

(2) D.W.

**REPORT ON THE FOREST RESOURCES**  
**OF**  
**WEST CHAMPARAN DISTRICT**  
**( BIHAR )**

10-89  
By Director (Date)  
Forest Survey of India  
25-Subhash Road, Dehra Dun



**FOREST SURVEY OF INDIA**  
**EASTERN ZONE**  
**APRIL, 1986**

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## P R E F A C E

The inventory of forest resources in the West Champaran district of Bihar was first taken up by the Eastern Zone of Forest Survey of India in the year 1981-82 but the work had to be abandoned within a fortnight due to administrative problems. Subsequently, in compliance of the decision of the Zonal Co-ordination Committee Meeting held at Calcutta in May, 1982 an attempt was made to resume the inventory work in the area during 1982-83, but this time also the various local problems of the Champaran area stood in the way of work. Finally the field work was again taken up during 1984-85 from April, 1984 to February, 1985. It was supervised by Shri D.R. Das, Dy. Director under the overall guidance of Shri S.C. Dey, Joint Director of Eastern Zone.

For carrying out survey in forest areas, a systematic cluster sampling design at grid intervals of  $2\frac{1}{2}' \times 2\frac{1}{2}'$  was followed. The total number of sample plots actually inventoried were 96 of which 77 fell in the Sal stratum and the remaining 19 in the miscellaneous stratum. The standard error for the volume in Sal stratum works out to 7.5% and that for the miscellaneous stratum to 16%. The higher standard error in the miscellaneous stratum is due to a smaller number of sample plots.

Wood consumption Study in the district was also carried out simultaneously. A two-stage stratified random sampling method was adopted. Sampling units were first stratified into urban and rural sectors. Households in both the sectors constituted the second stage sampling units. Villages were selected at random by selecting random numbers from random tables with the compulsion of taking at least one village from each administrative block. Number of households were also decided at random with the obligation of taking at least one household each from pucca, semi-pucca and kachcha houses in the selected villages.

Present inventory indicates that the forests of Champaran district occur as a compact block in the extreme north-west part of Bihar State adjoining Nepal and Uttar Pradesh. This is the only sizeable forest area that exists in the entire terrain of North Bihar covering approximately 50,000 km<sup>2</sup>. Shorea robusta forms the principal crop in the area. Quality of the crop varies from quality class II to V but density is fair to good except in some fringe areas in southern portion, and in narrow strips along western and eastern parts of the district. The volume per hectare varies widely from an extremely low figure of 1 m<sup>3</sup> to a high figure of 200 m<sup>3</sup>, the average volume per hectare for the Sal stratum being 74 m<sup>3</sup> and that for the miscellaneous stratum 47 m<sup>3</sup>.

Annual consumption of timber in the district for various purposes works out approximately to 50,000 m<sup>3</sup> and the same for firewood to roughly 3,35,000 m<sup>3</sup>. Out of this local demand, the recorded supply from forests meets only 15% of the demand of timber and 4% of the demand of firewood. Thus bulk of the supply of timber and fuelwood for the local people comes from extraneous sources. The demand for bamboo is to the tune of 40 lakh pieces annually and almost the entire quantity is collected by the people from the bamboos grown in private holdings.

Since the forest area largely falls in the Siwaliks, the forests have been managed under a conservation-oriented system and the same needs to be continued for maintaining proper ecological balance in the area. The forests are fairly rich in wildlife particularly tigers and leopards. As the forests are infested with dacoits and a large number of armed police personnel are posted in the area as an anti-dacoity measure, the onslaught on the forests is reasonably under control and conditions are favourable for establishment of a Tiger Reserve.

The dacoits posed a great menace when field work was being carried out in the Champaran area and occasionally threatened the inventory crews of the FSI but the latter carried on their field work despite the danger for which they deserve to be complimented. Our sincere thanks are due to the Managing Director, Bihar Forest Development Corporation for providing all possible help to the FSI parties by sparing their trucks and tractors for their movement and allowing camping facilities, but for which it would not have been possible for them to continue the work and complete it in time against heavy odds in the Champaran area.

