to remove timber and fire wood on concessional rates for their requirements only and not for sale or barter. Villagers are allowed to cultivate lac on Kusum trees and bamboos can also be allowed to be removed from the annual coupes leased out to paper mill. As a result of all these concessions forests of the district are very much depleted almost in all accessible area.

2.4 WILDLIFE

As has been detailed in para 1.3, the district boasts of three Wildlife sanctuaries with a total area of 77Ø.93 m^2 in Sambalpur, Bamra and Rairakhol Divisions to preserve the precious habitat for Wildlife. Among carnivores Tigers are rare and found in Bamra and Rairakhol divisions, but leopards are quite common especially in Rairakhol division. Other common carnivores found are Hyaena, Jackal, Honey badger, Wild dogs etc. Ushakoti sanctuary in Bamra Division and Khalasuni block of Rairakhol division are famous for elephants having a sizeable population. In the same area gaurs are also occassionally seen. Among herbivores, Sambar spotted deer. Barking deer, Charsinga are commonly seen. Sloth bears are also quite common. The wild boar population in the forests of Sambalpur is sizeable. The forests have rich avifauna, common being Peacocks, Jungle fowl, Myna, Cuckoo, Partridge, Wood peckers, Hornbills, Parakeets, Racquet tailed drongo, Orioles, Bulbuls, Robin, etc. Among reptiles, Cobras, Vipers and Pythons are important.

2.5 FOREST MANAGEMENT

Systematic forest management was not in vogue till about 1927. Most of the forests were under the control of local rulers. Big trees were felled for railway sleepers and podu (shifting) cultivation was practised without hinderance. At the beginning of the third decade of the 2Øth century the forests were brought under established systems of Forest

management. Working plans prepared by such stalwarts as Shri Mathur (for Bamra), Dr. H.F.Mooney (Rairakhol division) gave the forests the required treatment through Selection working circle, Conversion working circle, Coppice working circle, Bamboo working circle etc. After implementation of the Act, abolishing Zamindari, the forests of the district, as a whole, were brought under systematic management.

At present, the management is concerned with the following main objectives.

(a) Maintenance of well stocked forests, especially on hills so as to arrest soil erosion and conserve water.

(b) To improve the existing forests qualitatively and quantitatively by sound silvicultural and management practices.

(c) To cater to the needs of local populace in terms of wood products on a sustained basis.

(d) To rehabilitate depleted forests through tending and enrichment plantations, preferably with the active participation of public.

(e) To Conserve and develop wildlife in the area.

There are two Social Forestry Divisions in Sambalpur District; one is at Sambalpur and the other is at Bargarh. Main activities of SF Wing are: (a) Creation of village wood lots on Govt. waste lands, other available govt. lands, (b) Reforestation of degraded B class reserved and protected forests, (c) Rehabilitation of degraded forests, (d) Raising plantation on barren hills, (e) Forest farming for rural poor and, (f) farm forestry.

Due to population growth and a perceptible change in socio-economic concepts of the society, the forest administration is beset with problems of illicit removal of timber and firewood, smuggling of Kendu leaves and Mahuwa flowers, unauthorised removal of bamboos, grazing in forest area and forest fires - mostly manmade.

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CHAPTER - III

RESOURCES SURVEY METHODOLOGY.

3.Ø OBJECTIVES OF THE SURVEY:

The objectives of this resources survey were :-

1. To collect information on distribution of forest with regard to various parameters such as topography,latitude, aspect, slope, soil-depth etc.

2 To collect various information on crop data including origin of crop (whether the crop is of seed origin,coppice origin or a plantation), its composiition,height,size,quantum of regeneration,, injury to crop,fire incidence, grazing incidence, presence of weeds and grasses etc.

3. To collect information under bamboo occurrence such as species found,their density,quality, quantity and regeneration etc.

4. To estimate the forest areas under different crop composition and also to assess the extent of forest area under non forest use.

5. To estimate the growing stock of trees and bamboos in areas having forest cover.

6. To determine the plantation potential of the land which is poorly stocked or unstocked.

7. To focus attention of the planners and forest officials on the critical aspects and condition of the forests for timely remedial measures and for future planning.

3.1 AREA CONSIDERED FOR SURVEY:

For the purpose of this inventory, the forest area falling in Sambalpur District of Orissa State was considered. In order to decide forest areas, the recent Survey of India toposheets, preferably of 1:50,000 scale and in case of their non-availability, 1" = 1 mile toposheets were used. All those areas which were demarcated by double dotted forest boundaries on these toposheets and were having green wash within or outside such boundaries, were taken as forest areas for undertaking this inventory.

3.2 INVENTORY DESIGN:

A common inventory design for the whole organisation was evolved in consultation with the Central Statistical Organisation (Govt. of India) for undertaking inventory work in various parts of the country. The design envisaged the survey of two randomly selected plots each of 0.1 ha area in each grid of 2 1/2'x 2 1/2' (latitudes and longitudes) on the toposheet of 1:50,000 or 1:63,360 scale. A grid bounded by 2 1/2'x2 1/2' latitudes and longitudes covers about 20 km^2 area in which 0.2 ha area is actually sampled. Thus the sampling intensity of the survey comes to 0.01%. The method of marking the plot centre on the map within grid is as follows :-

Two sides (X - axis and Y - axis) of a grid were measured in millimeters. The length of these sides was divided by 0.6324 mm (side of 0.1 ha. square plot) in case the map was on 1:50,000 scale, or by 0.4990 mm in case the map was on 1:63,360 scale. The quotient so obtained was rounded up. Let the numbers (quotient) for X axis be x and that of Y axis be y. Actually the number x gives the no. of plots that may fall along X axis and number y gives the no. of plots that may fall along Y axis. The product x X y gives the total number of sample plots that may exist in a grid of 2 1/2'x 2 1/2'. Out of these plots (x X y), one plot has to be selected on the basis of random number and the second one with the help of the first plot which will be explained in the next para. For the selection of 1st plot, one set of three random numbers were selected from random number table. If the random number selected for X axis was

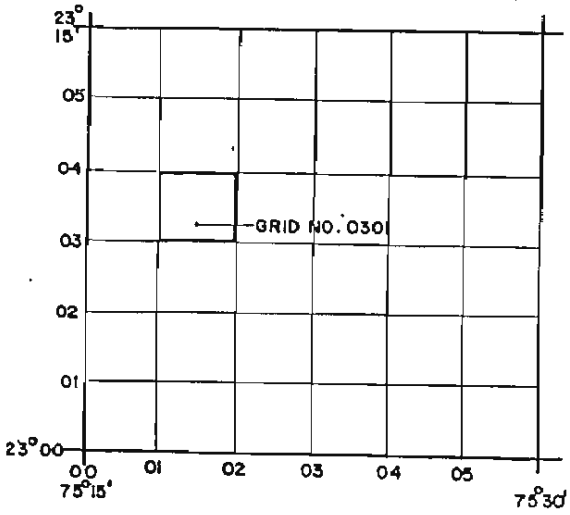
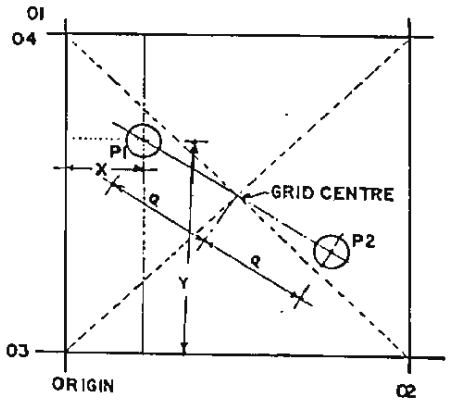


DIAGRAM – 1
DIAGRAM SHOWING IDENTIFICATION OF GRIDS ON 1:50,000 OR 1:63,360 SCALE TOPOSHEETS

DIAGRAM – 2
DIAGRAM SHOWING LAY-OUT OF PLOT IN 2½X2½' GRID

'X' & 'Y' ARE THE DISTANCES ALONG 'X' & 'Y' AXES WITH SW CORNER AS THE ORIGIN



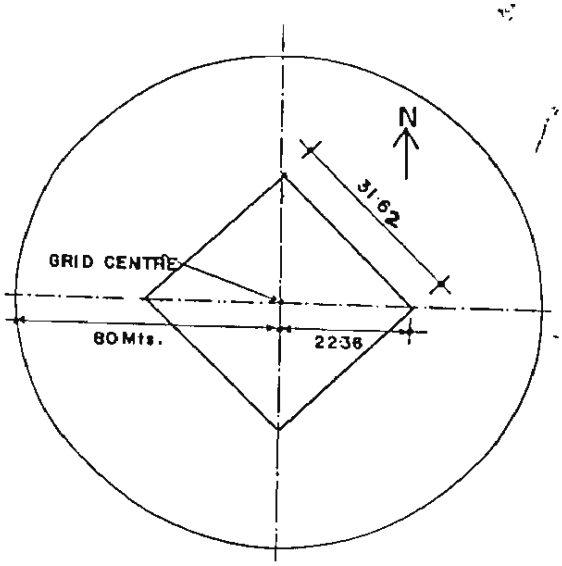


DIAGRAM – 3
DIAGRAM SHOWING LAY-OUT OF PLOT

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less than x (quotient for X axis), then it was retained and if the random number was more than x, then it was divided by x and the remainder was retained. Similar exercise had to be done for Y axis also by taking next 3-digit set of random numbers. The figure (remainder) so obtained was multiplied by the side of the plot i.e. Ø.6324 mm in case of 1:50,ØØØ scale map and by Ø.4990 mm in case of 1:63,36Ø scale map so as to get the actual coordinates of the 1st plot. The plot no. 1 of all the grids was marked on the map taking south west corner of respective grids as origin. The distance along X axis was measured towards east and along Y axis towards north. Thus the centre of plot 1 was marked on the map at the crossing of the two coordinates.

For marking the centre of second plot of each grid, the plot centre of 1st plot and centre of 2 1/2'x2 1/2' grid were joined and the line extended to the same distance in opposite direction beyond grid centre. The point so reached was the plot centre of the second plot. The location of second plot is thus linked with the first plot. The layout of 2 1/2'x 2 1/2' grid and the plots are shown in diagrams 1, 2, and 3 on the preceeding page. All such plots were marked on the toposheets. The plots so marked were to be visited only when they fall in forest areas i.e. the area covered by green wash or by double dotted forest boundaries on 1:50,ØØØ scale or 1:63,36Ø scale mapsheets.

3.3 LOCATION OF PLOT ON THE GROUND

As stated earlier, the survey was confined to the forest areas only as decided on the basis of forest boundaries and green wash shown on the toposheets. The plot has to be visited when it falls in some forest area. All the forested plots of the survey area i.e Sambalpur district of Orissa State, duly marked on toposheets, were allotted to various crews. The crews had drawn up their programme of halts at some convenient places in order to tackle maximum plots from those camps. The plots marked on the toposheet had to be exactly located on the ground with the help of some conspicuous features which could be identified on the map as well as on the ground. Usually the following features were selected for this purpose:

1. Bench Mark.
2. Triangulation point.
3. Village or road trijunction.
4. Old bridges and culverts.
5. Old temples, mosques and churches.
6. Crossing of rail tracks with roads, streams, rivers etc.
7. Confluence of rivers or streams and junction of roads.
8. Prominent bends in roads, rivers or streams.
9. Old ponds and wells.
10. Springs.
11. Prominent topographical features in hilly region such as spurs, knolls etc.
12. Mile stones or kilometer stones on the road side.
13 Pillars of international,inter state or inter-district boundaries and those forest areas etc.
14. Prominent bends of boundary etc.

After locating any of the above reference points on the ground as well as on the map, the bearing and distance from reference point to the plot centre were marked. This distance has to be traversed at the bearing calculated for the plot using Silva Compass and distance by measuring nylon rope/tape etc. While using compass the magnetic declination as indicated on the concerned toposheet was also taken into account. Similarly, for distance measurement the slope correction was applied to cover the actual horizontal distance of the plot measured from the map.

On reaching the plot centre, a square plot was laid out by taking distance of 22.36 m. in all the four directions (north, south, east and west) from the plot centre. Thus an exact plot of 0.1 ha. area (having each side of 31.62 m. and diagonal of 44.72 m.) was laid out horizontally after making corrections for the slopes measured with the help of Blumleiss hypsometer along 4 semidiagonals (north, south, east, west).

3.4 FORMAT FOR DATA COLLECTION

After laying out the plots in the field, various data were collected in the following field forms in codified manner (except in Plot Approach Form wherein information was collected in descriptive manner) as described in the field manual issued to the crews for the purpose of data

collection. This facilitated the transfer of data on punch cards, consistency checking of collected data and finally in procesing the data on electronic computer at a later stage. Various field forms used in this survey were:-

1. Plot Approach form.
2. Plot Description form,
3. Plot Enumeration form.
4. Sample Tree form.
5. Bamboo Enumeration-Cum-Clump Analysis form.
6. Bamboo Weight form.

1. Plot Approach form.

As the title indicates, the form was a record of approach to the plot centre from the field camp of a crew. It was filled in by the Crew Leader as he proceeded from his camp to some conspicuous feature called reference point existing near by the plot. The distance and bearing from this well defined reference point to the plot centre were also recorded on it. The exact location of plot centre i.e. bearing and distance from two trees to the plot centre was also mentioned together with the time of departure from camp, time taken in various studies and time of arrival in the camp.

This form helps the check crew or any other person to relocate the plot easily when required. The data on this form is recorded in descriptive manner with a neatly drawn sketch showing the location of reference point and the plot centre.

2. Plot Description form.

This form is designed for recording qualitative description of 2 ha area around the plot centre. The information regarding administrative units, legal status, land use, topography, soil, vegetation, bamboo regeneration, biotic influence, accessibility and plantation potential etc. were recorded. The data were recorded in codified manner and was transferred to punch cards for further computer analysis. The stratification of area and classification of growing stock was done on the basis of these descriptions only.

3. Plot Enumeration form.

In this form, all the trees with dia 10 cm. and above and all the bamboo clumps occuring in all 0.1 ha sample plots were recorded by species. This was meant for computing total growing stock existing in all such sample plots and finally in whole of the survey area which was estimated on the basis of these plots.

This form helps in distributing the growing stock in terms of stems and volume by various parameters like species, diameter class, forest types etc.

4. Sample Tree form.

Detailed information regarding the species, diameter at breast height (over bark), height of tree, clear bole, bark thickness, dominance and defects etc. of all the trees occurring in north west quadrant of all the plots, were recorded in this form.

On the basis of these parameters (i.e. height, diameter and clear bole), we get volume of the plots which further enables us to estimate the total growing stock of the area falling under various strata.

5. Bamboo Enumeration-Cum-Clump Analysis form.

In this form, the data of individual culms occurring in the selected clumps bearing S.No. 1,9,17,25,33 ..... etc. (i.e. the first and every eighth clump appearing in Plot enumeration form were recorded. Thus, the information about age, soundness, size and condition etc. of the culms of the above clumps was obtained and analysed in various columns of this form.

This information gives the position of total bamboo stock by clump sizes occurring under various conditions.

6. Bamboo Weight form.

This form was designed for collecting data to determine the green weight of bamboos of different species and sizes and further for establishing relationship between

green weight and dry weight of bamboo culms. The data were recorded in respect of two selected culms from each dia.class i.e. 2 to 5 cm, 5 to 8 cm and 8 cm and above and the green weight of three 50 cm long sub-samples, each taken from the bottom, the middle and the top portions of the culms were recorded. Further, these three samples were dried in air and finally in the oven in order to remove their entire moisture contents and to get their air dry weight. This facilitated to establish relation between the green weight and the dry weight of culms by species and sizes to know the total growing stock of bamboos in terms of weight.

3.5 FIELD WORK

The field work of Sambalpur district of Orissa State was completed during the period from March 1985 to June 1985 keeping the Base camp at Pathalgaon. The entire field work of this district was completed from this Base camp only. There were eight crews deployed on this work, each consisting of one Jr. Technical Assistant as Crew Leader, one Dy.Ranger and two Fieldmen. One vehicle was provided between two parties to undertake the field work.

3.6 FIELD CHECKING

During the course of field work, the checking of the surveyed plots was done by the Sr. Technical Assistant who was incharge of the survey work. About 10% of the total number of plots tackled by various crews were checked and mistakes found during the checking were rectified in the field forms.

3.7 MAPS AND PLOTS:

The Survey of India toposheets, which were used during the inventory work and the number of plots falling in each of them have been mentioned below for the entire survey area of Sambalpur district, indicating the scale of map and year of survey of the sheet.

S.No.	Toposheet No.	Scale of map.	No. of plots inventoried by F.S.I.
1.	64 O/4	1:50,000	14
2.	64 O/6	"	7
3.	64 O/7	"	9
4.	64 O/8		1
5.	64 O/9	"	6
6.	64 O/10	"	39
7.	64 O/11	"	3
8.	64 O/12	"	1
9.	64 O/13	"	20
10.	64 O/14	"	9
11.	64 O/15	"	4
12.	64 O/16	"	8
13.	64 K/12	"	5
14.	64 K/16		17
15.	64 L/9	"	2
16.	64 L/13	"	18
17.	64 P/1	"	9
18.	64 P/5	"	4
19.	73 B/8	"	22
20.	73 B/12	1:50,000	2
21.	73 C/1	"	15
22.	73 C/2	"	20
23.	73 C/3	"	38
24.	73 C/4	"	54
25.	73 C/5	"	37
26.	73 C/6	"	40
27.	73 C/7	"	61
28.	73 C/8		57
29.	73 C/9	"	2
30.	73 C/10	"	57
31.	73 C/11	"	47

32.	73 C/12	"	37	
33.	73 C/14	"	25	
34.	73 C/15	"	34	
35.	73 C/16	"	15	
36.	73 D/1	"	Ø4	
37.	73 D/5	"	Ø6	
38.	73 G/2	"	16	
39.	73 G/3	"	1Ø	
		Total ..	775	Plots

3.8 CONSISTENCY CHECKING AND FORWARDING OF FIELD FORMS TO DATA PROCESSING UNIT:

After completion of field work, the field forms pertaining to inventory of 775 plots of Sambalpur district of Orissa State were manually checked in the zonal office as per field manual and coding instructions meant for the purpose. Inconsistencies noticed in these forms were removed after discussing the specific point with the concerned Crew Leader. All these field forms were finally forwarded to the Data Processing Unit of the Headquarter office at Dehradun on 3Øth June, 1992 for computer analysis and processing the data for deriving various kinds of information to meet the objectives of the survey.

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CHAPTER - IV

DATA PROCESSING

4.Ø SAMPLING DESIGN

In case of Sambalpur District of Orissa, existing design for carrying out forest inventory surveys developed by Forest Survey of India was used. During this survey, in order to adopt the design, the grids were marked on Survey of India toposheet of 1:5Ø,ØØØ at the interval of 2 1/2' latitude by 2 1/2' longitude and two sample plots were selected by random method in each of these 36 grids thus obtained in a toposheet. The plots were square in shape having an area of Ø.1 ha each.

4.1 FIELD DATA

The basic data of the inventory survey were collected in the Plot Description Form, Plot Enumeration Form, Sample Tree Form and Bamboo Enumeration Form etc.
The field forms were precoded so that the field data could be easily transferred on to the floppy/tape/disk directly. There were 2683 field forms which required punching of the following number of cards under each card design.

	Card design	No. of records
1.	Plot description	775
2.	Plot enumeration	2484
3.	Sample tree	4467
4.	Bamboo enumeration(CDØ5)	423
5.	Bamboo weight Form	228
	Total	8377

4.2 PLOT DETAILS IN SAMBALPUR DISTRICT

In Sambalpur District there were 775 total plots in all giving weightage to each plot by 8.Ø sq.km considering an area of 62Ø1 km^2. Mainly two types of forests, Sal and Miscellaneous forest were recognised.

4.3 DATA PROCESSING

The data processing involved the following operations:-

i) Manual processing

Field forms received in the Machine Data Management Unit of Forest Survey of India, Dehradun were checked with the list supplied by the zonal office. Entries of the field forms were made in the register, regarding the number of field forms relating to each map-sheet, grid and plot. The total number of records required to be entered under each card design was also estimated and indicated in the register for future references.

Job numbers, Card design and left hand zeros, wherever missing, were filled up in the field forms to avoid mistake during entering the data on to the floppy or disk.

Each entry in the field forms was checked for consistency in the data. The main checks applied were the range check for the maximum and minimum value of the codes and logical check for inter-relation between the entries for two and or more fields. Card designwise all the data was loaded on to the floppy/disk and verified. Then listings were taken and checked manually to ensure complete loading and proper sequence of data. Mistakes if any were incorporated.

Sample statistics were calculated and checked with the computer output results to see if the calculations on computer were correct. These involved local volume equations, volume of enumerated tree, plot, volumes and standard error etc. Prior to this, the programmes were developed according to the requirement of the data processing.

Intermediate and final computer output were checked for consistency and relevance of results. Area tables were also prepared manually.

ii) Processing on electronic computer.

The data were loaded on floppy/disk through direct data entry operation. Then they were verified and sorted. The listings of loaded data were taken to check if the data have been loaded completely in the desired sequence. Volume of each tree was estimated with the help of the local volume equations.

Contribution of the volume of each enumerated tree per hectare was derived and stored in a tree/plot volume file created for future processing. Using the tree/plot volume file, growing stock tables by species and diameter class under each crop composition were prepared and standard error of the estimated growing stock was calculated.

The data of this survey was processed on Vax 11/780 of our own system. The computer has the following configuration:-

1.	Memory	4	MB
2.	Tape drives	2	
3.	Disk drives	3	
4.	Line printer	1	
5.	Image processing Terminals (Peri color - 2001 with VT-220)	3	
6.	Alphanumeric terminals	5	
7.	Digitizer	1	
8.	Dunn camera	1	
9.	80 Coloumn printer	3	
10.	Console with hard copy	1	

4.4 AREA

Area figures were supplied by the zonal office. The geographical area and forest area were given as under.

(a) Geographical area - 17516 km^2

(b) Forest area - 6201 km^2

Average weightage to each plot- 8 km^2

In Sambalpur District weightage of each plot was estimated by dividing the total forest area by the number of total sample plots and the areas under different parameters were estimated by multiplying the number of sample plots. The total forested area was calculated on the above basis and classified by land use class and given in Table no. 5.1T.

The area falling in land use classes such as dense tree forests, moderately dense forests, open tree forests, Bamboo forests, young plantations and young crop regeneration was, considered as tree vegetated area and was classified mainly by two crop compositions viz; (1) Sal and (2) Miscellaneous forests and corresponding areas are given in table no. 5.2T. The area under each crop composition was classified by topography in table no. 5.3T, by slope class in table no. 5.4T, by soil depth class in table no. 5.5T, by top height in table no. 5.6T, by size class in table no. 5.7T, by canopy layer in table no. 5.8T. Similarly break up of forest area is done by grazing incidence in table no.5.12T, by regeneration in table no.5.10T, by soil erosion in table no.5.11T, by fire incidence in table no.5.13T and by plantation potential in table no.5.9T.

4.5 VOLUME ESTIMATION

Felled tree data for developing general volume equations were not collected during the inventory, because of restrictions on felling of trees. Local volume equations already derived and used in case of Koraput District forest inventory survey by Central Zone, Nagpur were used to estimate the volume.

The local volume equations used for different species were as under:-

1. Adina cordifolia(Ø24)
   $V = Ø.Ø85Ø7 + Ø.19669\ D + 7.16812\ D^2$

2. Ancgeissus latifolia (Ø63)
   $V = Ø.13928 \pm 2.87Ø67\ D + 2Ø.224Ø4\ D^2 - 13.8Ø572\ D^3$

3. Bombax ceiba (1Ø9)
   $V = Ø.Ø2834 + 4.68381\ D^2$

4. Boswellia serrata(111)
   $V = Ø.36432 - 1.32768\ \sqrt{D} + 9.48471\ D^2$

5. Bridelia retusa (114)
   $\sqrt{V} = Ø.1162Ø + 4.12711\ D - 1.Ø85Ø8\ \sqrt{D}$

6. Dalbergia latifolia (22Ø)
   $V = -Ø.ØØ965 + Ø.58546\ D - 2.56Ø5Ø\ D^2 + 24.342125\ D^3$

7. Diospyros melanoxylon (234)
   $\sqrt{V} = Ø.Ø6728 + 4.Ø6351\ D - Ø.99816\ \sqrt{D}$

8. Garuga pinnata (319)
   $V = -Ø.Ø9144 + 1.48588\ D - 5.53172\ D^2 + 24.Ø4851\ D^3$

9. Lagerstroemia parviflora(397)
   $V = Ø.Ø7199 - 1.25923\ D + 9.28416\ D^2$

1Ø. Lannea coromandelica(4ØØ)
   $V = -Ø.Ø1Ø71 - Ø.66528\ D + 9.54478\ D^2 - 4.58876\ D^3$

11. Madhuca latifolia (437)
   $V = Ø.1Ø423 - 1.38429\ D + 8.39379\ D^2$

12. Mitragyna parviflora (476)
   $V = Ø.Ø8444 - 1.268Ø1\ D + 8.75274\ D^2$

13. Pterocarpus marsupium(567)
   $\sqrt{V} = - Ø.16276 + 2.82ØØ2\ D + Ø.Ø4Ø34\ \sqrt{D}$

14. Shorea robusta(633)
$\sqrt{V} = 0.19994 + 4.57179\ D - 1.56823\ \sqrt{D}$

15. Syzigium cumini (665)
$\sqrt{V} = 0.30706 + 5.12731\ D - 2.09870\ \sqrt{D}$

16. Terminlia bellirica (676)
$V = -0.14823 + 2.44138\ D - 6.86434\ D^2 + 18.05444\ D^3$

17. Terminalia crenulata(681)
$V = 0.05061 - 1.11994\ D + 8.77839\ D^2$

18. Miscellaneous species (944)
$\sqrt{V} = 0.06063 + 3.43666\ D - 0.75571\ \sqrt{D}$

4.6 ENUMERATED TREE VOLUME

The volume of each enumerated tree of a species was estimated by substituting its breast height overbark diameter in a local volume equation of that species. The enumerated tree volumes were converted to per hectare volumes and stored in a tree/plot volume file together with species code, diameter of a tree, parameters of plot description form, per hectare volume and stems and the volume of that plot. The elements of information stored in the above files were utilised to classify the trees by species and diameter class, estimates of number of the stems and volume per hectare and total by species and diameter classes were obtained for different strata viz. crop composition etc.

4.7 PLOT VOLUME

The estimated volume of each enumerated tree in a plot when added up over the whole plot provided the plot volume. It was converted to per hectare and stored in the tree/plot volume file. The per hectare plot volumes were used to estimate volume under different classes of desired parameters. The plot volumes were also used to estimate the sampling error of the growing stock for each crop composition.

4.8 STAND TABLES

The elements of tree/plot volume file were utilised to classify the trees by species, diameter and crop composition etc. Estimates of the number of stems per hectare and total stems by species and diameter classes were obtained for each crop composition.

4.9 STOCK TABLES

Estimates of volume per hectare and total volume by species and diameter classes were obtained for each crop composition from the tree/plot volume file.

4.10 SAMPLING ERROR

The estimates obtained from the inventory will, of course, have some error association with them and the user of the results wants to have some control over its magnitude or at the very best have an error estimate computed after inventory is completed.

The sample was considered as a systematic cluster sample having two sample plots in each cluster. In order to estimate the sampling error the sample was considered to be of unequal sizes and ratio method of estimate was used since in many grids only one plot was enumerated.

Let n = total no. of clusters (grids) in the sample
Yi = sum of per hectare volumes in i th grid
xi = number of plots in the i th grid

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} xi$$ = Average number of plots per grid

$$R = \frac{\sum_{i=1}^{n} yi}{\sum_{i=1}^{n} xi} = \text{estimate of average volume per hectare over all grids.}$$

Estimate of variance of $\hat{R}$ is

$$V(R) = \frac{N-n}{Nn} \cdot \frac{\sum_{i=1}^{n} (yi - \hat{R}\, xi)^2}{n-1}$$

$$= \frac{1}{n(n-1)\bar{x}^2} \sum_{i=1}^{u} (yi - \hat{R}\, xi)^2$$

(Ignoring $\frac{N-n}{N}$ the finite population correction factor)

$$= \frac{1}{n(n-1)\bar{x}^2} \left[\sum_{i=1}^{n} Yi^2 - 2R \sum_{i=1}^{n} Yi\, Xi + R^2 \sum_{i=1}^{n} xi^2 \right]$$

Estimate of the standard error (S.E.) of R

$$S.E. = \sqrt{V(\hat{R})}$$

$$S.E\,\% = \frac{SE}{R}\ 100$$

Standard errors have been estimated for the growing stock in each forest type and over the entire area irrespective of the strata.

