FOREST RESOURCES
OF
RAIPUR DISTRICT
OF
MADHYA PRADESH
(Chhattisgarh)

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FOREST SURVEY OF INDIA
CENTRAL ZONE
NAGPUR
1991

Contents

Raipur
Chhattisgarh

P R E F A C E

This report contains results of the inventory of the forests of Raipur district in Madhya Pradesh made by the Central Zone of the Forest Survey of India. The inventory was made during the period February 1986 to May 1986. The report covers North Raipur, East Raipur and South Raipur Forest Divisions of Madhya Pradesh.

Total forest area in Raipur district is 7940 sq.km. which works out to 32.92% of the geographical area of the district. According to the survey, out of the forest area of the district nearly 88.71% area has some forest vegetation composed of dense, moderately dense, open forest, scrub jungle and young plantations. The rest of the area is devoid of any tree cover. Sal is the important species of the district and contributes 24.55% to the total growing stock which is nearly 47.57 million cubic metres. The average growing stock in one hectare of forest works out at 67.16 cubic metres. In addition to Sal, other important species in order of their preponderence are Terminalia tomentosa, Boswellia serrata, Anogeissus latifolia and Diospyros melanoxylon. These 5 species together account for nearly half of the growing stock. Teak hardly contributes 1.53% of the total volume of standing timber in the district.

Bamboo (Dendrocalamus strictus) occurs over some of the forest areas mixed with tree forests. No pure bamboo forest areas are present. Since large areas of bamboo forests were under regeneration crop, its contribution to the growing stock is very less.

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I hope the report will be useful in planning the Forest Management in Raipur district.

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FOREST SURVEY OF INDIA
25-SUBHASH ROAD
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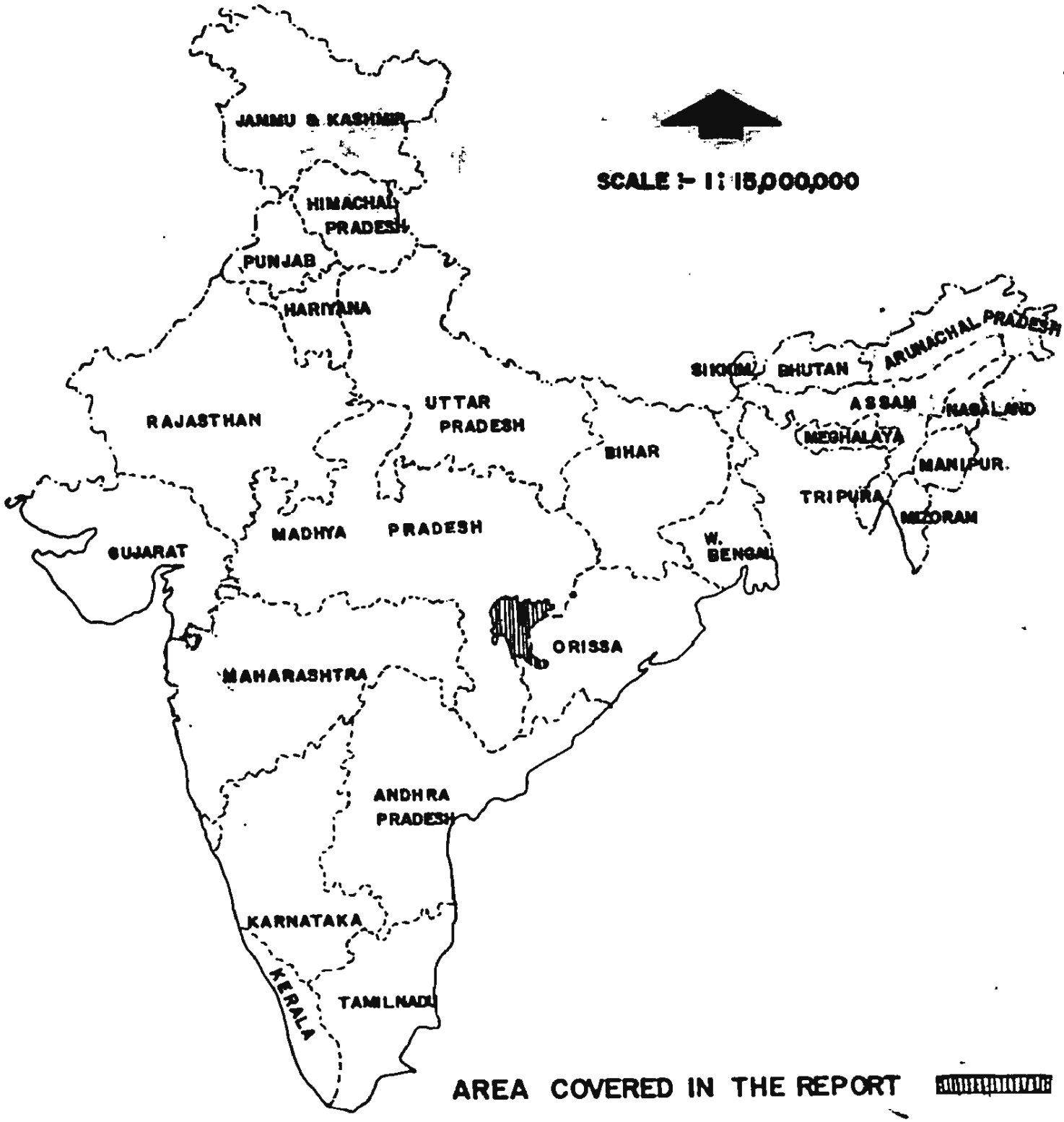
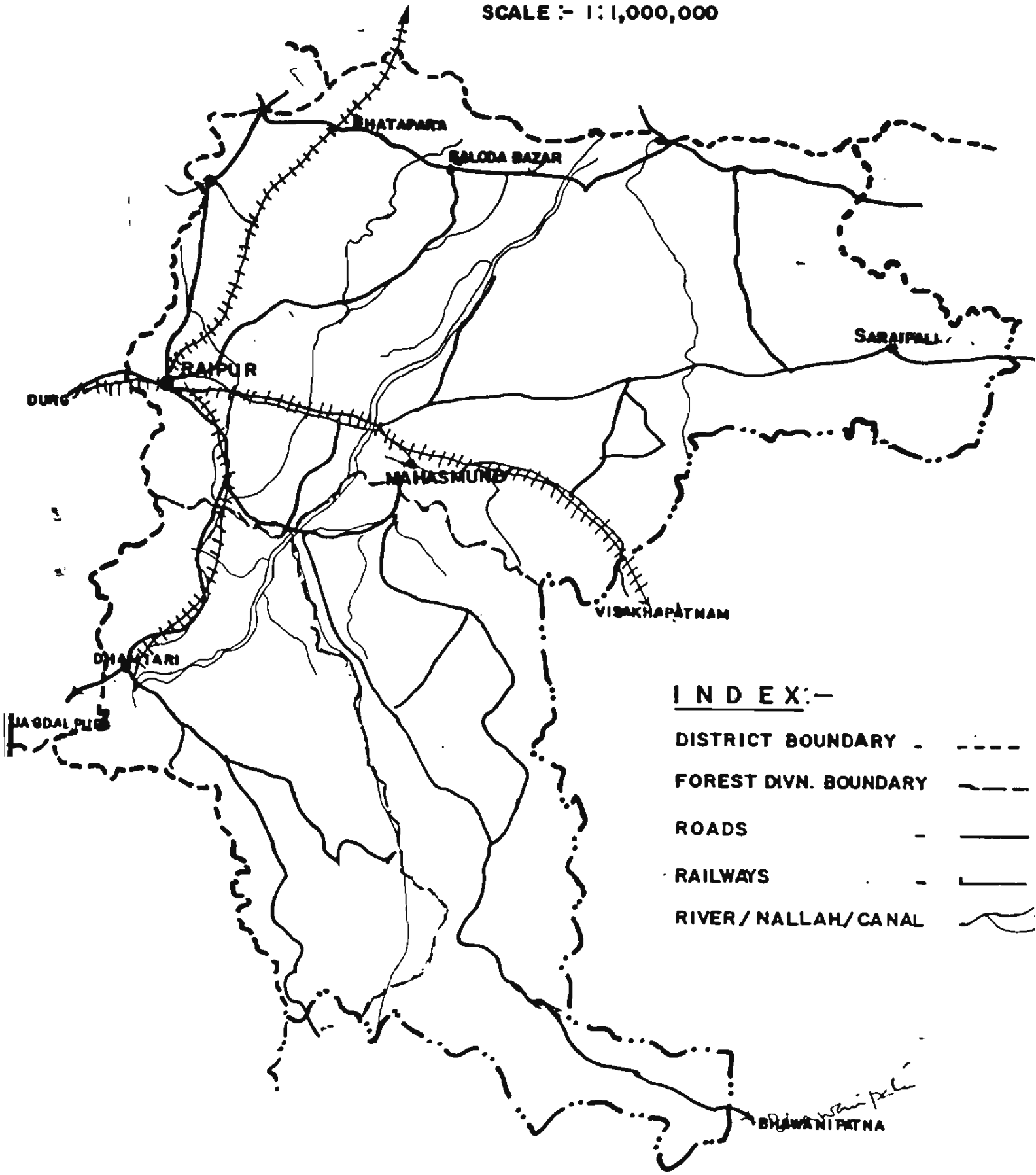
MAP OF INDIA
SHOWING
SURVEY AREA



ROAD MAP OF RAIPUR DISTRICT

SCALE :- 1 : 1,000,000



CHAPTER - ONE

INTRODUCTION

1.0 GENERAL:

Raipur district forms a part of the Raipur Commissioner's Division in the Chhattisgarh region and occupies the south-eastern part of the upper Mahanadi basin and a large belt of hilly areas to the east and south. The district is situated between the parallels of latitude 19°45' north and 21° 53' north and the meridians of longitude 81°24' east and 83°16' east. The district is bounded on the north by Bilaspur district, on the south by Koraput district of Orissa state, on the east by Sambalpur and Kalahandi districts of Orissa state and on the west by Durg district.

The Kharun and the Jonk rivers mark for some distance the western and the eastern boundaries respectively of the district. The Seonath and the Mahanadi form the northern boundary whereas the Tel river flows along a section of the southern boundary.

1.1 TOTAL AREA AND POPULATION:

The total area of the district is 24117 sq.km. Raipur is the most populated district in the state with a total population of 30,79,476 according to 1981 census.

1.2 ADMINISTRATIVE UNITS

This district has been divided into 5 Revenue subdivisions and further into 11 tahsils with headquarters at Raipur, Dhamtari, Baloda Bazar, Mahasamund, Bindranawagad, Simga, Khasdol, Bilaigarh, Bhatapara, Saraipali and Rajim. There are 36 police stations in the district for maintaining law and order and 24 development blocks for execution of development schemes. For the territorial administration of the forest areas the entire district is included in Raipur circle with three divisions namely North Raipur Division, East Raipur Division and West Raipur Division.

1.3 FOREST AREA:

The total forest area adopted for this survey report is 7940 sq.km. which is the total green coloured area shown as 'wooded area' on 1:50,000 scale toposheets published by the Survey of India. This includes following areas by legal classes under the charge of the forest department in Raipur district.

Reserved forest	-	4441.Ø2 sq.km.
Protected forest	-	27Ø7.99 sq.Km.
Unclassed forest	-	174.13 sq.km.
Total:	-	7323.14 sq.km.

In addition to above areas, during the last 17-18 years, large blocks of forest areas, mainly protected forests, had been transferred by the forest department to the Revenue department for various purposes. The total extent of these areas was 1747.13 sq.km. but most of them have been under cultivation or other non forestry uses. Thus, a very small portion of wooded area is in charge of the Revenue department in Raipur district.

The gross total of the forest areas under forest department and those possessing wooded cover under the Revenue department match with the total wooded area arrived after summing up entire green coloured area of all toposheets covered in this district.

1.4 CLIMATE AND RAINFALL:

The climate of the district is of extreme type. It is characterised by a very hot summer and cold winter. May is the hottest month and December is the coldest month of the year. The winter commences normally from November and lasts till the end of February. The hot season follows thereafter and continues till the middle of June when the monsoon sets in and lasts till the middle of October.

The average annual rainfall of the district is 1Ø87.Ø mm. About 6Ø percent of rainfall is received between July to September.

A diagram appended on page no.3 displays mean monthly variation of temperature and rainfall at Raipur.

1.5 TOPOGRAPHY:

The district occupies the south-eastern part of the upper Mahanadi valley and the bordering hills in the south and the east. Thus, the district is divided into two major physical divisions, viz. the Chhattisgarh plain and the hilly areas. The Mahanadi crosses the district diagonally from its south-western corner to the northern boundary. The country to the west of the river comprising the north-eastern part of Dhamtari tahsil, the whole of Raipur tahsil and the western part of Baloda Bazar tahsil is a part of the open Chhattisgarh plain which is gently sloping, thickly populated extensively cultivated and almost devoid of forests. The plains also extend in a belt of 13 to 16 kms. east of the Mahanadi except between Sirpur and Kasdole where the hills are very compact. To the east of the Chhattisgarh plain the

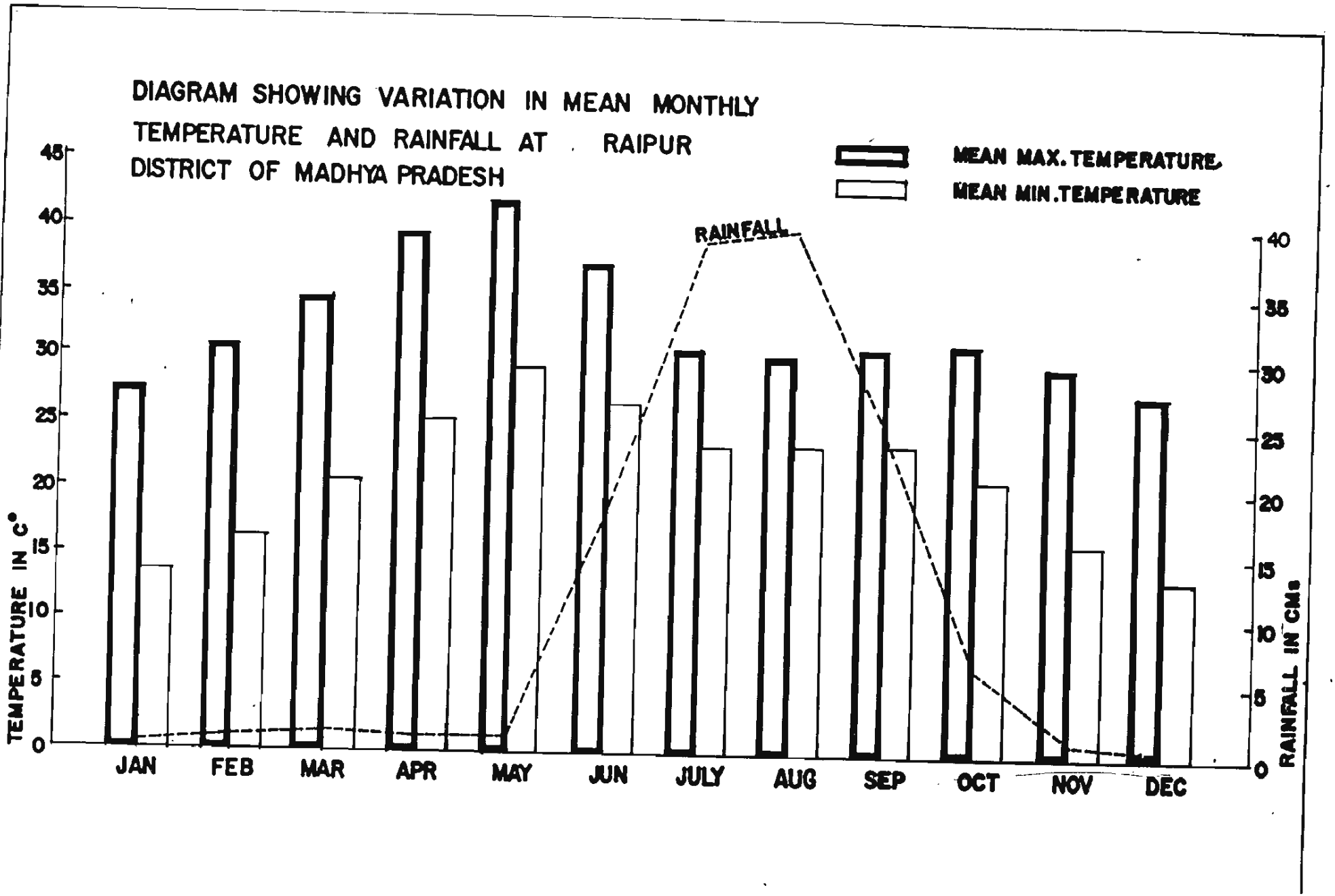


DIAGRAM SHOWING VARIATION IN MEAN MONTHLY TEMPERATURE AND RAINFALL AT RAIPUR DISTRICT OF MADHYA PRADESH
MEAN MAX. TEMPERATURE
MEAN MIN. TEMPERATURE
RAINFALL
TEMPERATURE IN C°
RAINFALL IN CMs.
0
5
10
15
20
25
30
35
40
45
JAN
FEB
MAR
APR
MAY
JUN
JULY
AUG
SEP
OCT
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DEC

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hilly areas oover the southern part of Dhamtari tahsil, the south-eastern part of Baloda Bazar tahsil and the bulk of Mahasamund and Bindranawagarh tahsil.

The Sihawa group of hills lies on the plateau to the west of Sondur valley in the southern part of Dhamtari tahsil. A large belt of hilly and forested areas border the eastern bank of the Mahanadi north of Raipur-Sambalpur National Highway. From the vicinity of Kasdol it bends towards the east and extends to Sarangarh tahsil of Raigarh district in south of the Mahanadi valley. Between the hills of Bindranawagarh and Jangla pahar lies a belt of fairly level country through which Raipur -Sambalpur and Raipur - Arang - Khariar roads pass. There are several small clearings in this tract. The Basna-Saraipali tract has been mostly accepted for agriculture. This tract falls in the Surangi valley. The Deobhog tract is to the extreme south-east of Bindranawagarh tahsil lying in the narrow valley of the Tel river.

The elevation in the entire area varies from 304 M to 914 M above mean sea level.

1.6 DRAINAGE:

The Mahanadi is the main river of the district. The whole of the district, except a few areas on the Kondagaon Bastar plateau are covered by the Mahanadi drainage system. The general slopes of the country, with local variations, are towards the north. However, the Tel and Surangi flow towards the east and south east respectively.

The important tributaries of the Mahanadi river are the Pairi, the Seonath and the Jong. The Hasdo, the Mand, the Ib and the Brahmini are the other rivers which join it on the left bank and the Jira, the Ong, and the Tel join it on the right bank.

1.7 GEOLOGY AND ROCKS:

The rock formation of the district is as under :-

Geological period	Name of formation	Rocks/soils.
1. Recent	Alluvium	Alluvial soil.
2. Pliestacine to recent	Laterite	Laterite & Lateritic soils.
3. Upper Precambrain cuddappahs.	Raipur series	Platy quartzites, Shaly limestone
	Chandrapur series	calcareous shales. Coarse ferruginous sandstones, Quartzites.

4. Lower Precambrain -Dharwars	Iron ore series	Ferruginous shales Banded Haemali quartzites, Phyllites & schists.
5. Archeans	Igneous metamorphic.	Granites, granitic gneisses, Pegmatites etc.

Most parts of the district are covered by Cuddapah rocks. However, in the eastern and southeastern parts of the district the Archean granites, Granitic gneisses and other intrusive rocks are found. In the north-eastern parts of the district Dharwar rocks, which are metamorphic rocks of sedimentary origin, are exposed. At places, intrusions of Pegmatites and basic Dolerites are also found in this district.

1.8 SOILS:

The parent rock or parent material is one of the important soil formation factors. However, its effect is altered by other soil forming factors like climate, vegetation, topography etc. In Raipur district, one can observe broad correlation between the main geological formations, soils obtained from them and main forest types. The rocks of the Cuddapah system, particularly the Chandrapur sandstones, give rise to poor soils where generally mixed forest of inferior type is found. Where biotic interference like heavy grazing combines with these soils, it results in occurrence of patches of stunted Khair and Euphorabia species. Granites and gneises many times give rise to poor soils and Mixed type of forest with low stocking as seen in such areas. However, fine granitic gneisses have given rise to sandy loam soils which are rich in iron contents and carry good quality Sal forest. The schists and ferruginous shales of Dharwar age give rise to reddish brown soils which are deep porous and soft and support very good Sal forests. Laterites generally support poor vegetation. Doleritic intrusions give rise to grey blackish soil and carry patches of Teak forests. Alluvial deposits which are met with along banks of rivers and nalas like Sandor, Parry, Amar, Udanti etc. are very good forest soils.

Cliestanthus collinus is common on laterites whereas heavy black cotton soils are characterised by dominance of Terminalia tomentosa. Sal forests are more common on the metamorphic rocks of Dharwar system. These forests end abruptly on the sand stone beds and are absent on the lime stones.

1.9 MINERALS:

The district is deficient in mineral wealth except for lime stone and dolomite.

Gold is washed at places from the bed of Mahanadi and Jong rivers. Rajim is particularly mentioned for gold washing. There had been a gold mine in Sonakhan hills but the percentage of gold reported was found to be very less. Iron ore is found in small quantities scattered over the entire district. Pyrites (Iron sulphide) is found in assocation with shaly lime-stone in Kasdol region. Clay for brick making is available on the bank of Kharun river. Minute quantity of Galena occurs in streaks and patches near Bijrabhata.

An occurrence of lignite is reported in the bed of Kharun river. Lime-stone extends in the form of discontinuous patches near Mahasamund and Raipur.

1.10 LAND USE PATTERN:

Out of the total geographical area of 24117 sq.km., 7940 sq.km. are under forest. The remaining area is chiefly under agricultural use. Some portion of land is under non-agricultural uses such as habitations, roads, fallow lands, pastures etc. The agricultural use of land is classified as under in the "Basic Agricultural Statistics of Madhya Pradesh (1982-83, 1986-87)" published by the Commissioner, Land Records & Settlement, Gwalior, Madhya Pradesh.

Area in (Ha)

Land under misc. tree crops and groves not included in net area sown	Cultivable waste	Old fallows	Current fallows	Net area sown
1	2	3	4	5
110	45,144	35,013	32,776	9,34,581

1.11 SOCIO-ECONOMIC CONDITION:

The district is one of the educationally backward districts of Madhya Pradesh. 30.81% population of the district is literate. Agriculture forms the basic economic activity in this district. However, it has remained under-developed due to lack of education and prevailing poverty. Nearly 75-80% population depends upon agriculture. Employment opportunities in other fields like industries etc. remain much limited. About 30% of the net sown area has irrigation facilities. The important crops of this area are paddy,

wheat, jawar, maize, kodo/kutki, sugarcane, potato etc. As per the District Statistical Handbook, 1985 the total live stock population of Raipur district is 2091479 out of which there were 1471378 cows and 3,24459 buffaloes. Using male buffaloes as draught animal or for ploughing is the peculiarity of this area.