Sd/-  
( N.K. AGRAWALA )  
DIRECTOR.

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## C H A P T E R - I

### BACKGROUND INFORMATION

#### 1.0 Need for the survey:

The forests of West Champaran District although rich in forest resources had no reliable data based on sound statistical technique. Accordingly, in pursuance of a request from the Chief Conservator Of Forests, Bihar, Forest Survey Of India undertook the survey of the district to furnish a comprehensive report on the growing stock and present status of the forest crop with a view to highlight the measures to be adopted for improved management of the forests and forest land.

#### 1.1. Name of the catchment:

The district lies in the catchment areas of Gandak or great Gandak, the little Gandak, the Masan, the Panchnad, the Manor, the Bhabsa and the Kapan.

#### 1.2. Situation and boundaries:

The forests are entirely situated within Bagaha, Ramnagar and Sikarpur Thanas of Bettiah Sub-Division. A small patch lies around the Sareyaman lake close to Bettiah in the Madhuban Thana. The former is fairly compact tract situated between  $27^{\circ} 10'$  and  $27^{\circ} 3'$  North latitude and  $83^{\circ} 50'$  and  $84^{\circ} 41'$  East longitude. It is bounded on north, north-east and east by Nepal. On the South by the flat cultivated alluvial expanse of Sikarpur, Ramnagar and Bagaha Thanas. In the West and north-west, it is bounded by the great Gandak river separating the forests from the Gorakhpur district of Uttar Pradesh, and Nepal. The Headquarters of all the forest Divisions are at Bettiah which is also the Civil Headquarter of West Champaran district.

#### 1.3. Location:

The district of West Champaran is situated in the western side of Northern most part of Bihar State. It is bounded in the North by Nepal, on east by East Champaran District and Nepal, on South by Gopal Gaunj District of Bihar and on west by Uttar Pradesh.

1.4. Administrative units:

The forests come under the administrative control of Champaran Forest Development Project headed by a Director, which is a unit under Bihar Forest Development corporation. The sub-units are Division-I, Division-II and Central, each headed by a Deputy Director. The Headquarters of all the above units are at Bettiah. Earlier the whole forest area was under a Forest Division called Champaran Forest Division under the State Forest Department.

1.4.1. Break-up of the area of the district:

The areas of the present forest divisions are:

<u>Division</u>	<u>Area in ha.</u>
Project Division-I	21,274.347
Project Division-II	45,200.428
Central Project Division	24,576.653
	<hr/>
	91,051.428

1.4.2. Geographical area of the district:

The geographical area of the district is 5228 sq.km. and the forest area is 910.514 sq.km. Thus the percentage of forested area to the geographical area of the district is 17.4%.

1.4.3. Range and Beats:

Formerly the Champaran Forest Division had five ranges viz., Eastern, Western, Central, Harnatar and Gansuli. At present there are four ranges in Division-I, five ranges in Division-II and four ranges in Central Division.

2.0 Locality factor:

2.1 Climate:

The general climate of the district is damp and moist but enervating and much cooler than the neighbouring districts of Bihar. Earlier it had an ill reputation of having the worst climate of Bihar particularly around Ramnagar, Bagha and Sikarpur Police Station. But with the activity of national extension and community development blocks, the condition of northern portion of the district has improved. The cold

weather starts from the first week of November and lasts up to February and hot weather begins at the end of March and continues up to end of May. Rainy season starts from early June and continues up to September. Frost is rare and is of no consequence except for young plantations where it damages particularly, teak crop.

2.1.1. Temperature:

The temperature varies greatly with change of season. In Summer, the maximum temperature goes up to  $36.7^{\circ}\text{C}$  while in winter the minimum temperature falls down to  $09^{\circ}\text{C}$ .