4.11 BAMBOO

The presence of Bamboo was examined in an area of about 2 ha around the plot centre and its quality and density recorded in the plot description form. The area under Bamboo was estimated from this information by applying the area weight of each plot. Area under each quality of Bamboo was also estimated from the number of plots falling in each quality. This information is classified in Table No. 5.14T.

4.12 CLUMPS PER HECTARE

The Bamboo clumps occuring in each sample plot were enumerated by species and diameter classes of the clump for estimating the number of clumps per hectare by species and clump size class. To estimate the number of clumps per hectare in each quality and clump size class, the data of plot description form and the plot enumeration form were merged together. This information is given in table no. 7.2T.

4.13 CULMS PER CLUMP

Every eighth clump starting with first clump in a sample plot was selected and the number of culms by age (current year, one to two years and over two years) and soundness (green sound, green damaged, dry sound, dry damaged and decayed) were enumerated and recorded. The culms were further classified by culm diameter class - 2 cm to under 5 cm; 5 cm to under 8 cm and 8 cm and above for estimating the number of culms per clump in different classes. This is given in table no. 7.3T.

4.14 CULMS PER HECTARE

The estimates of the number of clumps per hectare and the number of culms per clump gives an estimate of the number of culms per hectare under different classes. This is given in table no. 7.4T.

4.15 TOTAL NO. OF CULMS

The estimates of the number of culms per hectare and the Bamboo area under the specific quality classes were used to estimate the total number of Bamboo culms in the inventoried area. This is given in table no. 7.5T.

4.16 BAMBOO STOCK

Weight of the utilisable length of green culms of diameter 2 cm to 5 cm to 8 cm, 8 cm and above were recorded by felling Bamboo culms from the first clump in each plot. Thus average green weight of a culm was obtained in separate diameter classes of culms.

The following factors were used to obtain the correlation between the green weight and the dry weight of different categories of culms to obtain green equivalent weight for that category.

Dry sound culms	= 2.Ø
Dry damaged culms	= 1.Ø
Green sound culms	= 1.Ø
Green damaged culms	= Ø.5
Decayed culms	= Ø.Ø

Applying the above factors to the green weight of Bamboo culms and the total number of culms, the total green Bamboo stock was estimated and then green Bamboo stock was converted into dry Bamboo stock by applying driage factors. These are given in table no. 7.6T.

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CHAPTER V

INVENTORY RESULTS: AREA

5.Ø GENERAL

Status of forest resources in Sambalpur District was assessed by reckoning greenwash area, on Survey of India toposheets of 1:5Ø,ØØØ scale, denoting vegetated area, and carrying out inventory in sample plots located in it. A total of 775 sample plots of Ø.1 ha each were inventoried over 62Ø1 km^2 forested area of the District. The method of selection of sample plots and their layout has already been explained in Chapter III. Weighted area represented by each sample plot reckons to approximately 8 km^2 (62Ø1 / 775). Break up of area by various parameters like landuse classes, crop composition, topography classes, slope classes, soil depth classes, height classes, size classes, canopy layers etc was worked out by considering the weightage obtained by the total number of sample plots occurring in each as noted during the course of field work. Detailed observations are given below:

5.1 FOREST AREA BY LAND USE CLASSES

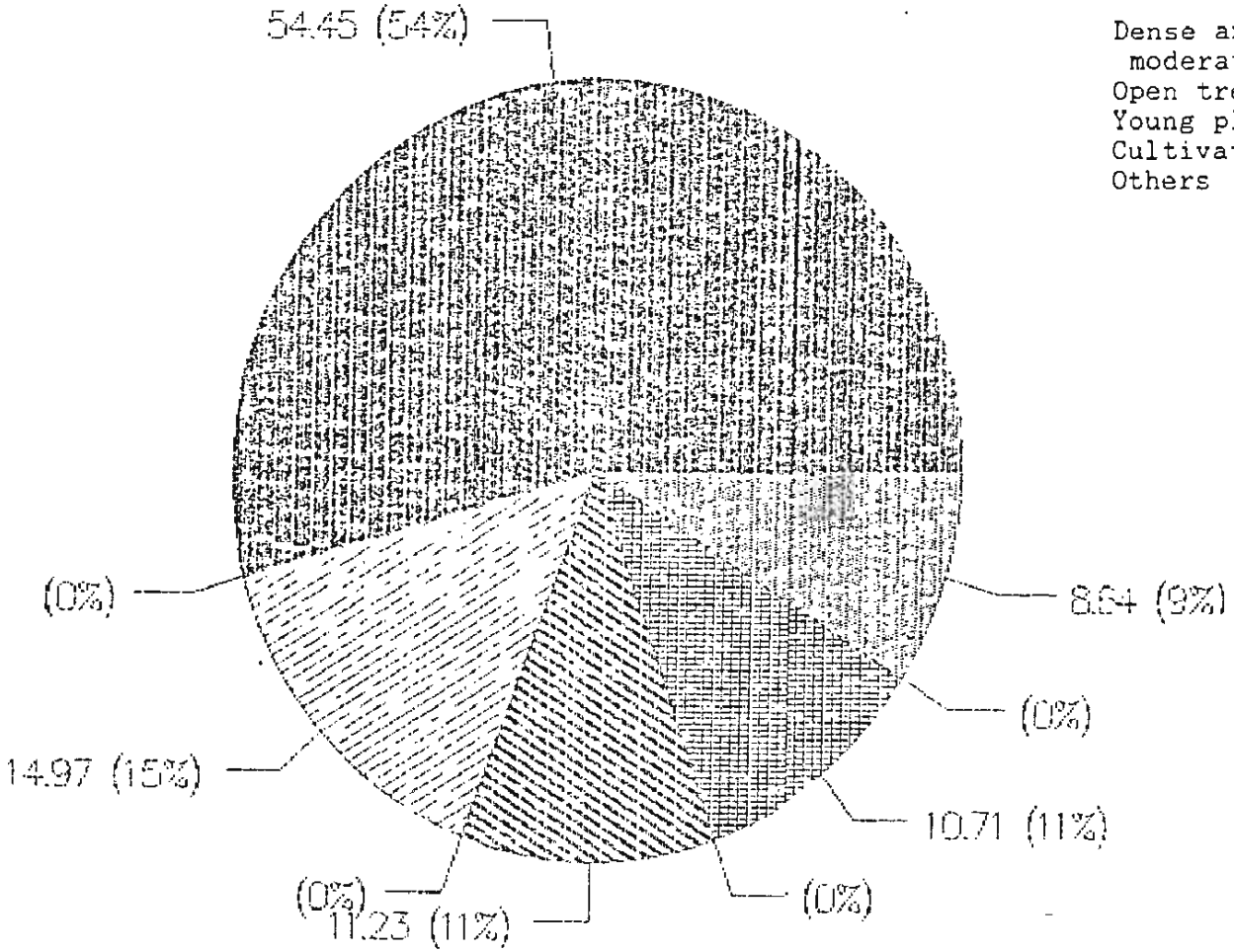
Table no. 5.1T given overleaf elaborates the various parameters of land use classes and their contribution to the total forest coverage of the District. The area bearing dense and moderately dense forest having density above 3Ø% is 3,376.54 km^2 constituting 54.45 percent of the wooded area. Open forest with density 5 to 3Ø% is confined to 928.15 km^2 reckoning to 14.97% of the wooded area. If both these areas are taken into account then 69.42 percent of the vegetated area is covered with forest of density above 5 percent.

TABLE 5.1T

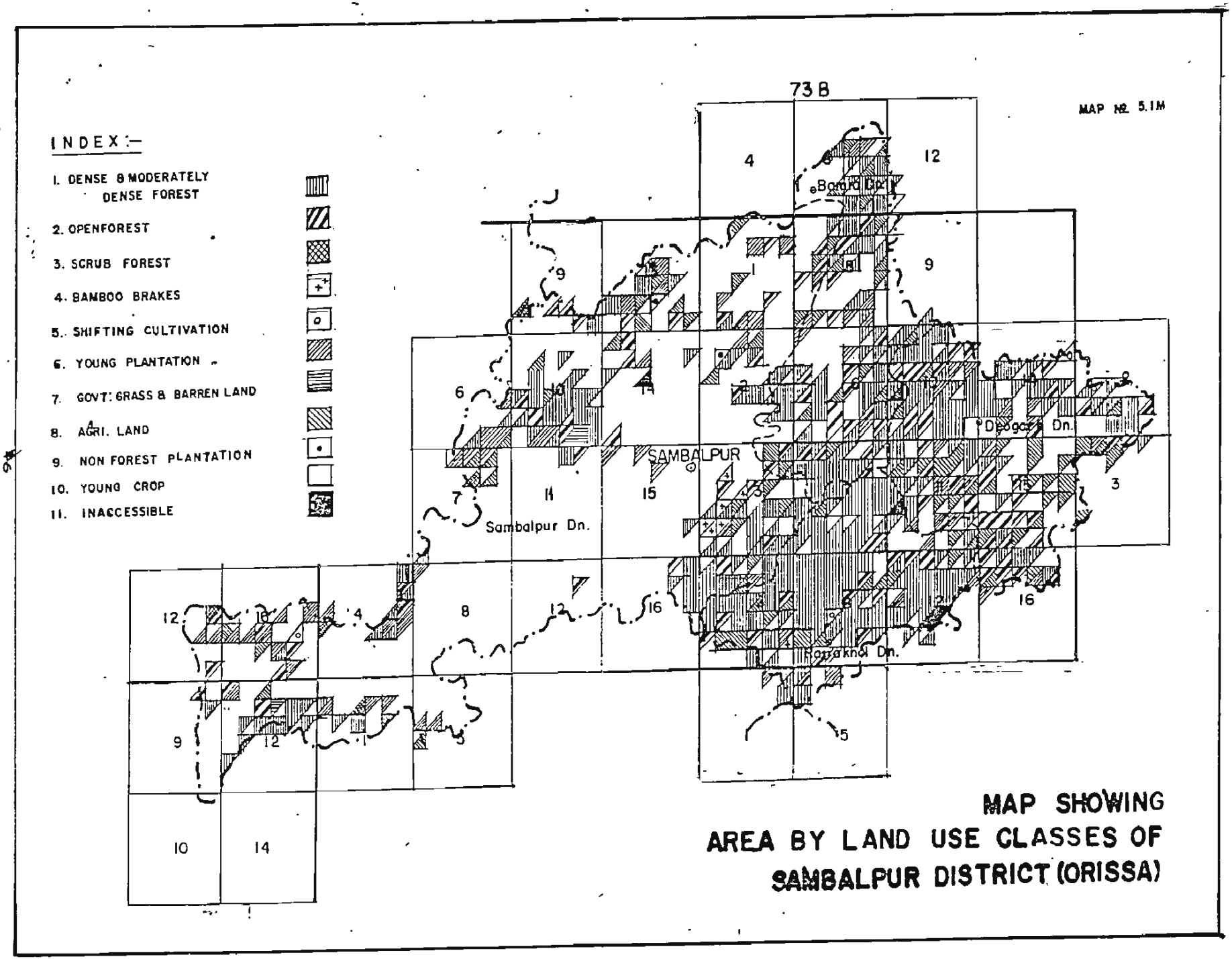
DISTRIBUTION OF AREA BY LAND USE CLASSES

Land use classes	No.of sample plots	Area (in km^2)	Percentage area
1	2	3	4
1. Dense and moderately dense forest(density above 30%)	422	3376.54	54.45
2. Open forest(density 5 to 30%)	116	928.15	14.97
3. Scrub forest(density below 5%)	02	16.00	0.25
4. Bamboo brakes	11	88.01	1.42
5. Shifting cultivation	02	16.00	0.25
6. Young plantation	87	696.12	11.23
7. Government grass land	01	8.00	0.13
8. Cultivation	83	664.11	10.71
9. Water bodies	12	96.02	1.55
10.Habitation	10	80.01	1.29
11.Non forestry plantations	04	32.01	0.52
12.Young crop	18	144.02	2.33
13.Inaccessible	07	56.01	0.90
Total:	775	6201.00	100.00

DISTRIBUTION OF AREA BY LAND USE CLASSES



Dense and moderately dense	54.45%
Open tree forest	14.97%
Young plantation	11.23%
Cultivation	10.71%
Others	8.64%


73 B
MAP No. 5.1M
INDEX :-
1. DENSE & MODERATELY DENSE FOREST
2. OPENFOREST
3. SCRUB FOREST
4. BAMBOO BRAKES
5. SHIFTING CULTIVATION
6. YOUNG PLANTATION
7. GOVT: GRASS & BARREN LAND
8. AGRI. LAND
9. NON FOREST PLANTATION
10. YOUNG CROP
11. INACCESSIBLE
SAMBALPUR
Sambalpur Dn.
Deogarh Dn.
Rairakhol Dn.
MAP SHOWING
AREA BY LAND USE CLASSES OF
SAMBALPUR DISTRICT (ORISSA)

Contents

Scrub forest contributes to a negligible extent of Ø.25%. Bamboo brakes are found over an area of 88.Ø1 km^2 constituting 1.42 per cent. Shifting cultivation is also observed over an area of 16.ØØ km^2 forming Ø.25% to total. Young plantations are found over an area of 696.12 km^2 constituting 11.23%. Government grass lands exist to a negligible extent constituting only Ø.13 percent. Barren lands are not noticed. Cultivable land is found over 664.11 km^2, constituting 1Ø.71%. Non forestry plantations are observed over 32.Ø1 km^2, young crop is found over 144.Ø2 km^2 i.e. over 2.33% area, and inaccessible area, which is generally found with substantial forest growth but could not be approached on account of various physical constraints such as steep terrain, etc. have an extent of over 56.Ø1 km^2.

Map no. 5.1 M shows the pattern of land use in Sambalpur district. It is seen that forest area in general is much more in the eastern half of the district, North-eastern and Western corners sharing forests in blocks.

5.2 AREA BY CROP COMPOSITIONS

For classification of vegetated area under differnt parameters, two major forest types have been recognized after post stratification of sample plots was done according to the forest crop found in two ha area around the plot centre. The two types are : (i) Sal (including teak) forests and (2) Miscellaneous forests inclusive of bamboos and Salai. Similarly for parameters i.e. topography classes, slope classes, soil depth classes, top height classes, size classes, and canopy layers, vegetated area only has been taken in to account as it is the target area for future planning and prescriptions. Therefore no. of sample plots reckoned for the above parameters was 654, representing an area of 5232.84 km^2. The vegetated area considered thus is 84.39% of the total area of 62Ø1 km^2 taken into account for this survey. Table no. 5.2T below shows area under the two major forest types:

TABLE NO. 5.2T

BREAK UP OF FOREST AREA BY FOREST TYPES

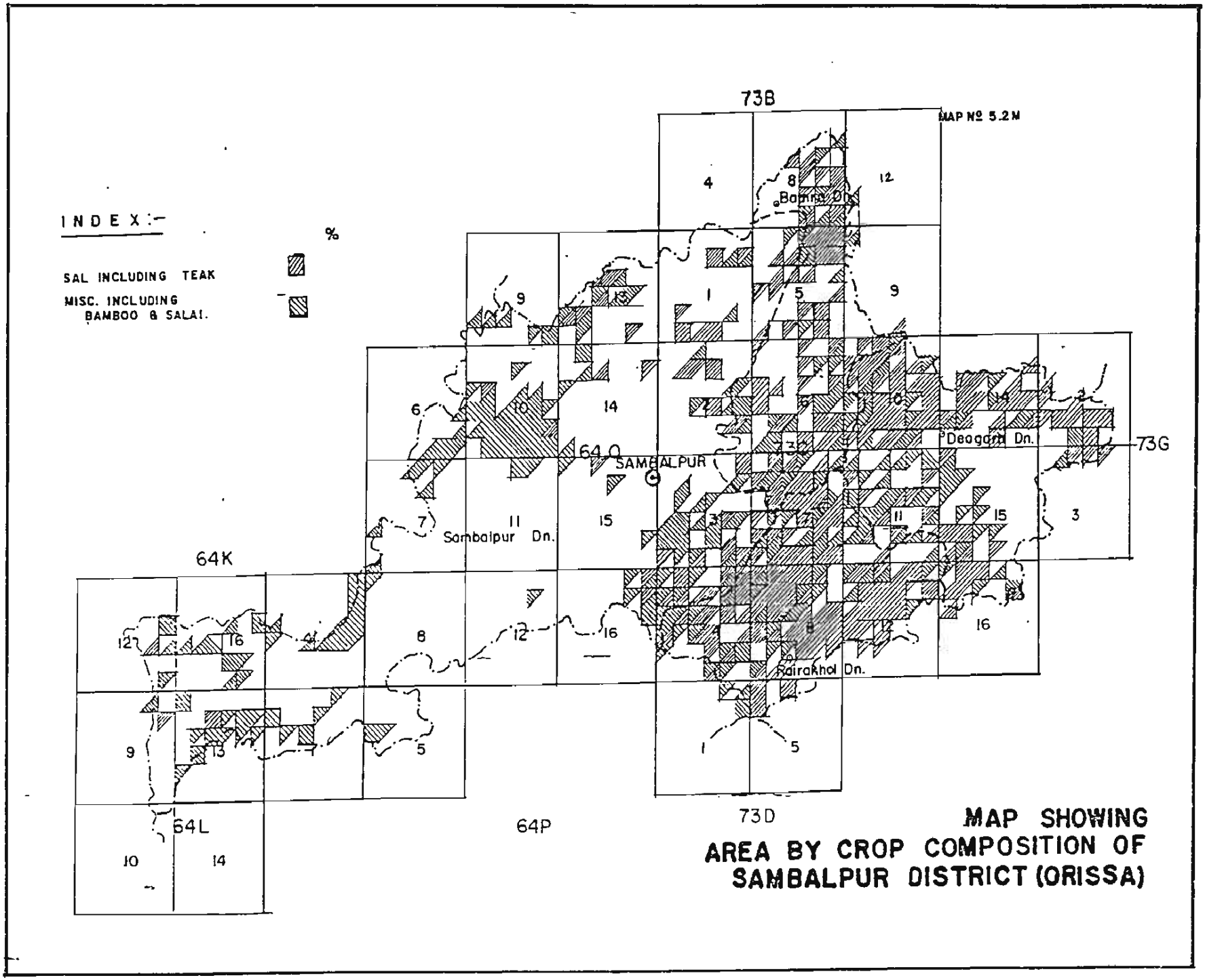
Forest type	No. of sample plots	Area in km^2	Percentage of area
Sal (including Teak) (11 + 10)	335	2680.43	51.22
Miscellaneous (Bamboo + Salai)(20+12+18)	319	2552.41	48.78
Total	654	5232.84	100

It is seen that Sal forest type and Miscellaneous forest type are more or less in equal proportion, the former being 51.22% and the latter being 48.78%. Teak, Salai and bamboo types were not identified separately as their extent is meagre.

Map no. 5.2M illustrates the pattern of forest types found in Sambalpur District. It is seen that the western half of the District has mostly Miscellaneous forests whereas the eastern half has preponderance of Sal forests intersperced with Miscellaneous forest type. Thus Sambalpur Division has Miscellaneous forests while Deogarh, Bamra and Rairakhol Divisions have Sal forests in general, the last named having better representation. Concentration of forest cover is clearly brought out in this map.

5.3 AREA BY CROP COMPOSITION AND TOPOGRAPHY CLASSES

Table no. 5.3T produced below gives distribution of forest crop according to the general topography of the District. The hilly region contains maximum forest crop spread over 3208.52 km^2 (61.32% of the total area). This is followed by flat topography region sustaining tree cover over 1112.18 km^2, (21.25%). Gently rolling area supports forest crop over


INDEX :-
%
SAL INCLUDING TEAK
MISC. INCLUDING BAMBOO & SALAI.
MAP No 5.2 M
73B
73G
73D
64K
64L
64P
64O
SAMBALPUR
Sambalpur Dn.
Deogarh Dn.
Bamra Dn.
Rairakhol Dn.
MAP SHOWING
AREA BY CROP COMPOSITION OF
SAMBALPUR DISTRICT (ORISSA)

896.14 km^2(17.13%) and very hilly region is confined to only 8 km^2 (Ø.15%). In the hilly region Sal stratum is spread over 1472.24 km^2 and Miscellaneous is over 1736.28 km^2 constituting 45.89% and 54.12% respectively. Gently rolling topography has 44Ø.Ø7 km^2 area under Sal type and 456.Ø7 km^2 under Miscellaneous type, having 49.11% and 5Ø.89% respectively. Flat terrain has 76Ø.12 km^2 Sal forest and 352.Ø6 km^2 Miscellaneous forest corresponding to 68.35% and 31.65% respectively. Thus it is seen that percentage of Sal type vis-a-vis Miscellaneous type is more in flat lands and decreases as the terrain becomes rugged and hilly. Converse is true for Miscellaneous crop.

TABLE NO. 5.3T

Break up of forest area by forest types and topography classes

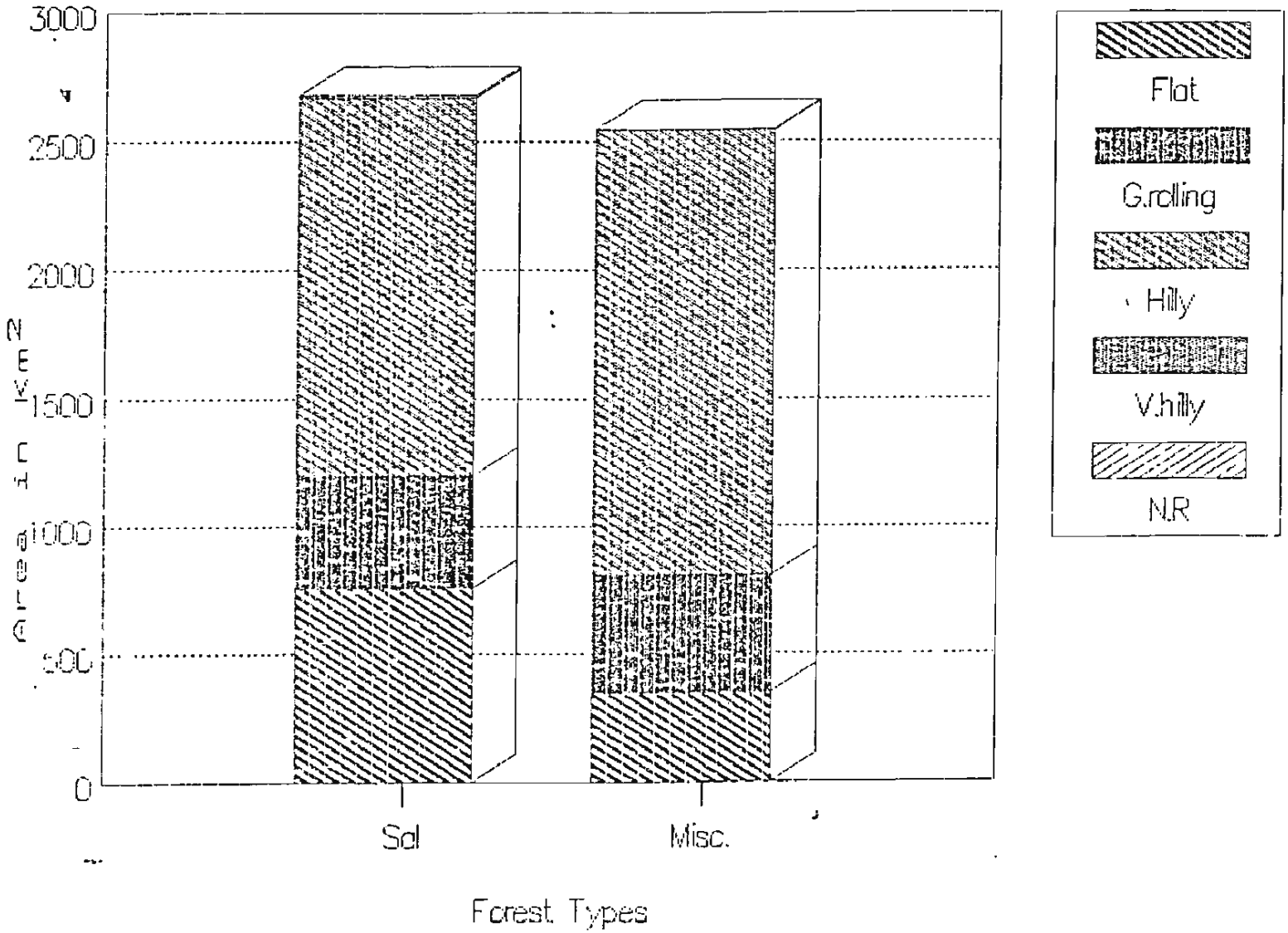
(Area in km^2)

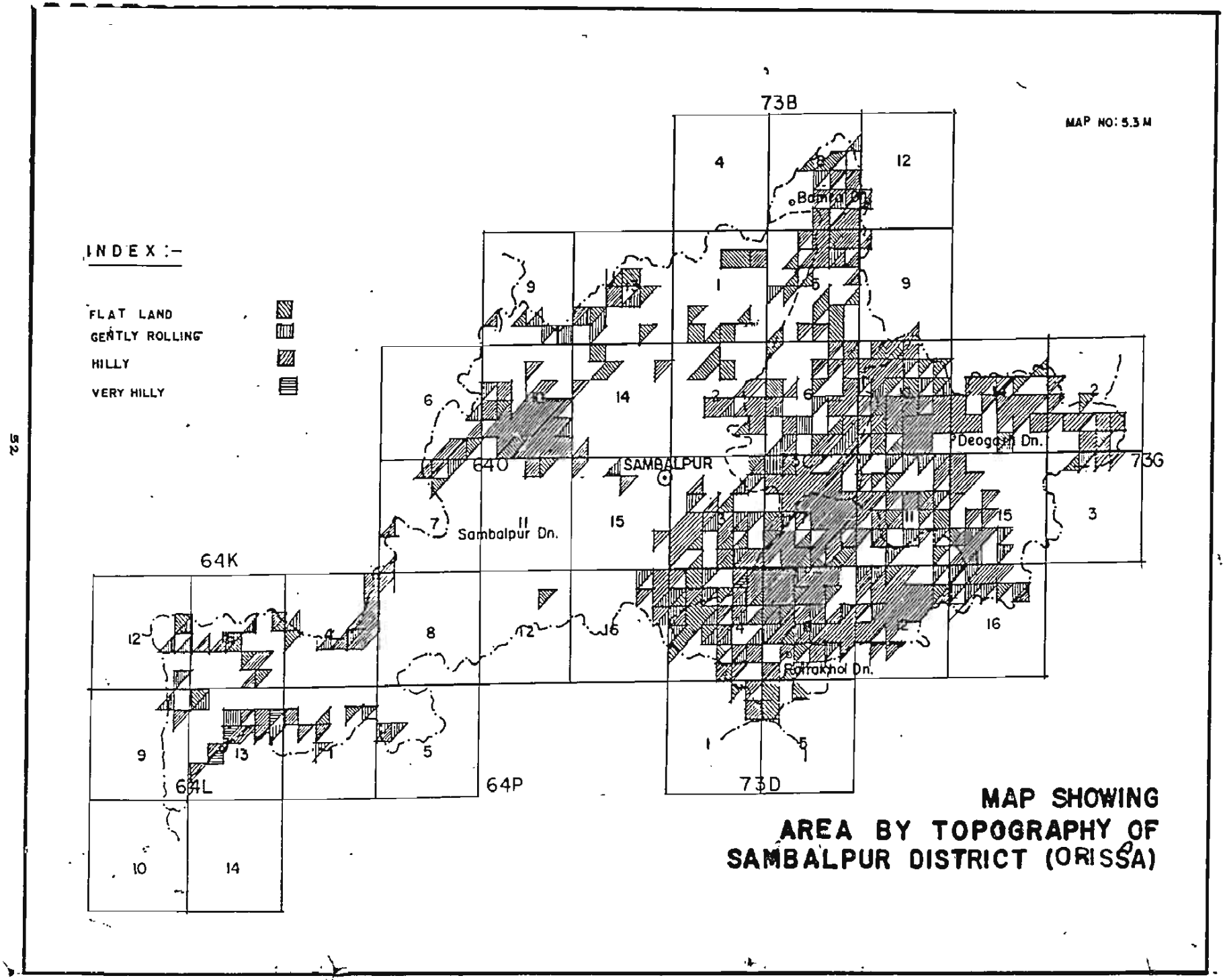
Sl. No.	Crop Composition	Topographyhy classes					
		Flat	Gently rolling	Hilly	Very hilly	N.R.	Total
1.	Sal forest	76Ø.12 (95)	44Ø.Ø7 (55)	1472.24 (184)	-	8.Ø (1)	268Ø.43 (335)
2.	Misc. forest	352.Ø6 (44)	456.Ø7 (57)	1736.28 (217)	8.Ø (1)	-	2552.41 (319)
	Total:	1112.18 (139)	896.14 (112)	32Ø8.52 (4Ø1)	8.Ø (1)	8.Ø (1)	5232.84 (654)
	%	21.25	17.13	61.32	Ø.15	Ø.15	1ØØ

Note: The figures in bracket denote number of plots.