The following table gives some idea of the various socio-economic features of the district(as per 1981 census).

1.	Population	30,79,476
2.	Percentage of urban population	17.19
3.	Percentage of rural population	82.81
4.	Percentage of scheduled caste population to the total population	13.77
5.	Percentage of scheduled tribes population to the total population	18.55
6	Population density per sq.km.	145
7.	Percentage of male literacy	44.90
8.	Percentage of female literacy	16.82
9 .	Total quantum of land under irrigation(ha)	3,44,042
10.	Area irrigated more than once (ha)	1,668
11.	Average yield of paddy in quintals per ha	12.97

(Source : District Statistical Handbook for Raipur, 1985)

1.12 INFRASTRUCTURE:

The transport and communication are the most important factors contributing to the development of an economy. This district has good communication system. Railway lines from Howrah to Bombay and Durg to Waltair pass through this district. The narrow guage railway line from Raipur to Dhamtari and Raipur to Rajim also serves this district. National Highway No.6 connecting Calcutta-Dhulia via. Raipur and Nagpur and No.43 connecting Raipur to Vishakhapatnum via Jagdalpur(Bastar) run through this district. There are 3,779.64 km.of pakka roads and 2,474.46 km.of kachha roads in the district. These roads are maintained by the state P.W.D.

Tahsil-wise details of pakka and kachha roads maintained by state P.W.D. during 1984-85 are given as under:

Name of Tahsil	Pakka roads(km.)			Kachha roads(km.)		
	Maintained by PWD	Local organisation.	Total	Maintained by PWD	Local organisation.	Total
1	2	3	4	5	6	7
Raipur	813.32	-	813.32	524.88	-	524.88
Dhamtari	427.90	-	427.90	397.60	-	397.60
Baloda Bazar	274.50	-	274.50	231.80	-	231.80
Simga	154.80	-	154.80	115.70	-	115.70
Kasdol	208.00	-	208.00	128.20	-	128.20
Bilaigarh	243.20	-	243.20	100.70	-	100.70
Bhatapara	142.00	-	142.00	120.00	-	120.20
Mahasamund	473.62	-	473.62	317.62	-	317.62
Saraipali	270.99	-	270.99	273.51	-	273.51
Rajim	287.01	-	287.01	47.70	-	47.70
Gariaband	484.30	-	484.30	216.55	-	216.55

In addition, there are large number of forest roads maintained by the Forest Department which also help the communications in the interior areas and facilitate transport of forest and agricultural produce.

1.13 FOREST PRODUCE AND FOREST BASED INDUSTRIES:

The important forest produces of Raipur district are timber, fuelwood, ballies, bamboos, charcoal, tendu leaves, mahua flowers, mahua seeds, sal seeds etc.

There is one plywood industry, two paper industries and one bobbins blocks and shuttles industry at Raipur. In addition, there are about 160 saw mills and a good number of Bidi manufacturing units in the district. Furniture making, bamboo-basket weaving etc. are the cottage industries in several urban and rural areas of the district.

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CHAPTER TWO

THE FORESTS.

2.0 GENERAL DESCRIPTION:

The factors which influence distribution of various forest types are mainly climate, soil, topography and past treatment. Nevertheless, the forests of Raipur district are very interesting from ecological point of view as several instances of the effect of parent rock on forest types are observed in this district. Moreover; two important forest types i.e. Sal and Teak, are found to occur side by side in this area. In some areas, teak and sal can be seen growing together naturally.

2.1 FOREST TYPES:

According to Champion and Seth's classification following main forest types occur in this district:

1. 3 C/C2 e : Moist Peninsular Sal
2. 5 B/C1 (c) : Dry Peninsular Sal Forest.
3. 5 A/C3 : Southern Tropical Dry Deciduous Mixed Forests.
4. 5 A/C1 (b) : Southern Tropical Dry Deciduous Teak Forests.
5. 3 B/C1 c : Slightly Moist Teak Forests.

Wherever sal or teak is more than 20% in the crop such areas have been classed as Sal forest or Teak forest. All these forest types occur with or without bamboo i.e. Dendrocalamus strictus. No pure bamboo forest has been seen during the survey in this district.

1. SAL FORESTS:

Good quality Sal forests are confined to deep sandy loam soils derived from fine grained granitic gniesses or metamorphic rocks of Dharwar formation. These are mostly on flat lands or on lower slopes of the hills. These are classified under moist peninsular low level Sal forests. Here, sal trees are well shaped and with straight boles. Sal forms a very large percentage of these forests and generally grows pure over vast stretches. Important associates of sal commonly met with are Terminalia crenulata (Saja), Pterocarpus marsupium (Bija) and Anogeissus latifolia (Dhauda), Adina cordifolia (Haldu), Diospyros melanoxylon (Tendu), Madhuca latifolia (Mahua), Dlabergia paniculata (Dhobin). Gmelina arborea (Khamer) Mitragyna parvifolia(Mundi), Schleichera oleosa (Kusum) are less common. Salmalia malabaricum (Semal) is confined to stream banks.

In the second storey, we commonly find Emblica officinalis, Buchanania lanzan, Cleistanthus collinus, Lagerstroemia parviflora, Grewia tiliaefolia, Kydia calycina. Ougenia oojeinensis, Cassia fistula etc. Medium to poor

quality Sal (Quality III & IV) classified under moist peninsular high level sal or under northern tropical dry deciduous Sal forests occurs mostly over hill tops, plateaus or where soils are shallow and granular. Dry sal occurs on soils where soil conditions are not favourable for retention of moisture. Proportion of sal is much less in these forests. Large patches of Miscellaneous forests occur in between the Sal forests. Common associates of sal are Terminalia crenulata, Anogeissus latifolia, Lagerstroemia parviflora. Other associates are Mitragyna parvifolia, Pterocarpus marsupium, Diospyros melanoxylon, Adina cordifolia etc. Boswellia serrata (Salai) is an important associate in dry Sal forests though occasionaly met in high level peninsular Sal forests also. Underwood is usually thin and species like Cleistanthus collinus, Zizyphus xylopyra, Buchnania lanzan etc. are met with.

2. MIXED FORESTS:

Large forest areas of the district are occupied by Mixed Forests where important species like sal or teak are either absent or present in small proportion and are not dominant.

Good quality Mixed forests are found on deep soils with well drained sandy or clay loam underlain by schists or gniesses of metamorphic origin. In many of these forests, dense understorey of bamboo is present. Principal species found are Terminalia crenulata, Anogeissus latifolia, Diospyros melanoxylon, Pterocarpus marsupium, Adina cordifolia, Dalbergia latifolia, Boswellia serrata, Lannea coromandelica, Lagerstroemia parviflora etc. Madhuca latifolia and Dalbergia paniculata also occur at places. Schleichera oleosa, Terminalia chebula, Terminalia belerica, Syzygium cumini occur scantly. Salmalia malabarica is mainly confined to alluvial soils.

Where there is thick bamboo understorey, other underwood species are sparse. In these forests the same underwood species as occur under Sal forests are commonly found. Where bamboos are absent there is sufficient underwood mainly of Cleistanthus collinus and other underwood species.

Poor quality mixed forests are found on various geological formations where the soil is shallow and sandy with pebbles and gravels. In such areas salai is an important component along with Terminalia crenulata and Anogeissus latifolia. Acacia catechu (Khair) is also found in some of these forests. Sterculia urens (Kullu) is found on rocky areas. Cleistanthus collinus, Emblica officinalis, Buchnania lanzan, Gardenia latifolia, Cassia fistula and Holarrhena antidysenterica are mainly found in the underwood. Bamboos occur in many areas in Mixed forests either of good or poor quality. Khair sometime occurs in small dense patches on sandy soils derived from coarse grained sandstones with intrusions of pegmatites.

3. TEAK FORESTS:

Good quality Teak forests are found on schists of lower foot hills and on alluvial soils. Proportion of teak varies from 20% to 90% in such areas. It grows well on deep loams or clay loams in valleys and lower slopes. Associates of teak are the same as found in Sal forests i.e. Terminalia crenulata, Anogeissus latifolia, Pterocarpus marsupium, Adina cordifolia etc. In second storey we came across the Cleistanthus collinus, Lagerstroemia parviflora, Diospyros melanoxylon etc.

Poor quality Teak forests are found on soils derived from doleritic intrusions along with granitic gneisses. Soil is loamy to clayey with boulders. Important associates are Anogeissus latifolia, Boswellia serrata and other common associates mentioned above.

In many of the forest areas Teak, Sal and Mixed forests alternate at very short distance. In some places teak and sal are found to be growing together. Bamboo occurs in many of the Teak forest as understorey.

In south Raipur Forest Division, we come across slightly moist Teak forests also in alluvial belts particularly along river banks where Schleichera oleosa and Adina cordifolia are important associates of teak in addition to Terminalia crenulata and bamboos. Extent of this forest type is, however, limited.

2.2 FOREST MANAGEMENT:

As already mentioned in Chapter I, there are three territorial divisions in this district for management of forests. In addition, there are two production divisions and one division each of plantation, wildlife and soil conservation. Out of the total forest area in the district 3749.87 sq.km. is covered by working plans and 3260.99 sq.km. by working schemes. Only unclassed forest area of 174.13 sq.km is not covered by any working plan or scheme.

Since the area is covered by three forest divisions and there are separate working plans for each division in addition to working schemes, it is not feasible to describe forest management in the district in details in this report. However, a general and broad outline of forest management is given below.

Forest management is primarily based on the objectives of management and different treatments are given to the forest areas to suit the character of vegetation and its requirements.

Forests on steep slopes in hilly areas, which must be protected in the interest of soil and water conservation,

are placed in the Protection working circle. In these areas either there is complete protection or very light fellings are permitted.

Sal forests occupy large part of this district. Better quality sal forest generally occurs where moisture condition are favourable i.e. in deep soils on plateau or gently undulating areas. The forests are mostly irregular. In such areas only over-matured and matured trees can be removed without sacrificing younger growth. These are, therefore, managed under Selection-cum-Improvement working circle. Poor Sal forests are generally open with heavy invasion of weeds and grasses. Such areas need proper silvicultural treatment to nurse the sound trees. These are placed under Sal improvement working circle. Yield from these areas is low as it is obtained only from dead and dying trees. Mixed forests cover the major portion of the forests and there are large areas where valuable mixed forests are found. Hence, matured and over matured trees are harvested under Mixed improvement working circle. Some areas of Mixed forests are also worked under Coppice-with-reserve working circle.

Teak areas, though much less in extent, are valauble and deserve special attention. Such forests are generally irregular and are deficient in higher age classes. Regeneration is also not adequate. These are managed under Teak selection-cum-improvement working circle.

In addition to these, there are other important species like bamboo, Khair, Semal etc. occurring in association with other forest types but requiring separate management practices. Such species are managed under separate Overlapping working circle like Bamboo working circle, Khair working circle, Semal working circle, Kullu working circle etc.

Large scale plantations of teak are raised under Teak plantation working circle which includes areas not only of Teak forest but also some areas of Mixed and Sal forests suitable for raising teak. Existing forest villages and areas under preservation plans etc are managed under Miscellaneous working circle or Forest village upliftment working circle.

2.3 DAMAGE TO THE FORESTS:

As is common all over India, the major damage to the forest is caused by human interference either directly or indirectly, through the cattle kept by him. Most of the damage is for meeting the needs of the people for fire wood, building material, grazing of the cattle, collection of minor forest produce for sale etc. Practice of shifting cultivation which was common in the past seems to have been controlled now and no area under shifting cultivation could

be observed during the survey. Damage to soil by heavy biotic interferences is one of the major hazards as this district lies in the water shed of the Mahanadi river. Hirakud Dam constructed on the Mahanadi river, near Sambalpur is about 300 km. to the east of Raipur. If it is to be preserved longer, adequate soil conservation measures in the agricultural as well as forest areas of the district are absolutely essential.

2.4 RIGHTS AND CONCESSIONS:

There are no rights of any description recognized over the government forest in the district. However, certain concessions are allowed to agriculturists. These include grazing of their cattle in the forests, collection of small timber and fuel from the forests for their bonafide requirements etc.

2.5 WILD LIFE:

This district had once the reputation of being abundant in wild animals. However, there is an appreciable depletion of the wild life at present which can be attributed to indiscriminate shooting, destruction of forests and extension of cultivation. Some of the tribals, who have inherent hunting instinct, are also responsible for destruction of wild life. They hunt by bows and arrows and also lay out traps. Wild life is scarce in scattered blocks of forest which are interspersed with or surrounded by populated villages.

There are three wild life sanctuaries in this district, namely :

1. Barnawapara - 244.66 sq.km.
2. Sitanadi - 553.36 sq.km.
3. Udanti - 247.59 sq.km.

Udanti wild life sanctuary is the only sanctuary in Madhya Pradesh for wild buffaloes. Barnawapara sanctuary is quite rich in Chital and Wild boars.

Wild animals commonly found in this district are Tiger, Panther, Gaur, Wild buffaloes, Sambhar, Chital, Nilgai, Barking deer, Bear, Wild dogs, Wild pigs, Hares, Monkeys etc.

Bird life is not abundant. However, birds like Peacock, Greenpigeon, Red jungle fowl, Woodpeckers, Hornbills, Bulbuls etc. are commonly seen in this area. Due to the absence of large reserviors and tanks no migratary birds or ducks are seen.

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CHAPTER – THREE

RESOURCES SURVEY METHODOLOGY.

3.0 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, altitude, 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 composition, height, size, quantum of regeneration, injury to crop, fire incidence, grazing incidence, presence of weeds and grasses etc.

3. To collect information regarding 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 conditions 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 Raipur distt. of Madhya Pradesh 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, the 1" = 1 mile toposheets were used. All those areas which are demarcated by double dotted forest boundaries on these toposheets and are 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 Ø.1 ha area, in each grid of 2 1/2'x 2 1/2' (latitudes and longitudes) on the toposheet of 1:5Ø,ØØØ or 1:63,36Ø scale. A grid bounded by 2 1/2'x2 1/2' latitudes and longitudes covers about 2Ø sq.km. area in which Ø.2 ha area is actually sampled. Thus the sampling intensity of the survey comes to Ø.Ø1%. 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 Ø.6324 mm (side of Ø.1 ha square plot) in case the map was on 1:5Ø,ØØØ scale, or by Ø.499Ø mm in case the map was on 1:63,36Ø 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'x2 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 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 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 1:5Ø,ØØØ scale map and by Ø.499Ø 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 grid 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'x 2 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. All such plots were marked on the toposheets. The plots so marked are to be visited only when they fall in

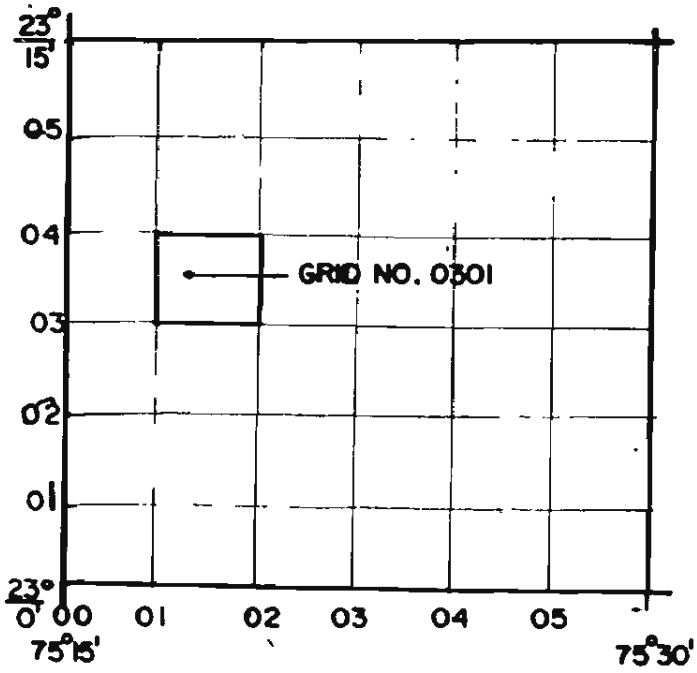


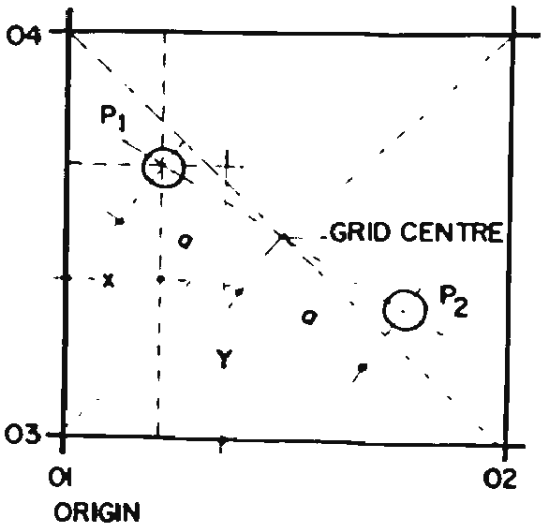
DIAGRAM-1

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

DIAGRAM-2

DIAGRAM SHOWING LAY-OUT OF PLOT IN 2½'X 2½' GRID

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



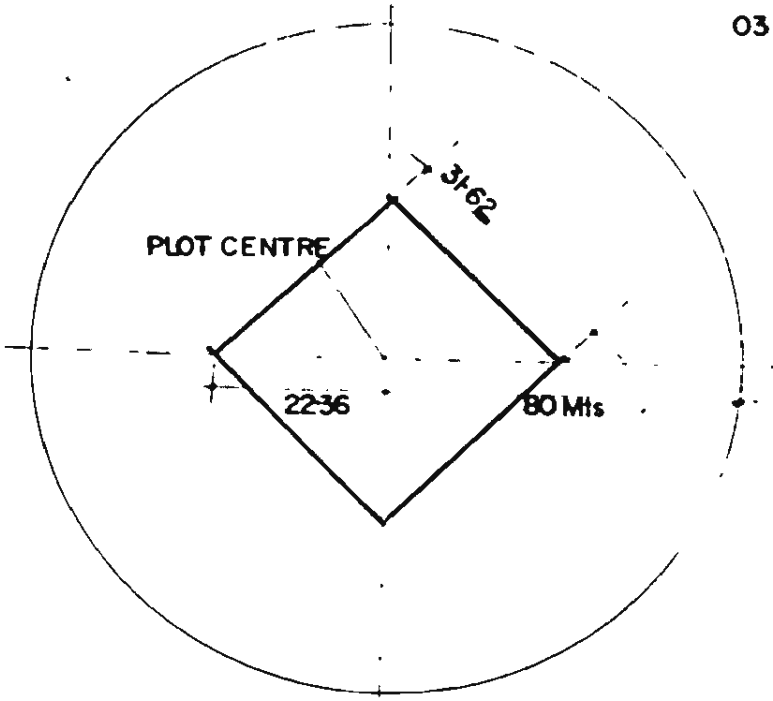


DIAGRAM-3

DIAGRAM SHOWING LAY-OUT OF PLOT

forest areas i.e.the area covered by green wash or by double dotted forest boundaries on 1:50,000 scale or 1:63,360 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 has fallen in some forest area. All the forested plots of the survey area falling in Raipur district of Madhya Pradesh and duly marked on the 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 feature 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 point.
4. Old bridges and culverts.
5. Old temples, mosques and churches.
6. Crossing of rail tracks with roads, streams, rivers etc.
7. Junctions of rivers or stream and roads.
8. Confluence of streams and rivers.
9. Junction of roads.
10. Prominent bends in roads, rivers or streams.
11. Old ponds and wells.
12. Springs.
13. Prominent topographical features in hilly region such as spurs, knolls etc.
14. Mile stones or kilometer stones.
15. Boundary pillars of international, state, district and forest areas etc.
16. Prominent bends of boundary etc.

After locating one 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 on the bearing calculted for the plot using Silva Compass and distance measured with a 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 22.36m. 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 semi-diagonals (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 processing the data on electronic computer at a later stage. Various field forms used in this survey are:

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 is a record of approach to the plot centre from the field camp of a crew. It is filled in by the crew leader as he proceeds 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 in it. The exact location of plot centre i.e. bearing and distance from two trees to the plot centre is 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 was 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 having dia 10 cm. over bark and above and all the bamboo clumps occurring in whole of 0.1 ha sample plot 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 classes, 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 was 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 gave 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 was 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 Raipur district of Madhya Pradesh was completed during the period from February 1986 to May 1986 keeping the Base camp at Government Timber Depot, Gariyaband in the South Raipur Forest Division. 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 Junior Technical Assistant acting 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 Senior Technical Assistant who was also the incharge of the survey work. About 10% of the total number of plots tackled by various crews were checked and mistakes found (if any) during the checking were rectified in the field forms.

3.7 MAPS AND PLOTS:

The Survey of India toposheets covering the forest areas of Raipur district are listed below giving details of their scale, year of survey and number of plots tackled in each of them.

S.No.	Map sheet No.	Scale of map.	Year of survey of toposheet.	No. of plots inventoried by F.S.I.
1.	64 G/10	1:50,000	1979-80	-
2.	64 G/11	"	1979-80	-
3.	64 G/12	"	1979-80	-
4.	64 G/13	"	1979-80	-
5.	64 G/14	"	1979-80	01
6.	64 G/15	1"=1 mile	1933-34	03
7.	64 G/16	1:50,000	1979-80	-
8.	64 H/6	1:50,000	1976-77	03
9.	64 H/9	"	1976-77	-
10	64 H/10	"	1976-77	31
11.	64 H/11	"	1974-75	01
12.	64 H/13	"	1976-77	-
13.	64 H/14	"	1976-77	63
14.	64 H/15	"	1974-75	40
15.	64 H/16	"	1974-75	32
16.	64 K/3	"	1976-77	13
17.	64 K/4	"	1977-78	18
18.	64 K/6	"	1977-78	15
19.	64 K/7	"	1976-77	60
20.	64 K/8	"	1977-78	11
21.	64 K/10		1977-78	29
22.	64 K/11	"	1977-78	31

23.	64	K/12	"	1977-78	19
24.	64	K/14	"	1977-78	12
25.	64	K/15	"	1977-78	Ø8
26.	64	K/16	"	1978-79	Ø4
27.	64	L/1	"	1977-78	43
28.	64	L/2	"	1977-78	58
29.	64	L/3	"	1977-78	63
3Ø.	64	L/4	1:5Ø,ØØØ	1977-78	6Ø
31.	64	L/5	"	1977-78	26
32.	64	L/6	"	1977-78	26
33.	64	L/7	"	1977-78	48
34.	64	L/8	"	1977-78	46
35.	64	O/3	"	1978-79	1Ø
36.	64	O/4	"	1980-81	15
37.	65	I/1	"	1967-68	Ø1
38.	65	I/5	"	1967-68	18
39.	65	I/9	"	1967-68	Ø1
			Total:		8Ø9

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

After completion of field work, the field forms for inventory of 8Ø9 plots of Raipur district of Madhya Pradhesh were manually checked in the Zonal office as per field manual and coding instructions meant for the purpose. Inconsistency noticed in the forms was 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 21st July 1986 for computer analysis and processing the data for deriving various kinds of informations to meet the objectives of the survey.