2.1.2 Rainfall:

The rain fall in the district is heavier than the neighbouring districts and specially heavy in submontane tract. Maximum precipitation occurs in July-August reaching up to about 650 m.m. a month. Annual rainfall varies greatly from year to year. Average annual rainfall is 1422 m.m. but in the forested feet hills area of Balmikinagar it is high being 2053 m.m. The distribution of rain fall is uneven but hardly <sup>any</sup> month is totally dry.

2.1.3 Relative humidity:

Mean relative humidity as recorded in 1983 is 52 in April and 83 in July at 08.30 hours while it is 38 in April and 80 in August at 17.30 hours.

2.2. Topography:

The district can be divided into three distinct tracts. The first consists of the hilly tracts of Sonaswar and Dun ranges in the extreme north of the district lying at the feet hills of the Himalayas. These hills run east-west for about 15 miles with an average peak height of 1500', the highest point being 2884'. The hills bear a large number of streams which bring down huge quantities of sand and destroy cultivated lands in lower reaches. There are large stretches of jungles and forests on the hills. Next to the hilly tract comes sub-montane tract called Terai, which is comparatively unhealthy and consists of mostly grass land and open forests. Beyond this, the alluvial plains mostly under cultivation.

2.2.1 Altitude:

Though the average peak height of the hill ridges in the North is about 500 meter with maximum height as 900 meter, the general terrain lies at a much lower elevation which will be evident from the altitudes of the plots surveyed as are given below:-

Stratum	Altitude in meters						No.
	0-100	100-200	200-300	300-400	400-500	500-600	
Sal	13	38	16	6	3	1	77
% of plots	16.8	49.35	20.78	7.79	3.90	1.30	-
Misc.	5	11	1	-	2	-	19
%	26.32	57.89	5.26	-	10.53	-	-
							96

2.2.2 Mountain ranges:

Major part of the forest vegetation is on the two hill ranges namely the Semeswar and Dun hill ranges former being bigger. Semeswar practically runs along the whole length of Nepal border in northernmost side. The only breaks are the river passing through it from north to south.

The hill system runs from west to east then south east with numerous ridges and spurs projecting out in all direction. The formation is highly friable with steep ravines knife edge ridges and precipitous wall. The depth of ravines varies from 30 to 60 meter in Semeswar hills and 10 to 15 meter in Dun hills. Gradually it steps down to undulating and flat alluvium.

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2.2.3. Terrain distribution:

An analysis of the plots surveyed shows the following classification:-

Sl.No.	Description	Sal strata	Misc. strata
1.	Ridge top	2	-
2.	Upper one third	13	-
3.	Middle one third	18	1
4.	Lower one third	19	1
5.	Valley bottom	1	5
6.	Flat land	24	11
7.	Shallow ravine	-	1
8.	Deep ravine	-	1
Total:		77	19

2.2.4 Aspect:

Study of the details shows the following distribution of aspects in the plots enumerated:-

Sl.No.	Description	Sal strata	Misc. strata
1.	Northern	3	-
2.	North Eastern	3	1
3.	Eastern	9	-
4.	South Eastern	12	2
5.	Southern	18	1
6.	South Western	15	7
7.	Western	5	3
8.	North Western	4	1
9.	Flat areas	8	4
Total:		77	19

The observation above indicate that main aspect lies between South eastern to South western.

2.2.5 Drainage:

The general line of drainage is first from North to South and then from North-west to South-west. The Gandak flows along the whole western length of the district. Gandak and Masan collect all water from the tract through their tributaries. Courses of the rivers change frequently through easily erodable soil. Most of the smaller streams become dry in summer.

The Gandak originates in the central mountain basin of Nepal, though some of its tributaries originate from the hills of Champaran. It forms the main drainage in the west. The Masan originates from Sonoswar hills above Naurangia. This along with its tributaries form the main drainage system in the eastern portion of the forest and district.