Map no. 5.3M shows the location of various plots and their distribution according to topography classes. As may be seen from the map, hilly topography prevails over entire District followed by flat land.

BREAK UP OF FOREST AREA BY FOREST TYPES AND TOPOGRAPHY CLASSES




MAP NO: 5.3 M
INDEX :-
FLAT LAND
GENTLY ROLLING
HILLY
VERY HILLY
73B
64K
64O
64L
64P
73D
73G
SAMBALPUR
Sambalpur Dn.
Deogarh Dn.
Rairakhol Dn.
MAP SHOWING
AREA BY TOPOGRAPHY OF
SAMBALPUR DISTRICT (ORISSA)

5.4 AREA BY CROP COMPOSITION AND SLOPE CLASSES

Table 5.4T produced below gives distribution of forest crop according to the slope classes. The slope class varying from 10% to 60% possesses maximum forest crop spread over an area of 2768.45 km^2 i.e. 52.90% of the total area of 5232.84 km^2. Out of this area the Sal stratum (forest type Sal including Teak) is over an area of 1192.19 km^2 and Miscellaneous forest exists over 1576.26 km^2 correspnding to 43.06 and 56.94% respectively. This is followed by slope class of below 10% gradient found over 2344.37 km^2 forming 44.80% of the total area. This slope class sustains maximum Sal crop over an area of 1456.23 km^2 (62.12%) followed by Miscellaneous crop over 888.14 km^2 (37.88%). The forest area having gradient of above 60% is found over 120.02 km^2 only. The Sal crop is thinly distributed over this slope class i.e. over 32.01 km^2. However, Miscellaneous crop exists up to a fairly large extent of 88.01 km^2. The trend of occurrence of forest types is consistant with that of their topographywise distribution.

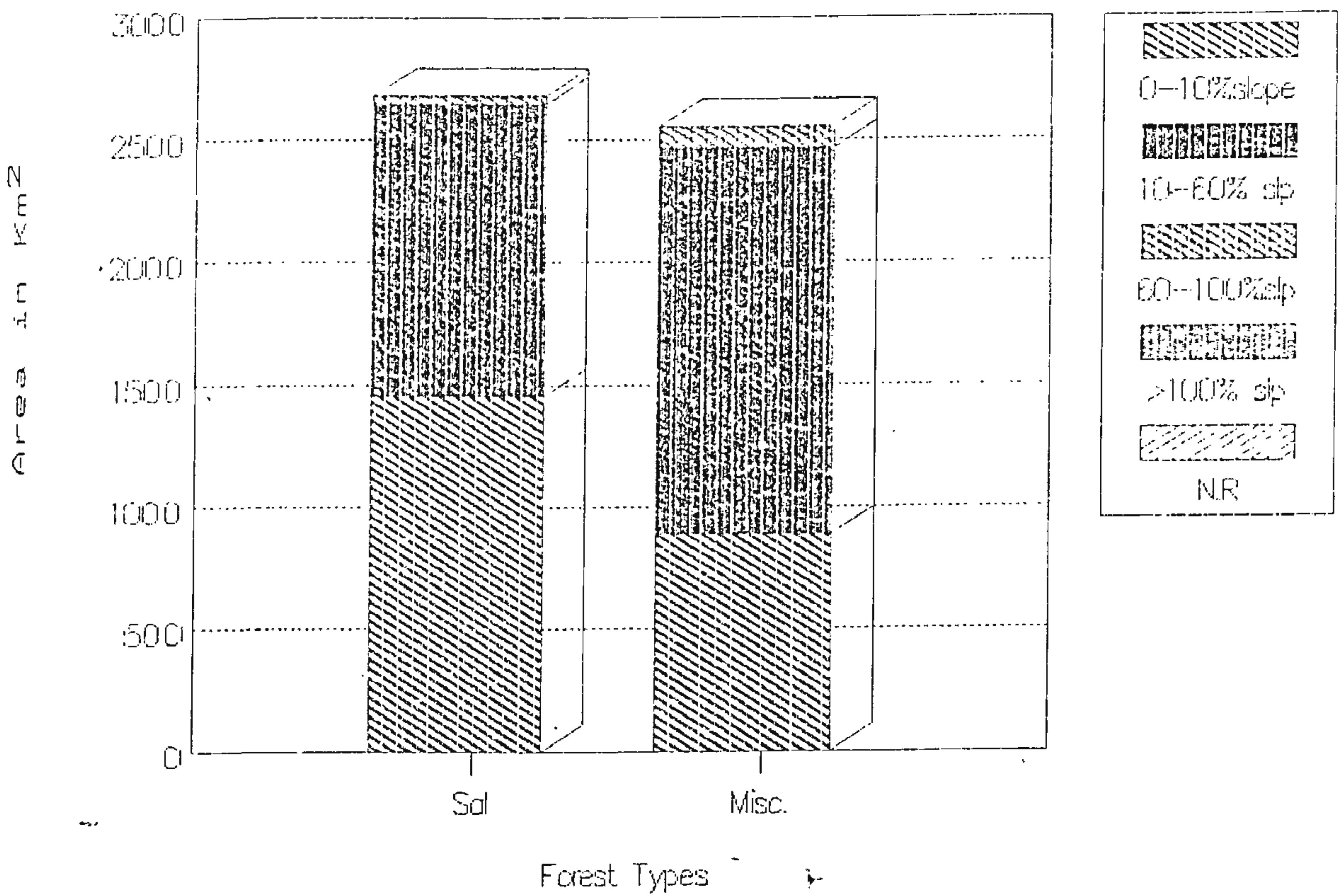
TABLE No. 5.4 T

Break up of tree forest area by forest types and slope classes

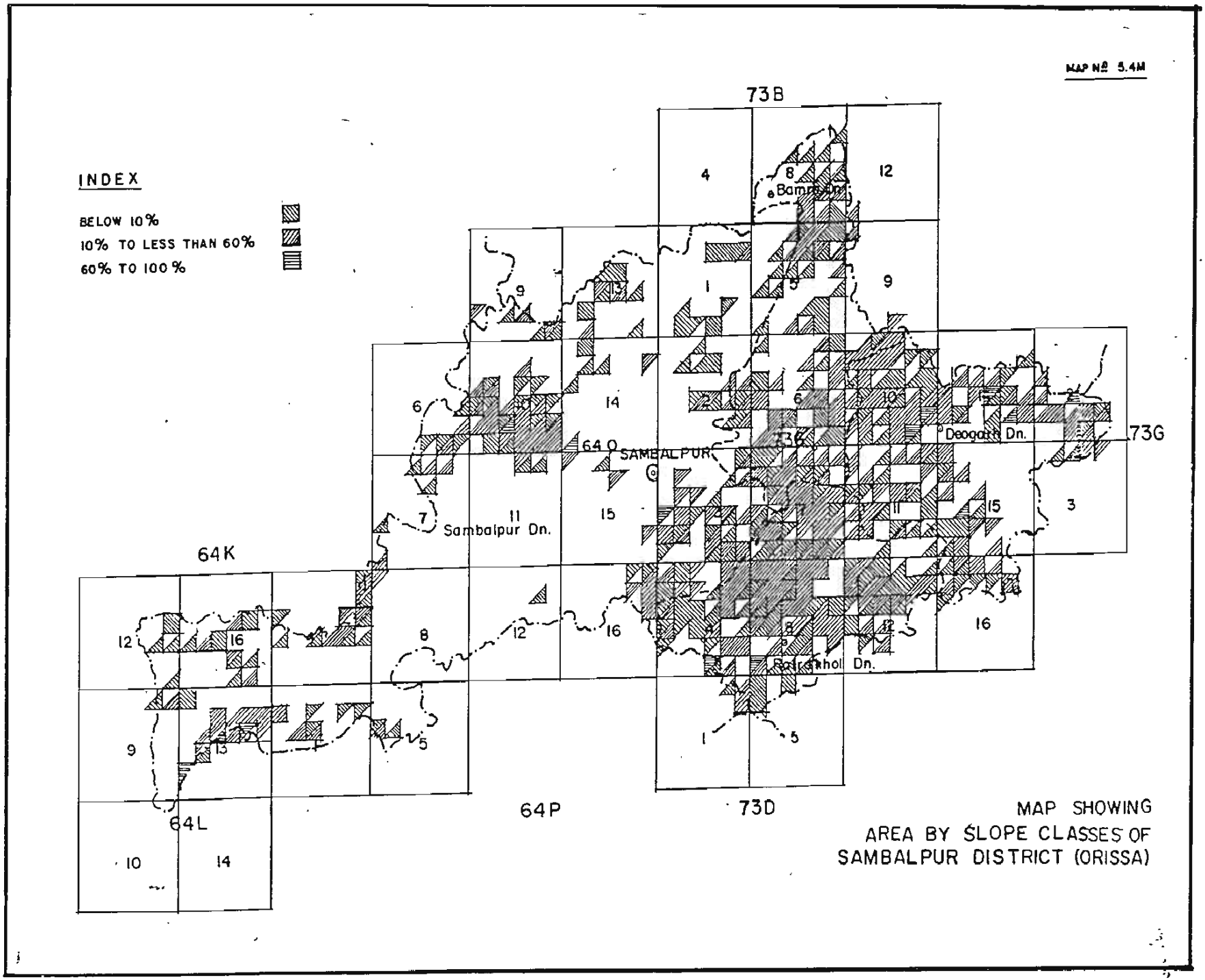
(Area in km^2)

Forest types	Slope classes						
	0-10%	10-60%	60-100%	100% above.	Not recorded.	Total	Percentage of area
Sal (10+11)	1456.23 (182)	1192.19 (149)	32.01 (4)	-	-	2680.43 (335)	51.22
Misc.	888.14 (111)	1576.26 (197)	88.01 (11)	-	-	2552.41 (319)	48.78
Total:	2344.37 (293)	2768.45 (346)	120.02 (15)	-	-	5232.84 (654)	100
%	44.80	52.90	2.30	-	-	100	

BREAK UP OF FOREST AREA BY FOREST TYPES AND SLOPE CLASSES



Contents


MAP No. 5.4M
INDEX
BELOW 10%
10% TO LESS THAN 60%
60% TO 100%
73B
64K
64L
64P
73D
73G
SAMBALPUR
Sambalpur Dn.
Deogarh Dn.
Bargarh Dn.
MAP SHOWING
AREA BY SLOPE CLASSES OF
SAMBALPUR DISTRICT (ORISSA)

Map no. 5.4M shows the distribution of forest area according to the slope classes of terrain. The map indicates that the predominant slope class throughout the District is between 10% to 60%. As a whole, forests in the District are confined to the terrain between 10% and 60% slope class, located in the Rairakhol and Deogarh forest Divisions. It is interesting to note that grids having slopes between 60% to 100% invariably support Miscellaneous vegetation.

5.5 AREA BY CROP COMPOSITION AND SOIL DEPTH CLASSES

Table no. 5.5T given below apprises about the distribution of forest area by soil depth. There are five classes that have been recognised i.e. (i) No soil (ii) Very shallow: Soil depth< 15 cm (iii) Shallow : Depth: 15 cm to 30 cm (iv) Medium deep soil, 30 cm to 90 cm (v) Deep > 90 cm.

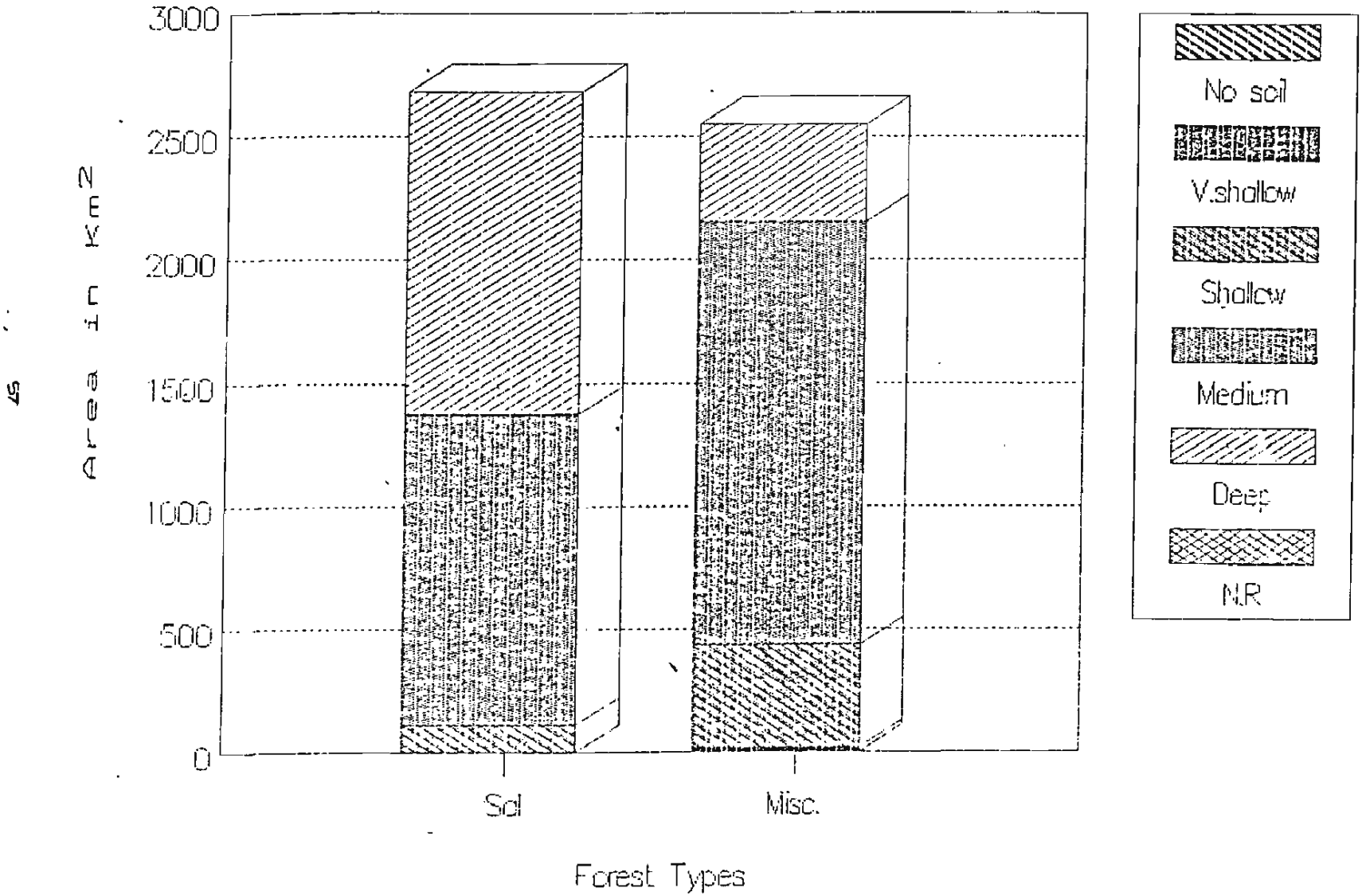
TABLE NO. 5.5T

Break up of tree forest area by forest types and soil depth classes.

(Area in km^2)

Forest Type	No soil	Soil depth classes					
		Very shallow	Shallow	Medium	Deep	Not recorded	Total	Percentage
Sal	-	-	112.02 (14)	1264.20 (158)	1304.21 (163)	-	2680.43 (335)	51.22
Misc	-	16.00 (2)	424.07 (53)	1712.28 (214)	400.06 (50)	-	2552.41 (319)	48.78
Total	-	16.00 (2)	536.09 (67)	2976.48 (372)	1704.27 (213)	-	5232.84 (654)	100

BREAK UP OF FOREST AREA BY FOREST TYPES
AND SOIL DEPTH CLASSES



It is seen from the table that 2976.48 km^2 area corresponding to 56.88% of the total forested area has medium deep soils whereas 17Ø4.27 km^2 area reckoning to 32.57% has deep soils. Shallow soils occur over 536.Ø9 km^2 i.e. 1Ø.24% and very shallow soils occur over only 16 km^2 area with a meagre percentage of Ø.31.

Most striking feature of this table is that in deep soils, Sal forms 76.53% of the crop corresponding to 13Ø4:21 km^2 area whereas Miscellaneous type constitutes 23.47%, being spread over 4ØØ.Ø6 km^2. Reverse trend is seen in shallow soils with Miscellaneous crop forming 79.1Ø% of the forest crop standing over 424.Ø7 km^2 and Sal type showing 2Ø.9Ø% with an area of 112.Ø2 km^2. In medium deep soils Sal is found over 1264.2Ø km^2 (42.47%) and Miscellaneous crop occupies 1712.28 km^2 (57.53%), Very shallow soils support only Miscellaneous vegetation over 16 km^2. It is thus clear that Miscellaneous crop hasnot been able to compete Sal out where deep soils occur in the District and conversely, Sal has lost ground where shallow soils exist. In medium deep soils also the Miscellaneous crop has an edge over Sal. The relationship between terrain, slopes and consequent erosion with that of forest types becomes amply clear. On slopes, wherever erosion becomes heavy due to various factors, soils must have lost depth with the result that degradation has set in and drier type of vegetation has replaced Sal.

5.6 AREA BY CROP COMPOSITION AND TOP HEIGHT CLASSES

Table no. 5.6T produced overleaf gives the distribution of forest area by top height classes. The classes have been fixed at an interval of 5 metres.

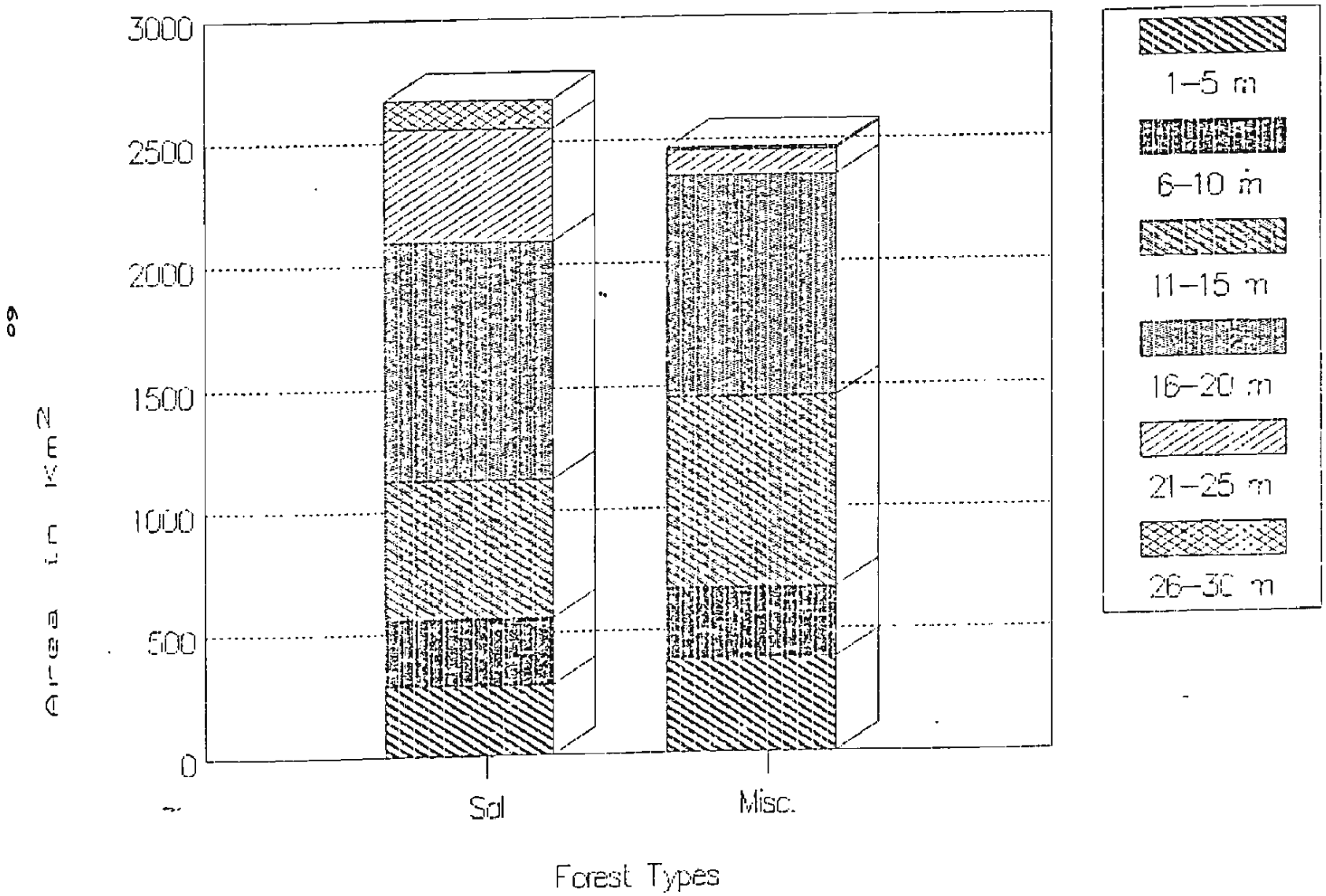
TABLE NO. 5.6T

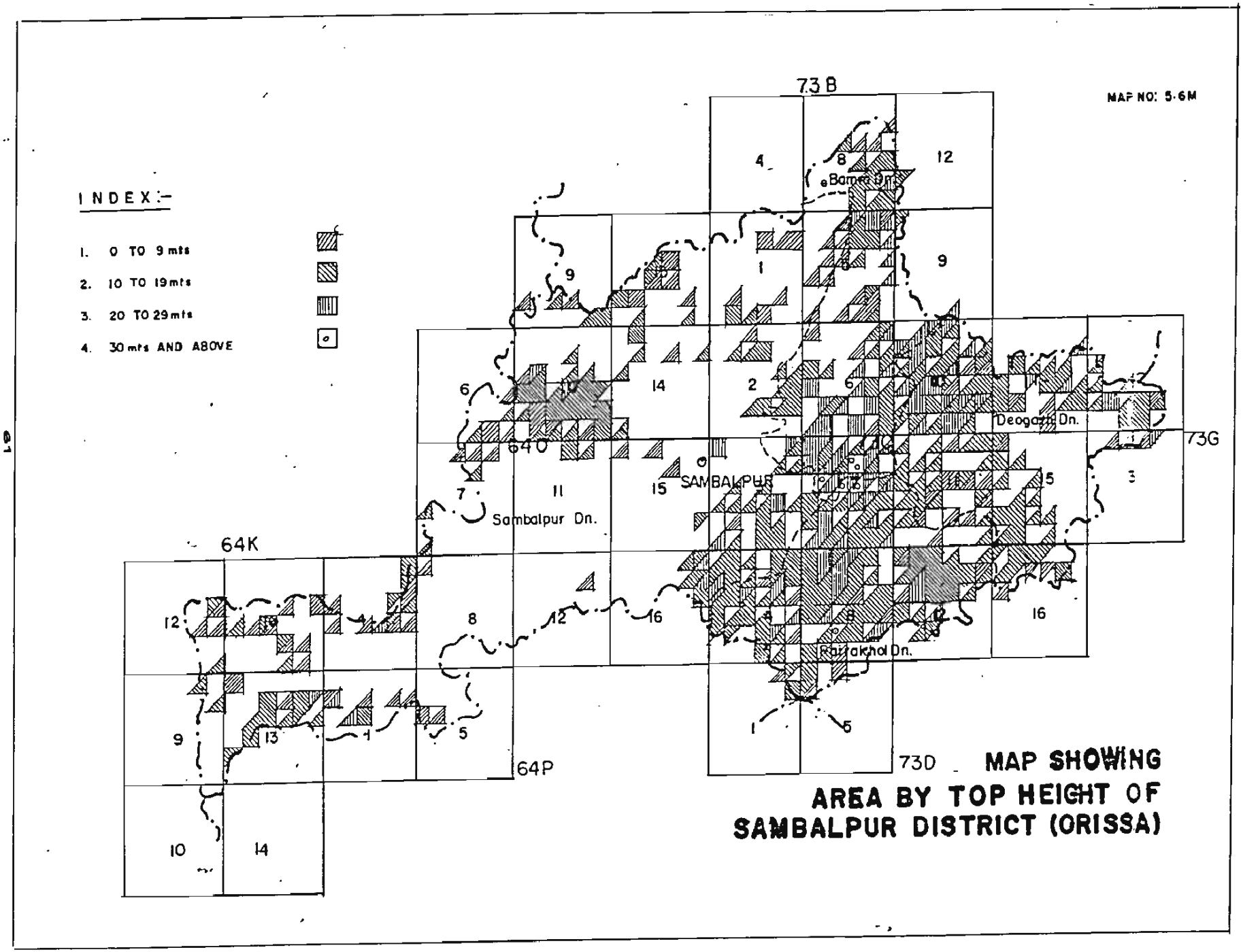
Break up of forest area by forest types and top height classes

(Area in km^2)

Forest types	Top height classes in metres(m)							Total	Not recorded	Percentage
	1-5	6-10	11-15	16-20	21-25	26-30	30+			
Sal	288.05	272.04	568.09	968.16	456.07	120.02	8.00	2680.43	-	51.22
	(36)	(34)	(71)	(121)	(57)	(15)	(1)	(335)		
Per-cent	42.86	48.57	42.01	51.93	81.43	93.75	100			
Misc.	384.06	288.05	784.13	896.14	104.02	8.00	-	2552.41	88.01	48.78
	(48)	(36)	(98)	(112)	(13)	(1)		(314)	(11)	
per-cnet	57.14	51.43	57.99	48.00	18.57	6.25				
Total	672.11	560.09	1352.22	1864.30	560.09	128.02	8.00	5232.84	88.01	100
	(84)	(70)	(169)	(233)	(70)	(16)	(1)	(654)	(11)	
Per-cent	12.84	10.70	25.85	35.63	10.70	2.45	0.15			1.68

BREAK UP OF FOREST AREA BY FOREST TYPES
AND TOP HEIGHT CLASSES




MAP NO: 5-6M
INDEX:-
1. 0 TO 9 mts
2. 10 TO 19 mts
3. 20 TO 29 mts
4. 30 mts AND ABOVE
73 B
73G
73D
64K
64P
64O
SAMBALPUR
Sambalpur Dn.
Deogarh Dn.
Bamra Dn.
Kuchinda Dn.
MAP SHOWING
AREA BY TOP HEIGHT OF
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Contents

It is seen from Table No. 5.6T on the preceding page that the largest contributor is the top height class 16 to 2Ø m, constituting 35.63% to the total forest area and whithin the class, distribution of Sal is 51.22% and of Miscellaneous it is 48.78%. Next top height class is 11 to 15 m, constituting 25.85% of total forest area. In Sal stratum this height class contributes about 42.Ø1% and in Miscellaneous it is 57.99%. Both these top height classes taken together form 61.48% forest crop. Thus majority of forest crop is between 11 to 2Ø m height. Height beyond 31 m is insignificant and found over only 9 km^2. Top height class 21-25 m, which forms 1Ø.7Ø% area has high concentration of Sal forest (81.43%). Similarly top height class 26-3Ø m, forms 2.45% of the total area, has 93.75% Sal forest in it. Young crop of 1 to 5 m height has considerable existance over 672.11 km^2 consisting 12.84% of the total forest area.