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CHAPTER - FOUR

DATA PROCESSING.

4.0 SAMPLING DESIGN:

Grids were marked at 2 1/2'x 2 1/2' interval in the green wash area of the Survey of India toposheets relating to Raipur district of Madhya Pradesh. Two plots were laid in each grid. The first plot was laid out at random and the second was linked to the first in the opposite quadrant at equal distance from the grid centre. The plots were square in shape, each having an area of 0.1 ha.

4.1 DATA:

The basic data of the inventory survey was collected in the Plot description form, Plot enumeration form, Bamboo enumeration form, Sample tree form and Bamboo weight form. Data on felled trees was not collected.

The field forms were precoded so that the field data could be easily transferred on to the punch cards. There were 2600 field forms which required punching of the following number of cards under each card design.

	Card design	No. of cards.
1.	Plot description	809
2.	Plot enumeration	2677
3.	Sample tree	5173
4.	Bamboo enumeration	120
5.	Bamboo weight data	72
	Total	8851

4.2 DATA PROCESSING:

The data processing involved the following operations:

i) Manual processing:

The field forms received in the Machine Data Management Unit of Forest Survey of India, Dehradun were checked with the list supplied by the central zone 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 cards required to be punched under each card design was also estimated and recorded 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 punching.

Each entry in the field forms was checked for consistency. 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.

Listings taken out of the data loaded on the magnetic tape/disk were checked to ensure complete loading and proper sequence of data.

Sample statistics were calculated and checked with the computer output to see if the calculations on computer were correct. These involved volume of enumerated tree from local volume equation, plot volume and standard error etc.

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

ii) Processing on unit record machine:

The data of field forms were punched on cards with the help of punching machine. The punched data cards were verified using card verifier to detect punching mistakes. The verified cards were sorted out for proper input to the computer.

iii) Processing on electronic computer:

The punched, verified and sorted data on cards were loaded on magnetic tapes/disks and listings of the loaded data were taken out to check if the data have been loaded completely in the desired sequence.

Volume of each enumerated tree was estimated with the help of local volume equation used for the species.

Contribution of the volume of each enumerated tree towards per hectare volume was derived and stored in a tree/plot volume file for further processing.

Growing stock tables by species and diameter class under each crop composition were prepared from tree/plot volume file. Standard error of the estimated growing stock in each crop composition (forest type) was calculated.

The data of this survey was processed on System - IBM - 370 of Oil and Natural Gas Commission, Dehradun.

The computer has the following configurations.

Memory	512 K bytes
Card reader	1
Tape drives	6
Disk drives	4
Line printer	1

AREA:

Figures relating to the forest area were not available from interpreted aerial photographs. Forest area was compiled from the mapsheets. From the total forest area(green wash) and the total number of sample plots falling in this area weightage of each sample plot was calculated. This factor was used to derive area by different landuse classes.

The total area was classified by land use pattern and this is given in table no 5.1 T. The area falling in land use dense tree forests, moderately dense, open forest, young plantation of forestry species and young crop of natural and aritifical regeneration was considered as tree vegetation cover and classified by crop composition classes (forest types) on the basis of number of sample plots in each separate estimate for three crop compositions viz. TeaK, Sal and Miscellaneous only. As the number of plots in Khair and Salai crop compositions are 6 and 14 respectively, which are less in numbers, the same were merged with the Miscellaneous forest type and is given in table no. 5.2T.

The area under each crop composition (forest type) was classified by topography(table no.5.3T), slope classes (table no. 5.4T), soil depth classes(table no. 5.5T), top height classes (table no. 5.6T), size classes (table no. 5.7T), canopy layers (table no. 5.8T), government forest land utilisation pattern (table no. 5.9T), plantable area in govt.forest land (table no. 5.10 T).

However, it may be noted that in many cases the above area tables are based on a few sample plots, therefore, these tables should be considered as indicative only and used with due caution.

4.4 SAMPLE TREE VOLUME:

Felled tree data was not collected, therefore, sample tree volumes were obtained by substituting height and diameter of sample tree data in the general volume equations of the species taken from the Report on Forest Resources of Rajnandgaon and Durg districts of Madhya Pradesh and a sample tree volume file was created.

4.5 LOCAL VOLUME EQUATIONS:

The estimated sample tree volume and its transformed form is considered as dependent variable and the diameter or its transformed form as independent variable for the regressions.

The following types of regression functions were tried for each species.

1. $V = a + b\ D^2$
2. $V = a + b\ D + c\ D^2$
3. $V = a + b\ D + c\ D^2 + d\ D^3$
4. $V = a + b\sqrt{D} + C\ D^2$
5. $\sqrt{V} = a + b\ D$
6. $\sqrt{V} = a + b\ D + c\sqrt{D}$
7. $V/D^2 = a + b/\ D^2$
8. $V/D^2 = a + b/D + c/D^2$
9. $V/D^2 = a + b/D^2 + c/D + d\ D$
10. $\text{Log } V = a + b \text{ Log } D$

One of the equations from these is selected for each species on the basis of

a) standard error of the estimate,
b) co-efficient of determination and
c) apllicability of the equation to the entire range of the data.

The following local volume equations were selected on the above criterion for different species as under:

1. Anogeissus latifolia (251) R

$\sqrt{V} = 0.28802 + 5.12791\ D - 1.87116\ \sqrt{D}$ 0.92310

2. Boswellia serrata(130) = 0.77817

$V/D^2 = 10.86801 + 0.044621/D^2 - 1.25694/D - 3.09085\ D$

Diospyros melanoxylon (227)

$V/D^2 = -0.00858 - 0.04233/D^2 + 0.49232 /D + 13.27481\ D$

or

$V = -0.04233 - 0.00858\ D^2 + 0.492321\ D + 13.27481\ D^3$

4. Lagerstroemia parviflora(120)

$V = 0.05680 - 1.19611\ D + 9.11319\ D^2$

5. Lannea coromandelica(215)

$V = -0.05957 + 0.93959\ D - 4.04701\ D^2 + 22.23900\ D^3$

6. Mitragyna parviflora(46)

$V/D^2 = 4.49414 - 0.023941\ D^2$

or

$V = -0.023941 + 4.49414\ D$

7 Ougenia oogeinensis (67)

$V = -0.10715 + 0.25684\sqrt{D} + 4.68486\ D^2$

8. Pterocarpus marsupium(156)

$V/D^2 = 9.39716 - 1.14471/D + 0.04482/D^2$

or

$V = 0.04482 - 1.14471\ D + 9.39716\ D^2$

9. Shorea robusta(626)

$V = 0.48104 - 6.28923\ D + 24.48398\ D^2 - 9.20515\ D^3$

10. Tectona grandis(124)

$V/D^2 = 16.52336 + 0.12591/D^2 - 2.45212/D - 7.57135\ D$

or

$V = 0.12591 - 2.45212\ D + 16.52336\ D^2 - 7.57135\ D^3$

11. Terminalia crenulata(458)

$V = 0.00376 - 0.77604\ D + 8.35533\ D^2$

12. Rest of the species(2684)

$V/D^2 = 7.71869 + 1.15753\ D - 0.91545/D + 0.03646/D^2$

or

$V = 0.03646 - 0.91545\ D + 7.71869\ D^2 + 1.15753\ D^3$

(N.B. Figures in brackets against the name of the species denote the number of trees on which the equations are based).

4.6 ENUMERATED TREE VOLUME:

Volume of each enumerated tree was estimated from the breast height over bark diameter of the tree and the local volume equation used for the species. The estimated tree volumes were converted to per hectare volumes and stored in tree/plot volume file with speices code, tree diameter, parameters of Plot description form, per hectare stems and volume in the sample plot. The file helped in the tabulation of results by species and diameter for different crop compositions (forest types).

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. Average volume/ ha (in cu.m.) were calculated in different classes of topography, slope percentage, soil depth, canopy layer, top height and size classes under each crop composition (forest type). These are given from table no. 6.9 T to 6.14T of Chapter VI on growing stock.

The plot volumes were also used to estimate the sampling error of growing stock in each forest type.

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. These are given from table no. 6.1T to 6.3T of Chapter VI dealing with growing stock.

The number of stems per hectare and total stems for all forest types combined were also derived which are given in table no.6.7T.

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. These are given from table no. 6.4T to 6.6T.

Estimate of volume per hectare and total volume by species and diameter classes for all the forest types combined was also derived and given in table no. 6.8T.

4.10 SAMPLING ERROR:

The sampling was considered as systematic cluster sample having two sample plots in each cluster. In order to estimate sampling error, the sample plots were considered to constitute simple random sample of unequal clusters because in many cases only one plot was enumerated from a grid. As such the ratio method of estimation is used and the sampling error is estimated as follows:

Estimate of variance of $\hat{R}$

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

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

(Ignoring the finite population correction factor)

$$= \frac{1}{n\ (n-1)\ \bar{x}^2} \left(\sum_{i=1}^{n} Y_i^2 - 2\hat{R} \sum_{i=1}^{n} Y_i + \hat{R}\ x_i^2 \right)$$

Where n = total number of clusters in the sample
yi = the total of per hectare volume in the ith grid.

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

$$\hat{R} = \frac{\sum_{i=1}^{n} yi}{\sum_{i=1}^{n} xi}$$ = Estimate of average volume per hectare overall clusters.

Estimate standard error (S.E.) of $\hat{R}$

$$S.E. = \hat{V}\ \hat{R}$$

$$S.E\ \% = \frac{S.E.}{\hat{R}} \times 100$$

Standard errors have been estimated for the growing stock in each crop composition and are given in table no. 6.15 T.

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CHAPTER - FIVE

INVENTORY RESULTS: AREA

5.0 GENERAL:

The forest resources information of Raipur district of Madhya Pradesh has been compiled on the basis of the data collected from 809 sample plots which were located all over the forest area of the district. The total geographical and forest area was taken as 24117.0 sq.km. and 7940 sq.km. respectively . The total forest area divided by the total number of sample plots falling in entire forest land gives the weighted area represented by each sample plot which comes to 9.81 sq.km. Further, break up of the area under various parameters like land-use classes, crop compositions, topography classes, slope classes, soil depth classes, hieght classes, size classes and canopy layers etc, was worked out giving due weightage to the sample plots located in various classes of the parameters as observed during the course of field work. These are discussed in details in following paragraphs.

5.1 FOREST AREA BY LAND USE CLASSES:

Table no.5.1T produced below gives a picture of how the entire green wash area/forest land of Raipur district is presently being used. The table indicates that about 59.55% area of total forest land is under dense and moderately dense tree forest having crown density 30% and above, 20.39% open forest having density 5-30 %. About 6.55% of the total forest land was found to be under young plantations having dia 2-10 cm. at breast height. About 2.22% area of the vegetation was under young crop of natural or artificial regeneration having dia below 2 cm. In all 7390.64 sq.km. area which is nearly 93.08% of the total forest land is under land use "forest". The balance forest area at present is under the land use agriculture and shifting cultivation which also includes areas water bodies. The agricultural land found in the forest/green wash areas is the result of either old encroachments or diversion/ allotment of forest land for non-forestry purposes. However, the net vegetated area on the basis of which the forest under various parameters and the growing stock was estimated, is 7043.58 sq.km. only represented by 718 sample plots. Shifting cultivation is not a problem in the district as revealed from the table. Only 0.12% area of forest land is affected by shifting cultivation.

LAND USE CLASSES MAP OF RAIPUR DISTRICT

No. 5-M

SCALE:- 1:1,000,000

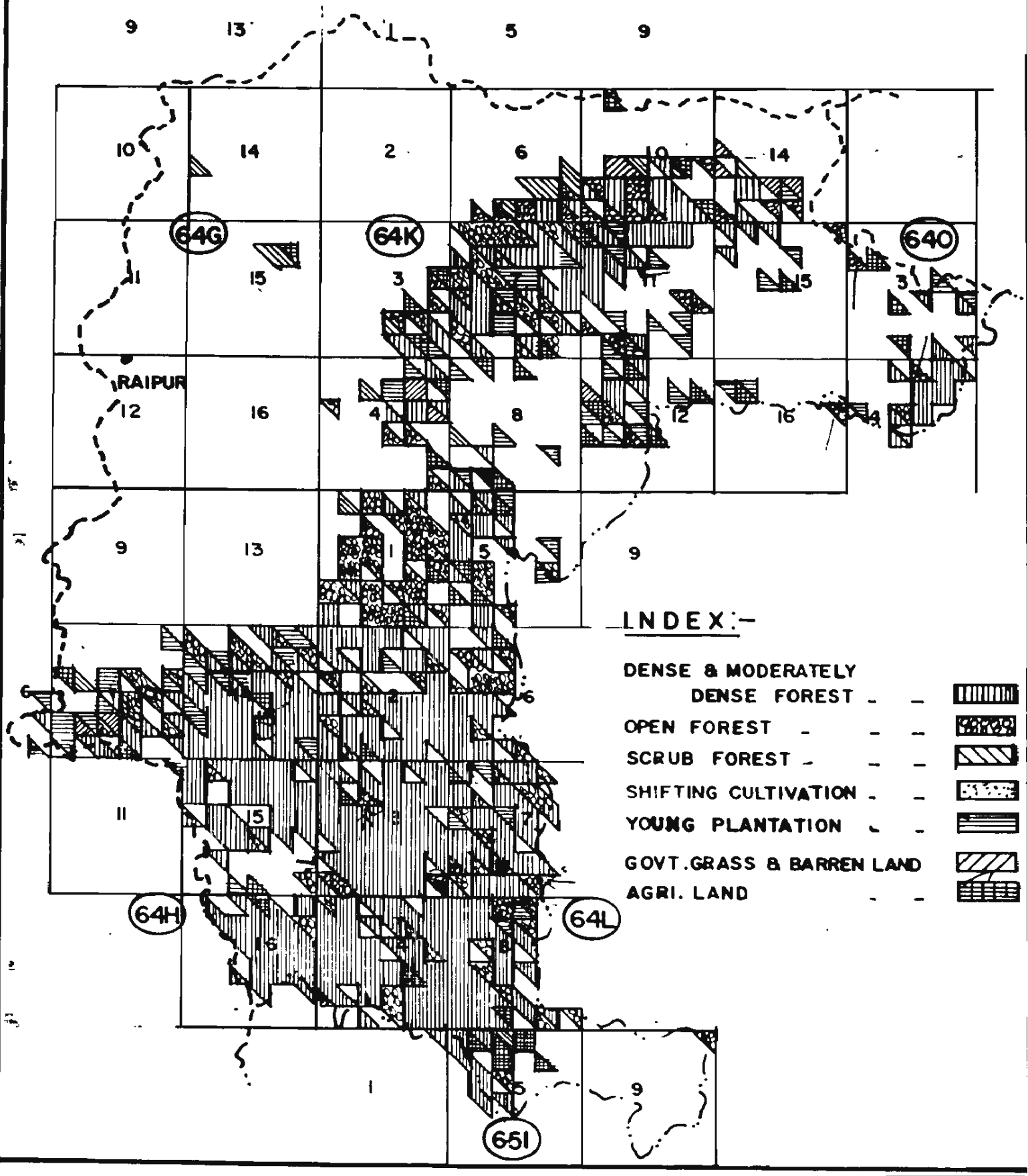


Table No. 5.1 T

Distribution of total forest area by land use classes

).	Land use class	No. of sample plots	Area (sq.km.)	Percentage of area
1.	Dense and moderately densee forest (density 30% & above)	482	4728.42	59.55
2.	Open forest (density 5-30%)	165	1618.65	20.39
3.	Young plantations (dia 2-10 cm.)	53	519.93	6.55
4.	Scrub forest (density below 5%)	18	176.58	2.22
5.	Shifting cultivation	1	9.81	0.12
6.	Forest roads	1	9.81	0.12
7.	Bamboo brakes	7	68.67	0.87
8.	Agricultural land with or without trees & non-forestry plantations.	49	480.69	6.05
9.	Water bodies	6	58.86	0.74
10.	Young crop of natural or artificial regeneration.	18	176.58	2.22
11.	Inaccessible	9	92.00	1.17
	Total	809	7940.00	100%

A map no. 5.1 M has been prepared on the basis of above table which indicates the location of various land use classes. It shows that the southern part of the district has dense forest having density 30% and above. The open forest with density (5-30%) is mostly confined to central and northern parts of the district in patches along with dense forest. The central and northern parts have comparatively poorer forest than in the southern part. The northern and western parts have more areas under plantations than the southern part of the district.

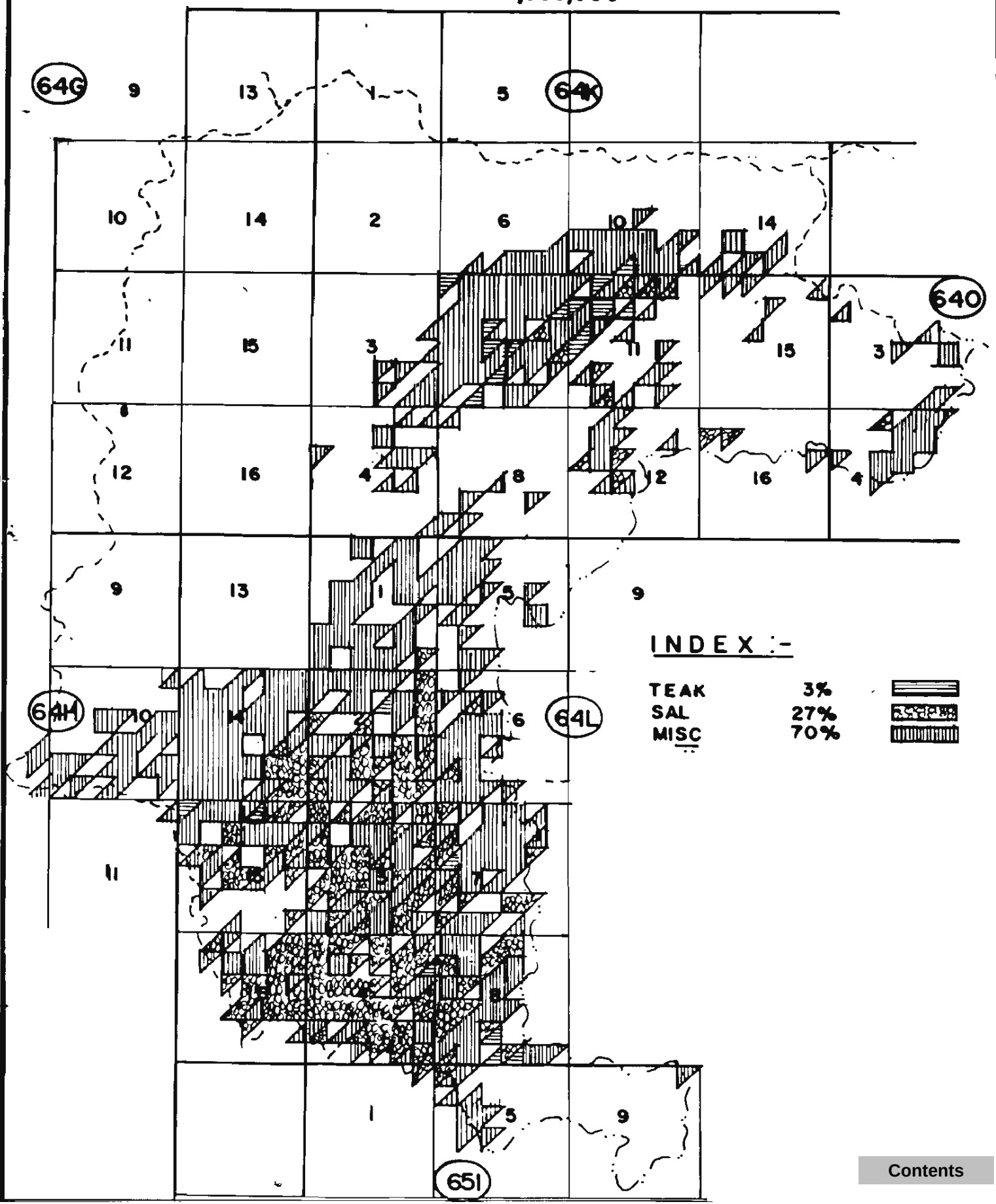
5.2 AREA BY CROP COMPOSITIONS:

For the purpose of working out the distribution of vegetated area under different categories viz. crop compositions, topography classes, slope classes, soil depth classes, top-height classes, size classes and canopy layers, only the sample plots bearing vegetation such as dense forest, moderately dense forest, open forest, young plantations and young crop of natural or artificial regeneration, have been taken into consideration which collectively form 718 sample plots representing 7043.58sq.km.

CROP COMPOSITION MAP OF RAIPUR DISTRICT

No :- 5.2 M

SCALE :- 1 : 1,000,000



Remaining 91 sample plots representing about 892.71 sq.km. of forest land of the district have been kept out of description upto paras 5.8.

Stratification of entire forest areas of the district has been done into crop compositions (forest types) on the basis of existing vegetation in 2 ha area around the centre of the sample plots. Accordingly, three main strata (crop compositions) in the vegetation of the district were identified. They are Teak, Sal and Miscellaneous. Besides these three strata, Khair and Salai forests types were also identified which cover 58.86 sq.km. and 137.34 sq.km. respectively.

Since Khair and Salai forests contribute very little towards the vegetated area and also towards the total growing stock, these two strata have been merged with Miscellaneous stratum as their individual contribution is insignificant. Table no. 5.2T produced below gives the distribution of the vegetated area under three strata of the crop compositions found in Raipur district. The table reveals that about 3% of the vegetated area is under Teak, which are mostly plantations, 27% under Sal and 70% under Miscellaneous forest wherein no dominance of any particular species was observed during the course of survey.

Table No. 5.2T

Break up of tree vegetated area under different crop compositions.