2.3. Geology, rock and soil:

The hill system of the district is the continuation of Siwalik Range largely made of sandstone and conglomerates of middle and upper tertiary age. The strata of the Sonoswar and Dun ranges are thrust against the younger deposits on further south by a series of faults which is known as the "Main boundary fault" in Indian Geology.

In the northern part, the rock formation is Calciranites, Fossiliferous, Concretionary or Apengy lime stone. The thickness of these rocks varies from 900 m. to 5500 m. Here the rocks are low dipping but shows intricate folding in some places. A few strike faults are noted. In the lower reaches the ground is marshy and high grass replaces the forest, the remainder of the district is alluvial plain. The soil at the foot hills is immature containing a good proportion of decomposed mineral grains. Many parts of the district are characterised by Saline and Alkaline efflorescence known locally as keller.

The soil is generally leamy but at places comprises of very loose sand, hard clay or even red loam. The pH varies from 6 to 8.5. The colour of the soil varies from yellowish to reddish. At foot hills and valleys depth of the soil is good with deep layer of humus. Depth of humus is however less on top of spurs and ridges.

2.3.1. Mineral resources:

The district does not have deposits of any mineral that may be commercially extracted. However, the soils of the feet hills contain a good proportion of undecomposed mineral ~~grain~~ grain.

3.0 Land use pattern and assessment of condition of land, erosion status etc.:

Land use pattern in the district is as below:-('000 Ha.

District	Area(allocating to village paper	Area under forest land.	Agricultural land.	Barren land	Flooded area	Water river etc.
W. at Champaran	522.8	91.05	309.29	26.74	31.76	44.47
						+ 19.59
	<u>Double cropped area</u>		<u>Net irrigated area</u>			
	193.28		150.14			

3.1. Land use:

The land use pattern indicates that agriculture is the principal land use. Cultivation of crop vegetables etc. is the main economic activity of the district, the land holding pattern is not fragmented and land owners possess big tract of land cultivated under farming system with modern equipments like Tractor, Pump etc.

3.2. Soil erosion:

Study of the inventory data for soil erosion indicates that about 14.5% of the forest area falls under heavy erosion, 47.4% under moderate erosion and 38.1% under mild erosion. High rate of run off carry heavy boulders and erode banks of the streams in hilly areas. Sheet erosion is also extensive. Presence of deep ravine and frequent landslips indicate the loose formation of soil.

#### 4.0 People and socio-economic condition:

Total population of the district is 1967579 which is 2.3% of the population of the State. The rural and urban population are 1823020 and 144559 respectively which represent 92.65% and 7.35% of the total population of the district. The density of population is 376 per km<sup>2</sup> as against 402 km<sup>2</sup> for the State. (Source: 1981 Census operation).

The total literate persons are 370579, the literacy being 13.93%. Out of total literates 77.3% are male and 22.7% are female. The Scheduled Castes and Scheduled Tribes population of the district are 290812 and 26815 respectively which cover 16% of the total population.

#### 4.1. Occupational pattern:

The occupation is primarily agriculture. The following table shows the distribution of the occupational pattern:-

	<u>Main Workers</u>			<u>Cultivation</u>			<u>Agricultural labourers</u>		
	People	Male	Female	People	Male	Female	People	Male	Female
Total	648389	540101	108288	235592	223228	12364	334140	243117	91023
Rural	610610	505282	105328	230360	218151	12209	327593	237592	90001
Urban	37779	34819	2960	5232	5077	155	6547	5525	1022

Tharus and Dhongars are the main backward classes. The economic condition of these people is unsatisfactory. 25% of them have some land and rest are landless. They were imported by indigo planters and Raja of Ramnagar in the 18th century as bonded labourers from Gaya District and Chottanagpur areas. They mostly earn their livelihood by working in others fields as labourers.

Rice and sugar mills are the principal industries of the district. There are a number of small scale industries like textile establishment, sweetmeat making, paddy husking, flour mill, oil crushing, Cur making, hide making, shoe making, stone cutting etc. Among the cottage industries mention may be made of Khadi, wool, silk, Cur, Carpet, Khair, Basket making, Potteries, rope making etc.