Map no. 5.6M depicts the distribution of top height classes over entire District. Whereas the top height class 1Ø m to under 2Ø m is found to be evenly spread over entire forest area of the District, the top height class 2Ø m to under 3Ø m is restricted to the eastern part of Rairakhol, Bamra and Deogarh divisions. The top height class Ø to 1Ø m also has got even distribution over the entire forest area of the District, except Rairakhol division.

5.7 AREA BY CROP COMPOSITION AND SIZE CLASSES

Table no. 5.7T overleaf gives the distribution of forest area by size classes.

TABLE NO. 5.7 T

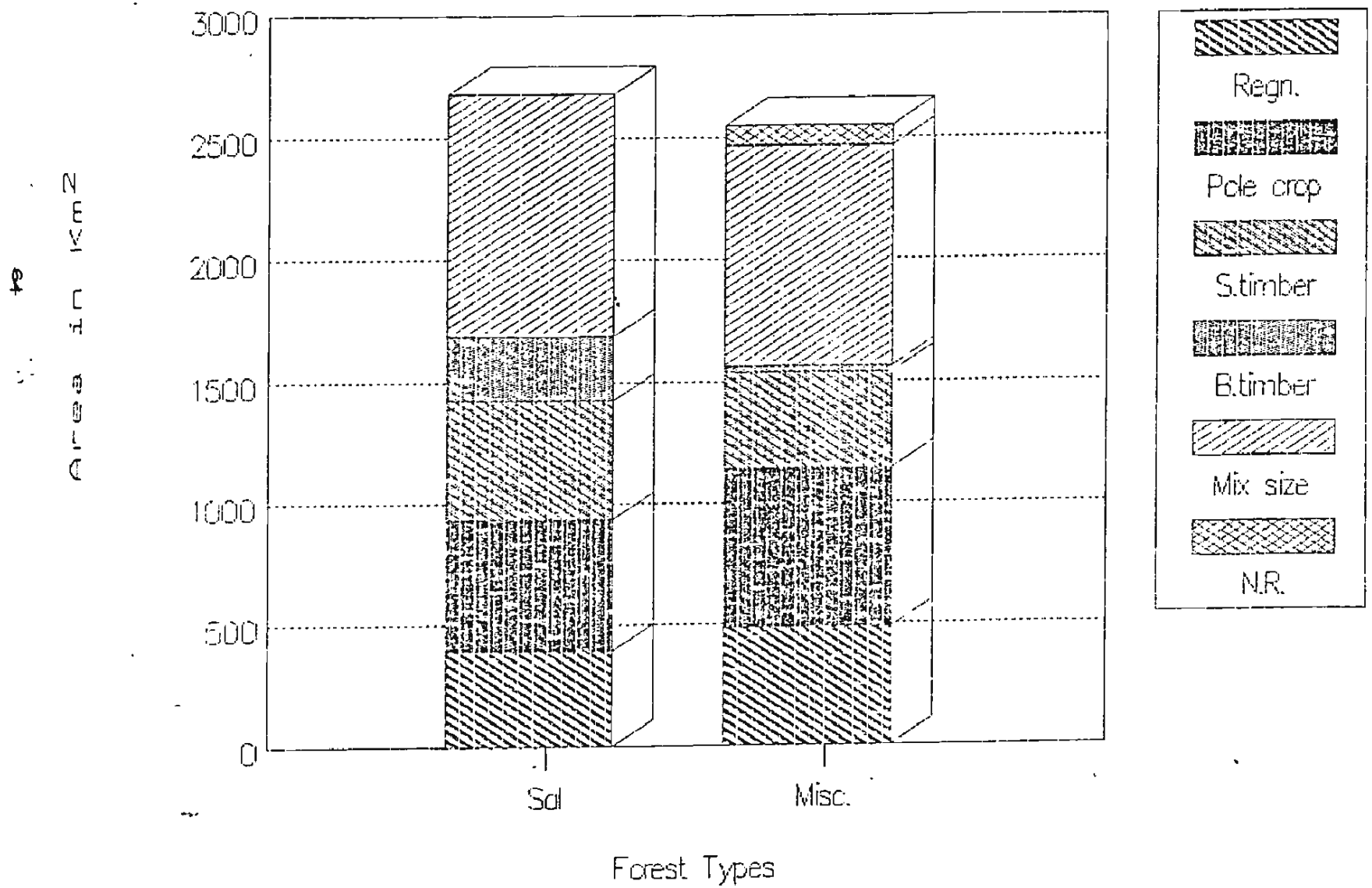
Break up of tree forest area by forest types & size classes.

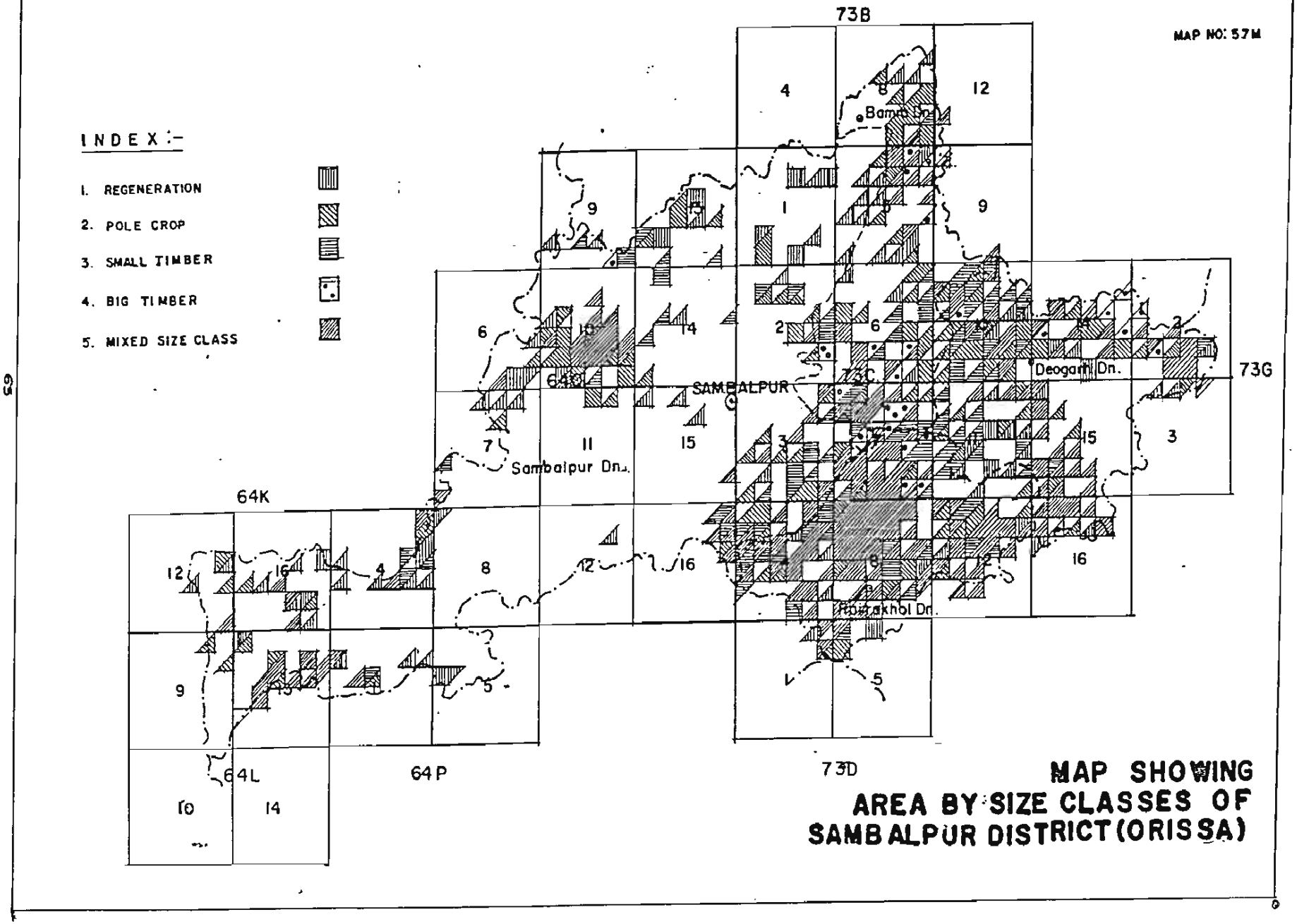
(Area in km^2)

Forest Types	Size classes.							
	Regeneration.	Pole crop	Small timber	Big timber	Mixed size classes.	N.R.	Total	Percentage
Sal	392.Ø6	544.Ø9	488.Ø8	264.Ø4	992.16	-	2680.43	51.22
	(49)	(68)	(61)	(33)	(124)		(335)	
Percent	44.55	45.33	55.45	91.67	52.32			
Misc.	488.Ø8	656.11	392.Ø6	24.ØØ	9Ø4.15	88.Ø1	2552.41	48.78
	(61)	(82)	(49)	(3)	(113)		(319)	
Percent	55.45	54.67	44.55	8.33	47.68			
Total	88Ø.14	12ØØ.2Ø	88Ø.14	288.Ø4	1896.31	88.Ø1	5232.84	1ØØ
	(11Ø)	(15Ø)	(11Ø)	(36)	(237)	(11)	(654)	
Percent	16.82	22.94	16.82	5.5Ø	36.24	1.68		

Mixed size class is commonly observed in the entire forests of the District and constitutes 36.24% to the total forest area. The distribution in this class shows that Sal is 51.22% and Miscellaneous is 48.78%. Pole class, constituting 22.94% to the total forest area comes next, with its distribution among Sal stratum being 45.33% and Miscellaneous being 54.67%. Small timber category contributes to the extent of 88Ø.14 km^2 constituting 16.82% with its distribution in Sal being 55.45% and Miscellaneous being 44.55%. Big timber category contributes to only 288.Ø4 km^2 constituting 5.5%. 91.67% area in big timber category belongs to Sal type of forest. Small and big timber taken together form 22.32% and out of the total area of 1168.18 (88Ø.14+288.Ø4) km^2 comprising of these two categories, the distribution in Sal stratum is 64.38%, Miscellaneous being 35.62%. The regeneration crop exists over an area of 88Ø.14 km^2 constituting 16.82% of the total sample plots, sharing 44.55% and 55.45% distribution in Sal and Miscellaneous forests respectively. Cropwise areas, it can be seen, are almost similar in regeneration and pole

BREAK UP OF FOREST AREA BY FOREST TYPES
AND SIZE CLASSES




MAP NO: 57M
INDEX :-
1. REGENERATION
2. POLE CROP
3. SMALL TIMBER
4. BIG TIMBER
5. MIXED SIZE CLASS
73B
73C
73G
73D
64K
64L
64P
SAMBALPUR
Sambalpur Dn.
Deogarh Dn.
Bamra Dn.
Rairakhol Dn.
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crop category, signalling reduction in future pole crop in Sal area from 55% to 45%.

Map 5.7 M indicates pictorially the distribution of various size classes over the entire stretch of Forest area of the District. It indicates that the pole crop, and regeneration crop are evenly distributed over entire stretch of the District and on the other hand the big timber, small timber and mixed size classes are mainly confined to the eastern region comprised of Bamra, Rairakhol and Deogarh divisions. Big timber is noticed along the division border of Bamra and Rairakhol. Similarly greatest agglomeration of mixed size class is seen in Rairakhol Division.

5.8 AREA BY CROP COMPOSITION AND CANOPY LAYERS

Table no.5.8T given over leaf shows the distribution of forest area by canopy layers.

TABLE NO. 5.8T

Break up of tree forest area by forest type and canopy layer

(Area in km^2)

Forest Types	Canopy layers						
	No storey	One storyed forest	Two storyed forest	Three or more storyed forest.	Not recorded	Total	Percentage
Sal	336.Ø5 (42)	528.Ø9 (66)	18ØØ.29 (225)	-	16.ØØ (2)	268Ø.43 (335)	51.22
Percent	44.68	51.16	53.83				
Misc.	416.Ø7 (52)	5Ø4.Ø8 (63)	1544.25 (193)	-	88.Ø1 (11)	2552.41 (319)	48.78
Percent	55.32	48.84	46.17				
Total	752.12 (94)	1Ø32.17 (129)	3344.54 (418)	-	1Ø4.Ø1 (13)	5232.84 (654)	1ØØ
Percent	14.37	19.72	63.92		1.99		

The forests of the District are predominantly two storeyed, spread over an area of 3344.54 km^2 constituting 63.92%. The distribution of Sal type is over 51.22% and Miscellaneous is 48.78%. One storeyed forests are 19.7% with almost equal percentage distribution in each stratum i.e. 51.16% in Sal and 48.84% in Miscellaneous. Forests without forming any storey or young crop constitutes 14.4% having distribution in Sal and Miscellaneous with 44.68% and 55.32% respectively.

5.9 AREA ESTIMATED FOR PLANTATION

Areas suitable for raising artificial forests, have been assessed as those areas which have forest crop either with less than Ø.3% crown density or are devoid of any forest growth. Due consideration then has been given to the aspects, soil depth, drainage, crop in surrounding area and other biotic and climatic factors while determining the potentiality of an area for raising a forest plantation. The maximum permissible slope upto which plantation could be raised has been taken as 4Ø degrees. The plantable area in the District is found to be to the tune of 1128.18 km^2 constituting 92.76% of the total open areas of 1216.19 km^2. The area not found suitable for plantation is 88.Ø1 km^2 constituting 7.24%).

TABLE NO. 5.9T

Estimated Plantable area in(km^2)

Land use	No. of plots	Area (km^2)	Percentage
Plantable area	141	1128.18	92.76
Unplantable area	11	88.Ø1	7.24
Total ...	152	1216.19	1ØØ

5.1Ø REGENERATION STATUS

Regeneration status of any forest fairly indicates its health. The data to assess the regeneration status of the forest were also collected from the forested grids of Sambalpur. For this purpose data from a square plot of 16 m^2 (4m x 4m) around plot centre were collected for economically important species which had attained diameter between 2 to 1Ø cm dbhob. The extent of regeneration was noted as profuse, adequate, inadequate , absent and damaged regeneration as below:-

1.	More than 16 seedlings	Profuse
2.	8 - 16 seedlings	Adequate
3.	Upto 8 seedlings	Inadequate
4.	No regeneration	Absent
5.	Regeneration damaged by grazing/fire	Damaged regeneration.

The data were collected for the important species found commonly in the region i.e. Accacia catechu, Adina cordifolia, Albizzia species, Anogeissus latifolia, Salmalia malabaricum, Boswellia serrata, Dalbergia latifolia., Dalbergia sissoo, Diospyros melanoxylon, Eucalyptus species, Garuga pinnata, Gmelina arborea, Lagerstroemia parviflora, Lannea coromandelica, Mitragyna parvifolia, Ougeinia oojeinensis, Pterocarpus marsupium, Shorea robusta, Syzigium cuminii, Schleichera oleosa, Terminalia crenulata, Terminalia bellirica, Terminalia chebula, Terminalia arjuna and Tectona grandis. Regeneration status is tabulated below:-

TABLE NO. 5.1ØT

Break up of area by regeneration

Items	No. of sample plots	Area in km^2	Percentage
Dense	8	64.Ø1	1.22
Medium	4Ø5	324Ø.52	61.83
Scattered	242	1936.31	36.95
Total	655	524Ø.84	1ØØ

Adequate regeneration, as observed in 655 plots, is over 61.83% area, i.e. 324Ø.52 km^2 followed by inadequate regeneration in 1936.31 km^2 constituting 36.95%. Profuse regenration is seen over 64.Ø1 km^2 constituting only 1.22%. It is thus seen that over about 37% of area regeneration status is not satisfactory and can be directly linked with grazing incidence.

5.11 SOIL EROSION

The term soil erosion indicates wearing away of the earth's surface by forces of water and wind. This factor is assessed on the basis of predominent type of erosion occurring in 2 ha. area around the plot centre. Accordingly, occular estimation is made by classifying the extent of erosion into four categories. Heavy, where more than 75% of top soil is removed, and areas have deep gullies, ravines, landslip etc; moderate, where 25÷75% top soil appears to be washed away and mild gullies and rills are formed; mild, where slight sheet erosion and mild rill erosion exist, less than 25% of top soil appears to be washed away, and no erosion where the surface of the land is seen undisturbed.

TABLE NO. 5.11T

Break up of area by soil erosion by erosion classes

Erosion class	No. of sample plot	Area in km^2	Percentage
Mild erosion	2	16.ØØ	Ø.45
Moderate erosion	58	464.Ø8	12.92
Heavy erosion	389	3112.5Ø	86.63
Total :	449	3592.58	1ØØ%
Not recorded	326	26Ø8.42	
Grand Total	775	62Ø1.ØØ	

The assessment of soil erosion in the sample plots reveals that most of the forest area is under heavy soil erosion covering 3112.5Ø km^2 constituting 86.63% of the area surveyed for this aspect i.e. 449 plots. Moderately eroded areas are observed over an area of 464.Ø8 km^2 reckoning to 12.92%.

5.12 GRAZING INCIDENCE

An occular estimation of the grazing incidence is made by observing an area of 2 ha around the centre of the plot. The intensity of grazing is estimated by classifying the incidence into four categories. Heavy, where regular grazing causes absence of grass on the ground, regeneration is damaged by trampling of cattle, 5Ø to 75% of ground cover is lost, severe sheet erosion with occassional gullies is seen. Grazing is categorised as moderate when seasonal grazing causes lesser damage to regeneration, 25 to 5Ø% of ground cover is lost, but severe sheet erosion is present. Light grazing is termed for grazing damage, when occassional grazing indicated by hoof marks/ cattle droppings exist, adequate grass for grazing is available, less than 25% ground cover is lost but no degradation of soil is seen and no signs of grazing are visible.

Table 5.12 T produced below indicates the grazing incidence seen in the surveyed forest area. Grazing in Orrisa forests is allowed on payment of prescribed rates. Heavy grazing is seen affecting 1680.27 km^2 constituting 32.01% of the forested area of the District. No grazing is observed over an area of 1552.25 km^2 i.e. 29.58%. Medium grazing is seen over 824.13 km^2 i.e. 15.70% and light grazing is seen over an area of 1192.19 km^2 i.e. 22.71% area.

TABLE NO. 5.12T

Break up of area by grazing incidence

Items	No. of sample plots	Area in km^2	Percentage
1. Heavy grazing	210	1680.27	32.01
2. Medium grazing	103	824.13	15.70
3. Light grazing	149	1192.19	22.71
4. No grazing	194	1552.25	29.58
Total	656	5248.84	100

5.13 FIRE INCIDENCE

Fire incidence is assessed by occular estimation over an area of 2 ha around the sample plot centre. After estimation, the incidence is classified into four categories. Very heavy fire incidence is where fallen material and under growth are totally burnt, soil is charred and hardened and burning of base of trees and undergrowth affecting more than 50% of ground vegetation etc. are seen. Frequent fire incidence is termed for those areas where fire incidence occurs frequently, occasional fire is not an annual event of fire.and no fire is termed where aforesaid symptoms are found absent.

Table 5.13T given below indicates classwise fire incidence in forests of Sambalpur District.

TABLE NO. 5.13T

Area by Fire Incidence classwise

Items	No. of sample plots	Area in km^2	Percentage
Very heavy	-	-	-
Frequent	10	80.01	1.52
Occassional	254	2032.33	38.66
No fire	393	3144.51	59.82
Total ..	657	5256.85	100
Not recorded	118	944.15	
Grand Total	775	6201.00	

About 60% of the forest area spread over 3144.51 km^2 remains unaffected by fires, occassional fire is observed over 2032.33 km^2 i.e. over 38.66% area and frequent fire is observed over 80.01 km^2 i.e. 1.52% of the forest area.

5.14 OCCURRENCE OF BAMBOO

Occurrence of bamboo is observed occularly for estimation of bamboo over 2 ha area around the sample plot centre and indicated to show density, quality and flowering. The sample plots bearing Bamboo in Sambalpur were found to be 250 representing an area of 2000.32 km^2. Quality I bamboo i.e. Dendrocalamus strictus having average culm height more than 6 metres is seen over an area of 1568.25 km^2 which is 78.40% of total area covered with bamboos. Quality II with average culm height between 4 and 6 metres is observed over

216.Ø3 km^2 i.e. 1Ø.8Ø%. Quality III bamboo with height between 2-4m also exists over 56.Ø1 km^2 with a meagre percentage of 2.8Ø. Table no. 5.14T produced overleaf gives the details of occurrence of bamboo in Sambalpur. The bamboo crop occurs as an understorey in the forests of Sambalpur and its presence is observed mainly in the eastern part of the District belonging to Rairakhol and Deogarh divisions.

Density classification for bamboos as given in the field mannual for forest inventory is reproduced below:-

(a) Bamboo density (Col.62) — The density of the bamboo clumps of all species will be depicted using following code numbers:-

Code	Description
1	Pure bamboo- 2ØØ or more clumps/ha
2	Very dense - 15Ø-2ØØ clumps/ha
3	Dense - 1ØØ -15Ø clumps/ha.
4	Moderately dense - 5Ø-1ØØ clumps/ha
5	Scattered - 2Ø-5Ø clumps/ha
6	Sparse - 1Ø25 clumps/ha
7	Bamboo present but clumps completely hacked by people.
8	No bamboo - Bamboo totally absent
9	Regeneration crop - clump formation has not yet taken place.

Note:- Bamboo clump means an aggregate of culms issuing from the same rhizome system. (A clump would normally have more than one culm). A clump will be distinguished as an independent clump where its periphery is easily discernible from adjacent clumps irrespective of its distance from others. However, when such distinction is not possible two clumps within half metre distance will be recorded as one.

TABLE NO. 5.14T

Break up of Bamboo Area (km^2) by quality and Density wise

Quality/ Density	1	2	3	4	Total	Percentage
1	80.01 (10)	-	-	-	80.01 (10)	4.00
2	112.02 (14)	-	-	-	112.02 (14)	5.60
3	160.03 (20)	8.00 (1)	-	-	168.03 (21)	8.40
4	256.04 (32)	24.00 (3)	-	-	280.04 (35)	14.00
5	152.02 (19)	24.00 (3)	16.00 (2)	-	192.02 (24)	9.60
6	808.13 (101)	160.03 (20)	32.01 (4)	8.00 (1)	1008.17 (126)	50.40
7	-	-	8.00 (1)	152.03 (19)	160.03 (20)	8.00
Total	1568.25 (196)	216.03 (27)	56.01 (7)	160.03 (20)	2000.32 (250)	
%	78.40	10.80	2.80	8.00		

Map no. 5.14M gives the distribution of bamboo occurrence by density. Bamboo occurs on the east of Mahanadi river. In Sambalpur division, bamboo occurs in the south east corner, Northern part of this bamboo area has dense to moderate dense bamboo. Southern part having sparse and hacked bamboo. Very dense, dense and moderately dense bamboo is also observed along border of Bamra, Rairakhol and Deogarh divisions. Majority crop is hacked. More details on growing stock, yield etc. may be seen in Chapter VII on Bamboo growing stock.

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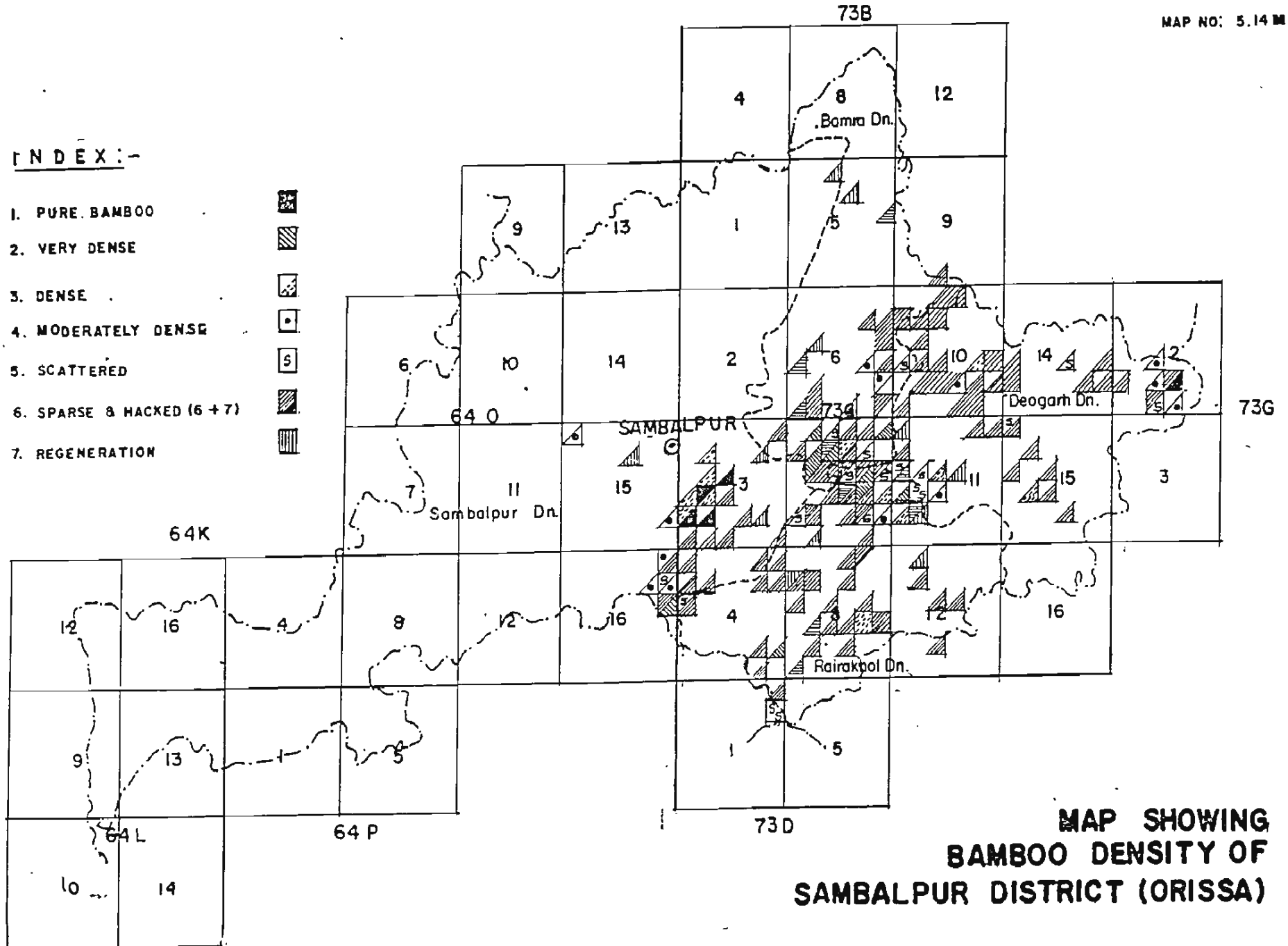
MAP NO: 5.14 M
INDEX :-
1. PURE BAMBOO
2. VERY DENSE
3. DENSE
4. MODERATELY DENSE
5. SCATTERED
6. SPARSE & HACKED (6 + 7)
7. REGENERATION
73B
73G
73D
64K
64L
64P
64O
SAMBALPUR
Bamra Dn.
Deogarh Dn.
Sambalpur Dn.
Rairakhol Dn.
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BAMBOO DENSITY OF
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CHAPTER VI