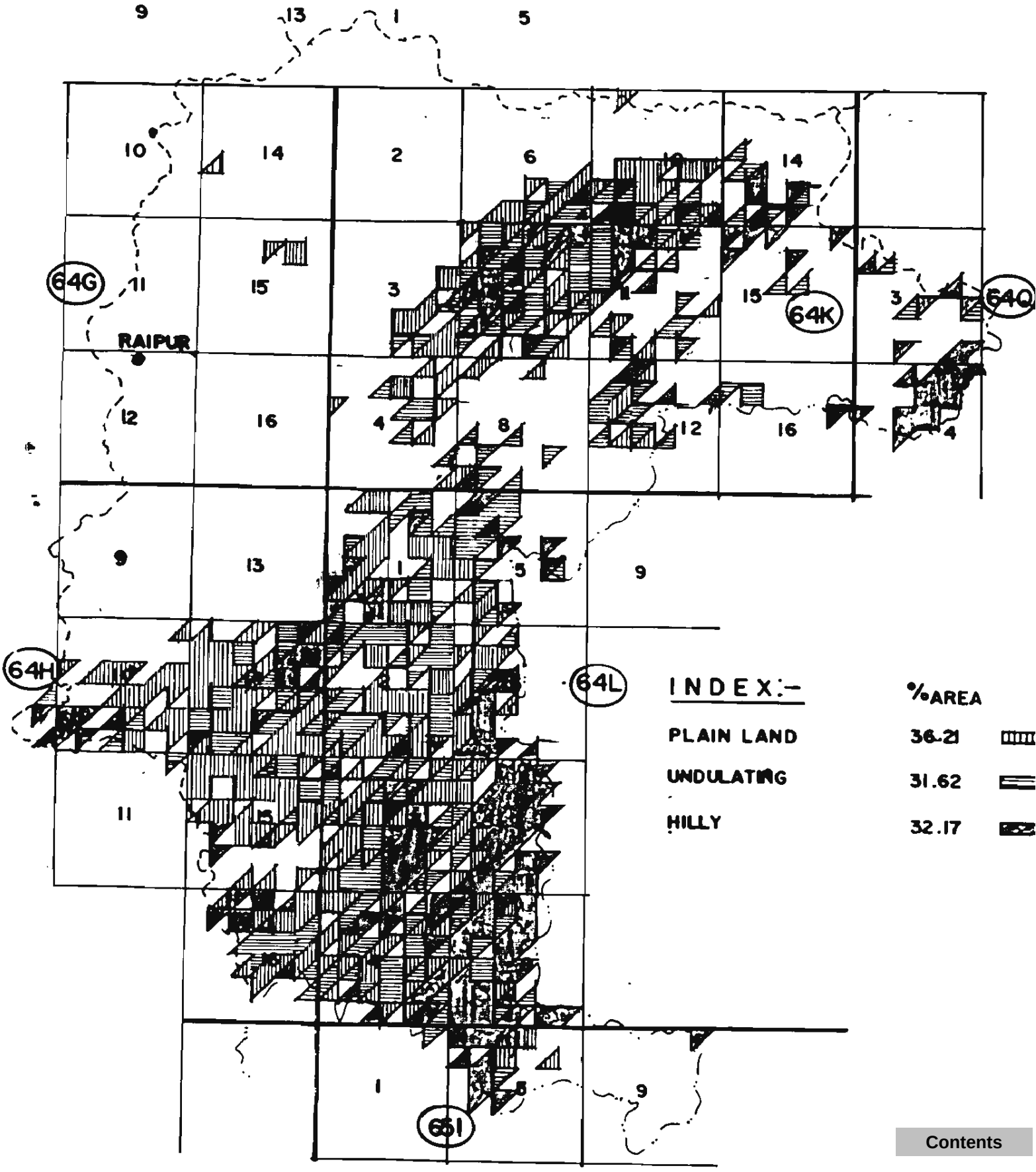
S.No.	Crop composition	No. of sample plots	Area (sq.km.)	Percentage of area
1	Teak forests	23	225.63	3.20
2	Sal forests	194	1903.14	27.02
3	Miscellaneous forests	501	4914.81	69.78
	Total	718	7043.58	100.00

A map no. 5.2 M has been prepared to indicate the location of the plots in the above three strata of vegetation. The map reveals that southern part of the district has Sal forest whereas central and northern parts mostly have Miscellaneous forest. Teak forest contributes just 3% to the vegetal cover which was found in northern part of the district in scattered and sporadic manner. A few plots were found in southern part also. They are mostly plantations. A few plots of Teak were found under natural regeneration also. However, there is no marked locality of Teak in Raipur district. Sal, on the other hand is the main species found almost everywhere but its major concentration is in the southern part of the district.

TOPOGRAPHY CLASSES MAP OF RAIPUR DISTRICT

Nº : 5.3M

SCALE :- 1 : 1,000,000



AREA BY CROP COMPOSITIONS AND TOPOGRAPHY:

Table no. 5.3 T produced below give details about the vegetated area of the district by crop composition and topography classes. The table reveals that in all the three forest types, 36.21% area of vegetated cover is supported by flat lands, 31.61% by undulating lands and the rest 32.18% by hilly terrain. Sal forest is mostly confined to flat and undulating terrain whereas Miscellaneous forest occurs almost evenly in all kinds of topography classes. Same is the case with Teak also. Since Teak has mostly been raised by plantations in the district, it is represented under all the topography classes in Raipur district. In general it can be stated that the forest is uniformly and evenly distributed in all the topography classes. However, very hilly terrain was not found in Raipur district.

Table No. 5.3 T

Break up of tree vegetation area under different crop compositions by topography classes(Area in sq.km.)

Crop composition.	Topography classes			Total
	Flat lands	Gently rolling	Hilly	
Teak	68.67 (7)	107.91 (11)	49.05 (5)	225.63 (23)
Sal	912.33 (93)	696.51 (71)	294.3 (30)	1903.14 (194)
Misc.	1569.60 (160)	1422.45 (145)	1922.76 (196)	4914.81 (501)
Total area	2550.60 (260)	2226.87 (227)	2266.11 (231)	7043.58 (718)
% Area	36.21	31.61	32.18	100%

(Note:Figures in bracket denote the number of plots.)

A map no. 5.3 M has been prepared to show the location of various topography classes where the vegetation occurs in this district. The map indicates that the south-eastern part of district is hilly. The south-western part is mostly plain land. The northern part of the district has mixed kind of terrain. All the three topography classes support vegetation equally and having all the above three strata.

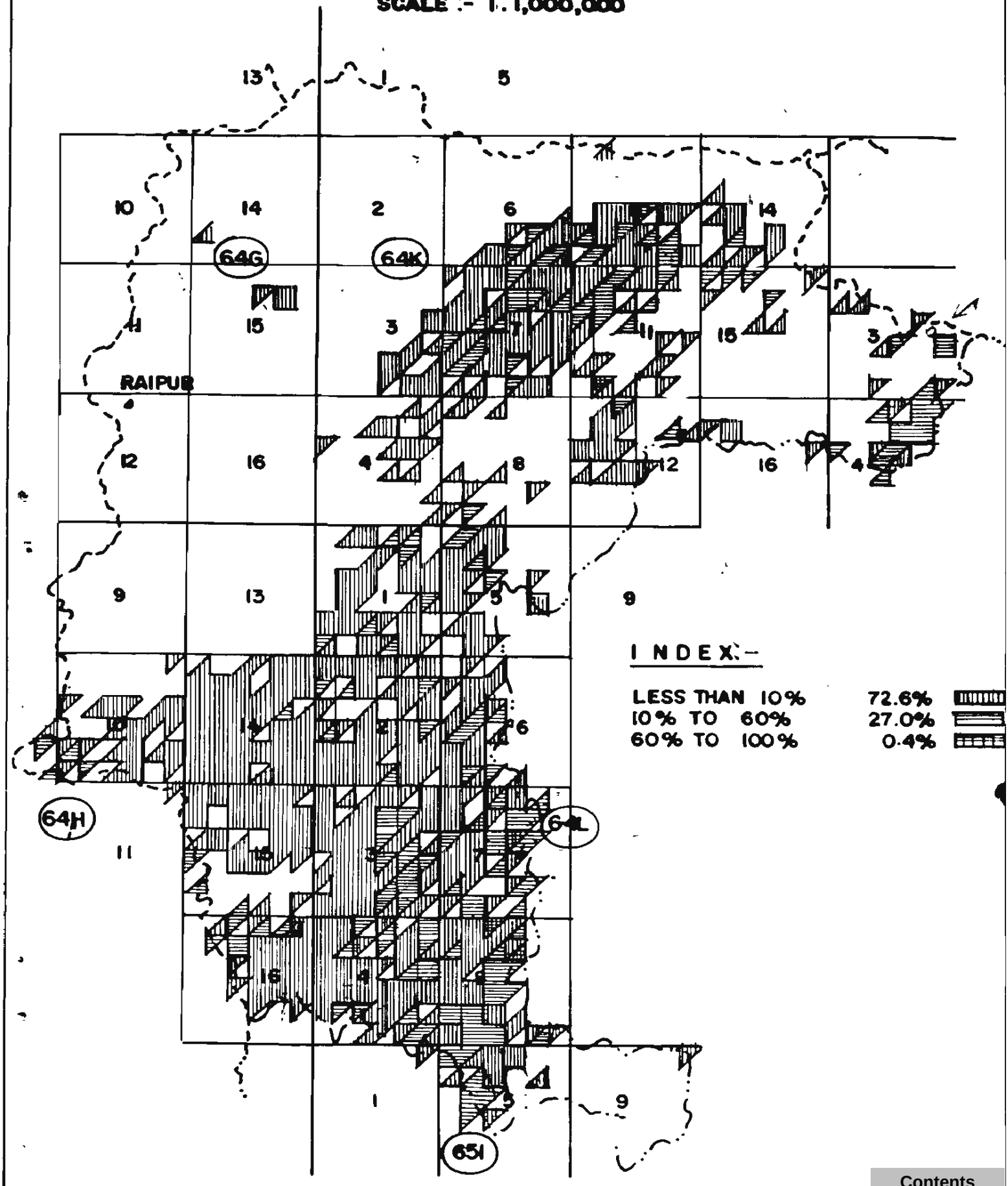
5.4 AREA BY CROP COMPOSITIONS AND SLOPE CLASSES:

Table no. 5.4T produced below gives distribution of vegetated area by crop compositions and slope classes of the terrain. The table indicates that major part of the vegetation in all the strata (72.56%) occurs on the terrain

SLOPE CLASSES MAP OF RAIPUR DISTRICT

No. : 5.4M

SCALE :- 1 : 1,000,000



which has slope less than 10%. About 27.02% vegetation is found on the terrain having slope between 10<60%. The terrain having slope more than 60% has just 0.42% of the vegetal cover. In whole of the district, it is observed that the vegetation exists mostly on plain and moderate slopes. The higher slopes do not support any vegetation. All the three strata exhibit similar behaviour with regard to their occurrence in various slope classes. However, Miscellaneous forest grows even on 60<100% slopes where Teak and Sal were found to be absent.

Table No. 5.4T

Break up of tree vegetated area under different crop compositions by slope classes (Area in sq.km.)

Crop composition	Slope classes <10%	10 - <60%	60 - <100%	Total
Teak	186.39 (19)	39.24 (4)	-	225.63 (23)
Sal	1618.65 (165)	284.49 (29)	-	1903.14 (194)
Misc.	3305.97 (337)	1579.41 (161)	29.43 (3)	4914.81 (501)
Total area	5111.01 (521)	1903.14 (194)	29.43 (3)	7043.58 (718)
% Area	72.56	27.02	0.42	100%

A map no. 5.4 M has been prepared to indicate the various slope classes of the terrain in the district wherever vegetation occurs. The map indicates that the south-western parts of forest land have moderate slope between 10-60% and the rest of the forest area has mixed slope classes, plain land and slopy lands.

5.5 AREA BY CROP COMPOSITIONS AND SOIL DEPTH CLASSES:

Table no. 5.5T produced below gives distribution of vegetated area by soil depth classes. The table reveals that 44.29% of the vegetal cover is supported by the soil having medium soil depth and 42.48% by deep soils. Both Sal and Teak strata were found to exist exclusively in the soil having depth above 30 cm whereas the Miscellaneous forest crop (13%) was found to exist in the soil with shallow soil depth (below 30 cm) also. However, major occurrence of Miscellaneous forest was also on medium and deep soils.

Table No. 5.5T

Break up of tree vegetated area under different crop compositions by soil depth classes(Area in sq.km.).

Crop composition	Soil depth				Total
	Very shallow	Shallow	Medium	Deep	
Teak	-	-	117.72 (12)	107.91 (11)	225.63 (23)
Sal	-	29.43 (3)	549.36 (56)	1324.35 (135)	1903.14 (194)
Misc.	88.29 (9)	814.23 (83)	2452.5 (250)	1559.79 (159)	4914.81 (501)
Total	88.29 (9)	843.66 (86)	3119.58 (318)	2992.05 (305)	7043.58 (718)
% area	1.25	11.98	44.29	42.48	100%

5.6 AREA BY CROP COMPOSITIONS AND TOP HEIGHT CLASSES:

Table no. 5.6 T produced below gives distribution of vegetated area by top height classes at an interval of 5 metres. The table indicates that 21.45% area has vegetation having top height between 11-15 m. and 39.14% area with top height 16-20 m. Major part of vegetation (about 60%) has top height between 10-20 m. About 24% vegetation has top height above 20 m. and the rest 16% is under regeneration stage with height less than 10 m. As regards composition, it can be stated that Sal forest shares more in higher height classes than Teak and Miscellaneous forests. Teak is completely absent beyond 25 m. top height whereas small representation of Miscellaneous forest was found even upto 30 m. top height. Sal is represented in all top height classes.

TOP HEIGHT MAP OF RAIPUR DISTRICT

No.: 5.6M

SCALE :- 1 : 1,000,000

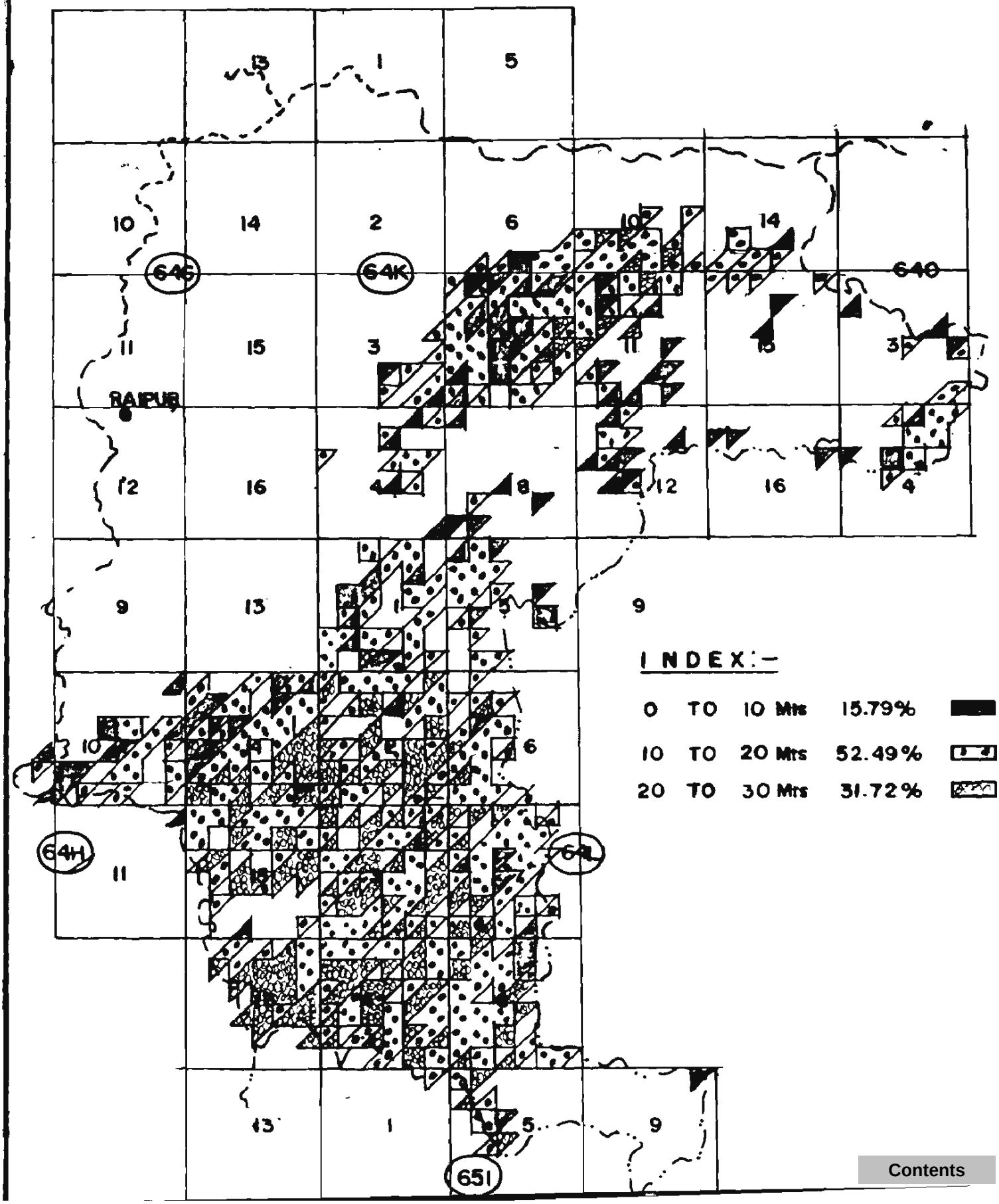


Table No. 5.6T

Break up of tree vegetated area under different crop compositions by top height classes(Area in sq.km.)

Crop composition	Top height classes(in metres) 1-5	6-10	11-15	16-20	21-25	26-30	31+	Total
Teak	49.05 (5)	29.43 (3)	78.48 (8)	29.43 (3)	39.24 (4)	-	-	225.63 (23)
Sal	29.43 (3)	68.67 (7)	78.48 (8)	735.75 (75)	735.75 (75)	215.82 (22)	39.24 (4)	1903.14 (194)
Misc.	176.58 (18)	755.37 (77)	1353.78 (138)	1991.43 (203)	549.36 (56)	88.29 (9)	-	4914.81 (501)
Tota	255.06 (26)	853.47 (87)	1510.74 (154)	2756.61 (281)	1324.35 (135)	304.11 (31)	39.24 (4)	7043.58 (718)
% area	3.62	12.12	21.45	39.14	18.80	4.32	0.55	100%

A map no. 5.6 M has been prepared to inciate the top height of the vegetation of the district at an interval of 10 m. Accordingly, it is revealed that southern parts of the district have vegetation mostly with top height 20-30 m. associated with middle ordered crop of 10-20 m. height. The central and the northern parts of the forest area have comparatively poor vegetation with dominating top height below 20 m. having major contribution of small sized trees of less than 10 m. height.

5.7 AREA BY CROP COMPOSITIONS AND SIZE CLASSES:

Table no. 5.7 T gives the distribution of vegetated area by crop compositions and size classes. The crop has been classified into five size classes based on the predominace of a particular size class in a 2 ha area around the sample plots falling in vegetated area of the district. These size classea are:

1. Regeneration crop with 2-10 cm. dia at breast height.
2. Pole crop with 10-20 cm. d.b.h.
3. Small timber with 20-30 cm. d.b.h.
4. Big timber with more than 30 cm. d.b.h. and
5. Mixed size class with no marked dominance of any particular size.

The mixed 'size' class is the most heterogenous crop with regard to its size.

The table shows that 9.75% area of vegetation is at regeneration stage, 19.50% under pole crop, 8.50% under small timber, 3.20% under big timber and the rest which accounts for 59.05% of vegetated area is under mixed size crop. The overall picture of the crop reflects that most of the vegetation in the district is of young age. Even among mixed size crop also, most of the vegetated area is under regeneration, pole crop and small timber though it could not be classified in any one of these classes for want of predominance of a particular diameter class.

All the three strata behave in similar manner with regard to their occurrence in various size classes.

Table 5.7 T

Break up of tree vegetated area under different crop compositions by size classes. (Area in sq.km.)

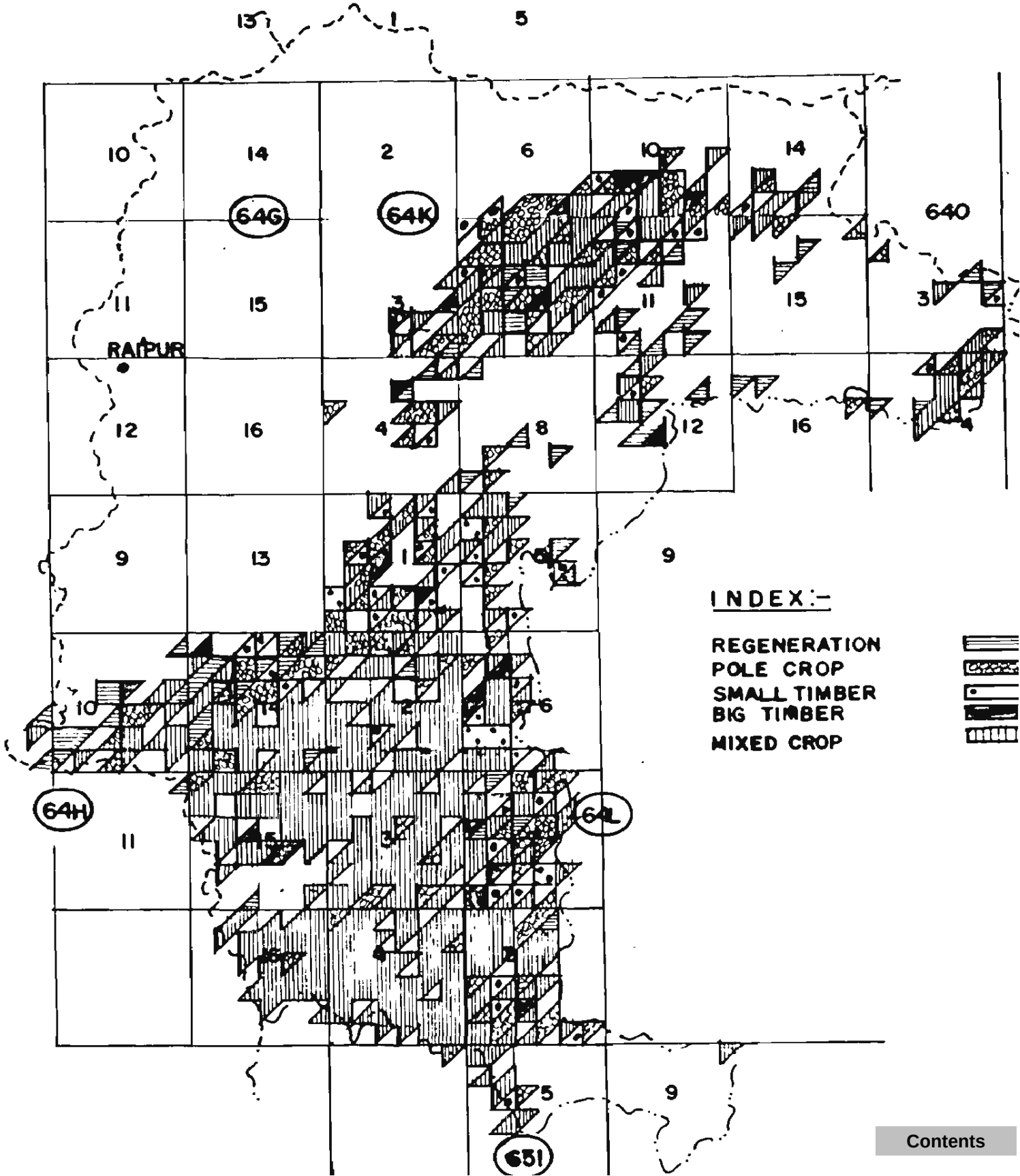
Crop composition	Size classes					Total
	Regeneration	Pole crop	Small timber	Big timber	Mixed size class	
Teak	68.67 (7)	98.10 (10)	19.62 (2)	-	39.24 (4)	225.63 (23)
Sal	98.10 (10)	78.48 (8)	98.10 (10)	58.86 (6)	1569.60 (160)	1903.14 (194)
Misc.	519.93 (53)	1196.82 (122)	480.69 (49)	166.77 (17)	2550.60 (260)	4914.81 (501)
Total	686.70 (70)	1373.40 (140)	598.41 (61)	225.63 (23)	4159.44 (424)	7043.58 (718)
% area	9.75	19.50	8.50	3.20	59.05	100%

A map no. 5.7 M has been prepared based on sample plots and appended to indicate the localities of various size classes of the crop existing in the forest area of Raipur district. The map shows that the central and northern parts of the district have mostly pole and regeneration crop interspersed with small timber. The southern part is mostly dominated by mixed sized crop. The small and big timber sized crops are very little having no marked locality. Such crops are present here and there in pockets in whole of the forest area.