4.2. Employment in forestry sector:

Special programmes have been undertaken in the district by the State Government to create employment facilities assisted by Central schemes like D.P.A.P., N.R.E.P., I.T.D.P. etc. A large part of the schemes are also implemented through forest department for soil conservation and afforestation works. The forestry programmes being labour intensive provide substantial employment to the unskilled labourers.

5.1. Forest:

In the remote past forest extended almost throughout the district. With the advent of civilization, the forest began to retreat towards north and at present it is pushed back to the hill portions mainly. A small patch of forest also exists along the eastern bank of Gandak.

The forests mainly consists of Sal although some miscellaneous patch exists in the plain lands of Madanpur Block and along nala banks. The quality of Sal varies from quality V to quality IV in upper ridges and quality III to quality II in lower slopes, valleys and shelter belts. A small portion of the forest also contain scattered natural chirpine on the upper reach of Sonaswar between Mirdhanga and Kapan Nala.

Khair and Sissee is found primarily along the bank of the Gandak and its tributaries and along Pandai and Dohram Nala of Sonaswar block. Smaller patches of the same are also found along Katha, Ganguli and other nalas. Sporadic occurrence of Khair - Sissee is also noticed in miscellaneous forests here and there. Cane brake is found in depressions of Madanpur and Udampur Blocks. Bamboo is scanty and can be seen in moist pockets of Harra valley and upper reaches of the Mirdhanga Nala in Raghia Block. The extensive grassy bank of Madanpur Block and smaller patches of Sonaswar Block is now being covered by plantation programme.

As per Champien & Seth's classification, the district has forests of following types:-

- I. Bhabar - Dun Sal Forest - 3C/C2/b(1)
- II. Dry Siwalik Sal Forest - 5 B/C1/a
- III. West Gangetic Moist Mixed Deciduous Forests - 3C/C3/a
- IV. Khair-Sissee Forest - IS/2
- V. Cane Brake - I B/E I
- VI. Eastern West Alluvial Forests - 4D/2S2
- VII. Barringtonia Swamp Forest - 4D/3S2

## 5.2. Stratification:

A reconnaissance of the forest area of the district clearly reveals that the forests can be identified into two main strata namely Sal and Miscellaneous. The Sal strata is considered to comprise of Sal species mainly, while the miscellaneous strata comprises of species mostly other than Sal. Since a large part of the area with miscellaneous vegetation has been covered with plantation of superior species, so the stratum has been named as miscellaneous and plantation stratum.

### 5.2.1 Sal stratum:

It covers 69795.311 ha. of forest area of the district which is well stocked with various qualities of Sal and is 76.7% of the total area.

In this district although the stock is reasonably dense and quality varies from II to V due to changing site qualities, regeneration condition of sal is not satisfactory due to intensive grazing and fire. Valleys and plateau offer better site conditions ~~resulting~~ due to its rich soil while ridge, tops and slopes present poor site conditions resulting in poor growth of the crop. The species found in the stratum are mainly Shorea robusta. There are 3 distinct canopy in the everwood in rich sites, but in poor sites the middle strata is not conspicuous. Common associates of Sal are Terminalia tomentosa, Terminalia belerica, Adina cordifolia, Albizia procera, Lannea grandis, Bombax ceiba, Anogeisus latifolia etc. The middle storey is composed of Careya arborea, Garuga pinnata, Syzygium cumini, Terminalia chebula, Stereospermum suaveolens, Kydia calycina, Buchanania lanzan etc.

The underwood is composed of Dillenia pentagyna, Milliusa velutina, Mallotus philippinensis, Casuarina tomentosa, Holarrhena antidysenterica, Bauhinia variegata, Symplocos racemosa. The ground cover is composed of Clerodendrum viscosum, Indigofera pulchella, Moghania chapparr, Randia longispina, Thespesia lampas, Litsaea monopetala etc. Grasses found in this strata are Imperata cylindrica, Heteropogon contorta etc. which cover the exposed areas.