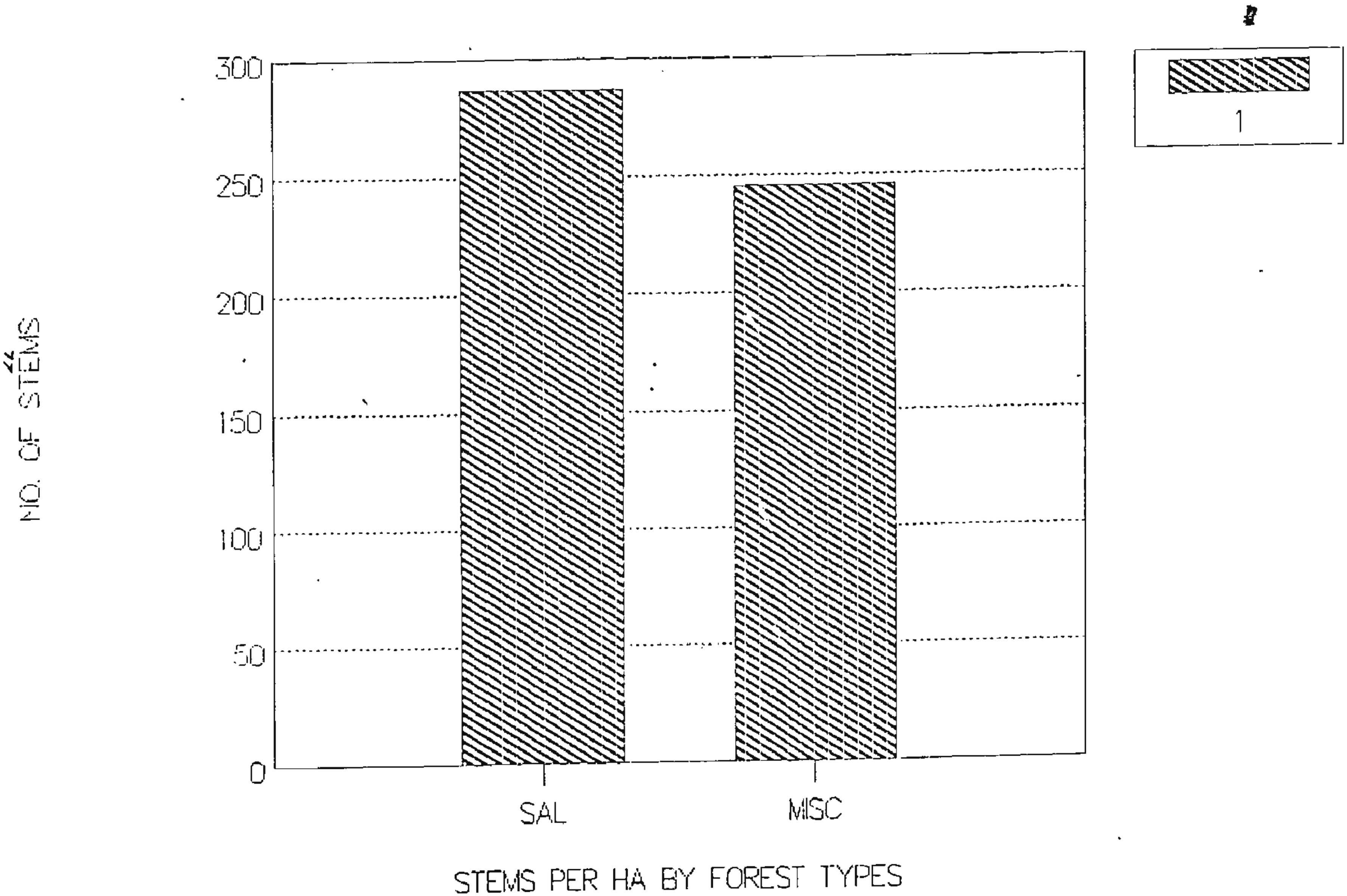
GROWING STOCK

6.Ø GENERAL

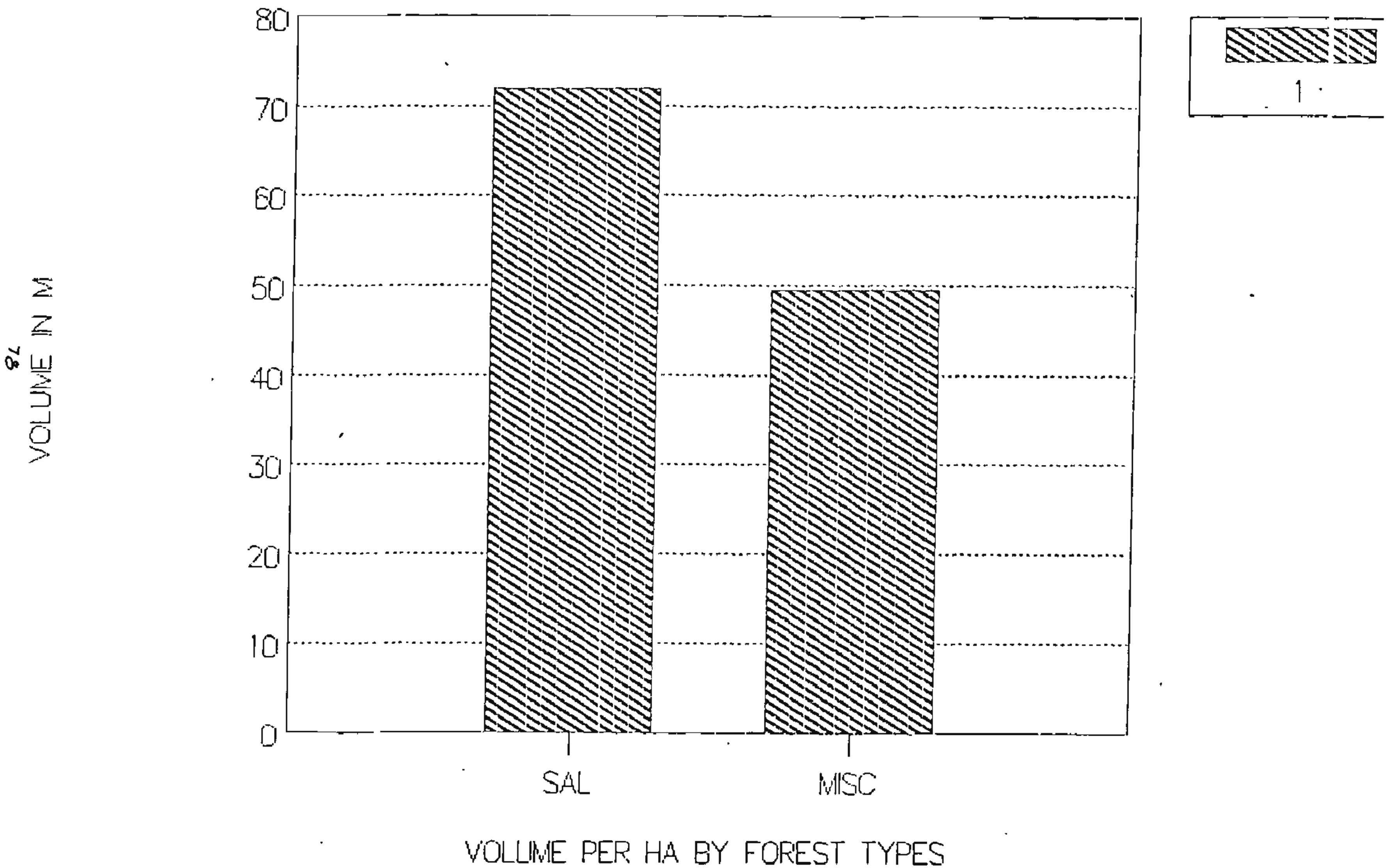
This Chapter deals with the results, in respect of growing stock, obtained after analysis of enumeration data. For this purpose data collected from 654 vegetated plots have been considered, leaving out 121 number of plots having no tree growth and hence of no use for estimation of growing stock. The data are presented for 2 strata i.e. Sal and Miscellaneous. A combined picture of entire forests inclusive of both these strata has also been given. The stratification of the forest area has been done on the basis of occurrence of Sal and other species in 2 ha surround of the centre point of the plot. In a sense, since stratification is done after collection of data, it is post-stratification. The data in the succeeding paragraphs are, accordingly, presented for different strata. After calculating the area under each stratum by giving weightage to the number of sample plots falling in it, the growing stock has been estimated in terms of no. of stems and volume for important species. The growing stock has been first calculated per ha and then total number of stems or total volume, as the case may be, were computed. Local volume equations derived from forest inventory undertqaken by this zone in Koraput District of Orissa in 1982-83 have been used, as due to ban on felling, trees could not be felled in Sambalpur during the inventory work.

Abstract of growing stock (stratum wise)in Sambalpur Distt.

Forest Type (Stratum)	No. of plots	Area in km^2	Stand	Stock		
			Stem/ha	Total (ØØØ)	Vol/ha m^3	Total Vol(ØØØ)m^3
SAL	335	268Ø.43	286.747	76860.516	71.949	19285.438
MISC	319	2552.41	245.5Ø3	62662.469	49.464	12625.282
TOTAL/Av	654	5232.84	266.569	139491.422	6Ø.949	31893.5Ø8


NO. OF STEMS
300
250
200
150
100
50
0
1
SAL
MISC
STEMS PER HA BY FOREST TYPES

Contents


VOLUME IN M
80
70
60
50
40
30
20
10
0
1
SAL
MISC
VOLUME PER HA BY FOREST TYPES

Contents

6.1 SAL STRATUM: STEMS PER HA AND TOTAL NO. OF STEMS

Specieswise and diameter class wise distribution of stems per ha and total stems is given in table no. 6.1T(A) and 6.1T(B). It is seen from the tables that number of stems per ha decreases as the diameter class ascends. Considering exploitable diameter of Sal at 40 cm, according to working plan prescriptions, majority of the crop is young, as 46.47% crop is in diameter class 10-15 cm and 20.50% is in 15-20 cm, total of both being 66.97%. Middle aged crop from 20 cm diamertre to 40 cm diameter is 29.24% and mature and over mature crop, the latter above 60 cm being negligible, account for 3.79%. It is seen that Sal forests have only 10.99 no.of trees per ha above 40 cm diameter, though Sal forms major share of 6.69 trees per ha. Of course, this is an average picture for the entire Sal area of 2680.43 km^2 and in blocks there are very good patches of forests with a fair amount of mature trees. However, while prescribing a silvicultural system utmost care needs to be taken to identify well stocked and poorly stocked areas.

Stems per ha and total no. of stems in the stratum by important species are given below:

S.No.	Name of species	No.of stems. per ha	Total no. of stems in Sal stratum. (no.in'000')	Percentage occurrence in total stand.
1.	Shorea robusta (Sal)	112.018	30026	39.06
2.	Terminalia crenulata(Saja)	25.181	6750	8.78
3.	Diospyros melanoxylon(Tendu)	18.946	5078	6.61
4.	Madhuca latifolia(Mahuwa)	12.922	3464	4.51
5.	Syzigium cuminii(Jamun)	8.765	2349	3.05
6.	Anogeissus latifolia (Dhaora)	7.681	2059	2.68
7.	Pterocarpus marsupium (Bija)	5.151	1381	1.80

8. Lannea coromandelica(Moyen)	4.578	1227	1.6Ø
9. Tectona grandis (Teak)	4.187	1122	1.46
1Ø.Lagerstroemia parviflora (Sidha)	2.41Ø	646	Ø.84
11.Others	84.9Ø8	22758	29.61
Total ..	286.747	76860	1ØØ%

Obviously, in Sal stratum Sal would have maximum representation, as in the present case, where no. of Sal stems per ha is 112.Ø18 with 39.Ø6% contribution in the total growing stock. Other species fall well below this stocking level, the next best to Sal being Terminalia crenulata with 25.181 stems per ha, reckoning to 8.78%. Kendu and Mahuwa follow as the third and the fourth species according to occurrence, having 18.946(6.61%) and 12.922 (4.51%) stems per ha respectively, showing potential of MFP. Teak has its presence because of teak plantations mostly, showing 4.187 stems per ha (1.46%) out of which 78.4Ø% stems are in diameter class 1Ø-15 cm.

6.2 MISCELLANEOUS STRATUM: STEMS PER HA AND TOTAL NO. OF STEMS

Species wise and diameter classwise occurrence of stems per ha and total no. of stems in Miscellaneous stratum are shown in table no. 6.2T(A) and 6.2(B). Total wooded plots enumerated in Miscellaneous stratum were 319, reckoning to an area of 2552.41 km^2. In this stratum also young crop predominates with diameter class 1Ø-15 cm showing 129.214 stems per ha reckoning to 52.63% and 15-2Ø cm diameter class representing 51.289 stems per ha i.e. 2Ø.89%. Total of these two classes add upto 73.52%. Considering exploitable diameter of Miscellaneous species being 3Ø cm, middle aged crop from 2Ø cm diameter to 3Ø cm diameter account for 43.774 stems totalling upto 17.83%. This shows that 91.35% crop is young to middle aged. Mature crop is only 8.65% of the total. Thus it is seen that in Miscellaneous stratum, no. of stems above exploitable diameter of 3Ø cm is 21.225 stems per ha. Total no. of stems in Miscellaneous stratum of important species found in this stratum, along with their percentages is shown overleaf.

S.No.	Name of species	No.of stems. per ha	Total no. of stems in Misc. stratum. in('ØØØ')	Percentage occurrence in total stand.
1.	Diospyros melanoxylon (Tendu)	17.642	45Ø3	7.19
2.	Terminalia crenulata(Saja)	13.3Ø2	3395	5.42
3.	Lannea coromandelica (Moyen)	12.673	3235	5.16
4.	Anogeissus latifolia (Dhawra)	11.918	3Ø42	4.85
5.	Shorea robusta (Sal)	1Ø.723	2737	4.37
6.	Lagerstroemia parviflora (Sidha)	1Ø.535	2689	4.29
7.	Pterocarpus marsupium (Bija)	6.352	1621	2.59
8.	Madhuca latifolia (Mahuwa)	5.912	15Ø9	2.41
9.	Boswelia serrata (Salai)	4.528	1156	1.84
1Ø.	Bridelia retusa (Kasi)	4.119	1Ø51	1.68
11.	Dalbergia latifolia (Sisam)	3.3Ø2	843	1.34
12.	Rest of the species	144.497	36881	58.86
	Total ..	245.5Ø3	62662	1ØØ%

It is observed that Kendu emerges as the single largest species with 17.642 stems per ha, reckoning to 7.19% of the total stand. Terminalia crenulata has 13.3Ø2 stems per ha and is 5.42%, Lannea coromandelica has 12.673 stems per ha and is 5.16%. Anogeissus latifolia has 11.918 stems per ha and a percentage of 4.85. Shorea robusta also makes an appearance with 1Ø.723 stems per ha, forming 4.37%. Another important timber species are Pterocarpus and Dalbergia latifolia with, 6.352 stems (2.59%) and 3.3Ø2 stems (1.34%) per ha. There are a total of 626,62,ØØØ trees in Miscellaneous stratum over an area 2552.4i km^2.

6.3 SAL STRATUM: VOLUME PER HA AND TOTAL VOLUME

Table no.6.3T(a) and 6.3T(b) give specieswise and diameter classwise distribution of volume per ha (m^3) and total volume (m^3), respectively. It is seen from the table of per ha volume that the volume is maximum in diameter class 25-3Ø cm with a volume of 1Ø.324 m^3 and sharing the highest percentage of 14.35 to the total volume. The next diameter class is 4Ø-5Ø having volume of 1Ø.Ø11 m^3 reckoning to 13.91% to the total.

A glance at the percentage figure in the tables mentioned above shows that volume has more or less equal distribution from diameter class 15-2Ø to 4Ø-5Ø. From diameter class 15-2Ø and above, it is observed that Sal shares maximum volume than that of the other species and that the cubical contents of Sal are more because of more number of trees in that particular diameter class. The volume table shows specieswise distribution of volume per ha and total volume as well as their percentage to the total volume. It is seen from the table overleaf seen that out of the total volume of 71.949 m^3 Sal has a regal share of 5Ø.88% while number two species is Saja with 6.697 m^3 with 9.31%. After Sal and Saja the next best species is Mahua with 4.534 m^3 per ha, sharing 6.3% of volume. Other important species are Kendu 3.785 m^3 (5.26%), Jamun 2.7Ø8 m^3 (3.76%), Anogeissus 2.414 m^3 3.36%, Bija 1.576 m^3 2.1Ø%, whereas rest of the species share 12.316 m^3(17.12%).

Sr.No.	Name of species	Vol.per ha in m^3	Total vol. in ØØØ m^3 (Rounded)	Percentage
1.	Shorea robusta (Sal)	36.611	9813	5Ø.88
2.	Terminalia crenulata (Saja)	6.697	1795	9.31
3.	Madhuca latifolia (Mahuwa)	4.534	1215	6.3Ø
4.	Diospyros melanoxylon(Kendu)	3.785	1Ø15	5.26
5.	Syzigium cuminii (Jamun)	2.7Ø8	726	3.76
6.	Anogeissus latifolia (Dhaora)	2.414	647	3.36
7.	Pterocarpus marsupium (Bija)	1.576	422	2.19
8.	Lannea coromandelica (moyen)	Ø.617	165	Ø.86
9.	Lagerstroemia parviflora (Sidha)	Ø.378	1Ø1	Ø.52
1Ø.	Tectona grandis (Teak)	Ø.313	84	Ø.44
11.	Others	12.316	33Ø2	17.12

Thus, if one compares the stand table with that of the volume table per ha, it would be seen that though Sal shares around 39% stems, it shares about 51% of volume.

6.4 MISCELLANEOUS STRATUM: VOLUME PER HA AND TOTAL VOLUME

Table nos. 6.4T(a) and 6.4T(b) give the details of specieswise and diameterwise volume per ha and total volume respectively for Miscellaneous stratum. As has been stated before, forest type 'Miscellaneous' was found in 319 sample plots signifying an area of 2552.41 km^2.

It can be seen that a total volume of 49.464 m^3 per ha is quite less than that of Sal stratum which has a stock of 71.949 m^3, showing that this type of forest is quite poor not only with regard to the species but also stocking. It is, however, seen that the volume is more or less uniformily spread from diameter class 10-15 to 40-50 cm, dropping steeply beyond this point. If one considers that the exploitable diameter in case of Miscellaneous species, according to the working plan in vogue, is 30 cm, then it is seen that within the limited availability of stock per ha, representation of mature trees is not insignificant. Whatever is the worth of the standing stock, one can reasonably say that the forests have been worked well.

Given below is a table showing volume per ha, total volume and percentage of occurrence for a few important species:-

Sr.No.	Name of species	Vol.per ha in m^3	Total vol. in 000 m^3 (Rounded)	Percentage
1.	Diospyros melanoxylon (Kendu)	4.685	1196	9.47
2.	Anogeissus latifolia (Dhaora)	4.065	1038	8.22
3.	Shorea robusta (Sal)	3.913	999	7.91
4.	Terminalia crenulata (Saja)	3.145	803	6.36
5.	Boswellia serrata (Salai)	2.666	680	5.39
6.	Madhuaca latiflia (Mahuwa)	2.363	603	4.78
7.	Lannea coromandelica (moyen)	2.162	552	4.37
8.	Lagerstroemia parviflora	1.879	480	3.80

(Sidha)

9. Pterocarpus marsupium (Bija)	1.533	391	3.1Ø
1Ø. Adina cordifolia (Haldu)	Ø.937	239	1.89
11. Bridelia retusa (Kasi)	Ø.858	219	1.73
12. Other species	21.258	5425	42.98

It is seen that Kendu has maximum volume per ha i.e. 4.685 m^3 per ha signifying 9.47%. This is followed by Anogeissus at 4.Ø65 m^3, 8.22%. Sambalpur being basically a Sal area, even in Miscellaneous stratum it is seen that Sal stands at no. III position with 3.913 m^3 and 7.91%. It is seen that Sal has a good representation from diameter class 3Ø-6Ø. Ain is the IVth species having 3.145 m^3 volume per ha forming 6.36% of the total. Salai, which had a meagre Ø.81% representation in Sal stratum has 5.39% share in Miscellaneous stratum having 2.66 m^3 of volume per ha. Presence of Boswellia shows that certain areas have turned drier for this species to dominate. Other species form the major share of 21.258 m^3 reckoning to 42.98%.

A total growing stock position of the Miscellaneous type of forests is 126.25 lakh m^3.

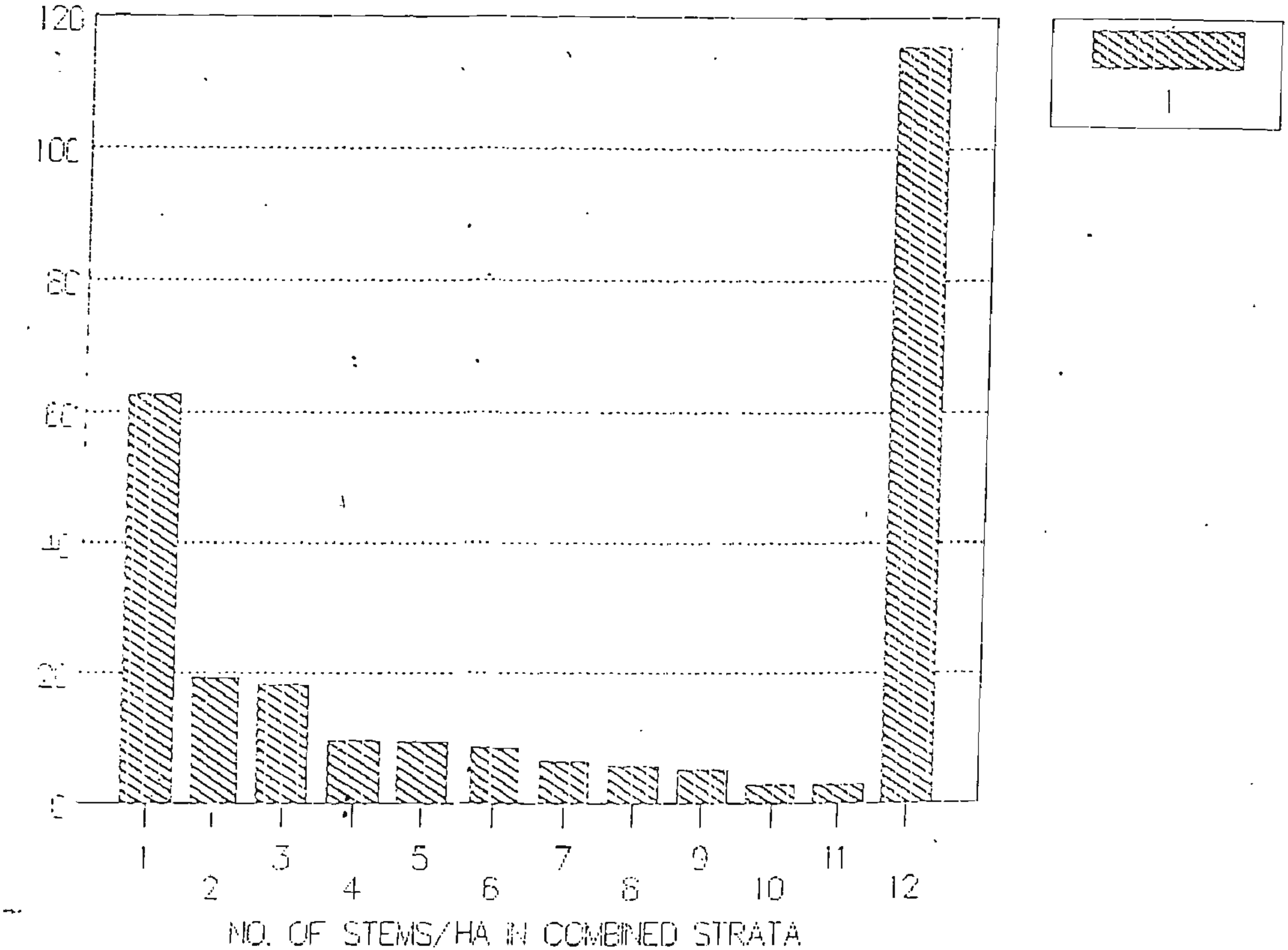
6.5 COMBINED GROWING STOCK: STEMS

Table no.6.5T gives details of species and diameter classwise no. of stems per ha and total stems occurring over 5232.84 km^2 wooded area corresponding to 654 sample plots, irrespective of forest types, or rather for both the forest types combined together. It is seen that stems per ha in diameter class 1Ø-15 cm is the highest i.e. 131.28Ø, followed by 55.12Ø stems in diameter class 15-2Ø cm, forming 49.24% and 2Ø.67% respectively. Thus, young crop alone shares 69.91% of the total crop. No. of stems decrease progressively as diameter class increases. If 3Ø cm is reckoned as exploitable diameter, middle aged crop from 2Ø to 3Ø cm has 52.162 stems per ha with 19.56%, while mature crop above 3Ø cm diameter forms a crop with 28.Ø63 stems per ha having a percentage of 1Ø.53%. Trees above 5Ø cm diameter are negligible.

Table produced below gives species wise details of stems per ha, total stems and percentage occurrence of the species to total no. of stems.

S.no.	Name of species	No.of stems. per ha	Total stems (ØØØ') rounded.	Percentage occurrence in total stand.
1.	Shorea robusta (Sal)	62.611	32763	23.48
2.	Terminalia crenulata(Saja)	19.387	1Ø145	7.27
3.	Diospyros melanoxylon(Kendu)	18.3Ø8	9581	6.87
4.	Anogeissus latifolia(Dhaora)	9.748	51Ø1	3.66
5.	Madhuca latifolia(Mahuwa)	9.5Ø2	4973	3.56
6.	Lannea coromandelica (Moyen)	8.527	4462	3.2Ø
7.	Lagerstormia parviflora(Sidha)	6.372	3335	2.39
8.	Pterocarpus marsupium (Bija)	5.736	3ØØ2	2.15
9.	Syzigium cuminii(Jamun)	5.119	2678	1.92
1Ø.	Bridelia retusa(Kasi)	2.935	1536	1.1Ø
11.	Boswelliia serrata(Salai)	2.918	1527	1.Ø9
12.	Other species	115.462	6Ø42Ø	43.31
	Total	266.625	139523	1ØØ

It is clear that Sal dominates the species composition even in combined stratum with 62.611 stems per ha reckoning to 23.48 percent. The next best i.e. Saja is far below with 19.387 stems per ha with a percentage of 7.27 to the total stems per ha. Percentage of unimportant other species is large i.e. 43.31% commensurating with 115.462 stems per ha.


120
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
11
12
NO. OF STEMS/HA IN COMBINED STRATA
1

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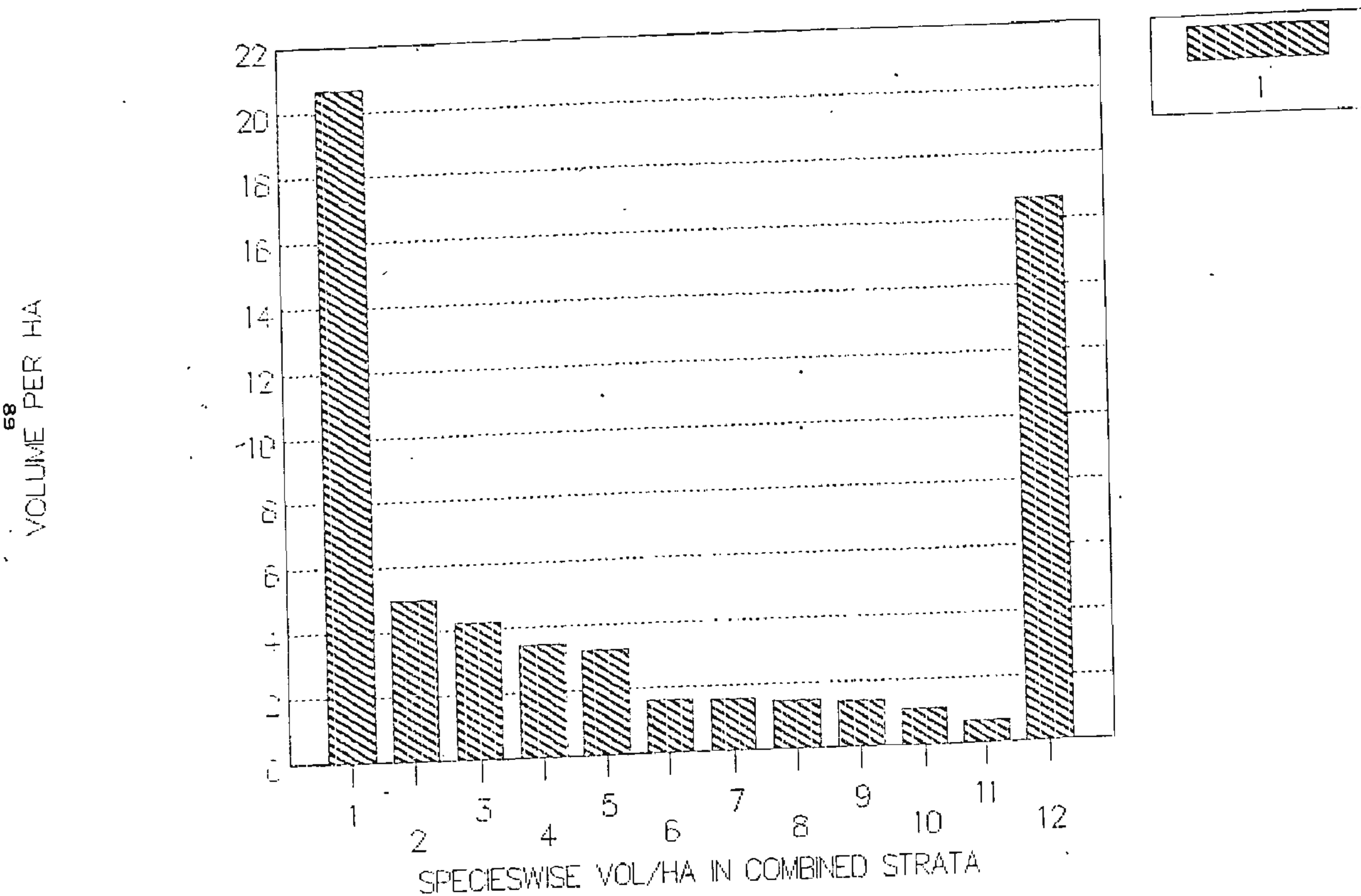
6.6 COMBINED GROWING STOCK: VOLUME

Table no. 6.6T presents species wise and diameter class wise volume in m^3 per ha and for the entire wooded area of 5232.84 km^2 representing 654 sample plots. It is seen from the table that volume is more or less evenly distributed in different diameter classes upto 40-50 cm dia (with a mean of 7.50 m^3, for which standard error works out to 0.71 for the seven classes i.e. from 10-15 to 40-50 cm). If 30 cm and above diameter is considered as mature crop, surprisngly combined stratum shows that volume in mature crop is 30.560 m^3 almost exactly half of the total volume of 60.977 m^3 per ha. However, major contribution is of Sal. Similarly stocking of around 61 m^3 per ha is relatively poor.