SIZE CLASSES MAP OF RAIPUR DISTRICT

No. : 5-7 M

SCALE :- 1:1,000,000



5.8 AREA BY CROP COMPOSITIONS AND CANOPY LAYERS:

Table no. 5.8 T produced below deals with the vegetated area by different crop compositions and canopy layers. The table indicates that about 7.38% area of vegetation has very young crop, mostly at regeneration stage, which has not yet formed any canopy/storey. 15.88% area under vegetation has one-storeyed forests and remaining 76.74% area, which has major share of the vegetal cover, has two-storeyed forest. All the three strata of vegetation exhibit similar behaviour with regard to their occurrence in different storey classes.

Table No. 5.8 T

Break up of tree vegetated area under different crop compositions by canopy layers. (Area in sq.km.)

Crop composition	Canopy layers			Total
	No storey	One-storeyed forests	Two-storeyed forests.	
Teak	58.86 (6)	58.86 (6)	107.91 (11)	225.63 (23)
Sal	78.48 (8)	88.29 (9)	1736.37 (177)	1903.14 (194)
Misc.	382.59 (39)	971.19 (99)	3561.03 (363)	4914.81 (501)
Total	519.93 (53)	1118.34 (114)	5405.31 (551)	7043.58 (718)
% area	7.38	15.88	76.74	100%

5.9 PLANTABLE AREA IN GOVERNMENT FOREST LAND:

For the purpose of estimating the plantable area in the forest land of Raipur district, the forest areas which have crop density below 0.3 or those areas which are devoid of any vegetal cover, have been taken into consideration. Table no. 5.9 T produced below, gives the estimate of plantable area in the govt. forest land which has either poor/scattered vegetation or where the vegetation is completely absent. Such areas include land use classes like open forest, scrub forest, shifting cultivation, agricultural

crop land with or without trees in surround and barren land etc. The plantability of the plot and its surrounding 2 ha area has been estimated on the basis of various other factors like soil depth, slope, altitude of the terrain etc. besides the present land use of the forest land. On the basis of the data from sample plots the total plantable area has been estimated. The well stocked areas such as dense forest with canopy density above 30% or where the canopy is not yet established, being young crop, but the stocking of tree and bamboos is better, have been kept out of estimation of the plantability because such vegetated areas do not require further planting or rehabilitation.

Accordingly, the plantability was assessed only in 227 plots representing 2226.87 sq.km. area of poor forest land out of a total of 7808.76 sq.km. area of govt. forest land represented by 796 sample plots in which it estimated that about 1971.81 sq.km. area is govt. forest land was found to be plantable with some suitable species.

Table No. 5.9 T

Estimation of plantable area in the govt. forest land.

S.No.	Land use taken for estimation.	No. of plots taken in to account	Area considered for studies (sq.km.)	Plantable area (sq.km.)
1.	Vegetated forest land (Open forest + Scrub+ shifting cultivation)	184	1805.04	
2.	Agricultural crop land/ agricultural tree land	36	353.16	1971.81 (201)
3.	Barren lands + otherlands	7	68.67	
	Total ..	227	2226.87	1971.81

5.10 REGENERATION STATUS:

An assessment of regeneration status of vegetation was made during the course of inventory of forest resources of the district. The exercise involved the counting of number of seedlings of commercially important species found

existing in 16 square metre area around all the plot centres located in the vegetated area. The important species taken into account for this purpose were, 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, Ougenia dalbergioides, Pterocarpus marsupium, Shorea robusta, Syzigium cumini, Schleichera oleosa, Terminalia crenulata, Terminalia belerica, Terminalia chebula, Terminalia arjuna and Tectona grandis.

The status of regeneration was classified as under based on 16 square metre area around the centre of the sample plot:

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.

Accordingly, the survey results reveal that most of the forest areas have either inadequate regeneration or no regeneration of the important species mentioned above. The factors like uncontrolled grazing, annual fire etc. contribute to this situation causing adverse effect on regeneration. However the regeneration of unimportant species was noticed almost everywhere.

5.11 SOIL EROSION:

Incidence of soil erosion in the forest area was studied during the course of survey. On the basis of observations from the sample plots it is found that heavy soil erosion was not noticed in the forest area of Raipur district. However, 15% area was found subjected to the moderate soil erosion and the rest, nearly 85% suffered from mild soil erosion. On the basis of these observations it can be concluded that soil erosion is not much of a problem in the forest areas of the district. Though needs for maintaining forests completely free of erosion can not be ignored.

Raipur

5.12 GRAZING INCIDENCE:

Grazing by cattle is a major problem which affects adversely the growth and regeneration of the forests particularly in the areas adjoining to habitations. The survey indicates that 36% area of vegetation is affected by heavy grazing, 33% by medium grazing and 18% area by light grazing. Only 13% area is left unaffected by grazing. Such areas are located quite away from habitation i.e. in remote places or on hilly terrain.

5.13 FIRE INCIDENCE:

The observations recorded during the field work reveal that 13% area of the vegetation had frequent fires and about 50% area had occasional annual fires. The rest 37% area of the vegetation was found unaffected by annual fire. Such areas are mostly located in south-western parts of the district. The south-central parts were found affected by frequent fires and central and northern parts were found to have occasional fires. The main reason of annual fire is the habit of local people burning the forest areas to clean the weeds and dry leaves from the ground surface to collect minor forest produce like mahua flowers, sal seeds, harra/baheda and tendu fruits etc.

5.14 OCCURRENCE OF BAMBOO:

The forest of Raipur district are not so rich in pure bamboo forest areas or bamboo brakes as revealed from table 5.1 T, showing various land use classes. However, about 1039.86 sq.km. area of the forest was found to have some bamboo growth together with tree forest, out of which 78.48 sq.km. area is under dense bamboo forest having more than 100 clumps/ha and 137.34 sq.km. is under moderately dense forests having 50-100 clumps/ha, 166.77 sq.km. under scattered forest having 20-50 clumps/ha and 402.21 sq.km. area is under sparse/hacked bamboo forest and the rest 255.06 sq.km. area has regeneration crop of bamboos where the clump formation has not yet taken place. A table no. 5.14T produced below gives distribution of bamboo forest areas of Raipur district by bamboo density and quality.

Table no. 5.14 T

S.No.	Density	Quality 1	2	3	4	Total
1.	Pure bamboo(above 200 clumps/ha.	-	-	-	-	-
2.	Very dense(150 -200 clumps/ha.)	29.43 (3)	-	-	-	29.43 (3)
3.	Dense (100-150 clumps/ha)	39.24 (4)	9.81 (1)	-	-	49.05 (5)
4.	Moderately dense (50-100 clumps/ha.	107.91 (11)	29.43 (3)	-	-	137.34 (14)
5.	Scattered(25-50) clumps/ha)	98.10 (10)	58.86 (6)	9.81 (1)	-	166.77 (17)
6.	Sparse(1-25) clumps/ha)	137.34 (14)	78.48 (8)	39.24 (4)	-	255.06 (26)
7.	Bamboo present bout hacked.	-	-	-	147.15 (15)	147.15 (15)
8.	No bamboo	-	-	-	-	-
9.	Regeneration crop	-	-	-	255.06 (26)	255.06 (26)
	Total	412.02 (42)	176.58 (18)	49.05 (5)	402.21 (41)	1039.86 (106)

78.48

Such overlapping bamboo forest areas are located in northern, central, eastern and south-eastern parts of the district.

A map no. 5.14 M has been prepared and appended to indicate the forest areas under various bamboo density classes. As compared to the total vegetated area of the forest in the district, the bamboo forest areas are not very significant in extent. Similarly, the growing stock of bamboo also does not contribute much to the growing stock as compared to the growing stock of the trees in the district.

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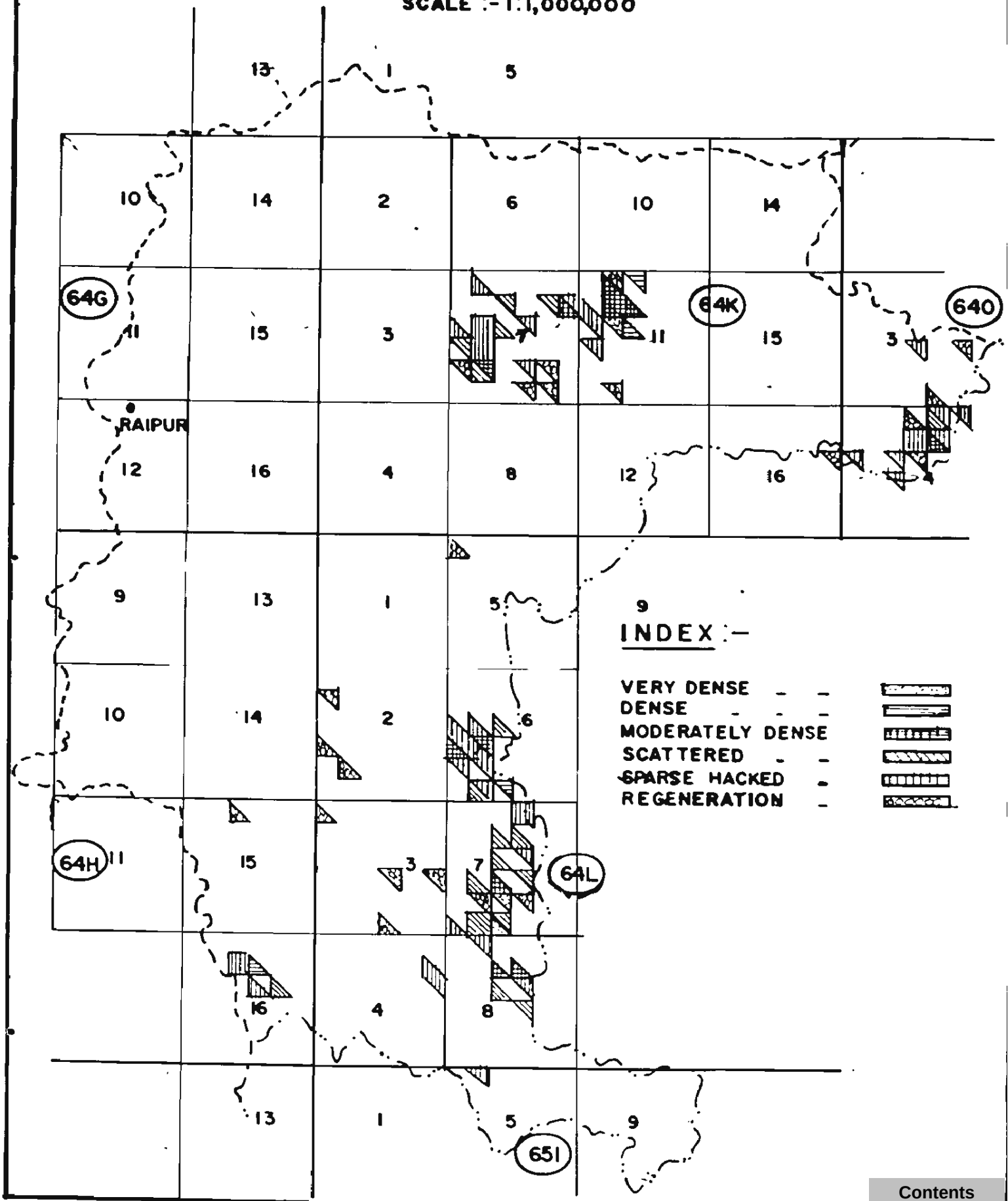
BAMBOO DENSITY MAP OF RAIPUR DISTRICT

No :- 5.18M

SCALE :- 1:1,000,000



CHAPTER - SIX

INVENTORY RESULTS: GROWING STOCK OF TREES

6.0 GENERAL:

As already discussed in Chapter V on Inventory Results: Area, out of a total forest area of 7940 sq.km. only 7043.58 sq.km. area was found to be having vegetal cover. On the basis of inventory data collected from 718 plots falling in this vegetated area, the forests of the district were stratified into three strata namely Teak, Sal and Miscellaneous with respective area of 225.63 sq.km. 1903.14 sq.km. and 4914.81 sq.km. This stratification of Raipur forest was contemplated on the basis of occurrence of these species in 2 ha area around the centre of the plots as observed during inventory survey. The area under each stratum was computed by giving weightage to the number of sample plots fallen in each stratum. Further, the growing stock in each stratum was estimated in terms of number of stems and stems per hectare, total volume and volume per hectare for important species occurring under each diameter class which have been discussed in details in the subsequent paragraphs. Besides the above three strata of vegetation, 6 sample plots representing an area of 58.86 sq.km. of Khair forests and 14 sample plots representing an area of 137.34 sq.km. of Salai forests, were also found in Raipur district but no separate stratum was assigned to them as their individual contribution to the total area as well as growing stock was quite insignificant and further estimation of area and growing stock under various parameters of these two strata would have yielded unreliable results due to abnormal increase of standard error due to inadequate number of sample plots. The forest areas under Khair and Salai and the growing stock existing therein have, therefore, been merged with Miscellaneous stratum. The growing stock has been estimated under the above three strata i.e. Teak, Sal and Miscellaneous only. All the related tables pertaining to the growing stock as described in the following paragraphs have been appended at the end of this chapter.

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

Distribution of total number of stems and stems per hectare in respect of Teak stratum has been given in table no. 6.1T(A) and 6.1T(B). This stratum is spread over an area of 225.63 sq.km. This table indicates that teak shares 62% of growing stock and justifiably tops the list of the species contributing to the growing stock present in this stratum in terms of total number of stems which is 4179051 out of a total of 6739435 stems. The per hectare growing stock of teak alone was found to be 185.217 stems in this stratum. Second place is occupied by Lagerstroemia parviflora with 274705 stems found at the rate of 12.174 stems per hectare,

third place by Lannea coromandelica and Pterocarpus marsupium with an equal share of 225630 stems each at the rate of 10 stems per hectare, fourth place by Terminalia crenulata with 196208 stems at the rate of 8.696 stems per hectare and fifth place is shared again jointly by Boswellia serrata and Ougeinia oogeinensis with 78520 stems each at the rate of 3.478 stems per hectare and so on. Sal has the lowest contribution to the growing stock of Teak stratum viz. 19630 stems or only 0.870 stems/hectare. Maximum number of stems(4532207) are found in the lowest diameter class i.e. 10-15 cm. which start decreasing with the progressive increase in size of diameter class. Lowest number of stems are found in the last two highest diameter classes viz. 70-80 cm. and 80+ cm. classes. Significantly whole contribution of 4179051 stems by teak is made from 10-40 cm. diameter classes and beyond this it has no representation at all. This gives indication that Teak forest is mostly at young stage found in lower diameter classes only. On the other hand, Boswellia serrata which occupies the fifth place in order of abundance is represented only in the middle diameter classes i.e. from 25-70 cm. diameter classes. Shorea robusta is represented only in two diameter classes i.e. in 10-15 cm. and 60-70 cm. diameter classes. Terminalia crenulata too exhibits the same behaviour as teak.

Total number of stems, stems per hectare and the percentage contribution of the leading species have been indicated in the following table in order of their occurrence:

Order	Species	Total no. of stems	Stems/ha	Percentage of growing stock
1	Teak	4179051	185.217	62.01%
2	Lendia	274705	12.174	4.08%
3	Mode/Bija	225630	10.000	3.35%
4	Saja	196208	8.696	2.91%
5	Salai/Tinsa	78520	3.478	1.16%
6	Tendu	58867	2.609	0.87%
7	Dhauda	49052	2.174	0.73%
8	Mundi	39260	1.739	0.58%
9	Sal	19630	0.870	0.29%
10	Other species	...	...	..
	Total	6739435	298.695	100%

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

Table no.6.2T(A)and 6.2T(B) give distribution of total number of stems and stems per hectare of various species estimated under different diameter classes in Sal stratum which occupies an area of 1903.14 sq.km. In this strtum, Sal justifiably tops the list of all other species with a total of 22531045 stems or 118.402 stems per hectare, out of an aggregate toal of 62936451 stems or 330.824 stems per hectare.Sal shares about 35.79% of the total growing stock in terms of number of stems in this stratum. .This is followed by Terminalia crenulata (saja) with 7112413 stems or 37.371 stems per hectare , Diospyros melanoxlyon(tendu) with 2795711 stems or 14.691 stems per hectare, Anogeissus latifolia (dhauda) with 2197364 stems or 11.546 stems per hectare, Pterocarpus marsupium (bija) with 1888102 stems or 10 stems per hectare, Lannea coromandelica (mode) with 1128370 stems or 5.928 stems per hectare and the next three places i.e.7th, 8th and 9th are occupied by Lagerstroemia parviflora(lendia), Ougenia oogeinensis(tinsa) and Boswellia serrata(salai) in close range. Total number of stems and stems per hectare and the percentage contribution of the leading species of Sal stratum is given in the following table in choronological order of their occurrence:

Order	Species	Total no. of stems	Stems/ha	Percentage of growing stock
1	Sal	22531045	118.402	35.79%
2	Saja	7112413	37.371	11.30%
3	Tendu	2795711	14.691	4.44%
4	Dhauda	2197364	11.546	3.49%
5	Bija	1888102	10.000	3.02%
6	Mode	1128370	5.928	1.79%
7	Lendia	650344	3.454	1.04%
8	Tinsa	637553	3.351	1.01%
9	Salai	549245	2.887	0.87%
10	Mundi	206110	1.082	0.33%
11	Teak	108098	0.567	0.17%
	...	....	...	...
	Total	62936451	330.824	100%

There is a striking coincidence that in Sal stratum teak occupies the last place with 108098 stems whereas in Teak stratum, sal occupies the bottom place with 19630 stems. Sal has representation in all the diameter classes which goes on decreasing with the increase in diameter class. Maximum number of stems have been found to occur in the lower diameter classes only thereby exhibiting a normal distribution of sal species in Sal stratum. Next to sal is bija which has representation upto 80 cm. diameter classs

followed by saja, tendu and salai which are represented upto 60 cm.diameter classes with the exception of tendu, of which 9896 stems have been estimated even in 70-80 cm. diameter class also.

Teak has shown abnormal trend with regard to its distribution in various diameter classes. Out of a total of 108098 stems, it has 58807 stems (54.5%) in the lowest dia. class (i.e.10-15 cm.) only. Teak has no representation in the diameter classes 15-20cm, 20-25 cm.and 25-30 cm.and again there is substantial representation in 30-50 cm. dia classes in increasing order.Such abnormal distribution indicates that most of the growing stock of teak is of the plantation origin. Natural crop of teak in Raipur is very little otherwise all the diameter classes particularly lower and middle classes would have certainly been represented. The major occurrence of teak in 10-15 cm. diameter class also indicates the stage of young plantation. The Sal stratum has better stocking with 330824 stems per hectare in comparison to Teak and Miscellaneous strata.

6.3 TOTAL NO. OF STEMS AND STEMS PER HA:STRATUM MISC.:

Distribution of various species in different diameter classes by way of total number of stems and stems per hectare in Miscellaneous stratum has been given in table no. 6.3T(A) and 6.3T(B) This stratum covers an area of 4914.81 sq.km. which also includes 58.66 sq.km. and 137.34 sq.km. area respectively of Khair and Salai forests as discussed in para 6.0 of this chapter. Since the contribution of these two types of forest in Raipur district is quite insignificant, all the data pertaining to area as well as growing stock have been merged with Miscellaneous stratum. This stratum was assigned to those forest areas where none of the species was found to have its own forest type based on occurrence of stems in 2 ha area around the sample plots. Such vegetation was classified as Miscellaneous forest and the growing stock of individual species found in the stratum was computed accordingly.

Total growing stock in terms of number of stems in this stratum was estimated to be 125247030 stems(255.221 stems/ha).The leading species are Terminalia crenulata(saja), Anogeissus latifolia(dhauda), Lannea coromandelica(mode), Diospyros melanoxylon(tendu), Boswellia serrata (salai) etc.