Climbers are Bauhinia vahlii, Utea parviflora, Millettia auriculata, Acacia pinnata, Smilax parviflora, Casualpinia, Pueraria tuberosa etc. Shrubs Piper peepuloides which belong to lower Himalayan flora are found in damp localities in hilly region. Piper longum is found in abundance as creeper in damp area of Raghia block.

Due to steep hills and friable geological formation in Northern portion, the soil depth is less and vegetation is poor. Average size of the crop varies between 0.61 to 0.91 m. girth. Bigger sizes are usually hollow and unsound. Density of crop seldom exceeds 0.4. Tops of the ridges and spurs are very open or devoid of trees. Regeneration of Sal is scanty. The proportion of Sal is also considerably low in comparison to the better sites. Mainly there are two storeys. The top canopy consists of Terminalia tomentosa, Pinus roxburghii, Buchanania lanzan, Anogeissus latifolia etc. The understorey consists of Terminalia chebula, Emblica officinalis, Madhuca lucida, Pterospermum app. etc. The area under protection Working Circle is 46,520.625 hectare.

#### 5.2.2. Miscellaneous forest:

This stratum comprises of about 23% of the total forest area of the district. The miscellaneous forests consists of (i) Natural mixed deciduous and (ii) Induced miscellaneous forests.

Natural mixed deciduous forest is observed in Madanpur block as edaphic formation in fresh alluvium. The tract is liable to inundation and soil remains immature perpetually. The width of the belt varies directly with the extent of inundation caused by the streams and nallas like Mirdhanga, Singha, Duardahna, Ganauli, Daini etc.

The induced miscellaneous forest of Someswar Block exists due to selection felling of Sal and adverse biotic factors like fire and grazing. A patch of miscellaneous forest over dry siwalik zone exists little below Someswar also.

Top storey consists of Terminalia tomentosa, Lannea grandis, Terminalia belerica, Garuga pinnata, Stereospermum suaveolens, Albizzia procera, Terminalia chebula, Albizzia lebbak. Middle storey comprises of Eugenia operculata, Mitragyna parviflora, Trewia nudiflora, Malletus philippinensis, Bridelia retusa, Bombax malabarica, Randia uliginosa, Cassia fistula, Casearia tomentosa, Spondias pinnata, Cordia dicotoma, Kydia calycina, Dalbergia sissoo, Ficus glomerata, Aegle marmelos. Ground cover comprises of Clerodendron viscosum, Colebrookia oppositifolia, Litsaea species, Grewia helicterifolia, Flemingia spp., Flacourtia indica, Sida rhombifolia, Urena lopata etc. The climbers are Acacia pinnata, Millettia auriculata, Smilax parviflora, Ventilago calyculata, Caesalpinia microphylla, Mozoneurum cucullatum etc.

### 5.3. Legal status:

Prior to 9-10-1950 the whole forest area of the district was under the control of Ramnagar Raj and Bettiah Raj. As per the Bihar Private Protected Forest Act, 1947, Section 19 & 21, the Government Of India Bihar had taken the control of the forest area of 657.86 km<sup>2</sup> under Ramnagar Raj by Government Notification dated 9-10-1950 and under Section 30 by Notification dated 20-12-1950. With the vesting of Ramnagar Raj to Govt. under land Reform Act, 1950 Notification No.61 L.R.Zam dated 6-11-1950 and 332 - L.R.Zam dated 25-11-1951 these forests became State property and notified as protected forest under section 29(3) of IFA - 1927 by notification dated 6-1-1953 and 19-1-1954.

Ex-Bettiah Raj Forests of 251.59 km<sup>2</sup> was taken over by Government for management u/s - 16 & 21 of B.P.P.F. Act, 1947 by notification dated 17-11-1953 & 18-9-1954. Consequent to vesting of Bettiah Raj as before these forests became State property and notified as protected forest under Sec. 29(3) of IFA 1927 by notification dated 7-5-1955.