Species wise picture, discounting diameter classes, is given below:

S.no.	Name of species	Volume per ha	Total volume (000'm^3) rounded.	Percentage occurrence in total stock.
1.	Shorea robusta(Sal)	20.661	10812	33.88
2.	Terminalia crenulata(Saja)	4.965	2598	8.14
3.	Diospyros melanoxylon(Kendu)	4.225	2211	6.93
4.	Madhuca latifolia(Mahuwa)	3.474	1818	5.70
5.	Anogeissus latifolia(Dhawra)	3.219	1685	5.28
6.	Boswellia serrata(Salai)	1.599	837	2.62
7.	Pterocarpus marsupium(Bija)	1.556	814	2.55
8.	Syzigium cuminii(Jamun)	1.468	768	2.41
9.	Lannea coromandelica(Moyen)	1.371	717	2.25
10.	Lagerstromia parviflora(Sidha)	1.110	581	1.82
11.	Bridelia retusa(Kasi)	0.673	352	1.10
12.	Other species	16.656	8718	27.32
	Total	60.977	31911	100%

Sal emerges as the main species of forests of Sambalpur district. If this species dominates in distribution of stand with a showing of 23.43%, it steals the show as far as volume per ha is concerned with 33.88% volume coorresponding to


VOLUME PER HA
22
20
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10
11
12
SPECIESWISE VOL/HA IN COMBINED STRATA
1

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20.661 m^3 per ha, whereas the next best - Saja has to contend with only 4.965 m^3 per ha with 8.14% representation. So there is a drop of around 25% from the first to the second species. Kendu is third with 4.226 m^3 sharing 6.93%.

Map no. 6.6M shows volume distribution per ha in various forested grids representative of 2 sample plots per grid. It is seen that maximum volume of 80 m^3 per ha and above is obtained in Rairakhol division (North- North-West part of the division) and Bamra division (South - South west part of the division). Deogarh Division ha also a fair portion having volume of 80 m^3 and above. Curiously South-West corner of Sambalpur division which has Miscellaneous type of forest in it has also this volume. It is seen that Rairakhol, Bamra and Deogarh divisions have mostly 50 to 80 m^3 and 80 m^3 and above per ha stocking. Sambalpur division in the East-North east, North west and west presents a picture of poor stocking of mostly below 20 m^3 per ha.

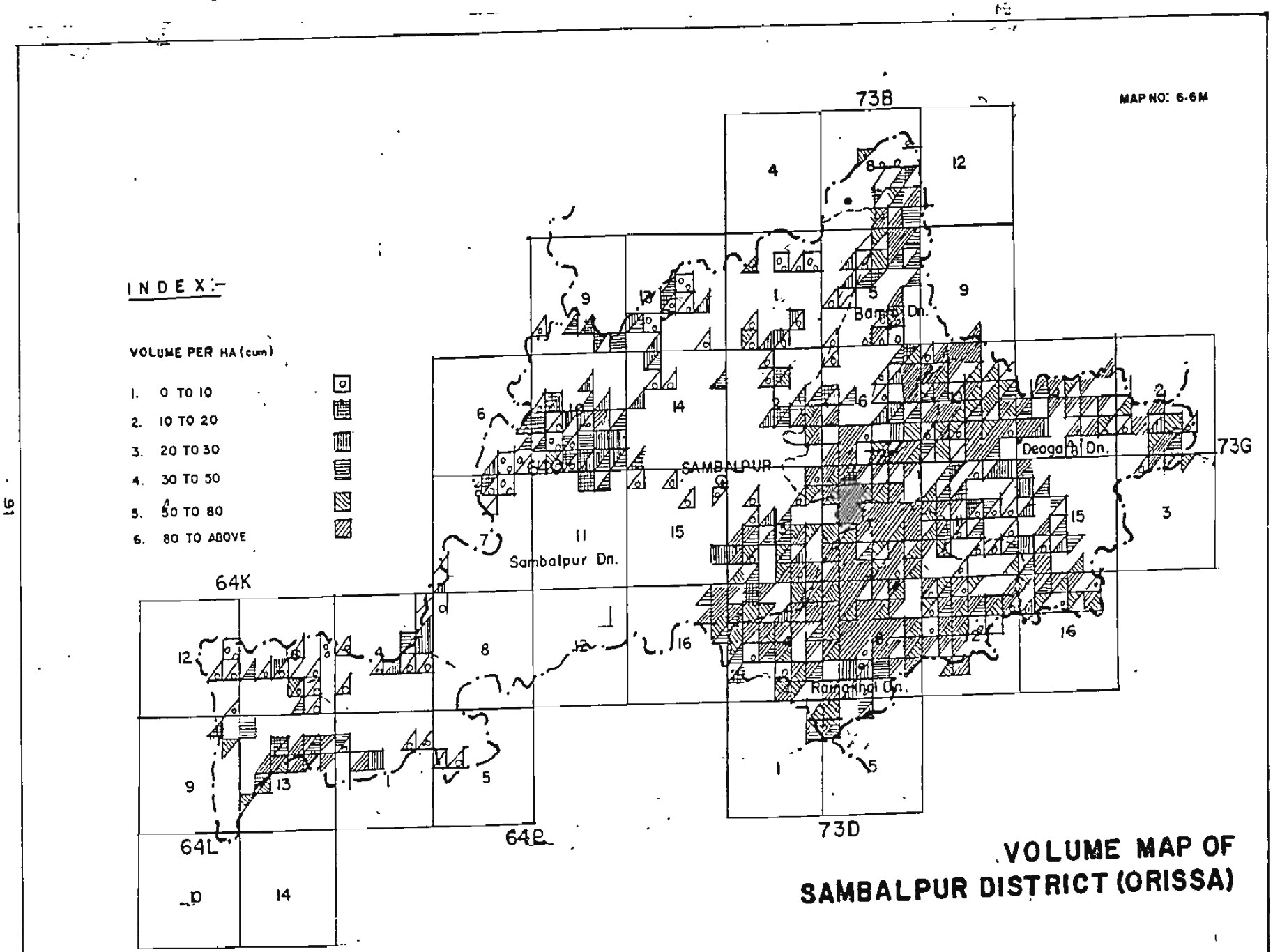
6.7 MEAN VOLUME PER HA BY TOPOGRAPHY CLASSES

Table 6.7T produced overleaf gives mean volume per ha distributed by topography classes in each stratum. Hilly terrain contains the highest mean volume per ha in Sal stratum i.e. 91.589 m^3. On the other hand highest volume in Miscellaneous forest exists over very hilly terrain with a mean volume of 74.448 m^3 per ha. Sal is absent in very hilly terrain. It appears that because in hilly and very hilly terrain biotic pressures are minimum and extraction is difficult, lot of big sized timber has still remained in the forest. Mean volume in Sal stratum for gently rolling topography has only 49.922m^3 which is a noteworthy slide from hilly terrain.

TABLE NO. 6.7T

Mean volume/ha. by Topography classes.

Forest Type	Flat	Gently rolling	Hilly	Very hilly
SAL	47.105	49.922	91.589	-
MISCELLANEOUS	21.759	35.500	58.785	74.448


MAP NO: 6-6M
INDEX:-
VOLUME PER HA (cum)
1. 0 TO 10
2. 10 TO 20
3. 20 TO 30
4. 30 TO 50
5. 50 TO 80
6. 80 TO ABOVE
73B
73G
73D
64K
64L
64P
SAMBALPUR
Sambalpur Dn.
Bamra Dn.
Deogarh Dn.
Ramgarh Dn.
VOLUME MAP OF
SAMBALPUR DISTRICT (ORISSA)

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6.8 MEAN VOLUME PER HA BY SLOPE CLASSES

Table 6.8T produced below gives mean volume per ha distributed by slope classes in each stratum. Over the slope of 60 to less than 100% Sal stratum gives the maximum mean volume per ha as 134.573 m^3. On the other hand, Miscellaneous stratum gives 88.445 m^3 per ha in the same slope class. Here also the reasons for finding high volume on steep slopes is the same as in para 6.7. The difference between the two strata especially in <10% slopes is remarkable.

TABLE 6.8T

Mean Volume/Ha by Slope Classes

Forest Type	<10%	10 - <60%	60 - <100%	+100
SAL	52.586	94.360	134.573	-
MISCELLANEOUS	24.492	61.556	88.445	-

6.9 MEAN VOLUME PER HA BY SOIL DEPTH CLASSES

Table 6.9T produced below gives the mean volume per ha by soil depth classes. Predictably, the maximum mean volume per ha in Sal stratum is available in deep soils i.e. 74.786 m^3 closely followed by medium soils i.e. 71.001 m^3, whereas medium soil sustains maximum Miscellaneous forest with 56.939 m^3 mean volume per ha and curiously deep soils support only 37.905 m^3 of volume

TABLE NO. 6.9T

Mean Volume per ha by Soil Depth Classes

Forest Type	No soil	Very shallow	shallow	Medium	Deep
SAL	-	-	45.193	71.001	74.786
MISCELLANEOUS	-	1.180	32.152	56.939	37.905

6.1Ø MEAN VOLUME PER HA BY TOP HEIGHT CLASSES

Table 7.ØT produced overleaf gives the distribution of mean volume per ha by top height classes. In both Sal and Miscellaneous strata maximum mean volume per ha is available at 172.954 m^3 and 193.397m^3 respectively in the top height classes of 26-3Ø metres. It is interesting to note that for top height 31 m and above, Miscellaneous stratum does not have any volume but in the class just below it i.e. 26-3Ø m volume per ha in Miscellaneous stratum is more than in Sal i.e. 193.397 m^3 against 172.954 m^3. This is because of bigger girths obtained in species like Mahuwa and Salai.

TABLE NO.6.1ØT

Mean Volume per ha by Top Height Classes

Forest Type	1-5M	6-1ØM	11-15M	16-2ØM	21-25M	26-3ØM	31 M
SAL	9.814	24.588	46.892	88.328	1Ø8.981	172.954	77.239
MISC.	12.146	16.Ø67	48.57Ø	75.Ø15	97.ØØ1	193.397	-

6.11 MEAN VOLUME PER HA BY SIZE CLASSES

Table 6.11T produced below gives mean volume per ha by size classes. In Sal and Miscellaneous strata big timber is available with mean volume per ha as 1Ø7.Ø37 m^3 and 12Ø.274 m^3 respectively. Here also Miscellaneous stratum shows lesser volume per ha in all the size classes except in big timber where Miscellaneous stratum has an edge over Sal.

TABLE NO.6.11T

Mean Volume Per ha by Size Classes

Forest Type	Regeneration	Pole Crop	Small Timber	Big Timber	Mixed size classes
SAL	13.357	48.654	82.293	107.037	94.615
MISC.	6.020	43.762	53.241	120.274	75.016

6.12 COMBINED GROWING STOCK WITH ESTIMATES OF STANDARD ERROR

Table no. 6.12T given below gives the accuracy of estimation by Standard Error percentage of area, volume per ha and total volume by the two strata i.e. Sal and Miscellaneous and also for the combined output of the same.

TABLE NO. 6.12T

Combined Growing Stock with Estimate of S.E.

Forest Type	Area (km^2)	SE%	Vol/ha	S.E%	Total vol. ($000M^3$)	S.E.%
SAL	2680.43 (335)	4.4	71.949 (332)	4.5	19285.4	6.3
MISC.	2552.41 (319)	4.5	49.464 (318)	5.2	12625.3	6.9
COMBINED	5232.84 (654)	3.1	60.982 (650)	1.4	31910.7	3.4

Note: Figures in brackets denote the number of plots.

It will be seen that for combined strata the precision of estimation is very high with SE% for area being 3.1%, for volume per ha, only 1.4% and for total volume 3.4%. SEs for various parameters in Sal and Miscellaneous strata are also quite low and hence the data are dependable for use in planning perspectives.

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CHAPTER VII

INVENTORY RESULTS: BAMBOO GROWING STOCK

7.0 GENERAL

As discussed earlier in Chapters II, V and VI, the forests of Sambalpur consist mainly of the moist peninsular Sal and Dry mixed deciduous forests with or without bamboos. Pure bamboo is not in existence but occurs as an understorey. Bamboo has, therefore, been extracted under overlapping Working Circles of the State Management Plans. Bamboo exploitation in Sambalpur has been carried out by contractors supplying it to M/s Titagarh paper Mills and cutting has been scattered and irregular and bamboo areas appear to have been overexploited. The results of survey indicate degraded condition of bamboo. The main users of bamboo crop are M/s. Titagarh Paper Mills and local population for manufacture of mats and bamboo baskets and for other domestic uses.

7.1 BAMBOO AREA

As described in para 5.14 bamboo occurs only in 250 sample plots representing an area of 2000.32 km^2 with distribution of density classes as given in the table overleaf:

TABLE NO. 7.1T

BREAK UP OF BAMBOO AREA (KM^2) BY QUALITY AND DENSITY

Density	Quality				Total	Percentage
	1	2	3	4		
1	80.01 (10)	-	-	-	80.01 (10)	4.00
2	112.02 (14)	-	-	-	112.02 (14)	5.60
3	160.03 (20)	8.00 (1)	-	-	168.03 (21)	8.40
4	256.04 (32)	24.00 (3)	-	-	280.04 (35)	14.00
5	152.02 (19)	24.00 (3)	16.00 (2)		192.02 (24)	9.60
6	808.13 (101)	160.03 (20)	32.01 (4)	8.00 (1)	1008.17 (126)	50.40
7			8.00 (1)	152.03 (19)	160.03 (20)	8.00
Total	1568.25 (196)	216.03 (27)	56.01 (7)	160.03 (20)	2000.32 (250)	
%	78.40	10.80	2.80	8.00		

Density classification of bamboo adopted in the Inventory of FSI is as below:

Code	Description
1	Pure bamboo - 200 or more clumps per ha
2	Very dense bamboo - 150 to 200 clumps per ha
3	Dense - 100 to 150 clumps per ha
4	Moderately dense - 50 to 100 clumps per ha
5	Scattered - 20 to 50 clumps per ha
6	sparce - 1 to 20 clumps per ha
7	Bamboo present but completely hacked by people
8	Bamboo absent
9	Regeneration crop Clump formation has not taken place.

Site quality classfication for Dendrocalamous strictus is as below:

I	Culm ht more than	6 m
II	"	4m - 6 m
III	"	2m - 4 m
IV	Regeneration crop.	

It is seen from the table that 50.40% area has sparse (1 to 20 clumps per ha) bamboos. Pure to moderately dense bamboos, (50 to 200 clumps per ha) account for a total of 32%, whereas scattered bamboos account for 9.60% area. A sizeable area of 8% comes under the category of hacked bamboo.

It is also seen that 78.40% area has site quality one and from the table it is apparent that the crop of density 1 and 2 is found entirely under quality class I, whereas density 3 & 4 also almost entirely occupy 8 quality class I. Naturally enough, maximum area under site qualities III & IV is found under density class 7 i.e. area which is hacked by people.

It is thus seen that there is scope to improve bamboo stocking by enrichment plantations, though with adequate protection measures.

7.2 CLUMPS/HA BY QUALITY AND CLUMP SIZE CLASSES

Table no. 7.2T produced overleaf gives estimated bamboo clumps per ha in Sambalpur District.

TABLE NO. 7.2T

MEAN NUMBER OF BAMBOO CLUMP/HA BY QUALITY AND SIZE CLASSWISE

Quality/Size class		1 small	2 Medium	3 Large	Total
	Clump diam	<1m	1m - 2m	> 2m	
1		89.739	33.791	3.268	126.798
	Percentage	70.77%	26.65%	2.58	
2		38.462	15.000	-	53.462
	Percentage	71.94%	28.06%		

It is seen that mean number of bamboo clumps per ha in quality class I are 126.798 i.e. dense. However, the clump diam of 89.739 clumps i.e 70.77% of total clumps is below 1m, i.e. small, showing deteriorated condition of bamboo. 26.65% clumps numbering 33.791 per ha, have dia, between 1 to 2 m i.e. medium and large size clumps of diam above 2m are only 3.268 per ha i.e. 2.58%.

In quality II bamboos, average no. of clumps per ha are 53.462 and the percentage distribution between small and medium is identical to that of quality I bamboo, with 71.94% under small and 28.06% under medium diam. category, large clumps being absent.

Generally, it is thus seen, that about 70% clumps in the District have lesser than 1m. diam.

7.3 MEAN NUMBER OF BAMBOO CULMS/CLUMP BY AGE

Table no. 7.3T given overleaf provides an insight to the status of bamboos in Sambalpur as it provides information about occurrence of culms per clump by quality, soundness and age. The table is given separately for green sound culms, green damaged culms, dry sound culms and dry damaged culms.

TABLE NO. 7.3T

MEAN NUMBER OF BAMBOO CULMS/ CLUMP BY QUALITY,SOUNDNESS, AGE AND SIZE CLASS - GREEN SOUND CULMS

Quality	Size class	Green Sound Culms							
		Current year	One to two seasons			Over two seasons			Total
			2<5 cm	5<8 cm	8+ cm	2<5 cm	5<8 cm	8+ cm	
1	1	Ø.6653	Ø.8745	Ø.ØØ42	Ø	1.9289	Ø	Ø	3.4728
	2	1.2976	1.4643	Ø.Ø476	Ø	4.8452	Ø.1667	Ø	7.8214
	3	2.5	2.3333	Ø	Ø	9	Ø	Ø	13.833
2	1	1.2	Ø.48	Ø	Ø	Ø.72	Ø	Ø	2.4
	2	1.3333	Ø.8889	Ø	Ø	1.1111	Ø	Ø	3.3333

GREEN DAMAGED CULMS

Quality	Size class	Green Damaged Culms							
		Current year	One to two seasons			Over two seasons			Total
			2<5 cm	5<8 cm	8+ cm	2<5 cm	5<8 cm	8+ cm	
1	1	Ø.1255	Ø.2929	Ø.ØØ42	Ø	Ø.728	Ø	Ø	1.15Ø6
	2	Ø.2738	Ø.4Ø48	Ø.ØØØØ	Ø	2.2381	Ø.Ø952	Ø	3.Ø119
	3	Ø.1667	Ø.3333	Ø.ØØØØ	Ø	1.3333	Ø	Ø	1.8333
2	1	Ø.24	Ø.64	Ø	Ø	Ø.76	Ø	Ø	1.64
	2	Ø.3333	Ø.4444	Ø	Ø	1.6667	Ø	Ø	2.4444

Quality	Size class	Dry Sound				Dry Damaged				Decayed culms	Grand total
		2<5 cm	5<8 cm	8+ cm	Total	2<5 cm	5<8 cm	8+cm	Total		
1	1	Ø.3Ø96	Ø	Ø	Ø.3Ø96	Ø.5858	Ø	Ø	Ø.5858	Ø.Ø586	5.57739
	2	1.Ø952	Ø.Ø476	Ø	1.1429	2.1548	Ø.Ø238	Ø	2.1786	Ø.1786	14.33335
	3	1	Ø	Ø	1	1.1667	Ø	Ø	1.1667	Ø	17.8333
2	1	Ø.16	Ø	Ø	Ø.16	Ø.16	Ø	Ø	Ø.16	Ø.Ø4	4.4
	2	Ø	Ø	Ø	Ø	Ø.2222	Ø	Ø	Ø.2222	Ø.1111	6.111Ø7

While looking at these tables, one must always remember that 71% bamboo clumps are small in diam. i.e. less than 1m and 5Ø% bamboo area has only 1-2Ø clumps per ha.

It is no wonder that in case of green sound culms, size class 3, 2 and 1, denoting clump dia of >2 m, 1 to 2m and <1m show decreasing no. of culms per clump. It is seen that size class 3, in quality one has maximum number of green sound culms. It is seen that there is very good representation of mature bamboos, mostly having 5-8 cm diam. These are the interior areas of Rairakhol, Bamra and Deogarh Divisions. It is found that green damaged culms are maximum in medium size clump of 1m to 2m dia with culm diam 2 to 5 cm. Dry Sound culms are not many but quality 1 size class 2, diam 5-8 class shows 2 bamboos.

It is thus seen that notwithstanding dia of bamboos, out of 5.58 culms in size class 1, 3.47 culms are sound i.e. 62.19%, whereas, out of 14.33 culms in size class 2, green sound culms are 7.82 i.e. 54.57%, and out of 17.83 culms in size class 3, 13.83 are green sound i.e. 77.56%. Thus one can infer that smaller size clumps, probably made

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small because of hacking, have less no. of green sound culms than the large size clumps though they themselves are not really free from getting hacked.

7.4 MEAN NO. OF BAMBOO CULMS PER HA

Table no.7.4T produced below shows mean number of bamboo culms per ha by quality, soundness, age and size class. The table shows figures which are arrived at by merely multiplying figures in table 7.3T by mean no. of clumps per ha shown in table no. 7.2T and hence the ratios or percentages of sound or damaged culms to total worked out in para 7.3 remain unchanged. It is only for per ha estimation of availability of bamboo or stand position that this table is important.

TABLE NO. 7.4T

MEAN NUMBER OF BAMBOO CULMS/HA BY QUALITY, SOUNDNESS, AGE AND SIZE CLASSWISE - GREEN SOUND CULMS

Quality	Size class	Green Sound Culms							
			One to two seasons			Over two seasons			Total
		Current year	2<5 cm	5<8 cm	8+ cm	2<5 cm	5<8 cm	8+ cm	
1	1	59.7Ø1	78.475	Ø.3751	Ø	173.Ø9	Ø	Ø	311.65
	2	43.848	49.48	1.6Ø91	Ø	163.73	5.6319	Ø	264.29
	3	8.17	7.6252	Ø	Ø	29.412	Ø	Ø	45.2Ø7
2	1	46.154	18.462	Ø	Ø	27.693	Ø	Ø	92.3Ø9
	2	19.999	13.333	Ø	Ø	16.667	Ø	Ø	49.999

GREEN DAMAGED CULMS

Quality	Size class	Green damaged Culms						
			One to two seasons			Over two seasons		Total
		Current year	2<5 cm	5<8 cm	8+ cm	2<5 cm	5<8 cm	8+ cm
1	1	11.264	26.284	Ø.3751	Ø	65.333	Ø	Ø	1Ø3.26
	2	9.2523	13.677	Ø	Ø	75.628	3.2183	Ø	1Ø1.78
	3	Ø.5447	1.Ø893	Ø	Ø	4.3573	Ø	Ø	5.9913
2	1	9.23Ø9	24.616	Ø	Ø	29.231	Ø	Ø	63.Ø78
	2	5	6.6666	Ø	Ø	25	Ø	Ø	36.667

DRY SOUND AND DRY DAMAGED CULMS

Quality	Size class	Dry Sound				Dry Damaged				Decayed culms	Grand total
		2<5 cm	5<8 cm	8+ cm	Total	2<5 cm	5<8 cm	8+cm	Total		
1	1	27.785	Ø	Ø	27.785	52.566	Ø	Ø	52.566	5.2569	5ØØ.5Ø94
	2	37.ØØ9	1.6Ø91	Ø	38.618	72.811	Ø.8Ø46	Ø	73.616	6.Ø341	484.33823
	3	3.268	Ø	Ø	3.268	3.8127	Ø	Ø	3.8127	Ø	58.279224
2	1	6.1539	Ø	Ø	6.1539	6.1539	Ø	Ø	6.1539	1.5385	169.2328
	2	Ø	Ø	Ø	Ø	3.3333	Ø	Ø	3.3333	1.6666	91.66Ø5

It is thus seen that for quality I bamboo, 312 culms per ha, 264 culms per ha and 45.2Ø7 culms per ha are available under the category of green sound culm under size class 1, 2 & 3 respectively. As pointed out earlier, about 71% clumps in both quality class I & II, are of small size, i.e. having diam. below 1m. About 27%-28% clumps have dia- between 1m-2m and only 2.5Ø% of clumps occurring in the district have dia. more than 2m. The significance is clearer in the next para.

7.5 TOTAL NO. OF CULMS

Table no. 7.5T given below gives total no. of culms in `ØØØ' numbers by quality, soundness, age and size class. This table is useful to find out the total available number of culms and the proportion of mature and young bam- boos.

TABLE NO. 7.5T

TOTAL NUMBER OF CULMS IN (ØØØ) BY QUALITY, SOUNDNESS, AGE AND SIZE CLASSWISE - GREEN SOUND CULMS

Quality	Size class	Green Sound Culms							
			One to two seasons			Over two seasons			Total
		Current year	2<5 cm	5<8 cm	8+ cm	2<5 cm	5<8 cm	8+ cm	(Rounded)
1	1	9362.6	12307	58.826	Ø	27146	Ø	Ø	48874
	2	6876.4	7759.7	252.35	Ø	25676	883.23	Ø	41448
	3	1281.3	1195.8	Ø	Ø	4612.5	Ø	Ø	7Ø9Ø
2	1	1255.6	5Ø2.23	Ø	Ø	753.35	Ø	Ø	2511
	2	544.Ø7	362.72	Ø	Ø	453.4	Ø	Ø	136Ø
								Total	..1Ø1283

GREEN DAMAGED CULMS

Quality	Size class	Green damaged Culms							
		Current year	One to two seasons			Over two seasons			Total
			2<5 cm	5<8 cm	8+ cm	2<5 cm	5<8 cm	8+ cm	
1	1	1766.5	4121.9	58.826	Ø	10246	Ø	Ø	16193
	2	1451	2144.9	Ø	Ø	11860	504.7	Ø	15961
	3	85.419	170.83	Ø	Ø	683.34	Ø	Ø	940
2	1	251.12	669.64	Ø	Ø	795.2	Ø	Ø	1716
	2	136.02	181.36	Ø	Ø	680.1	Ø	Ø	997
								Total ..	35807

DRY SOUND AND DRY DAMAGED CULMS

Quality	Size class	Dry Sound				Dry Damaged				Grand total (Rounded)	Percentage
		2<5 cm	5<8 cm	8+ cm	Total (Rounded)	2<5 cm	5<8 cm	8+cm	Total (Rounded)		
1	1	4357.4	Ø	Ø	4357	8243.7	Ø	Ø	8244	77668	46.00
	2	5804	252.35	Ø	6056	11419	126.18	Ø	11545	75010	44.43
	3	512.5	Ø	Ø	512	597.92	Ø	Ø	598	9140	5.42
2	1	167.41	Ø	Ø	167	167.41	Ø	Ø	167	4561	2.70
	2	Ø	Ø	Ø	Ø	90.679	Ø	Ø	91	2448	1.45
				Total ..	11092				20645	188827	MT

It is seen from the table that irrespective of size and quality classes, out of a total of 168.827 million culms, 101.283 million are green sound culms i.e. 59.99%, 35.807 million culms are green damaged, reckoning to 21.21%, 11.092 million culms are dry sound culms i.e. 6.57% and 20.645 million culms are dry damaged i.e. 12.23%. Thus it is seen that about 33% culms are damaged and green sound culms are only about 60%.