Total number of stems and stems per hectare with percentage of growing stock of leading species in their order of merit are given in the following table:

Order	Species	Total no. of stems	Stems/ha	Percentage of growing stock
1	Saja	1Ø313238	2Ø.984	8.22%
2	Dhauda	6937655	14.116	5.53%
3	Mode	6384828	12.892	5.Ø5%
4	Tendu	6227Ø64	12.671	4.96%
5	Salai	4835680	9.839	3.86%
6	Lendia	3927425	7.992	3.13%
7	Bija	3749628	7.631	2.99%
8	Sal	1835680	3.735	1.46%
9	Tinsa	1509828	3.Ø72	1.2Ø%
1Ø	Mundi	1301953	2.651	1.Ø4%
11	Teak	167114	Ø.341	Ø.13%
	....	...	...	...
	Total	125247Ø3Ø	255.221	1ØØ%

Table nos. 6.3 T(A) and 6.3 T(B) further show that salai has representation upto 8Ø+ cm. diameter class with substantial number of stems upto 6Ø cm. class, saja occupying first position in order of merit, has maximum number of stems in the lowest diameter class which go on decreasing with the increase in diameter of the trees. sal, lendia and tendu have representation upto 6Ø-7Ø cm. diameter classes whereas dhauda, mode, mundi, bija and teak have representation upto 5Ø-6Ø cm. diameter classes with the exception in the case of teak which is absent in two middle diameter classes of 3Ø-4Ø cm. Significantly, tinsa also does not figure beyond 35-4Ø cm. diameter classes. Out of the total number of stems nearly over 5Ø% are found upto 35 cm. diameter class which reveals that number of trees in the higher class is quite few. The Miscellaneous stratum has comparatively poor stocking as compared to Teak and Sal strata.

6.4 TOTAL VOLUME AND VOLUME/HA:STRATUM TEAK:

Table nos. 6.4T(A) and 6.4T(B) give distribution of total volume and volume per hectare of different species found in Teak stratum under various diameter classes. Teak rightly occupies first place in terms of its total volume with 532735 cu.m. (23.61Ø cu.m./ha), out of a total of 1316Ø53 cu.m. in whole of the Teak stratum. Teak being the leading species shares about 4Ø.47% of the total growing stock of the stratum. Salai follows teak with 96591 cu.m. of volume (4.282 cu.m./ha) whereas in case of stems, second place is occupied by lendia. This is because the former has more trees in higher diameter class which yielded more volume and the latter i.e. lendia has more representation in lower diameter classes which yieled less volume since there is a direct relationship between diameter and volume of the trees. Further, for both the character i.e. stems and volume, third and fourth place is occupied by bija

and saja. In case of sal which occupies the bottom position in terms of number of stems in Teak stratum but in case of its volumetric representation it has got fifth place in the same stratum. This is because of the fact that sal normally grows well and attains its normal height in every diameter class and is capable of yielding better volume than any other species of the same diameter class. A look at both the tables (i.e. those pertaining to stems and volume) reveals that 9815 stems from 10-15 cm. diameter classes yield 564 cu.m. of volume whereas the same number of trees in 60-70 cm. diameter class yield 44043 cu.m. of volume nearly 80 times more than that from the lowest diameter class.

Following table gives the occurrence of leading species in chronological order, their total volume, volume per hectare and their percentage contribution to total volume of Teak stratum:

Order	Species	Volume (cu.m.)	Volume/ha (cu.m.)	Percentage of total volume
1	Teak	532735	23.610	40.47%
2	Salai	96591	4.282	7.34%
3	Bija	52166	2.312	3.96%
4	Saja	50992	2.260	3.87%
5	Sal	44607	1.977	3.39%
6	Tendu	41132	1.823	3.13%
7	Lendia	33732	1.499	2.57%
8	Mode	30212	1.340	2.30%
9	Tinsa	15456	0.685	1.17%
10	Dhauda	11056	0.489	0.84%
11	Mundi	5437	0.242	0.41%
	...	...	...	...
	Total	1316053	58.335	100%

Table nos. 6.4T(A) and 6.4T(B) also reveal that volume is maximum in lowest diameter class and depicts a decreasing trend as the diameter increases with some exceptions.

6.5 TOTAL VOLUME AND VOLUME/HA:STRATUM SAL:

Distribution of total volume and volume per hectare pertaining to different species found in Sal stratum has been given under various diameter classes in table no. 6.5T(A) and 6.5T(B). Sal tops the list of total volume which is 10845612 cu.m. (57.048 / ha), out of an aggregate of 19163657 cu.m. (99.596 cu.m./ha) volume in Sal stratum. Second place is occupied by Terminalia crenulata(Saja) with 1626422 cu.m.(8.547 cu.m./ha) volume followed by Pterocarpus marsupium(bija), Diospyros

melanoxylon (tendu), Anogeissus latifolia(dhauda), Boswellia serrata (salai), Lannea coromandelica (mode) etc. Total volume and volume per hectare in respect of above species has been tabulated below in descending order of their contribution to the volume of the stratum:

Order	Species	Volume (cu.m.)	Volume/ha (cu.m.)	Percentage of total volume
1	Sal	10845612	57.048	57.28%
2	Saja	1626422	8.547	5.58%
3	Bija	713485	3.750	3.77%
4	Tendu	618330	3.248	3.26%
5	Dhauda	559713	2.941	2.95%
6	Salai	542965	1.693	1.70%
7	Mode	134362	0.707	0.71%
8	Lendia	90779	0.476	0.48%
9	Tinsa	85832	0.451	0.45%
10	Teak	79741	0.419	0.42%
	...	...	...	...
	Total	19163657	99.596	100.00%

As in the case of stems, here also teak occupies the lowest position in the overall tally of species contributing volume to the total growing stock. Overall position also reveals that volumetric contribution of each successive diameter class increases upto 35 cm.,dips in 35-40 cm. diameter class, again shoots up suddenly to 3252465 cu.m. for 40-50 cm. diameter class and then it shows a declining trend. Sal, bija and tendu have good volumetric representation almost in all diameter classes. The other species occurred only upto middle diameter classes.

6.6 TOTAL VOLUME AND VOLUME/HA:STRATUM MISC.:

Table no. 6.6T(A) and 6.6T(B)give distribution of total volume and volume per hectare for different species found under various diameter classes in Miscellaneous stratum. Terminalia crenulata(saja) leads the tally with 3357306 cu.m.(6.831 cu.m./ha) of volume followed closely by Boswellia serrata(salai) with 2965104 cu.m.(6.034 cu.m./ha) of Anogeissus latifolia(dhauda) with 1938891 cu.m. (3.948 cu.m./ha) of volume etc. List of various species in their order of occurrence in this stratum has been tabulated below giving details of volume, volume per hectare and their percentage contribution to the total growing stock of this stratum.

Order	Species	Volume (cu.m.)	Volume/ha (cu.m.)	Percentage of total volume
1	Saja	3357306	6.831	12.30%
2	Salai	2965104	6.034	10.87%
3	Dhauda	1938891	3.948	7.11%
4	Tendu	1702340	3.423	6.16%
5	Bija	1339285	2.725	4.91%
6	Mode	1132872	2.305	4.15%
7	Sal	775065	1.577	2.84%
8	Lendia	968216	1.551	2.79%
9	Mundi	292430	0.595	1.07%
10	Tinsa	287024	0.584	1.05%
11	Teak	127948	0.239	0.43%
	Total	27,520,491	55.520	100%

There is an aggregate of 27,520,491 cu.m. of volume in this stratum with an average volume of 55.520 cu.m./ha A direct relationship is witnesssed between the number of trees in a particular diameter class and their contribution to volumetric contents. There is gradual decrease in the number of stems in this stratum from lower to higher diameter class but on the contrary their is progressive increase in their respective volumetric contribution to the total growing stock upto 50-60 cm.diameter class and then there is decline in the volume.

A comparison of the tables giving growing stock figures in terms of volume per hectare of all the three strata reveals that Sal forests yield better volume of 99.596 cu.m./ha in comparison to Teak forests with 58.335 cu.m./ha followed by Miscellaneous forest with 55.520 cu.m./ha.

6.7 COMBINED GROWING STOCK:STEMS:

Table no.6.7T gives distribution of total number of stems and stems per hectare for entire vegetated area of the district which has coverage of 7043.58 sq.km. area under three strata combined together. In this set up also Shorea robusta leads the tally followed by Terminalia crenulata, Anogeissus latifolia, Diospyros melanoxylon, Lannea coromandelica, Pterocarpus marsupium, Boswellia serrata and so on. List of all the leading species in order of their occurrence, giving details of their respective number of stems, stems per hectare and their percentage contribution to the total number of stems occurring in the entire tract are tabulated below:

Order	Species	No. of stems	Stems/ha	Percentage of total no. of stems
1	Sal	24457849	34.606	12.50%
2	Saja	17621627	25.018	9.03%
3	Dhauda	9292873	13.039	4.71%
4	Tendu	9171444	12.895	4.65%
5	Mode	7816224	10.377	3.94%
6	Bija	6146225	8.348	3.01%
7	Salai	5635162	7.748	2.80%
8	Lendia	5038976	6.905	2.49%
9	Teak	4544518	6.326	2.26%
10	Tinsa	2314519	3.160	1.14%
11	Mundi	1636222	2.197	0.79%
12	...	...	...	..
	Total	196407659	276.471	100%

An aggregate of 196407659 stems with 276.471 stems per hectare have been estimated to be found in the entire forest tract of Raipur district. Estimated contribution of main species has been given above. Remaining unimportant species are clubbed under the heading 'Rest of species' which collectively account for over 50% of the aggregate number of stems as indicated in table no. 6.7. This table also shows that almost all the species listed above have found their representation upto 50-60 cm. diameter class. Beyond this only species which have their representation are sal, tendu, bija and salai.

6.8 COMBINED GROWING STOCK: VOLUME:

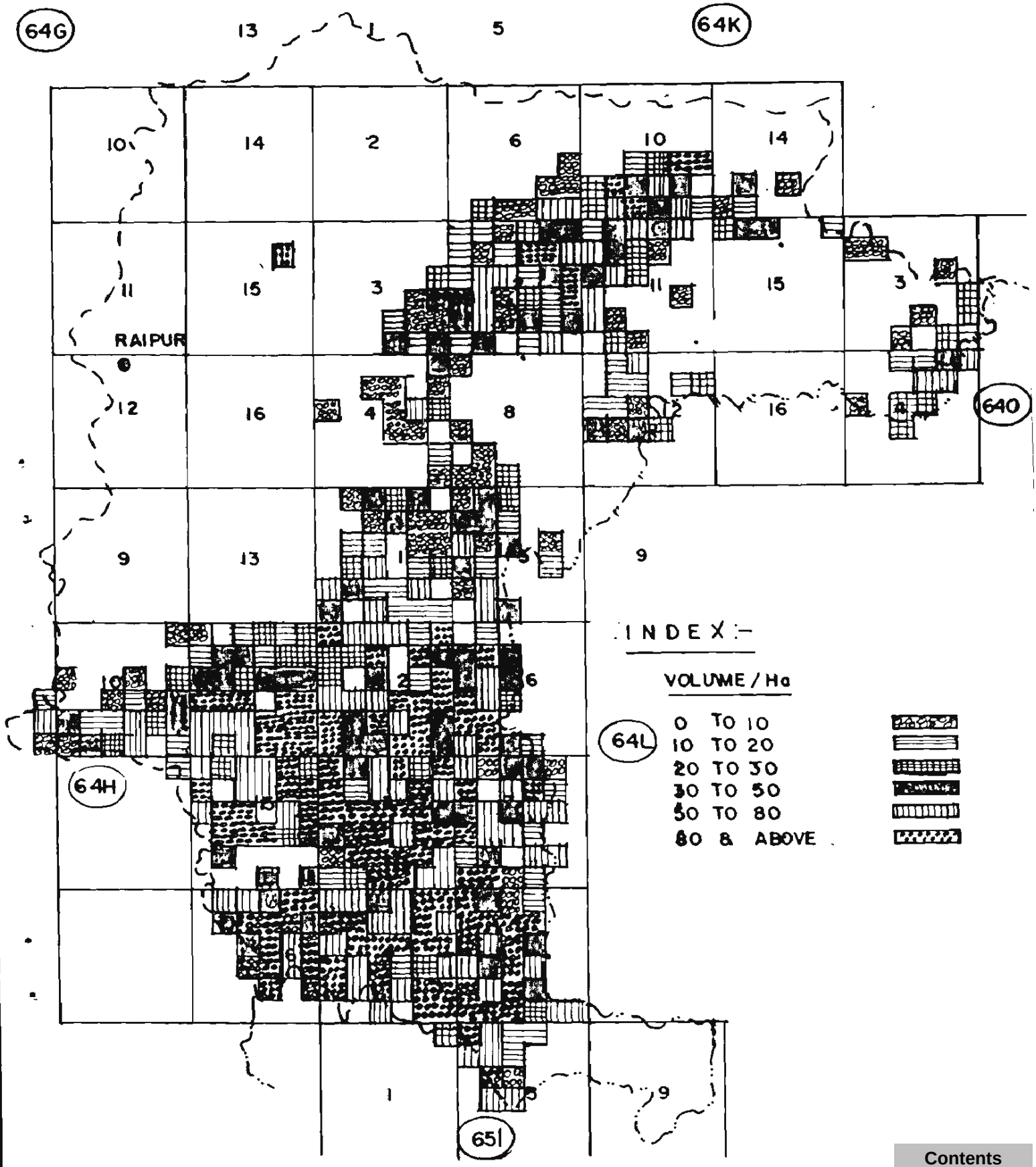
Table no. 6.8T gives distribution of combined total volume and volume per hectare for various species estimated in all the three strata identified in the entire vegetated tract of Raipur district. These species in order of their occurrence and their individual contribution to the total growing stock with their percentage volume have been tabulated below:

Order	Species	Volume (cu.m.)	Volume/ha (cu.m.)	Percentage of total volume
1	Sal	11676140	16.577	24.55%
2	Saja	5048837	7.168	10.59%
3	Salai	3385143	4.806	7.12%
4	Dhauda	2511740	3.566	5.28%
5	Tendu	2341285	3.324	4.92%
6	Bija	2105324	2.989	4.43%
7	Mode	1297427	1.842	2.73%

VOLUME MAP OF RAIPUR DISTRICT

No:-6-8M

SCALE :- 1 : 1,000,000



Contents

8	Lendia	886787	1.079	1.86%
9	Teak	729714	0.836	1.53%
10	Tinsa	388805	0.552	0.82%
11	Mundi	322590	0.458	0.68%
12	...	...	....	...
	Total	47572323	67.160	100%

An aggregate of 47572323 cu.m. of growing stock has been estimated in the district with an average of 67.160 cu.m. of volume per hectare over the entire forest area for three strata combined. Contribution of the above leading species collecively accounts for nearly two third of the total growing stock. The rest of the growing stock is shared by unimportant species which are clubbed together to form a group of 'Rest of species'. Per hectare volume progressively increases from lower diameter class to higher ones upto 50 cm. and then it starts declining whereas in terms of number of stems a reverse trend was observed.

Map no. 6.8 M has been prepared on the basis of per hectare volume yielded by different sample plots. The map indicates that southern part of the district is richer with regard to its per hectare volumetric contribution. The north-eastern and central parts of the forest areas have yielded very little volume thereby giving indication that such areas have either poor growth of forest vegetation or are under young regeneration.

A review of the tables pertaining to combined growing stock reveals that the forests in Raipur district predominantly comprise of sal which alone shares 24.55% of the total growing stock of the district though its own forest type is confined to 1903.14 sq.km. area only out of total vegetated area of 7043.58 sq.km. in the district. Besides, its major contribution in its own forest type, sal shares significantly in other two forest types also viz. Teak and Miscellaneous. Teak stratum on the other hand is confined to a very small area of 225.63 sq.km. and also its occurrence in other strata is insignificant though it has been assigned a separate stratum. Large areas as well as growing stock are shared by the Miscellaneous forests in which no species was found to be in dominating position.

6.9 MEAN VOLUME PER HA BY TOPOGRAPHY:

Mean volume per hectare by topography classes under three forest types (i.e. crop compositions) has been given in table overleaf. This is maximum on flat lands followed by hilly and then by gently rolling grounds for Teak and Sal forest types. In case of Miscellaneous forest type it gradually incrases with the change in topography of the tract i.e. from flat land to hilly terrain.

Table no. 6.9 T

Mean volume per ha by topography classes

Crop composition	Flat	Gently rolling	Hilly	Very hilly
Teak	61.615	41.056	91.757	-
Sal	106.376	91.078	98.746	-
Miscellaneous	48.819	49.321	65.650	-

6.10 MEAN VOLUME PER HA BY SLOPE CLASSES:

Table below gives distribution of mean volume per hectare for all the three forest types under various categories of slope classes.

Table no. 6.10 T

Mean volume per ha by slope classes

Crop compositions	<10%	10%<60%	60%<100%	100%+
Teak	52.087	88.015	-	-
Sal	100.311	95.531	-	-
Miscellaneous	48.782	69.808	44.524	-

Above table reveals that Teak and Sal forest types do not yield any volume beyond slope of 60%. Individually for Teak there is progressive increase in the quantum of mean volume per hectare but for Sal it decreases with the increase in the percentage slope. Miscellaneous forest type has maximum of 69.808 cu.m. per hectare volume in slopy land with slope class 10-60% whereas for the lowest slope class it is 48.782 cu.m. per hectare and for the higher one i.e. beyond 60% it is the maximum of the three i.e. 44.524 cu.m./ha.

6.11 MEAN VOLUME PER HA BY SOIL DEPTH CLASSES:

Table overleaf gives distribution of mean volume per hectare for all the three forest types under various categories of soil depths.

Table no. 6.11T

Mean volume per ha by soil depth classes

Crop compositions	Very shallow	Shallow	Medium	Deep
Teak	-	-	32.305	86.732
Sal	-	26.025	66.956	114.772
Miscellaneous	5.539	31.517	52.712	74.680

The table shows a direct relationship of per hectare volume of the trees with the depth of the soil. In all the three forest types there has been a progressive increase in volume per hectare with the increase in the depth of the soil.

6.12 MEAN VOLUME PER HA BY CANOPY LAYERS:

Table below deals with the distribution of mean volume per hectare for all the three forest types under different categories of canopy layers.

Table no. 6.12 T

Mean volume per ha by canopy layers

Crop composition	No storey	Single storeyed	Two storeyed	Three storeyed
Teak	21.131	37.432	90.030	-
Sal	6.088	33.889	107.164	-
Miscellaneous	11.293	22.039	69.388	-

This table also reveals a direct relationship between canopy of the vegetation and its volume contribution per hectare. There is a progressive increase in mean volume per hectare of the forest having different storeyes i.e. canopy layers for all the forest types. Obviously maximum volume per hectare was found in two storeyed forest followed by one storeyed forest and then by no storeyed forest.

All the three forest types also exhibit some volume in storeyless forest as well. Actually 'No storey' forest are the crops which have not yet formed any canopy being at regeneration stage. Since there is volumetric contribution from this class also, it may be either from mother trees or from other scattered trees which were over 10 cm. diameter at breast height as found in the sample plots even in regeneration crops.

6.13 MEAN VOLUME PER HA BY TOP HEIGHT CLASSES:

Table below gives distribution of mean volume per hectare for three forest types under various classes of top heights.

Table no.6.13 T

Mean volume per ha by top height classes

Crop composition	1-5m	6-10m	11-15m	16-20m	21-25m	26-30m	31m+
Teak	13.055	28.216	46.581	72.583	147.348	-	-
Sal	0.902	9.467	48.002	72.606	120.498	147.471	285.395
Misc.	2.769	16.874	37.959	68.938	106.593	135.747	-

The table reveals a progressive increase in the volumetric contribution with increase in the top height in each of the three forest types. There is no contribution beyond 25 m. top height in case of Teak forest type and beyond 30 m.top height in case of Miscellaneous forest types. But in case of Sal forest type, there is large volumetric contribution of 285.395 cu.m.volume per hectare from trees with top height beyond 30m. This is due to large sized Sal trees with height beyond 30m.

6.14 MEAN VOLUME PER HA BY SIZE CLASSES:

Table below gives distribution of mean volume per hectare for three forest types under various size classes of the crop. The table reveals that in all the forest types there is progressive increase in volumetric contribution with the increase in size class of the crop which is quite obvious. There is no volume from big timber size class for Teak stratum as teak was not found to occur in that size class.

Table no.6.14 T

Mean volume per ha by size classes

Crop composition	Regeneration	Pole crop	Small timber	Big timber	Mixed size class
Teak	19.187	52.594	83.094	-	128.819
Sal	10.625	42.465	50.884	132.225	109.835
Misc.	13.001	37.592	45.692	96.695	72.374

6.15 **GROWING STOCK WITH ESTIMATE OF STANDARD ERROR BY FOREST TYPES:**

Table below deals with the standard error calculated for all the three forest types for forest area, volume per hectare and total volume of the growing stock found in Raipur district.

Table no.6.15 T

Forest types	Area (ØØØ ha)	SE%	Vol/ha (cu.m.)	SE%	Volume (ØØØcu.m.)	SE%
Teak	22.563 (23)	21.3	58.335 (23)	18.6	1316.Ø	26.3
Sal	19Ø.314 (194)	7.3	99.596 (194)	4.5	19163.6	8.6
Misc.	491.481 (5Ø1)	3.1	55.52Ø (5Ø1)	3.8	27520.5	4.9
Total	7Ø4.358 (718)	3.1	67.160 (718)	3.4	~~48000.1~~ 47572	4.5

The above table reveals that the percentage of standard error in case of Teak forest type is rather high because of lesser number of plots falling under this stratum. Standard error in case of Sal and Miscellaneous forest types is well within permissible limits of ± 10%. Estimation of area and growing stock under Teak stratum is statisticalluy not very precise and therefore may be taken as indicative only.

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Table No. 6.1(A)

Stratum - Teak Area - 225.63 Sq.km. Stems '000'

Species description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Anogeissus latifolia	29.422	0.000	9.815	9.815	0.000	0.000	0.000	0.000	0.000	0.000	0.000	49.052
Bosuellia serrata	0.000	0.000	0.000	19.630	9.815	19.630	9.815	9.815	9.815	0.000	0.000	78.820
Diospyros melanoxylon	9.815	9.815	29.422	0.000	0.000	0.000	0.000	9.815	0.000	0.000	0.000	58.867
Lagerstroemia parviflora	186.395	49.052	9.815	19.630	9.815	0.000	0.000	0.000	0.000	0.000	0.000	274.705
Lannea coromandelica	127.526	78.474	0.000	0.000	0.000	19.630	0.000	0.000	0.000	0.000	0.000	225.630
Mitragyna parviflora	9.815	9.815	19.630	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	39.260
Ougenia oogeinesis	68.867	9.815	0.000	0.000	0.000	0.000	9.815	0.000	0.000	0.000	0.000	78.497
Pterocarpus marsupium	68.659	97.923	19.630	9.815	29.422	0.000	0.000	0.000	0.000	0.000	0.000	225.449
Shorea robusta	9.815	0.000	0.000	0.000	0.000	0.000	0.000	0.000	9.815	0.000	0.000	19.630
Tectona grandis	3060.716	804.416	196.208	58.867	29.422	29.422	0.000	0.000	0.000	0.000	0.000	4179.051
Terminalia crenulata	68.669	49.052	19.630	59.237	9.815	9.815	0.000	0.000	0.000	0.000	0.000	196.208
Rest of species	902.520	137.341	88.289	49.052	0.000	19.630	78.474	9.815	9.815	9.815	9.815	1314.566
All Species total	4532.207	1245.703	392.434	206.040	88.289	98.127	98.104	29.445	29.445	9.815	9.815	6739.435

Table no. 6.1 (B)

RAIPUR SURVEY

Stratum : Teak

Stems/ha.