When total culms are reckoned it is found that out of 168.827 million culms 77.668 million culms are from clump size 1 quality I i.e.46.00%, 75.010 million culms come from clump size class 2 and quality I i.e. 44.43%, whereas 0.914 million culms forming only 5.42% are produced from clump size 3 quality I. Total quality I bamboo is thus 95.85%. Quality II bamboo is negligible having only 0.700 million culms conforming to 4.15% to total.

It is seen from the table that big size bamboo i.e. having 8 cm and above is absent in Sambalpur District. Similarly even medium size i.e. 5 cm to 8 cm diam bamboo is negligible: only 0.213 million i.e. 1.26%. Rest of the bamboo i.e. 98.74% of bamboo has a diam of 2 to 5 cm.

In Green Sound category, total mature bamboo (over two seaons) in quality I is 58.83 million out of 97.4 million culms i.e. 59.85%. This is quite satisfactory. However in quality II only 1.21 million culms are mature out of 3.870 million culms i.e. 31.26%.

7.6 GROWING STOCK OF BAMBOO

The total green growing stock of bamboo in Sambalpur District is 5,43,421 M.T. Taking 60% of green weight as dry weight at 10% moisture level, dry weight comes to 3,26,053 M.T. Table no. 7.6T given overleaf gives details of the green bamboo stock in `000' M.T. by quality, soundness, age and size class, excluding current year bamboo.

TABLE NO. 7.6T

TOTAL NUMBER OF CULMS IN (ØØØ) METRIC TONS BY QUALITY, SOUNDNESS AND SIZE CLASSWISE - GREEN SOUND CULMS

Quality	Size class	Green Sound Culms						
		One to two seasons			Over two seasons			Total
	Current year	2<5 cm	5<8 cm	8+ cm	2<5 cm	5<8 cm	8+ cm	
1	1	46.Ø28	Ø.6842	Ø	1Ø1.52	Ø	Ø	148.24
	2	29.Ø21	2.9348	Ø	96.Ø29	1Ø.272	Ø	138.26
	3	4.4724	Ø	Ø	17.251	Ø	Ø	21.723
2	1	1.8784	Ø	Ø	2.8175	Ø	Ø	4.6959
	2	1.3566	Ø	Ø	1.6957	Ø	Ø	3.Ø523
							Total	315.971 MT

GREEN DAMAGED CULMS

Quality	Size class	Green Sound Culms						
		One to two seasons			Over two seasons			Total
	Current year	2<5 cm	5<8 cm	8+ cm	2<5 cm	5<8 cm	8+ cm	
1	1	7.7Ø8	Ø.3421	Ø	19.16	Ø	Ø	27.21
	2	4.Ø11	Ø	Ø	22.179	2.9348	Ø	29.125
	3	Ø.3195	Ø	Ø	1.2778	Ø	Ø	1.5973
2	1	1.2522	Ø	Ø	1.487	Ø	Ø	2.7393
	2	Ø.3391	Ø	Ø	1.2718	Ø	Ø	1.61Ø9
							Total ..	62.282 MT

DRY SOUND AND DRY DAMAGED CULMS

Qua-lity	Size class	Dry Sound				Dry Damaged				Grand total	Percen-tage.
		2<5 cm	5<8 cm	8+ cm	Total	2<5 cm	5<8 cm	8+cm	Total		
	1	32.593	Ø	Ø	32.593	30.832	Ø	Ø	30.832	238.875	43.96
	2	43.414	5.8697	Ø	49.283	42.706	1.4674	Ø	44.173	260.841	48.00
	3	3.8335	Ø	Ø	3.8335	2.2362	Ø	Ø	2.2362	29.390	5.41
										97.37%	
2	1	1.2522	Ø	Ø	1.2522	Ø.6261	Ø	Ø	Ø.6261	9.3130	1.71
	2	Ø	Ø	Ø	Ø	Ø.3391	Ø	Ø	Ø.3391	5.002	Ø.92
								Total ..		2.63%	
			Total ..		66.962				78.206	543.421	MT

Here also 97.37% stocking is in quality I bamboo and only 2.63% is in quality II. Similarly stocking of about 94.5% is concentrated in clump sizes 1 and 2. Stocking of green sound bamboos is 3,15,971 M.T. out of the total of 5,43,421 M.T. i.e. 58.14%, which more or less conforms to the percentage of number of culms given in para 7.5. However weight of green damaged culms of 62,283 M.T. is 11.46% as against 21.21% of number of culms as in para 7.5. Dry Sound culms form 86,962 M.T. of the stocking, reckoning to 16%. Remaining i.e. 14.40% weight is obtained from dry damaged culms.

Thus, for an area of 2000.32 km^2 over which bamboos are found, mean stocking of bamboos is 2.717 M.T.

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CHAPTER VIII

TREND OF WOOD CONSUMPTION IN RURAL AREAS OF SAMBALPUR DISTRICT

8.1 GENERAL:

In order to know the trend of wood consumption in rural areas of Sambalpur district, a small scale study of wood consumption was undertaken in the central portion of the district covering 12 villages and 107 households. The study have an idea of the extent of wood consumption in the villages. Since it is of small scale it is only indicative and not a sufficient material for estimating the total consumption in the district. However, the findings of the study are compiled here for the general information of the Forest Managers.

8.2 GENERAL INFORMATION ABOUT THE DISTRICT:

1) Total geographical area 17516 km^2

2) Population of the district as per 1981 Census

Rural	1928000
Urban	353000
Total	2281000

3) Total number of villages 3436

No. of towns 10

Total 3446

4) No.of households

Rural	4Ø64Ø3
Urban	74448
Total	48Ø851

5) Average size of households(persons)

Rural	4.74
Urban	4.74
Total	4.74

8.3 METHODOLOGY OF SURVEY

For conducting these studies, methodology prescribed in the manual for wood consumption survey prepared by the Forest Survey of India in the year 1985 was adopted. The study was confined only to the rural areas and following 12 villages which were representative of the district were studied.

S.No.	Name of the village	Tahsil	Forest Division
1.	Buriakata	Sambalpur	Sambalpur
2.	Bhimkhoj	"	"
3.	Hatibari	"	"
4.	Larsara	"	"
5.	Gagarbahal	"	"
6.	Kusumbahal	Raidakhol	Raidakhol
7.	Anilajhran	Sambalpur	Sambalpur
8.	Sanyasipali	Jharsiguda	Bamra
9.	Barbbahal	"	"
1Ø.	Dhumkata	Sambalpur	Sambalpur
11.	Dongapathar	Raidakhol	Raidakhol
12.	Banpur	Sambalpur	Sambalpur

In each village 6 - 10 households were selected for recording details of wood consumption. The data on actual wood consumed for various purposes was collected by measurment of wood actually used by house holds. So far as the consumption of firewood and other produce used by the people are concerned, the information was based on the details given by the residents of the house holds. Generally, the people used miscellaneous timbers for their domestic consumption. In areas where agricultural produce and bamboos were available the consumption of the same was also noticed as an alternative to the miscellaneous wood.

8.4 FINDINGS OF THE STUDY

In this study of 107 households of 12 villages were visited. The basic information was obtained is as under:-

Average number of members in the house hold	6.80
Annual income of household	Rs. 14,255.85
Average plinth area of the household	113.54 m2

As regards the rate of consumption per household, the findings are as under:

a) Consumption of wood for construction of houses: The average consumption of wood for construction of houses was 8.287 m3. The material used was chiefly miscellaneous timber. The houses in the rural areas were mostly huts made of mud plaster and grass roof but the trend was also seen towards construction of semi-permanent houses with bricks and tiles. This quantity of 8.287 m3 timber was the actual quantity of timber in use but certain quantity to the extent of 10% was expected to be needed annually for repairs and construction of new houses.

b) Consumption of wood for furniture: Normally in rural areas furniture comprised of wooden cots, stools, etc., and the quantity consumed per household was found to be Ø.238 m^3. The timber used was chiefly of superior misc. trees.

c) Consumption of wood for agricultural implements: The annual consumption of wood for agricultural implements was found to be Ø.278 m3 per house hold. Here also miscellaneous timbers were used for this purpose.

d) Consumption of fuel: The annual consumption of fuel per household was 4973.83 kg. The fuel was usually used for cooking, water heating and similar household pruposes.

e) Consumption of grasses: The consumption of grasses was observed to be 521.45 kg per household. This grass was chiefly used for thatching of houses and cattle sheds.

f) Consumption of bamboo: The areas where bamboo availability was adequate, the consumption of bamboo per-household was found to be 1181.85 kg. Bamboo was observed to be chiefly used for fencing, huts and agricultural purposes.

g) Consumption of other agricultural waste material and branch wood:

As a substitute for the fuel and fodder, agricultural waste such as root stock, stems, branch wood for local trees was also in use to the extent of 912.55 kg per household.

8.5 SUGGESTIONS

This study is only indicative and based on the population of 1981 census. Day by day the availability of timber is becoming rare in the rural areas and substitutes like agricultural produce bio-gas, kerosene, liquid gas etc., are also coming in use and hence the findings of the survey remain useful for a short period. Moreover since this study was on a small scale its findings be kused with due precautions.

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Table No. 6.1T(A)

STRATUM - SAL STEM/HA NO. OF PLOTS - 335 AREA - 2680.43 km2

SPECIES DESCRIPTION	DIAMETER CLASSES IN CM												
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total	%
Adina cordifolia	0.422	0.241	0.060	0.211	0.211	0.090	0.000	0.000	0.000	0.000	0.030	1.265	0.44
Anogeissus latifolia	2.651	2.048	1.386	0.964	0.331	0.181	0.120	0.000	0.000	0.000	0.000	7.681	2.68
Bombax ceiba	0.060	0.120	0.000	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.211	0.07
Boswellia serrata	0.271	0.361	0.181	0.090	0.301	0.120	0.030	0.000	0.030	0.000	0.000	1.386	0.48
Bridelia retusa	0.964	0.512	0.060	0.120	0.030	0.030	0.030	0.030	0.030	0.000	0.000	1.807	0.63
Dalbergia latifolia	0.151	0.030	0.030	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.271	0.10
Diospyros melanoxylon	8.825	4.669	2.620	1.386	0.843	0.361	0.151	0.090	0.000	0.000	0.000	18.946	6.61
Garuga pinnata	0.843	0.271	0.151	0.060	0.030	0.120	0.000	0.030	0.000	0.000	0.000	1.506	0.53
Lagerstroemia parviflora	1.386	0.572	0.241	0.090	0.060	0.030	0.030	0.000	0.000	0.000	0.000	2.410	0.84
Lannea coromandelica	2.651	0.994	0.633	0.241	0.000	0.060	0.000	0.000	0.000	0.000	0.000	4.578	1.60
Madhuca latifolia	3.855	2.801	1.687	1.837	0.904	0.753	0.693	0.271	0.060	0.030	0.030	12.922	4.51
Mitragyna parviflora	0.452	0.120	0.181	0.090	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.873	0.30
Pterocarpus marsupium	1.928	1.235	0.572	0.452	0.482	0.211	0.181	0.000	0.060	0.000	0.030	5.151	1.80
Shorea robusta	41.054	21.627	17.048	12.018	8.042	5.542	4.759	1.416	0.422	0.060	0.030	112.018	39.06
Syzygium cumini	2.922	2.199	1.235	0.964	0.693	0.422	0.181	0.060	0.060	0.030	0.000	8.765	3.16
Tectona grandis	3.283	0.482	0.331	0.060	0.030	0.000	0.000	0.000	0.000	0.000	0.000	4.187	1.46
[illegible]alia belerica	0.452	0.151	0.211	0.090	0.030	0.060	0.030	0.000	0.000	0.000	0.000	1.024	0.36
[illegible]alia crenulata	10.301	5.633	3.645	2.560	1.325	0.663	0.602	0.241	0.120	0.060	0.030	25.181	8.78
[illegible] species	50.783	14.699	5.452	3.102	1.084	0.512	0.542	0.151	0.090	0.030	0.120	76.566	26.70
[illegible]ecies total	133.253	58.765	35.723	24.428	14.428	9.157	7.349	2.289	0.873	0.211	0.271	286.747	
[illegible]tage	46.47	20.50	12.50	8.52	5.03	3.19	2.52	0.80	0.30	0.07	0.10		

Table No.6.1T(8)

STRATUM - SAL STEM(000) NO. OF PLOTS - 335 AREA - 2680.43 km2

SPECIES DESCRIPTION	DIAMETER CLASSES IN CM											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Adina cordifolia	113.030	64.589	16.147	56.515	56.515	24.221	0.000	0.000	0.000	0.000	8.074	339.091
Anogeissus latifolia	710.475	549.004	371.385	258.355	88.809	48.442	32.294	0.000	0.000	0.000	0.000	2058.764
Bombax ceiba	16.147	32.294	0.000	8.074	0.000	0.000	0.000	0.000	0.000	0.000	0.000	56.515
Bosuellia serrata	72.662	96.883	48.442	24.221	80.736	32.294	8.074	0.000	8.074	0.000	0.000	371.385
Bridelia retusa	258.355	137.251	16.147	32.294	8.074	8.074	8.074	8.074	8.074	0.000	0.000	484.415
Dalbergia latifolia	40.368	8.074	8.074	16.147	0.000	0.000	0.000	0.000	0.000	0.000	0.000	72.662
Diospyros melanoxylon	2365.560	1251.406	702.402	371.385	226.060	96.883	40.368	24.221	0.000	0.000	0.000	5078.284
Garuga pinnata	226.060	72.662	40.368	16.147	8.074	32.294	0.000	8.074	0.000	0.000	0.000	403.679
Lagerstroemia parviflora	371.385	153.398	64.589	24.221	16.147	8.074	8.074	0.000	0.000	0.000	0.000	645.887
Lannea coromandelica	710.475	266.428	169.545	64.589	0.000	16.147	0.000	0.000	0.000	0.000	0.000	1227.185
Madhuca latifolia	1033.419	750.843	452.121	492.489	242.208	201.840	185.692	72.662	16.147	8.074	8.074	3463.567
Mitragyna parviflora	121.104	32.294	48.442	24.221	8.074	0.000	0.000	0.000	0.000	0.000	0.000	234.134
Pterocarpus marsupium	516.709	331.017	153.398	121.104	129.177	56.515	48.442	0.000	16.147	0.000	8.074	1380.583
Shorea robusta	11004.295	5796.833	4569.648	3221.360	2155.647	1485.539	1275.626	379.458	113.030	16.147	8.074	30025.658
Syzygium cumini	783.138	589.372	331.017	258.355	185.692	113.030	48.442	16.147	16.147	8.074	0.000	2349.413
Tectona grandis	880.021	129.177	88.809	16.147	8.074	0.000	0.000	0.000	0.000	0.000	0.000	1122.228
Terminalia belerica	121.104	40.368	56.515	24.221	8.074	16.147	8.074	0.000	0.000	0.000	0.000	274.502
Terminalia cranulata	2761.166	1509.760	976.904	686.255	355.238	177.619	161.472	64.589	32.294	16.147	8.074	6749.517
Rest of species	13612.063	3939.909	1461.319	831.579	290.649	137.251	145.325	40.368	24.221	8.074	32.294	20523.049
All species total	35717.539	15751.563	9575.271	6547.676	3867.247	2454.370	1969.954	613.592	234.134	56.515	72.662	76860.516

Table No. 6.2T(A)

STRATUM - MISC. FOREST STEM/HA NO. OF PLOTS - 319 AREA - 2552.41 km2

SPECIES DESCRIPTION	DIAMETER CLASSES (IN cm)												
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total	%
Adina cordifolia	0.597	0.220	0.189	0.094	0.157	0.252	0.094	0.000	0.000	0.031	0.031	1.667	0.68
Anogeissus latifolia	4.780	2.170	1.855	1.761	0.723	0.346	0.252	0.031	0.000	0.000	0.000	11.918	4.85
Bombax ceiba	0.692	0.472	0.220	0.252	0.094	0.126	0.000	0.094	0.031	0.000	0.000	1.981	0.81
Boswellia serrata	0.692	0.566	0.818	0.692	0.440	0.723	0.346	0.157	0.094	0.000	0.000	4.528	1.84
Bridelia retusa	2.044	1.101	0.472	0.220	0.157	0.063	0.031	0.031	0.000	0.000	0.000	4.119	1.68
Dalbergia latifolia	1.887	0.692	0.503	0.126	0.063	0.000	0.031	0.000	0.000	0.000	0.000	3.302	1.34
Diospyros melanoxylon	6.824	4.151	2.704	1.730	1.289	0.440	0.377	0.063	0.031	0.031	0.000	17.642	7.19
Garuga pinnata	0.975	0.472	0.094	0.126	0.063	0.189	0.063	0.000	0.031	0.000	0.000	2.013	0.82
Lagerstroemia parviflora	5.692	2.107	1.226	0.943	0.377	0.094	0.063	0.031	0.000	0.000	0.000	10.535	4.29
Lannea coromandelica	6.792	2.830	1.541	0.629	0.440	0.283	0.126	0.031	0.000	0.000	0.000	12.673	5.16
Madhuca latifolia	1.541	1.101	0.849	0.755	0.597	0.409	0.472	0.094	0.063	0.031	0.000	5.912	2.41
Mitragyna parviflora	0.723	0.314	0.126	0.157	0.157	0.031	0.031	0.000	0.000	0.031	0.000	1.572	0.64
Pterocarpus marsupium	2.673	1.321	0.849	0.629	0.346	0.283	0.252	0.000	0.000	0.000	0.000	6.352	2.59
Shorea robusta	4.245	1.761	1.761	0.818	0.943	0.629	0.252	0.189	0.031	0.063	0.031	10.723	4.37
Syzygium cumini	0.692	0.252	0.220	0.063	0.063	0.000	0.000	0.000	0.000	0.000	0.000	1.289	0.52
Terminalia belerica	0.252	0.189	0.283	0.063	0.000	0.063	0.000	0.000	0.000	0.000	0.000	0.849	0.35
Terminalia crenulata	5.881	2.767	1.824	1.132	0.597	0.692	0.314	0.094	0.000	0.000	0.000	13.302	5.42
Rest of species	82.253	28.805	12.673	5.377	2.799	1.321	1.132	0.503	0.126	0.126	0.031	135.126	55.04
All species total	129.214	51.289	28.208	15.566	9.308	5.943	3.836	1.321	0.409	0.314	0.094	245.503	
Percentage	52.63	20.89	11.49	6.34	3.79	2.42	1.56	0.54	0.17	0.13	0.04		

Table No. 6.2T(B)

STRATUM - MISC. FORESTS STEM(000) NO. OF PLOTS - 319 Area- 2552.41 km2

SPECIES DESCRIPTION	DIAMETER CLASSES (IN cm)											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Adina cordifolia	152.502	56.185	48.159	24.079	40.132	64.212	24.079	0.000	0.000	8.026	8.026	425.402
Anogeissus latifolia	1220.020	553.825	473.560	449.481	184.608	88.291	64.212	8.026	0.000	0.000	0.000	3042.023
Bombax ceiba	176.582	120.397	56.185	64.212	24.079	32.106	0.000	24.079	8.026	0.000	0.000	505.666
Boswellia serrata	176.582	144.476	208.688	176.582	112.370	184.608	88.291	40.132	24.079	0.000	0.000	1155.808
Bridelia retusa	521.719	280.926	120.397	56.185	40.132	16.053	8.026	8.026	0.000	0.000	0.000	1051.464
Dalbergia latifolia	481.587	176.582	128.423	32.106	16.053	0.000	8.026	0.000	0.000	0.000	0.000	842.777
Diospyros melanoxylon	1741.739	1059.491	690.274	441.455	329.084	112.370	96.317	16.053	8.026	8.026	0.000	4502.836
Garuga pinnata	248.820	120.397	24.079	32.106	16.053	48.159	16.053	0.000	8.026	0.000	0.000	513.693
Lagerstroemia parviflora	1452.787	537.772	313.031	240.793	96.317	24.079	16.053	8.026	0.000	0.000	0.000	2688.860
Lannea coromandelica	1733.712	722.380	393.296	160.529	112.370	72.238	32.106	8.026	0.000	0.000	0.000	3234.658
Madhuca latifolia	393.296	280.926	216.714	192.635	152.502	104.344	120.397	24.079	16.053	8.026	0.000	1508.972
Mitragyna parviflora	184.608	80.264	32.106	40.132	40.132	8.026	8.026	0.000	0.000	8.026	0.000	401.322
Pterocarpus marsupium	682.248	337.111	216.714	160.529	88.291	72.238	64.212	0.000	0.000	0.000	0.000	1621.342
Shorea robusta	1083.570	449.481	449.481	208.688	240.793	160.529	64.212	48.159	8.026	16.053	8.026	2737.018
Syzygium cumini	176.582	64.212	56.185	16.053	16.053	0.000	0.000	0.000	0.000	0.000	0.000	329.084
Terminalia belerica	64.212	48.159	72.238	16.053	0.000	16.053	0.000	0.000	0.000	0.000	0.000	216.714
Terminalia crenulata	1500.945	706.327	465.534	288.952	152.502	176.582	80.264	24.079	0.000	0.000	0.000	3395.187
Rest of species	20989.156	7352.225	3234.658	1372.522	714.354	337.111	288.952	128.423	32.106	32.106	8.026	34489.641
All species total	32980.668	13091.134	7199.722	3973.091	2375.828	1516.993	979.226	337.111	104.344	80.264	24.079	62662.469

Table No. 6.3T(A)

Table No. 6.3T(A)

STRATUM - SAL VOL/HA(cum) NO. OF PLOTS - 335 Area- 2680.43 km2

SPECIES DESCRIPTION	DIAMETER CLASSES (IN cm)												
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total	%
Ailanthus cordifolia	0.025	0.048	0.021	0.107	0.162	0.088	0.000	0.000	0.000	0.000	0.202	0.652	0.91
Anogeissus latifolia	0.182	0.401	0.540	0.600	0.275	0.221	0.195	0.000	0.000	0.000	0.000	2.414	3.36
Bombax ceiba	0.005	0.021	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.038	0.05
Boswellia serrata	0.013	0.041	0.044	0.042	0.199	0.114	0.035	0.000	0.096	0.000	0.000	0.585	0.81
Bridelia retusa	0.050	0.081	0.021	0.068	0.022	0.031	0.057	0.069	0.096	0.000	0.000	0.496	0.69
Dalbergia latifolia	0.011	0.004	0.008	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.07
Diospyros melanoxylon	0.430	0.664	0.706	0.617	0.580	0.357	0.221	0.209	0.000	0.000	0.000	3.785	5.46
Garuga pinnata	0.044	0.033	0.035	0.023	0.018	0.118	0.000	0.082	0.000	0.000	0.000	0.353	0.49
Lagerstroemia parviflora	0.085	0.079	0.064	0.041	0.040	0.032	0.038	0.000	0.000	0.000	0.000	0.378	0.52
Lannea coromandelica	0.119	0.158	0.176	0.108	0.000	0.056	0.000	0.000	0.000	0.000	0.000	0.617	0.86
Madhuca latifolia	0.245	0.361	0.394	0.711	0.496	0.593	0.803	0.496	0.170	0.111	0.154	4.534	6.3
Mitragyna parviflora	0.031	0.017	0.048	0.039	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.153	0.21
Pterocarpus marsupium	0.091	0.153	0.145	0.183	0.294	0.183	0.208	0.000	0.175	0.000	0.144	1.576	2.19
Shorea robusta	1.901	2.752	4.220	5.047	5.196	5.233	6.673	3.362	1.548	0.316	0.363	36.611	50.99
Syzygium cumini	0.131	0.257	0.285	0.390	0.443	0.393	0.280	0.146	0.225	0.159	0.000	2.708	3.76
Tectona grandis	0.142	0.056	0.074	0.026	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.313	0.44
Terminalia belerica	0.035	0.027	0.058	0.035	0.018	0.044	0.039	0.000	0.000	0.000	0.000	0.255	0.35
Terminalia crenulata	0.472	0.742	0.920	1.068	0.814	0.606	0.791	0.491	0.351	0.269	0.172	6.697	9.32
Rest of species	2.418	1.790	1.255	1.179	0.618	0.403	0.670	0.267	0.261	0.105	0.765	9.732	13.53
All species total	6.431	7.685	9.014	10.324	9.210	8.472	10.011	5.123	2.920	0.958	1.801	71.949	
Percentage	8.94	10.6	12.53	14.35	12.80	11.78	13.91	7.12	4.06	1.33	2.50		

Table No. 6.3T(B)

STRATUM - SAL VOL(000) NO. OF PLOTS - 335 AREA - 2680.43 km2

SPECIES DESCRIPTION	DIAMETER CLASSES (IN cm)											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Adina cordifolia	6.603	12.782	5.526	28.798	43.484	23.482	0.000	0.000	0.000	0.000	54.173	174.848
Anogeissus latifolia	48.794	107.455	144.857	160.823	73.623	59.217	52.233	0.000	0.000	0.000	0.000	647.002
Bombax ceiba	1.373	5.706	0.000	2.986	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.065
Bosuallia serrata	3.419	11.020	11.928	11.197	53.447	30.653	9.503	0.000	25.731	0.000	0.000	156.899
Bridelia retusa	13.483	21.729	5.630	18.278	5.899	8.328	15.351	18.497	25.761	0.000	0.000	132.956
Dalbergia latifolia	2.962	1.094	2.054	7.907	0.000	0.000	0.000	0.000	0.000	0.000	0.000	14.017
Diospyros melanoxylon	115.307	178.098	189.329	165.473	155.426	95.767	59.109	56.153	0.000	0.000	0.000	1014.663
Garuga pinnata	11.699	8.749	9.496	6.133	4.889	31.638	0.000	21.980	0.000	0.000	0.000	94.585
Lagerstroemia parviflora	22.689	21.296	17.033	10.879	10.793	8.508	10.069	0.000	0.000	0.000	0.000	101.267
Lannea coromandelica	31.966	42.393	47.137	28.881	0.000	15.066	0.000	0.000	0.000	0.000	0.000	165.443
Madhuca latifolia	65.625	96.776	105.588	190.484	132.969	159.039	215.305	133.012	45.465	29.681	41.351	1215.295
Mitragyna parviflora	8.431	4.585	12.922	10.423	4.642	0.000	0.000	0.000	0.000	0.000	0.000	41.003
Pterocarpus marsupium	24.482	40.891	38.901	49.025	78.846	48.918	55.841	0.000	46.873	0.000	38.589	422.366
Shorea robusta	509.682	737.535	1131.048	1352.865	1392.798	1402.677	1788.704	901.287	414.818	84.609	97.189	9813.213
Syzygium cummini	35.142	68.943	76.280	104.560	118.717	105.398	75.087	39.058	60.231	42.557	0.000	725.974
Tectona grandis	37.938	14.973	19.887	6.842	4.336	0.000	0.000	0.000	0.000	0.000	0.000	83.977
Terminalia belerica	9.329	7.207	15.465	9.334	4.828	11.785	10.331	0.000	0.000	0.000	0.000	68.280
minalia crenulata	126.581	198.917	246.659	286.379	218.294	162.460	212.121	131.500	93.994	71.970	46.186	1795.062
t of species	648.234	479.854	336.510	315.982	165.574	107.968	179.687	71.684	69.858	28.048	205.124	2608.524
species total	1723.740	2060.005	2416.252	2767.250	2468.567	2270.904	2683.342	1373.171	782.731	256.866	482.612	19285.438

Table No. 6.4T(A)

STRATUM - MISC. FOREST VOL/HA NO. OF PLOTS 319 Area- 2552.41 km2

SPECIES DESCRIPTION	DIAMETER CLASSES (IN cm)												
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total	%
Alna cordifolia	0.032	0.042	0.059	0.048	0.117	0.253	0.121	0.000	0.000	0.115	0.150	0.937	1.89
Anogeissus latifolia	0.319	0.435	0.707	1.086	0.636	0.407	0.409	0.066	0.000	0.000	0.000	4.065	8.22
Bombax ceiba	0.075	0.082	0.062	0.098	0.047	0.084	0.000	0.132	0.058	0.000	0.000	0.638	1.29
Boswellia serrata	0.032	0.062	0.202	0.275	0.292	0.656	0.482	0.364	0.301	0.000	0.000	2.666	5.39
Bridelia retusa	0.131	0.180	0.144	0.101	0.108	0.065	0.054	0.075	0.000	0.000	0.000	0.858	1.73
Dalbergia latifolia	0.140	0.097	0.132	0.050	0.045	0.000	0.054	0.000	0.000	0.000	0.000	0.517	1.05
Diospyros melanoxylon	0.338	0.598	0.701	0.789	0.881	0.426	0.553	0.141	0.106	0.154	0.000	4.685	9.47
Grugo pinnata	0.053	0.057	0.022	0.058	0.040	0.191	0.095	0.000	0.204	0.000	0.000	0.720	1.46
Lagerstroemia parviflora	0.339	0.302	0.337	0.414	0.243	0.088	0.089	0.066	0.000	0.000	0.000	1.879	3.80
Lannea coromandelica	0.294	0.420	0.442	0.273	0.293	0.237	0.154	0.050	0.000	0.000	0.000	2.162	4.37
Madhuca latifolia	0.097	0.134	0.195	0.281	0.333	0.324	0.538	0.178	0.171	0.112	0.000	2.363	4.78
Mitragyna parviflora	0.045	0.040	0.032	0.063	0.096	0.029	0.034	0.000	0.000	0.147	0.000	0.487	0.98
Pterocarpus marsupium	0.115	0.170	0.207	0.265	0.213	0.234	0.330	0.000	0.000	0.000	0.000	1.533	3.10
Shorea robusta	0.195	0.210	0.442	0.336	0.611	0.600	0.373	0.476	0.098	0.294	0.279	3.913	7.91
Syzygium cumini	0.028	0.029	0.050	0.023	0.036	0.000	0.000	0.000	0.000	0.000	0.000	0.166	0.34
Terminalia belerica	0.017	0.030	0.075	0.024	0.000	0.046	0.000	0.000	0.000	0.000	0.000	0.192	0.39
Terminalia crenulata	0.265	0.365	0.466	0.470	0.373	0.627	0.397	0.182	0.000	0.000	0.000	3.145	6.36
species	3.928	3.629	2.959	2.022	1.616	1.055	1.328	0.970	0.348	0.515	0.169	18.538	37.47
cies total	6.441	6.881	7.235	6.677	5.979	5.322	5.011	2.699	1.285	1.338	0.597	49.464	
age	13.02	13.91	14.63	13.50	12.08	10.76	10.13	5.46	2.60	2.70	1.21		

Table No. 6.4T(B)

STRATUM - MISC. FOREST VOL(000) NO. OF PLOTS - 319 AREA - 2552.41 km2

SPECIES DESCRIPTION	DIAMETER CLASSES (IN cm)											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Adina cordifolia	8.080	10.773	14.981	12.168	29.785	64.551	30.916	0.000	0.000	29.441	38.344	239.040
Anogeissus latifolia	81.419	110.952	180.434	277.279	162.327	103.852	104.355	16.889	0.000	0.000	0.000	1037.509
Bombax ceiba	19.091	20.976	15.927	25.055	12.002	21.504	0.000	33.577	14.679	0.000	0.000	162.809
Bosuallia serrata	8.245	15.831	51.663	70.168	74.426	167.412	123.074	92.872	76.744	0.000	0.000	680.434
Bridelia retusa	33.491	45.834	36.639	25.825	27.651	16.558	13.817	19.221	0.000	0.000	0.000	219.037
Dalbergia latifolia	35.613	24.820	33.694	12.756	11.448	0.000	13.677	0.000	0.000	0.000	0.000	132.009
Diospyros melanoxylon	86.258	152.576	178.949	201.294	224.818	108.618	141.044	55.923	27.028	39.402	0.000	1195.909
Garuga pinnata	13.628	14.505	5.689	14.866	10.222	48.718	24.141	0.000	52.066	0.000	0.000	183.835
Lagerstroemia parviflora	86.426	77.171	85.931	105.665	62.110	22.552	22.816	16.850	0.000	0.000	0.000	479.522
Lannea coromandelica	74.984	107.093	112.887	69.645	74.796	60.551	39.210	12.674	0.000	0.000	0.000	551.839
Madhuca latifolia	24.753	34.287	49.797	71.793	84.892	82.634	137.238	45.438	43.562	28.628	0.000	603.022
Mitragyna parviflora	11.451	10.222	8.255	16.138	24.564	7.394	8.796	0.000	0.000	37.498	0.000	124.318
Pterocarpus marsupium	29.229	43.383	52.835	67.692	54.262	59.708	84.237	0.000	0.000	0.000	0.000	391.346
Shorea robusta	49.740	53.527	112.866	85.803	155.905	153.171	95.267	121.451	24.973	74.985	71.133	998.821
Syzygium cummini	7.034	7.357	12.841	5.797	9.287	0.000	0.000	0.000	0.000	0.000	0.000	42.315
Terminalia belerica	4.441	7.593	19.218	6.095	0.000	11.738	0.000	0.000	0.000	0.000	0.000	49.086
[illegible]alia crenulata	67.583	93.114	118.957	120.026	95.189	160.097	101.328	46.358	0.000	0.000	0.000	802.652
[illegible] species	1002.544	926.210	755.195	516.147	412.451	269.303	339.076	247.524	88.880	131.442	43.028	4731.779
[illegible]ecies total	1644.011	1756.226	1846.759	1704.210	1526.112	1358.362	1278.992	688.778	327.931	341.396	152.506	12625.282

Table No. 6.5T

COMBINED STAND TABLE IRRESPECTIVE OF FOREST TYPE BY DIAMETER CLASSES

SPECIES DESCRIPTION	DIAMETER CLASSES (IN cm)												%
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total	
Acacia cercifolia T.Stem(000)	265.532	120.774	64.506	30.594	16.647	08.483	24.079	0.000	0.000	8.026	16.100	764.491	0.55
Stem/ha	0.507	0.231	0.123	0.154	0.185	0.169	0.046	0.000	0.000	0.015	0.031	1.461	
Anogeissus latifolia	1930.495	1102.829	844.945	707.836	273.418	136.753	56.506	8.026	0.000	0.000	0.000	5100.709	3.66
	3.689	2.108	1.615	1.353	0.523	0.261	0.184	0.015	0.000	0.000	0.000	9.748	
Bombax ceiba	192.729	152.681	56.185	72.286	24.079	32.106	0.000	24.079	8.026	0.000	0.000	562.181	0.40
	0.368	0.292	0.107	0.138	0.046	0.061	0.000	0.046	0.015	0.000	0.000	1.073	
Boswellia serrata	249.244	241.359	257.130	200.603	195.106	216.902	96.365	40.132	32.153	0.000	0.000	1527.194	1.09
	0.476	0.461	0.491	0.383	0.369	0.415	0.184	0.077	0.061	0.000	0.000	2.918	
Cordelia retusa	780.074	418.177	136.544	89.479	48.206	24.127	16.100	16.100	8.074	0.000	0.000	1535.881	1.10
	1.491	0.799	0.261	0.169	0.092	0.046	0.031	0.031	0.015	0.000	0.000	2.935	
Dalbergia latifolia	521.955	184.656	136.497	48.253	16.053	0.000	8.026	0.000	0.000	0.000	0.000	915.440	0.66
	0.997	0.353	0.261	0.092	0.031	0.000	0.015	0.000	0.000	0.000	0.000	1.749	
Diospyros melanoxylon	4107.299	2310.897	1392.676	812.840	555.144	209.253	136.685	40.274	8.026	8.026	0.000	9581.120	6.87
	7.849	4.416	2.661	1.553	1.061	0.040	0.261	0.077	0.015	0.015	0.000	18.308	
Ficus pinnata	474.880	193.059	64.447	48.253	24.127	80.455	16.053	8.074	8.026	0.000	0.000	917.372	0.66
	0.907	0.369	0.123	0.092	0.046	0.154	0.031	0.015	0.015	0.000	0.000	1.752	
Lagerstroemia parviflora	1824.172	691.170	377.620	265.014	112.464	32.153	24.127	8.026	0.000	0.000	0.000	3334.746	2.39
	3.486	1.321	0.722	0.506	0.215	0.061	0.046	0.015	0.000	0.000	0.000	6.372	
Lannea coromandelica	2444.187	988.808	562.841	225.118	112.320	88.385	32.106	8.026	0.000	0.000	0.000	4461.841	3.20
	4.671	1.890	1.076	0.430	0.215	0.169	0.061	0.015	0.000	0.000	0.000	8.527	
Madhuca latifolia	1426.715	1031.769	668.835	685.124	394.710	306.184	306.089	96.741	32.200	16.100	8.074	4972.541	3.56
	2.726	1.972	1.278	1.309	0.754	0.585	0.585	0.185	0.062	0.031	0.015	9.502	
Mitragyna parviflora	305.712	112.558	80.548	64.353	48.206	8.026	8.026	0.000	0.000	8.026	0.000	655.455	0.45
	0.584	0.215	0.154	0.123	0.092	0.015	0.015	0.000	0.000	0.015	0.000	1.215	
Odoratcarpus marsupium	1198.957	668.128	370.112	281.633	217.468	128.753	112.654	0.000	16.147	0.000	8.074	3001.926	2.15
	2.291	1.277	0.707	0.538	0.416	0.246	0.215	0.000	0.031	0.000	0.015	5.736	
Shorea robusta	12087.865	6246.314	5019.123	3430.048	2396.440	1646.068	1339.833	427.617	121.056	32.200	16.100	32762.675	23.48
	23.100	11.937	9.592	6.555	4.580	3.146	2.560	0.817	0.231	0.062	0.031	62.611	
Syzygium cumini	959.72	653.584	387.202	274.409	201.745	113.030	48.442	16.147	16.147	8.074	0.000	2678.499	1.92
	1.834	1.249	0.740	0.524	0.386	0.216	0.093	0.031	0.031	0.015	0.000	5.119	
Tectona grandis	880.021	129.177	88.809	16.147	8.074	0.000	0.000	0.000	0.000	0.000	0.000	1122.228	0.80
	1.682	0.247	0.170	0.031	0.015	0.000	0.000	0.000	0.000	0.000	0.000	2.145	
Terminalia belerica	185.316	83.527	128.753	48.274	8.074	32.200	8.074	0.000	0.000	0.000	0.000	491.218	0.35
	0.354	0.169	0.246	0.077	0.015	0.062	0.015	0.000	0.000	0.000	0.000	0.938	
Terminalia crenulata	4262.111	2216.087	1442.438	975.207	507.240	354.201	241.736	88.668	32.294	16.147	8.074	10144.703	7.27
	8.145	4.236	2.757	1.864	0.970	0.677	0.462	0.169	0.062	0.031	0.015	19.387	
Rest of species	34601.219	11292.134	4835.977	2204.101	1005.003	474.562	434.272	168.791	56.327	40.180	40.320	55012.691	39.44
	66.123	21.579	8.974	4.212	1.921	0.907	0.830	0.323	0.108	0.077	0.077	105.131	
Grand total	68698.203	28842.698	16774.994	10520.771	6243.075	3971.369	2949.183	950.701	338.476	136.779	96.742	139522.991	100
	131.280	55.120	32.058	20.104	11.932	7.590	5.634	1.816	0.646	0.261	0.184	266.625	
%	49.24	20.67	12.02	7.54	4.48	2.85	2.11	0.68	0.24	0.10	0.07	100	

Contents

Table No. 6.6T

COMBINED STOCK TABLE IRRESPECTIVE OF FOREST TYPE BY DIAMETER CLASSWISE

SPECIES DESCRIPTION		DIAMETER CLASSES (IN cm)												
		10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total	%
Acna cordifolia	T.Vol(000)	14.689	23.555	20.507	40.966	73.269	83.033	30.916	0.000	0.000	29.441	92.517	413.887	
	Vol/ha	0.028	0.045	0.039	0.078	0.140	0.158	0.059	0.000	0.000	0.056	0.177	0.790	1.30
Aegeissus latifolia		130.213	218.407	325.291	438.102	235.950	163.069	156.588	16.889	0.000	0.000	0.000	1684.509	
		0.249	0.417	0.622	0.837	0.451	0.312	0.299	0.032	0.000	0.000	0.000	3.219	5.28
Bombax ceiba		20.464	26.682	15.927	28.039	12.002	21.504	0.000	33.577	14.679	0.000	0.000	172.874	
		0.039	0.051	0.030	0.054	0.023	0.041	0.000	0.064	0.028	0.000	0.000	0.330	0.54
Boswellia serrata		11.664	26.851	63.591	81.365	127.873	198.065	132.577	92.872	102.475	0.000	0.000	837.333	
		0.022	0.051	0.122	0.155	0.244	0.379	0.253	0.177	0.196	0.000	0.000	1.599	2.62
Bridelia retusa		46.974	67.563	42.269	44.103	33.550	24.886	29.168	37.718	25.761	0.000	0.000	351.992	
		0.090	0.129	0.081	0.084	0.064	0.048	0.056	0.072	0.049	0.000	0.000	0.673	1.10
Dalbergia latifolia		38.575	25.914	35.748	20.663	11.448	0.000	13.677	0.000	0.000	0.000	0.000	146.025	
		0.074	0.050	0.068	0.039	0.022	0.000	0.026	0.000	0.000	0.000	0.000	0.279	0.46
Diospyros melanoxylon		201.565	330.694	368.278	366.767	380.244	204.385	200.153	92.076	27.028	39.402	0.000	2210.592	
		0.385	0.632	0.704	0.701	0.727	0.391	0.382	0.176	0.052	0.075	0.000	4.225	6.93
Ehretia pinnata		25.327	25.254	15.185	20.999	15.111	80.356	24.141	21.980	52.066	0.000	0.000	278.419	
		0.048	0.044	0.029	0.040	0.029	0.154	0.046	0.042	0.099	0.000	0.000	0.531	0.87
Lagerstroemia parviflora		109.115	98.467	102.964	116.544	72.903	31.060	32.885	16.850	0.000	0.000	0.000	580.788	
		0.209	0.188	0.197	0.223	0.139	0.059	0.063	0.032	0.000	0.000	0.000	1.110	1.82
Lannea coromandelica		106.950	149.486	160.024	98.535	74.796	75.617	39.210	12.674	0.000	0.000	0.000	717.292	
		0.204	0.286	0.306	0.188	0.143	0.145	0.075	0.024	0.000	0.000	0.000	1.371	2.25
Madhuca latifolia		90.378	131.063	155.385	262.277	217.861	241.673	352.543	178.450	89.027	58.309	41.351	1818.317	
		0.173	0.250	0.297	0.501	0.416	0.462	0.674	0.341	0.170	0.111	0.079	3.474	5.70
Mitragyna parviflora		19.882	14.807	21.177	26.561	29.206	7.394	8.796	0.000	0.000	37.498	0.000	165.321	
		0.038	0.028	0.040	0.051	0.056	0.014	0.017	0.000	0.000	0.072	0.000	0.316	0.52
Pterocarpus marsupium		53.711	84.274	91.736	116.717	133.108	108.626	140.078	0.000	46.873	0.000	38.589	813.712	
		0.103	0.161	0.175	0.223	0.254	0.208	0.268	0.000	0.090	0.000	0.074	1.556	2.55
Shorea robusta		559.422	791.062	1243.914	1438.668	1548.703	1555.848	1883.971	1022.738	439.791	159.594	168.322	10312.033	
		1.069	1.512	2.377	2.749	2.960	2.973	3.600	1.954	0.840	0.305	0.322	20.661	33.88
Syzygium cumini		42.176	76.300	89.121	110.357	128.004	105.398	75.087	39.058	60.231	42.557	0.000	768.289	
		0.081	0.146	0.170	0.211	0.245	0.201	0.143	0.075	0.115	0.081	0.000	1.468	2.41
Tetona grandis		37.938	14.973	19.887	6.642	4.336	0.000	0.000	0.000	0.000	0.000	0.000	83.976	
		0.072	0.029	0.038	0.013	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.160	0.26
Terminalia belerica		13.770	14.800	34.683	15.429	4.828	23.523	10.331	0.000	0.000	0.000	0.000	117.364	
		0.026	0.028	0.066	0.029	0.009	0.045	0.020	0.000	0.000	0.000	0.000	0.225	0.37
Terminalia crenulata		194.164	292.031	365.616	406.405	313.483	322.557	313.449	177.858	93.994	71.970	46.180	2597.707	
		0.371	0.558	0.699	0.777	0.599	0.616	0.599	0.340	0.180	0.138	0.088	4.965	8.14
Rst of species		1650.778	1406.064	1091.705	832.129	578.009	377.271	518.763	319.208	158.738	159.490	248.152	7340.303	
		3.155	2.687	2.086	1.590	1.105	0.721	0.991	0.610	0.303	0.305	0.474	14.027	23.00
Al species total		3367.749	3816.247	4263.008	4471.468	3994.660	3629.265	3962.333	2061.948	1110.663	598.261	635.111	31910.733	
		6.436	7.292	8.146	8.543	7.634	6.937	7.571	3.939	2.122	1.143	1.214	60.977	100.00
%		10.55	11.96	13.36	14.01	12.52	11.38	12.42	6.46	3.48	1.87	1.99	100.00	

ANNEXURE - I

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Annexure - II

Glossary of vernacular (Oriya) names with corresponding Botanical names of common species met with in Sambalpur district.

S.No.	Local Name	Botanical Name
1.	Andiri	Bursera serrata
2.	Atundi	Combretum decandrum
3.	Aonla	Emblica officinalis
4.	Arakh	Calotropis procera
5.	Amba	Mangifera indica
6.	Ankhu-kolt	Carrisa spinarum
7.	Anchu	Morinda tinctoria
8.	Akanabindhi	Cissampelos pareira
9.	Asan	Terminalia crenulata
10.	Ananta-mula	Hemidesmus indicus
11.	Arjun	Terminalia arjuna
12.	Amda	Spondias mangifera
13.	Amthi	Bauhinia retusa
14.	Ankula	Alangium lamarckii
15.	Arkala	Millettia auriculata
16.	Bahada	Terminalia belerica
17.	Bela	Aegle marmelos
18.	Barangi	Albizzia stipulata
19.	Bija	Pterocarpus marsupium
20.	Baincha	Flacourtia sepiaria
21.	Behenta	Limonia acidissima
22.	Bamur	Acacia arabica
23.	Ban-khajuri	Phoenix acaulis
24.	Ban-capasia	Kydia calycina
25.	Ban-tulsi	Perilla ocimoides
26.	Bandhan	Ougeinia dalbergioides
27.	Bhanta	Clerodendron infortunatum
28.	Budel-mal	Spatholobus roxburghii
29.	Bat-guri	Ardisia solenasea
30.	Bam-oda	Zingiber casumunar
31.	Bans(Dongor)	Dendrocalamus strictus
32.	Bans(Pani)	Oxytenanthera albociliata
33.	Bans(Patsi)	Oxytenanthera monostigma
34.	Bans(Topi)	Cephalostachyum purgracile
35.	Bet	Calamus species
36.	Bara	Ficus bengalensis
37.	Bod-kurhein	Wrightia tomentosa
38.	Barbakulia	Dalbergia paniculata
39.	Benimonj	Casearia tomentosa
40.	Ban-kandul	Atylosia volubilis
41.	Bankadeli	Musa superba
42.	Bhalia	Semicarpus anacardium
43.	Bhersinga	Murraya koenigii

44.	Bheru	Chloroxylon swietenia
45.	Baidhanka	Mucuna prurita
46.	Boro	Callicarpa lanata
47.	Baruna	Crataeva religiosa
48.	Chadel gudi	Vitex peduncularis
49.	Chauli	Elaeodendron glaucum
50.	Chara	Buchanania latifolia
51.	Chandan	Santalum album
52.	Chhatian	Alsotonia scholaris
53.	Chhai patoli	Stereospermum angustifolium
54.	Chhota Rai	Dillenia aurea
55.	Chun -koli	Zizyphus funiculosa
56.	Bengasag(Brahmi buti)	Hydrocotyle asiatica
57.	Dam kurudu	Gardenia latifolia
58.	Dhatki	Woodfordia fruticosa
59.	Dhauranjan	Holoptelia integrifolia
60.	Dhaman	Grewia tiliaefolia
61.	Dumtari(Chilli-mal)	Acacia pinnata
62.	Dhaura	Anogeissus latifolia
63.	Dimiri	Ficus glomerata
64.	Dudhi-mal (Gar)	Cryptolepsis buchanani
65.	Gambhari	Gmelina arborea
66.	Girli	Indigofera pulchella
67.	Garkhair	Albizzia procera
68.	Gila	Entada scandens
69.	Genduli	Sterculia urens
70.	Gurudu(kurlu)	Gardenia gummifera
71.	Ghanto	Zizyphus xylopyra
72.	Gonairi	Cochlospermum gossipium
73.	Giringa	Pterospermum heyneanum
74.	Gohira	Acacia leucophloca
75.	Gud mari	Premna herbacea
76.	Gutikhadika	Nyctanthes arbortristis
77.	Gad panas	Litsia macrophylla
78.	Gandh palas	Miliusa velutina
79.	Harida	Terminalia chebula
80.	Haldi(Ban)	Curcuma amada
81.	Hinjala	Barringtonia acutangula
82.	Had kinkali	Murraya exotica
83.	Hatkan	Leea macrophylla
84.	Iswar-jata	Asparagus racemosus
85.	Jatjotia	Urena species
86.	Jamu	Syzygium cumini
87.	Jamarla	Antidesma diandrum
88.	Jamla	Homonoia riparia
89.	Japhra	Bixa orellana
90.	Kaitha	Feronia elephantum
91.	Khurdu	Gardenia turgida
92.	Kendu	Diospyros melanoxylon
		" sylvatica
93.	Kamalagundi	Mallotus philippinensis
94.	Kanteikoli	Zizyphus oenoplia
95.	Karada	Cleistanthus collinus
96.	Khus-khus (Bena)	Vetiveria zizanioides
97.	Karanjo	Pongamia glabra

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98.	Kirkichi	Mimosa himalayana
99.	Kodali	Sterculia villosa
100.	Kansa (Budhimahul)	Hymenodictyon excelsum
101.	Kasi	Bridellia retusa
102.	Kochila	Strychnos nux-vomica
103.	Koilakha	Asteracantha longifolia
104.	Khair	Acacia catechu
105.	Kansarilota	Ipomoea pes-caprae
106.	Katak	Strychnos potatorum
107.	Kumbhi	Careya arborea
108.	Kekad	Garuga pinnata
109.	Kundo-phul	Jasminum humile
110.	Kusum	Schleichera oleosa
111.	Kalami sag	Ipomoea reptans
112.	Kurum	Adina cordifolia
113.	Kulhia kanda	Dioscorea spp.
114.	Kandei	Urginea indica
115.	Laipalas	Butea superba
116.	Mahalimba	Ailanthus excelsa
117.	Mardha-mal	Spatholobus roxburghii
118.	Mahul	Bassia latifolia
119.	Madang	Loranthus Spp.
120.	Moi	Lannea coromandelica
121.	Muturi	Smilax macrophylla
122.	Makadkendu	Diospyros embryopteris
123.	Mur-muri	Helicteres isora
124.	Mundi	Mitragyna parvifolia
125.	Mali (bara)	Hiptage madablota
126.	Mohana	Randia dumatorum
127.	Malpi	Patalidium barlerioides
128.	Makha	Schrebera swietenoides
129.	Murga	Agave species
130.	Nalbali	Cipadessa futicosa
131.	Nim	Azadirachta indica
132.	Nirmuli	Cuscuta reflexa
133.	Oluo (Ban)	Amorphophallus species
134.	Palasa	Butea monosperma
135.	Patmasu(Gandha palas)	Miliusa velutina
136.	Paldhua	Erythrina suberosa
137.	Papuni	Oroxylon indicum
138.	Padhel	Stereospernum suaveolens
139.	Palua	Curcuma aromatica
140.	Phasi	Anogeissus acuminata
141.	Pengu-mal	Celastrus paniculata
142.	Pipal	Ficus religiosa
143.	Purhei(Padeikoli)	Ficus cunia
144.	Poi-gam	Eugenia operculata
145	Panas	Artocarpus integrifolia
146,	Petchurimal	Ventilago madaraspatana
147.	Panasi	Eulaliopsis binata
148.	Phul badhuni	Thysanolaena agrostis
149.	Pita alu	Dioscorea spp.
150.	Rani-kathi	Flemingia chappar
151.	Rai	Dillenia pentagyna
152.	Rohini	Soymida febrifuga

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153	Raj simal	Xanthoxylon rhetsa
154.	Runjo	Abrus precatorius
155.	Saguan	Tectona grandis
156.	Sahada	Streblus asper
157.	Sal(Sargi)	Shorea robusta
158.	Salai	Boswellia serrata
159.	Sena(Sidha)	Largerstroemia parviflora
160.	Siali	Bauhinia vahlii
161.	Siju	Euphorbia royaleana
162.	Simul	Salmalia malabarica
163.	Sinkulia (Sweeper grass)	Heteropogon contortus
164.	Siris	Albizzia lebbek
165.	Sisoo	Dalbergia latifolia
166.	Sunari	Cassia fistula
167.	Suna-ragoda	Grewia hirsuta
		Strobilanthes circarensis
		Strobilanthes jeyporensis
		Strobilanthes auriculatus
168.	Sugandhi-mal	Ichnocarpus frutescenes
169.	Sigakai (Chilli)	Acacia concinna
170.	Salap	Caryota urens
171.	Saru (Bono)	Colocasia spp.
172.	Tentuli	Tamarindus indica
173.	Tal	Borassus flabellifer
174.	Telkuran	Ixora parviflora
175.	Thelka	Randia uliginosa
176.	Tilai	Wendlandia tinctoria
177.	Tangini	Xylia xylocarpa
178.	Tandi(Kasatandi)	Saccharum spontaneum

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Contents

ANNEXURE - III

LIST OF OFFICERS AND STAFF ASSOCIATED WITH SURVEY WORK IN SAMBALPUR DISTRICT OF ORISSA STATE

1. S/shri V.B. Joshi, IFS
Joint Director

2. M.D. Singh, STA
3. B.R. Pandey,STA
4. M.K. Madåria,JTA
5. P.R. Singh, JTA
6. R.P. Sao, JTA
7. R.K. Mahobe,JTA
8. P.R. Rawani,JTA
9. S.K. Bajpai, JTA
10. J.S. Kumbhkar,JTA
11. C.B. Murty, Jr.D/Man
12. D.S. Gulkari,Jr.D/Man
13. N.P. Singh, Dy.Ranger
14. M.H. Kanoje, Dy.Ranger
15. G.G. Pathak, Dy.Ranger
16. R.C. Verma,Dy.Ranger
17. N.C. Dewangan,Dy.Ranger
18. A.K. Bose, Dy.Ranger
19. Jagdeo Prasad, Dy.Ranger
20. C.S. Rawat, Fieldman
21. Bhagbali Dawana,Fieldman
22. Fagoo Ram, Fieldman
23. M.K. Singh, Fieldman
24. Sarwan Das, Fieldman
25. B.P. Sharma, Fieldman
26. D.G.K.Pillai, Fieldman
27. L.N. Kuril, Fieldman
28. Bansi Ram, Fieldman
29. R.P. Thapliyal, Fieldman
30. P.A. Swamy, Fieldman
31. Dwarika Prasad, Fieldman
32. Chandan Singh, Fieldman
33. B.K.Maharana, Fieldman
34. Dharam Singh, Fieldman
35. Chandrika Prasad, Fieldman
36. R.R. Singh,Fieldman
37. V.S. Bist, Fieldman
38. Ramadhin Yadav, Fieldman
39. Bharat Singh, Fieldman
40. Dharam Deo, Driver
41. R.S. Pandey, Driver
42. R.A. Dondre, Driver
43. R.S. Ukey, Driver
44. V.J. Gondane,Driver
45. N.C. Malakar,Driver