Species Description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Anogeissus latifolia	1.304	0.000	0.435	0.435	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.174
Boswellia serrata	0.000	0.000	0.000	0.870	0.435	0.870	0.435	0.435	0.435	0.000	0.000	3.478
Diospyros melanoxylon	0.435	0.435	1.304	0.000	0.000	0.000	0.000	0.435	0.000	0.000	0.000	2.609
Lagerstroemia parviflora	8.261	2.174	0.435	0.870	0.435	0.000	0.000	0.000	0.000	0.000	0.000	12.174
Lannea coromandelica	5.652	3.478	0.000	0.000	0.000	0.870	0.000	0.000	0.000	0.000	0.000	10.000
Mitragyna parviflora	0.435	0.435	0.870	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.739
Ougeinia oogeinensis	2.609	0.435	0.000	0.000	0.000	0.000	0.435	0.000	0.000	0.000	0.000	3.478
Pterocarpus marsupium	3.043	4.348	0.870	0.435	1.304	0.000	0.000	0.000	0.000	0.000	0.000	10.000
Shorea robusta	0.435	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.435	0.000	0.000	0.870
Tectona grandis	135.652	35.652	8.696	2.609	1.304	1.304	0.000	0.000	0.000	0.000	0.000	185.217
Terminalia crenulata	5.043	2.174	0.870	1.739	0.435	0.435	0.000	0.000	0.000	0.000	0.000	8.696
Rest of species	40.000	6.087	3.913	2.174	0.000	0.870	3.478	0.435	0.435	0.435	0.435	59.261
All species total	200.869	55.217	17.391	9.130	3.913	4.348	4.348	1.304	1.304	0.435	0.435	298.695

Table No. 6.2(A)

Stratum - Sal Area - 1903.14 Sq.km. Stems '000'

Species description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Anogeissus latifolia	1020.273	510.041	343.326	166.715	107.908	29.499	19.602	0.000	0.000	0.000	0.000	2197.364
Boswellia serrata	19.602	147.113	58.807	107.908	117.804	58.807	19.602	19.602	0.000	0.000	0.000	549.245
Diospyros melanoxylon	1383.202	598.347	343.326	255.021	78.409	78.409	29.499	19.602	0.000	9.896	0.000	2796.711
Lagerstroemia parviflora	362.929	176.611	71.409	29.499	9.896	0.000	0.000	0.000	0.000	0.000	0.000	650.344
Lannea coromandelica	617.949	264.917	176.611	49.101	9.896	9.896	0.000	0.000	0.000	0.000	0.000	1128.370
Mitragyna parviflora	147.113	19.602	29.499	0.000	0.000	9.896	0.000	0.000	0.000	0.000	0.000	206.110
Dugenia eogeinesie	412.030	98.012	98.306	39.205	0.000	0.000	0.000	0.000	0.000	0.000	0.000	637.553
Pterocarpus marsupium	549.436	510.041	343.326	210.487	78.409	78.409	68.703	29.499	9.896	9.896	0.000	1888.102
Shorea robusta	6611.889	4090.799	3580.567	2825.211	2216.960	1353.103	1373.306	323.724	98.012	47.578	9.896	22531.045
Tectona grandis	88.807	0.000	0.000	0.000	9.896	9.896	29.499	0.000	0.000	0.000	0.000	108.098
Terminalia cranulata	3237.241	1501.006	1049.962	686.653	313.828	127.510	176.611	19.602	0.000	0.000	0.000	7112.413
Rest of species	15078.007	3914.188	2168.057	784.855	519.938	304.122	186.317	88.306	29.499	19.602	39.205	23152.096
All Species total	29498.478	11830.677	8253.196	5154.655	3462.944	2059.547	1903.139	500.338	137.407	86.972	49.101	62936.451

Contents

Table no. 6.2 (B)

RAIPUR SURVEY

Stratum : Sal Stems/ha.

Species Description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Anogeissus latifolia	5.361	2.680	1.804	0.876	0.567	0.155	0.103	0.000	0.000	0.000	0.000	11.546
Boswellia serrata	0.103	0.773	0.309	0.567	0.619	0.309	0.103	0.103	0.000	0.000	0.000	2.887
Diospyros melanoxylon	7.268	3.144	1.804	1.340	0.412	0.412	0.155	0.103	0.000	0.052	0.000	14.691
Lagerstroemia parviflora	1.907	0.928	0.412	0.155	0.052	0.000	0.000	0.000	0.000	0.000	0.000	3.454
Lannea coromandelica	3.247	1.392	0.928	0.258	0.052	0.052	0.000	0.000	0.000	0.000	0.000	5.928
Mitragyna parviflora	0.773	0.103	0.155	0.000	0.000	0.052	0.000	0.000	0.000	0.000	0.000	1.082
Ougeinia oogeinensis	2.168	0.515	0.464	0.206	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.351
Pterocarpus marsupium	2.887	2.680	1.804	1.186	0.412	0.412	0.361	0.155	0.052	0.052	0.000	10.000
Shorea robusta	34.742	21.495	18.814	14.845	11.649	7.113	7.216	1.701	0.515	0.258	0.052	118.402
Tectona grandis	0.309	0.000	0.000	0.000	0.052	0.052	0.155	0.000	0.000	0.000	0.000	0.567
Terminalia arenulata	17.010	7.887	5.517	3.608	1.649	0.670	0.928	0.103	0.000	0.000	0.000	37.371
Rest of species	79.227	20.567	11.392	4.124	2.732	1.598	0.979	0.464	0.155	0.103	0.206	121.546
All species total	365.869	117.582	60.795	36.296	22.109	15.173	14.348	3.933	2.026	0.899	0.693	630.824

Table No. 6.3(A)

Stratum -Miscellaneous Area - 4914.81 Sq.km. Stems '000'

Species description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Anogeissus latifolia	3375.000	1411.042	907.765	572.575	444.299	138.016	79.128	9.850	0.000	0.000	0.000	6937.685
Boswellia serrata	720.020	691.022	868.447	799.639	552.425	582.405	444.299	118.445	39.318	9.850	9.850	4835.680
Diospyros melanoxylon	2506.553	1302.916	907.765	641.383	404.489	227.064	187.746	29.489	19.659	0.000	0.000	6227.064
Lagerstroemia parviflora	2210.681	720.511	444.299	286.042	147.936	49.148	49.148	9.850	9.850	0.000	0.000	3927.425
Lannea coromandelica	3276.212	1371.723	878.276	375.000	246.723	147.936	79.128	9.850	0.000	0.000	0.000	6384.828
Mitragyna parviflora	542.595	286.042	128.276	138.106	79.128	58.978	58.978	9.850	0.000	0.000	0.000	1301.933
Ougenia oogeinesis	779.489	325.852	128.276	167.765	79.128	39.318	0.000	0.000	0.000	0.000	0.000	1509.828
Pterocarpus marsupium	1490.170	710.681	404.499	375.000	404.499	167.595	157.765	29.489	0.000	0.000	9.850	3749.628
Shorea robusta	670.871	316.022	266.383	207.405	118.445	147.936	69.299	29.489	9.850	0.000	0.000	1835.680
Tectona grandis	29.489	49.148	29.499	19.659	0.000	0.000	29.489	9.850	0.000	0.000	0.000	167.114
Terminalia crenulata	3651.704	1973.788	1736.894	1075.852	937.746	424.148	424.148	88.958	0.000	0.000	0.000	10313.238
Rest of species	50480.504	13915.301	6671.363	3197.575	1473.001	888.106	848.788	335.681	128.276	39.318	79.128	78087.041
All Species total	69733.288	23074.048	13371.742	7846.001	4987.819	2870.650	2427.916	680.701	206.913	49.148	98.788	126247.050

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Table no. 6.3(B)

RAIPUR SURVEY

Stratum : Miscellaneous Stems/ha.

Species Description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Anogeissus latifolia	6.867	2.871	1.847	1.165	0.904	0.281	0.161	0.020	0.000	0.000	0.000	14.116
Bosuellia serrata	1.465	1.406	1.767	1.627	1.124	1.185	0.904	0.241	0.080	0.020	0.020	9.839
Diospyros melanoxylon	5.100	2.651	1.847	1.305	0.823	0.462	0.382	0.060	0.040	0.000	0.000	12.671
Lagerstroemia parviflora	4.498	1.466	0.904	0.582	0.301	0.100	0.100	0.020	0.020	0.000	0.000	7.992
Lannea coromandelica	6.666	2.791	1.787	0.763	0.502	0.301	0.161	0.020	0.000	0.000	0.000	12.892
Nitraguna parviflora	1.104	0.582	0.261	0.281	0.161	0.120	0.120	0.020	0.000	0.000	0.000	2.651
Ougeinia oogeinensis	1.586	0.663	0.261	0.321	0.161	0.080	0.000	0.000	0.000	0.000	0.000	3.072
Pterocarpus marsupium	3.032	1.446	0.823	0.763	0.823	0.341	0.321	0.060	0.000	0.000	0.020	7.631
Shorea robusta	1.368	0.643	0.542	0.422	0.241	0.301	0.141	0.060	0.020	0.000	0.000	3.738
Tectona grandis	0.060	0.100	0.060	0.040	0.000	0.000	0.060	0.020	0.000	0.000	0.000	0.341
Terminalia crenulata	7.430	4.016	3.534	2.189	1.908	0.863	0.863	0.181	0.000	0.000	0.000	20.984
Rest of species	102.711	28.313	13.574	6.606	3.404	1.807	1.727	0.683	0.261	0.080	0.161	159.297
All species total	497.654	164.330	88.002	52.259	32.520	21.016	19.287	8.319	2.448	0.999	0.893	255.221

Table No. 6.4(A)

Stratum - Teak Area - 225.63 Sq.km. Volume'000'

Species description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Anogeissus latifolia	1.715	0.000	3.565	5.776	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.056
Boswellia serrata	0.000	0.000	0.000	10.627	6.892	18.411	13.064	19.336	28.275	0.000	0.000	96.591
Diospyros melanoxylon	0.203	1.579	8.777	0.000	0.000	0.000	0.000	30.573	0.000	0.000	0.000	41.132
Lagerstroemia parviflora	7.589	7.175	3.204	8.890	6.904	0.000	0.000	0.000	0.000	0.000	0.000	33.752
Lannea coromandelica	4.558	8.777	0.000	0.000	0.000	16.877	0.000	0.000	0.000	0.000	0.000	30.212
Mitragyna parviflora	0.293	1.354	3.790	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.437
Ougenia oogeinesis	5.362	1.715	0.000	0.000	0.000	0.000	10.379	0.000	0.000	0.000	0.000	15.456
Pterocarpus marsupium	4.287	17.689	4.851	4.513	20.826	0.000	0.000	0.000	0.000	0.000	0.000	52.166
Shorea robusta	0.564	0.000	0.000	0.000	0.000	0.000	0.000	0.000	44.043	0.000	0.000	44.607
Tectona grandis	209.858	153.090	73.330	36.665	25.474	34.318	0.000	0.000	0.000	0.000	0.000	532.735
Terminalia cranulata	2.008	7.130	5.889	20.983	6.002	8.980	0.000	0.000	0.000	0.000	0.000	50.992
Rest of species	42.193	21.751	28.838	21.299	0.000	18.682	104.060	25.631	36.214	47.460	58.822	401.957
All Species total	276.600	220.260	129.241	108.753	66.088	97.268	127.503	75.540	108.528	47.460	58.822	1316.063

Table No. 6.4 (B)

RAIPUR SURVEY

Stratum : Teak Volume/ha.

Species Description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Anogeissus latifolia	0.076	0.000	0.158	0.256	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.489
Bosuellia serrata	0.000	0.000	0.000	0.471	0.305	0.816	0.579	0.857	1.263	0.000	0.000	4.282
Diospyros melanoxlyon	0.009	0.070	0.389	0.000	0.000	0.000	0.000	1.355	0.000	0.000	0.000	1.825
Lagerstroemia parviflora	0.335	0.318	0.142	0.398	0.306	0.000	0.000	0.000	0.000	0.000	0.000	1.499
Lannea coromandelica	0.202	0.389	0.000	0.000	0.000	0.748	0.000	0.000	0.000	0.000	0.000	1.340
Mitragyna parviflora	0.013	0.060	0.168	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.242
Ougeinia oogeinensis	0.149	0.076	0.000	0.000	0.000	0.000	0.460	0.000	0.000	0.000	0.000	0.685
Pterocarpus marsupium	0.190	0.784	0.215	0.200	0.923	0.000	0.000	0.000	0.000	0.000	0.000	2.312
Shorea robusta	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.952	0.000	0.000	1.977
Tectona grandis	9.301	6.785	3.260	1.625	1.129	1.521	0.000	0.000	0.000	0.000	0.000	25.610
Terminalia crenulata	0.089	0.316	0.261	0.930	0.266	0.398	0.000	0.000	0.000	0.000	0.000	2.260
Rest of species	1.870	0.964	1.145	0.944	0.000	0.828	4.612	1.136	1.605	2.103	2.607	17.815
All species total	12.259	9.762	5.727	4.825	2.929	4.312	5.652	3.348	4.810	2.103	2.607	68.335

Contents

Table No. 6.5(A)

Stratum -Sal Area - 1903.14 Sq.km. Volume'000'

Species description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
	0-0122											
Anogeissus latifolia	80.883	102.389	121.611	93.634	90.589	36.160	34.447	0.000	0.000	0.000	0.000	589.715
Bosuellia serrata	1.713	245.505	17.889	53.298	92.112	59.758	26.263	46.457	0.000	0.000	0.000	542.965
Diospyros melanoxylon	73.271	83.548	87.164	103.721	48.530	74.984	39.395	51.765	0.000	85.952	0.000	618.330
Lagerstroemia parviflora	19.602	26.263	25.218	13.703	7.993	0.000	0.000	0.000	0.000	0.000	0.000	90.779
Lannea coromandelica	22.838	33.876	41.108	19.983	5.900	10.657	0.000	0.000	0.000	0.000	0.000	134.362
Mitragyna parviflora	7.612	2.855	7.993	0.000	0.000	6.471	0.000	0.000	0.000	0.000	0.000	24.931
Ougenia oogeinesis	25.883	16.938	26.073	16.938	0.000	0.000	0.000	0.000	0.000	0.000	0.000	85.832
Pterocarpus marsupium	29.308	85.070	108.860	112.475	60.520	82.896	95.918	62.042	36.540	40.156	0.000	713.485
Shorea robusta	431.061	447.428	925.116	1376.922	1794.851	1601.492	2512.525	942.245	421.545	296.509	95.918	10848.612
Tectona grandis	4.567	0.000	0.000	0.000	8.945	12.180	54.049	0.000	0.000	0.000	0.000	79.741
Terminalia crenulata	136.455	229.138	317.444	323.153	217.338	124.275	241.318	37.301	0.000	0.000	0.000	1626.422
Rest of species	695.970	859.142	580.648	356.458	332.288	274.242	248.550	187.269	82.786	80.883	443.241	3841.485
All Species total	1529.171	1832.152	2257.124	2470.275	2659.066	2282.815	3252.466	1527.059	540.871	473.500	539.189	19165.657

Table no. 6.5(B)

RAIPUR SURVEY

Stratum : Sal Volume/ha.

Species Description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Anogeissus latifolia	0.425	0.538	0.639	0.492	0.476	0.190	0.181	0.000	0.000	0.000	0.000	2.941
Bosuellia serrata	0.009	0.129	0.094	0.280	0.484	0.314	0.138	0.244	0.000	0.000	0.000	1.695
Diospyros melanoxylon	0.385	0.439	0.458	0.545	0.255	0.394	0.207	0.272	0.000	0.294	0.000	3.248
Lagerstroemia parviflora	0.103	0.138	0.122	0.072	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.476
Lannea coromandelica	0.120	0.178	0.216	0.105	0.031	0.056	0.000	0.000	0.000	0.000	0.000	0.707
Mitragyna parviflora	0.040	0.013	0.042	0.000	0.000	0.034	0.000	0.000	0.000	0.000	0.000	0.130
Ougeinia oogeinensis	0.136	0.089	0.137	0.089	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.451
Pterocarpus marsupium	0.154	0.447	0.572	0.591	0.318	0.434	0.504	0.326	0.192	0.211	0.000	3.750
Shorea robusta	2.265	2.351	4.861	7.238	9.431	8.415	13.202	4.981	2.215	1.558	0.604	57.048
Tectona grandis	0.024	0.000	0.000	0.000	0.047	0.064	0.284	0.000	0.000	0.000	0.000	0.419
Terminalia crenulata	0.717	1.204	1.668	1.698	1.142	0.653	1.268	0.196	0.000	0.000	0.000	8.547
Rest of species	3.667	2.938	3.051	1.873	1.746	1.441	1.306	0.984	0.435	0.425	2.329	20.186
All species total	20.296	18.226	17.588	17.906	16.901	16.367	22.742	10.322	7.653	4.590	2.853	99.596

Table No. 6.6(A)

Stratum -Miscellaneous Area - 4914.81 Sq.km. Volume '000'

Species description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Anogeissus latifolia	267.857	275.229	325.360	334.698	390.727	172.510	142.038	30.472	0.000	0.000	0.000	1938.891
Boswellia serrata	46.691	131.225	288.500	423.165	412.844	586.337	619.266	245.740	123.853	35.878	51.605	2968.104
Diospyros melanoxylon	123.362	183.814	233.945	270.806	286.062	201.999	286.383	68.807	77.162	0.000	0.000	1702.340
Lagerstroemia parviflora	115.006	111.075	128.276	132.208	101.245	48.657	68.807	230.996	31.946	0.000	0.000	968.216
Lannea coromandelica	134.174	169.561	203.473	157.765	158.748	153.342	119.951	35.878	0.000	0.000	0.000	1132.872
Mitragyna parviflora	28.506	40.301	27.031	61.114	39.318	38.827	54.063	13.270	0.000	0.000	0.000	292.430
Ougenia oogeinesis	53.080	54.554	34.895	66.841	48.165	29.489	0.000	0.000	0.000	0.000	0.000	287.024
Pterocarpus marsupium	86.501	118.447	125.819	185.288	302.261	166.612	229.030	68.807	0.000	0.000	56.520	1339.285
Shorea robusta	44.235	34.404	67.333	108.126	98.296	173.984	127.785	82.077	38.827	0.000	0.000	775.065
Tectona grandis	1.966	19.830	13.270	12.771	0.000	0.000	50.622	29.489	0.000	0.000	0.000	127.948
Terminalia crenulata	149.902	312.090	517.529	511.632	660.059	415.301	592.256	198.558	0.000	0.000	0.000	3357.306
Rest of species	2368.447	2002.785	1791.448	1402.195	1107.798	816.350	1121.068	732.798	408.421	167.595	715.105	12634.010
All Species total	3419.725	3453.315	3756.879	3656.609	3575.523	2803.408	3411.228	1736.892	680.209	203.473	823.230	27820.491

Table no.6.6 (B)

RAIPUR SURVEY

Stratum : Miscellaneous Volume/ha.

Species Description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Anogeissus latifolia	0.545	0.560	0.662	0.681	0.795	0.351	0.289	0.062	0.000	0.000	0.000	3.948
Boswellia serrata	0.095	0.267	0.587	0.861	0.840	1.193	1.260	0.500	0.252	0.073	0.105	6.034
Diospyros melanoxylon	0.251	0.374	0.476	0.551	0.521	0.411	0.542	0.140	0.157	0.000	0.000	3.423
Lagerstroemia parviflora	0.234	0.228	0.261	0.269	0.206	0.099	0.140	0.047	0.068	0.000	0.000	1.551
Lannea coromandelica	0.273	0.345	0.414	0.321	0.323	0.312	0.244	0.073	0.000	0.000	0.000	2.308
Mitragyna parviflora	0.058	0.082	0.055	0.104	0.080	0.079	0.110	0.027	0.000	0.000	0.000	0.595
Ougenia oogeinensis	0.108	0.111	0.071	0.135	0.098	0.060	0.000	0.000	0.000	0.000	0.000	0.584
Pterocarpus marsupium	0.176	0.241	0.256	0.377	0.615	0.339	0.466	0.140	0.000	0.000	0.115	2.725
Shorea robusta	0.090	0.070	0.137	0.220	0.200	0.354	0.260	0.167	0.079	0.000	0.000	1.577
Tectona grandis	0.004	0.020	0.027	0.026	0.000	0.000	0.103	0.060	0.000	0.000	0.000	0.239
Terminalia crenulata	0.505	0.636	1.053	1.041	1.343	0.845	1.205	0.404	0.000	0.000	0.000	6.831
Rest of species	4.819	4.075	3.645	2.853	2.254	1.661	2.281	1.491	0.831	0.341	1.455	25.708
All species total	27.256	26.237	25.233	25.244	24.176	22.072	29.642	13.434	9.037	5.004	1.676	85.520

Table no.6.7

RAIPUR SURVEY

STAND AND STOCK DISTRIBUTION (COMBINED) CHARACTER-STEMS AREA -7043.88 Sq.km

Species Description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Anogeissus latifolia	4424691	1921583										9184107
Total	4424777	1921489	1260801	748732	552217	187637	98610	9861	0000	0000	0000	9292873
Per ha.	6.282	2.728	1.790	1.063	0.784	0.238	0.140	0.014	0.000	0.000	0.000	13.039
Boswellia serrata												
Total	740280	838186	927939	926935	673366	660688	473328	147915	49305	98610	98610	8635162
Per ha.	1.051	1.190	1.317	1.316	0.956	0.938	0.672	0.210	0.070	0.014	0.014	7.748
Diospyros melanoxylon												
Total	3900030	1910925	1280523	896648	483189	305691	216942	59166	19722	98610	0000	9171444
Per ha.	5.537	2.713	1.818	1.273	0.686	0.434	0.308	0.084	0.028	0.014	0.000	12.895
Lagerstroemia parviflora												
Total	2760379	947361	532495	335274	167637	49305	49305	98610	98610	0000	0000	5038976
Per ha.	3.919	1.345	0.756	0.476	0.238	0.070	0.073	0.014	0.014	0.000	0.000	6.905
Lannea coromandelica												
Total	3972579	1715112	1055128	462023	256386	177498	78888	98610	0000	0000	0000	7816224
Per ha.	5.640	2.435	1.498	0.062	0.364	0.252	0.112	0.014	0.000	0.000	0.000	10.377
Mitragyna parviflora												
Total	699427	315552	177498	138054	78888	69027	59166	98610	0000	0000	0000	1636222
Per ha.	0.993	0.448	0.252	0.196	0.112	0.098	0.084	0.014	0.000	0.000	0.000	2.197
Ougenia oogeinensis												
Total	1260235	433884	216238	197220	78888	39444	98610	0000	0000	0000	0000	2314819
Per ha.	1.775	0.616	0.307	0.280	0.112	0.056	0.014	0.000	0.000	0.000	0.000	3.160
Pterocarpus marsupium												
Total	2108143	1318556	767750	610678	512772	246525	226803	59166	98610	98610	98610	6145225
Per ha.	2.993	1.872	1.090	0.867	0.728	0.350	0.322	0.084	0.014	0.014	0.014	8.348
Shorea robusta												
Total	7292923	4406464	3847203	3032261	2335651	1501691	1422525	383589	117628	49308	98610	24487849
Per ha.	10.354	6.256	5.462	4.305	3.316	2.132	2.048	0.502	0.167	0.070	0.014	34.606
Tectona grandis												
Total	3149185	853682	226099	78888	39444	39444	59166	98610	0000	0000	0000	4544518
Per ha.	4.471	1.212	0.321	0.112	0.056	0.056	0.084	0.014	0.000	0.000	0.000	6.326
Terminalia crenulata												
Total	6957648	3523903	2806162	1801748	1261505	561373	600817	108471	0000	0000	0000	17621627
Per ha.	9.878	5.003	3.984	2.558	1.791	0.797	0.853	0.154	0.000	0.000	0.000	25.018
Rest of species												
Total	66461107	17966763	8927738	4031745	2220136	1212200	1113590	433884	167637	69027	128193	102752020
Per ha.	94.357	25.508	12.675	5.724	3.152	1.721	1.581	0.616	0.238	0.098	0.182	145.852
All species total												
Total	103716715	36151877	22025574	13260206	8660079	5050523	4497750	1655240	551512	414162	424023	196407659
Per ha.	147.250	51.306	31.270	18.232	12.295	7.142	6.291	1.720	0.531	0.210	0.224	276.471

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Table no.6.8

RAIPUR SURVEY

STAND AND STOCK DISTRIBUTION (COMBINED) AREA -7043.59 Sq.km. CHARACTER-VOLUME

Species Description	Diameter classes											
	10-15	15-20	20-25	25-30	30-35	35-40	40-50	50-60	60-70	70-80	80+	Total
Anogeissus latifolia												
Total	351475	377536	450789	433884	481781	209194	176794	30287	0000	0000	0000	2511740
Per ha.	0.499	0.536	0.640	0.616	0.684	0.297	0.251	0.043	0.000	0.000	0.000	3.566
Boswellia serrata												
Total	48601	155663	306396	487416	512068	664209	658576	312030	182141	35922	82122	3385143
Per ha.	0.069	0.231	0.435	0.692	0.727	0.943	0.935	0.443	0.216	0.051	0.074	4.806
Diospyros melanoxylon												
Total	196516	269065	329639	374014	304283	277517	305691	151457	77479	55644	0000	2341285
Per ha.	0.279	0.382	0.468	0.531	0.432	0.394	0.434	0.215	0.110	0.079	0.000	3.324
Lagerstromeia parviflora												
Total	142280	145802	154959	154959	116219	48601	69027	23244	31696	0000	0000	886787
Per ha.	0.202	0.027	0.220	0.220	0.165	0.069	0.098	0.033	0.045	0.000	0.000	1.079
Lannea coromandelica												
Total	162002	212012	244412	177498	164820	181020	119741	35922	0000	0000	0000	1297427
Per ha.	0.230	0.301	0.347	0.252	0.234	0.257	0.170	0.051	0.000	0.000	0.000	1.842
Mitragyna parviflora												
Total	36627	44374	38739	51418	39440	45079	53831	13382	0000	0000	0000	322590
Per ha.	0.052	0.063	0.055	0.073	0.056	0.064	0.076	0.019	0.000	0.000	0.000	0.458
Ougeinia oogeinensis												
Total	82410	73253	61279	83819	47896	29583	10565	0000	0000	0000	0000	388805
Per ha.	0.117	0.104	0.087	0.119	0.068	0.042	0.015	0.000	0.000	0.000	0.000	0.552
Pterocarpus marsupium												
Total	119741	221168	240186	302169	383171	249342	325413	131010	36627	40148	86349	2105324
Per ha.	0.170	0.314	0.341	0.429	0.544	0.354	0.462	0.186	0.052	0.057	0.090	2.989
Shorea robusta												
Total	476146	481781	992440	1484786	1893314	1786956	2639934	1024136	504320	296534	95793	11676140
Per ha.	0.676	0.684	1.409	2.109	2.688	2.537	3.748	1.454	0.716	0.421	0.136	16.877
Tectona grandis												
Total	216238	162707	86636	49305	34513	46487	104245	29583	0000	0000	0000	729714
Per ha.	0.307	0.031	0.123	0.070	0.049	0.066	0.148	0.042	0.000	0.000	0.000	0.836
Terminalia crenulata												
Total	288082	547990	841003	855795	883265	562782	833960	235960	0000	0000	0000	6048837
Per ha.	0.409	0.778	1.194	1.215	1.254	0.799	1.184	0.335	0.000	0.000	0.000	7.168
Rest of species												
Total	3106923	2684289	2398339	1779913	1439708	1109364	1473517	945953	627564	295830	1217131	16878531
Perha.	4.411	3.669	3.405	2.527	2.044	1.575	2.092	1.343	0.749	0.420	1.728	23.963
All species total												
Total	5227041	5275640	6144817	6234976	6300478	5210134	6770993	2932944	1529827	724078	1421598	47572323
Per ha.	7.421	7.110	8.724	8.852	8.925	7.397	9.613	4.164	1.888	1.028	2.018	67.160

CHAPTER - SEVEN

INVENTORY RESULTS : BAMBOO GROWING STOCK

7.0 AREA:

As discussed in details in para 5.14 of earlier Chapter, pure bamboo forest or bamboo brakes do not exist in Raipur district. However, bamboo does occur in about 1039.86 sq.km. area of forest land in association with tree species as estimated on the basis of 106 sample plots where bamboo crop was recorded. Most of these bamboo areas comprise of regeneration crop or of hacked/sparse bamboo clumps. Only one third of such bamboo forest has better crop of bamboo making good contribution to bamboo growing stock, though overall contribution of bamboo is insignificant in this district. Growing stock of bamboo has been discussed in the following paragraphs. Since number of sample plots under bamboo crop were 106 only (which are quite inadequate), the standard error for estimation of bamboo growing stock is high and as such the figures showing the growing stock of bamboo by various parameters should be treated as indicative only and used with due caution.

7.1 NO.OF CLUMPS PER HA BY QUALITY AND SIZE CLASSES:

Table no.7.1 T produced below gives occurrence of bamboo clumps per ha by bamboo quality and clump size classes. It is seen that the major bamboo crop is under the lower clump sizes of both the quality classes. Various clump sizes are as follows:

a) Size class 1 : clumps having basal diameter < 1m;
b) Size class 2 : clumps having basal diameter 1-2m; and
c) Size class 3 : clumps having basal diameter > 2m.

Similarly, bamboo clumps having 6 m. and above height were considered as 1st quality clumps, those with a height 4-6 m. were ranked 2nd quality and those with height below 4 m. were categorised as 3rd quality bamboo.

Table No. 7.1 T

No. of clumps/ha by quality and size classes

Quality	Clump size classes			Total
	1	2	3	
1	85.479	27.380	1.905	114.764
2 + 3	20.434	5.652	-	26.086

The above table also shows that major part of the bamboo crop is under 1st quality. 2nd and 3rd quality bamboo contribute very little, either alone or clubbed together, to the total bamboo growing stock.

7.2 BAMBOO CULMS PER CLUMP BY SOUNDNESS, QUALITY AND CLUMP SIZE CLASSES:

Table no. 7.2 T produced below gives distribution of culms per clump by soundness of culms, by quality and clump size classes. The table reveals that under 1st quality bamboo the lowest clump size has yielded 19.14 culms per clump whereas the next higher clump size class has yielded only 11.76 culms per clump. However, in the highest clump size, 45 culms per clump of varying degree of soundness were found. The reason for this abnormality in the middle clump size class may be over exploitation in this clump size class. The second quality class of bamboo has only a few culms per clump. However, number of culms increases from lower clump diameter class to higher diameter class. There are 2.4 and 5 culms in clump size class 1 and 2 respectively. Second quality class was found to be in a very deteriorated condition.

Table No. 7.2 T

Bamboo culms/clump by soundness of the culm, by quality and clump size classes:

Quality	Clump size	Green sound	Green damaged	Dry sound	Dry damaged	Decayed	Total
1	1	8.61226	4.59183	1.69388	2.34694	1.89798	19.14289
	2	6.40000	2.32000	1.16000	1.32000	0.56000	11.76000
	3	8.00000	21.0000	2.00000	8.00000	6.00000	45.00000
2	1	1.33332	0.88888	0.22222	-	-	2.44442
	2	-	3.00000	-	2.00000	-	5.00000
	3	-	-	-	-	-	-

Large number of bamboo culms in both the quality classes and all the clump size classes were found to be damaged, both green as well as dry culms.

7.3 CULMS PER HA BY SOUNDNESS, QUALITY AND CLUMP SIZE CLASSES:

Table no. 7.3 T produced below gives occurrence of bamboo culms per ha by soundness, quality and clump size class. From the table it is observed that in all 2122.238 culms per ha were found to occur in Raipur district. Out of which 2044.029 culms per ha were of first quality bamboo and 78.209 culms of second and third quality bamboo.

Table No. 7.3 T

Culms/ha by soundness of culms, bamboo quality and clump size classes:

Quality	Size class	Green sound	Green damaged	Dry sound	Dry damaged	Decayed	Total
1	1	736.167	392.505	144.792	200.614	162.237	1636.315
	2	175.232	65.522	31.761	36.142	15.332	321.989
	3	15.240	40.005	3.810	15.240	11.430	85.725
2&3	1	27.245	18.163	4.541	-	-	2044.029 49.949
	2	-	16.956	-	11.304	-	28.260
	3	-	-	-	-	-	28.209

7.4 TOTAL NUMBER OF CULMS BY SOUNDNESS, QUALITY AND CLUMPS SIZE CLASSES:

Table no.7.4 T gives distribution of total number of culms by their soundness, quality and clump size classes found in whole of the forest area of Raipur district. This table shows that in all 86,065,114 culms of different qualities and soundness were found existing in Raipur forest, out of which 84,300,485 culms were of 1st quality and 1,764,629 culms of 2nd and 3rd quality clubbed together. Out of this bamboo growing stock 7,787,137 culms are decayed ones (9.05%) having no practical utility. 2nd and 3rd quality bamboo have least contribution to the overall growing stock.

Table No. 7.4 T

Total number of culms (000) by soundness, quality and clump size classes

Size class	Green sound	Green damaged	Dry sound	Dry damaged	Decayed	Total
1ST QUALITY.						
1	30331.552	16171.991	5965.720	8265.698	6684.489	67419.450
2	7219.909	2699.637	1308.617	1489.123	631.709	13348.995
3	627.918	1646.286	156.979	627.918	470.939	3532.040
2nd & 3rd QUALITY .						
1	614.729	409.812	102.458	-	-	1126.999
2	-	382.578	-	255.052	-	637.630
3	-	-	-	-	-	-
	38794.108	21312.304	7533.774	10637.791	7787.137	86065.114
	45.08%	24.76%	8.75%	12.36%	9.05%	100%

90.95% of the total bamboo growing stock comprises of utilizable bamboo culms having 45.08% green sound, 24.76% green damaged, 8.75% dry sound and 12.36% dry damaged culms.

7.5 GREEN STOCK IN TONNES (000) BY SOUNDNESS, QUALITY AND CLUMP SIZE CLASSES:

Table no. 7.5 T produced below gives the distribution of total bamboo stock (green) in thousand tonnes by soundness, quality and clump size classes. The total stock of bamboo in Raipur district was estimated to be 244,241 tonnes of green bamboo out of which 237,399 tonnes are contributed by 1st quality bamboo and the rest 6,842 tonnes by 2nd and 3rd quality bamboo.

Table No. 7.5 T

Bamboo (green stock in thousand tonnes) by soundness of culms, by quality and clump size classes:

Quality	Clump size class	Green sound	Green damaged	Dry sound	Dry damaged	Total
1	1	86.708	29.812	42.140	30.517	189.177
	2	23.401	3.241	9.021	5.133	40.796
	3	1.204	2.976	1.082	2.164	7.426
2 & 3	1	4.144	0.454	0.706	-	5.304
	2	-	0.659	-	0.879	1.538
	3	-	-	-	-	-
		115.457	37.142	52.949	38.693	244.241
Percentage		47.27	15.21	21.68	15.84	100%

Out of the above stock of green bamboo, 47.27% is contributed by green sound culms, 15.21% by green damaged, 21.68% by dry sound and 15.84% by dry damaged culms.

The dry damaged culms do not have any utility whereas other culms have some utility including the damaged ones.

Green weight of a bamboo culm has been estimated using the following factors for green equivalent weight of different types of bamboo culms found during the course of inventory survey. Green weight of a bamboo sample from each quality and culm diameter class was collected during field work and total green weight was then estimated using the following factors for different kinds of bamboo culms:

1. Green sound - 1.0
2. Green damaged - 0.5
3. Dry sound - 2.0
4. Dry damaged - 1.0
5. Decayed - 0.0

The green bamboo stock given in the above table is based on these factors.

7.6 BAMBOO STOCK BY QUALITY AND CLUMP SIZE CLASSES

Table no. 7.6 T produced below gives composite picture of the distribution of total bamboo growing stock (green) in terms of weight, quality and clump size classes. The table reveals that in all 244241 tonnes of green bamboo are existing under various quality and clump size classes. The major contribution (97%) to growing stock is from 1st quality bamboo and the rest 3% is from 2nd and 3rd quality bamboo. Further, about 79.63% forming major part of bamboo stock is contributed by lower clump size class, 17.33% by middle clump size class and the remaining 3.04% stock of green bamboo is contributed by the highest clump size class (having more than 2 m. dia).

Table No. 7.6 T

Bamboo (green stock in thousand tonnes) by quality and clump size classes:

Quality	Clump size classes			Total
	1	2	3	
1	189.177	40.796	7.426	237.399
2 & 3	5.304	1.538		6.842
	194.481	42.334	7.426	244.241
%	79.63	17.33	3.04	100%

7.7 CONSOLIDATED BAMBOO STOCK:

Table no.7.7T appended separately gives consolidated picture of the distribution of growing stock of bamboo found in Raipur district by quality, clump sizes, age, soundness and diameter of culm. The table indicates that major contribution to bamboo stock is from lower dia class of culms i.e. 2-5 cm. followed by the next dia. class i.e. 5-8 cm. dia class. The highest dia class of culms contributes very little.

As already mentioned in previous paragraph total green bamboo stock was estimated to be 244,241 tonnes. Since the weight of undry bamboo (at 10% moisture contents) is about 60% of the green weight of bamboo as determined from earlier studies conducted by the Central Zone, the total undry weight of bamboo stock in Raipur district was estimated to be 1,46,544 tonnes.

****

Table no. 7.2T

Raipur survey

Green bamboo stock in tonnes in '000' by quality, size classes, age and soundness of culms : Species - Dendrocalamus strictus

Quality	Clump size class	GREEN SOUND CULMS							Total (A)	GREEN DAMAGED CULMS					Total (B)	DRY SOUND CULMS			Total (C)	DRY DAMAGED CULMS			Total (D)	GRAND TOTAL (A+B+C+D)
		Current year	One to two seasons			Over two seasons				Current year	1-2 seasons old		Over 2 seasons old			2<5cm	5<8cm		2<5cm	5<8cm			
			2<5cm	5<8cm	8+cm	2<5cm	5<8cm	8+cm			2<5cm	5<8cm	2<5cm	5<8cm									
1	1	9.775	37.906	6.033	1.508	29.978	0.754	0.754	86.708	0.862	14.123	4.524	8.795	1.508	29.812	40.632	-	40.632	27.501	3.016	30.517	189.177
	2	2.166	8.555	5.681	-	6.999	-	-	23.401	0.519	1.400	-	1.322	-	3.241	9.021	-	9.021	5.133	-	5.133	40.796
	3	0.392	-	-	-	0.612	-	-	1.204	-	2.570	-	0.406	-	2.976	1.082	-	1.082	2.164	-	2.164	7.426
2	1	0.205	0.177	2.150	1.612	-	-	-	4.144	0.102	0.176	-	0.176	-	0.454	0.706	-	0.706	-	-	-	5.304
	2	-	-	-	-	-	-	-	-	-	0.659	-	-	-	0.659	-	-	-	0.879	-	0.879	1.538
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANNEXURE -I

GLOSSARY OF LOCAL AND SCIENTIFIC NAMES OF COMMON TREES, WEEDS, CLIMBERS AND GRASSES

Local Name	Botanical Name	Family
1	2	3
Achar	Buchanania lanzan	Anacardiaceae
Am	Mangifera indica	-do-
Amaltas	Cassia fistula	Caesalpiniaceae
Amta	Bauninia malabarica	-do-
Aonla	Emblica officinalis	Euphorbiaceae
Apta	Bauhinia racemosa	Caesalpiniaceae
Arjun(koha)	Terminalia arjuna	Combretaceae
Bahera	Terminalia belerica	-do-
Bar	Ficus benghalensis	Urticaeceae
Baranga	Kydia calycina	Malvaceae
Bel	Aegle marmelos	Rutaceae
Ber	Zizyphus mauratiana	Rhamenaceae
Bhilwa	Semecarpus anacardium	Anacardiaceae
Bhirra	Chloroxylon swietenia	Maliaceae
Bhomrmal	Hymenodictyon excelsum	Rubiaceae
Bijasal	Pterocarpus marsupium	Papulionaceae
Chichwa	Albizzia odoratissima	Mimisaceae
Chirol	Holoptelea integrifolia	Urticaceae
Dahiwas	Cordia dishooma	Boraginaceae
Datrangi	Ehretia leavis	-do-
Dengla	Securinega virosa	Euphorbiaceae
Dhaman	Grewia tiliaefolia	Tiliaceae
Dhaora	Anogeissus latifolia	Combretaceae
Dhobin	Dalbergia paniculata	Papilionaceae
Dudhi	Holarrhena antidysentrica	Apocynaceae
Garari/Karra	Cleistanthus collinus	Euphorbiaceae
Ghont	Zizyphus xylopyra	Rhamnaceae
Haldu	Adina cordifolia	Rubiaceae
Gongal	Cochlospermum religiosum	Bixaceae
Harra	Terminalia chebula	Combretaceae
Harsinger	Nyctanthes arbortristis	Oleaceae
Hiwar	Acacia leucophloea	Mimisaceae
Imli	Tamarindus indica	Ceasalpiniaceae
Jamrasi	Elaeodendron glaucum	Celastroceae
Jamun	Syzygium cumini	Myrtaceae
Kachnar	Bauhinia variegata	Ceasalpiniaceae
Kakai	Flacourtia indica	Bixaceae
Kalmi	Mitragyna parvifolia	Rubiaceae
Karanji	Pongamia pinnata	Papilionaceae
Kasai	Bridelia retusa	Euphoribiaceae
Khair	Acacia catechu	Mimosaceae
Kulu	Sterculia urens	Sterculiaceae
Kumbhi	Careya arborea	Myrtaceae
Kusum	Schliechera oleosa	Sapindaceae

Lasora	Cordia dichotoma	Boraginaceae
Lendia	Lagerstroemia parviflora	Lythraceae
Lokhandi	Ixora arborea	Rubiaceae
Maharukh	Ailanthus excelsa	Simarubaceae
Mahua	Madhuca indica	Sapindaceae
Mainphal	Randia dumetorum	Rubiaceae
Mokha	Schrebra swietenioides	Oleaceae
Moyen	Lannea coromandelica	Anacardiaceae
Neem	Azadirachta indica	Meliaceae
Padar	Stereospermum suaveolens	Bignoniaceae
Palsas	Butea monosperma	Papilionaceae
Padar(chhota)	Stereospermum personatum	Bignoniaceae
Panjre	Erythrina suberosa	Papilionaceae
Papra	Gardenia latifolia	Rubiaceae
Phetra kala	Randia ulginosa	-do-
Phetra safed	Gardenia turgida	-do-
Pipal	Ficus religiosa	Urticaceae
Rohan	Soymida febrifuga	Meliaceae
Sagon	Tectona grandis	Verbenaceae
Saja	Terminalia tomentosa	Combretaeceae
Sal	Shorea robusta	Dipterocarpaceae
Salai	Boswellia serrata	Burseraceae
Semal	Bombax ceiba	Malvaceae
Shisham	Dalbergia latifolia	Papilionaceae
Sinduri	Mallotus philippensis	Euphorbiaceae
Siris safed	Albizzia procera	Mimosaceae
Siris kala	Albizzia lebbeck	-do-
Sissoo	Dalbergia sissoo	Papilionaceae
Siwan	Gmalina arborea	Verbenaceae
Tendu	Diospyros melanoxylon	Ebenaceae
Tilwa	Windlandia exserta	Rubiaceae
Tinsa	Ougeinia oojeinensis	Papilionaceae
Umar	Ficus glomerata	Urticaceae
Bans	Dendrocalamus strictus	Gramineae

COMMON WEEDS

Amera	Colebrookia
Baichandi	Dioscorea daemona
Baibarang	Embelia robusta
Chhind	Phoenix acaulis
Childi	Flemingia bracteata
Dhawai	Woodfordia floribunda
Dikamali	Gardenia lucida
Gursakri	Grewia hirsuta
Gokhuru	Tribulus terrestris
Khirsai	Nyetanthes arbortristis
Kuro	Holarrhena antidysenterica
Marorphal	Helicteres isora
Neel	Indigofera pulchella
Sindhuri	Mallotus phillipphensis

COMMON CLIMBERS

Gurar	Millittia auriculata
Kalsibel (keoti)	Ventilago calyculata
Malkamini	Celastrus paniculata
Mahul	Bauhinia vahlii
Nasbel	Spatholobus roxburghii
Palasbel	Butea superba
Ramdaton	Smilax macrophylla

COMMON GRASSES

Bhusbhusi	Eragrostis tenella
Chhir	Imperata cylindrica
Ghunad	Anthistiria cialiata
Khus	Vetiveria zizanioides
Kusal	Heteropogon contortus
Phulbahari	Thysanolaena maxima
Rusa	Cymbiopogon martinii
Sabai	Eulaliopsis binata

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ANNEXURE -II

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