Udaipur forests of Bettiah Thana was taken after the

vesting of Zamindary by Notification No.1718 R dated 8-5-1955 and 704 dated 13-3-1969.

5.4. Demarcation of boundaries:

Demarcation of Ramnagar Raj forest was completed in 1953-54 and Bettiah Raj forest in 1955-56 though some rectifications were done subsequently. Total length of boundary is 502.09 km. and the same is marked with 5422 numbers of earthen mounds with wooden posts at the centre. In some vulnerable points R.C.C. posts have been erected. There is some discrepancy in the boundary along the border of Nepal in the west.

5.5 Rights and privileges:

In Ramnagar Estate tenants used to enjoy the privilege of getting their timber, fuel wood and grass from forests. The privilege covered only those tenants who resided within 2 km. from forest boundary and the system was called as Charsa. The fee for it was Rs. 2/- to 25/- per village depending on the land holding of the village for timber and firewood. The rate for Sabai grass was Rs.0.06 and Rs. 0.12 per headload and bahangi load respectively for Tharus and Dhangars, for others the rate was just double the same.

As per Court's order the raiyats are allowed to graze their bonafide cattle in the parti waste and jungles adjacent to the place they reside, free of cost but not on hills or steep areas.

In forests under Bettiah Raj rights to collect fuel wood and wood for house construction is called Katihari. This right is levied @ Rs.6/- per bigha of land holding for fuel wood and @ Rs. 1/- per cart load for wood. Grazing is not allowed.

In all 142 villages enjoy the above rights from the whole forest areas of the district except in the forest of Udaipur and Bhimalpur. Grazing right is there in Bhimalpur forests. Besides these villages, 91 more villages also exercise this right, acquired on the basis of the permits issued to them by the Ex-Raj.

Study by State Government (as stated in Working Plan) indicates that an average household need 22.71 cft. of timber and 168 cft. of fuel wood per year. So the actual quantity is limited to this or the availability of "Jharta Parta" whichever is less, and no green tree is allowed to be felled. Thus if the availability is less quantity will be distributed proportionately reduced.

Right holders can collect for their own domestic need, thatch grass, dhup, honey, edible roots, fruits, leaves and use water courses etc. depending on the admissibility of the same by the Forest Settlement Officer on the merits of the case of individual village.

5.6. Present management practice:

Till June, 1975, the forests were under the management of the Forest Department of Bihar and the usual Working Plan prescriptions were folled for its management. Since July, 1975 the forests are being managed by the Bihar State Forest Development Corporation Ltd. There is a Project Office at Bettiah for this purpose. There are three Divisions under this Project, Headquarters of all of them are situated at Bettiah. At present the Forest Development Corporation followed almost all the Working Plan prescriptions with slight modification as is required for the better development of forests.

5.6.1. Area covered/not covered under Working Plan Management:

The whole foress of West Champaran is divided into six blocks with 305 compartments along with two separate small forests of Udaipur and Bhimalpur. The area distribution is as follows:-

Sl.No.	Name of Block of forest area.	No.of compartment	Area in hectare
1	Madanpur	30	10,963.741
2.	Tribeni	44	13,199.606
3.	Kosil	55	14,575.564
4.	Naurangia	38	10,749.669
5.	Raghia	64	19,353.293
6.	Someswar	74	21,274.327
7.	Udaipur	Nil	873.312
8.	Bhimalpur	Nil	61.916
Total:		305	91,051.428

The above area is distributed among the following Working Circle as under:-

Sl.No.	Working Circle	Area in hectare
1.	Sal Conversion	3574.990
2.	Sal Selection	13033.308
3.	Miscellaneous	7482.641
4.	Plantation	13418.971
5.	Protection	46520.625
6.	Pure Khair	354.504
7.	Unallotted(River encroachment etc.)	6666.388
Total:		91,051.427

Hence the whole area is covered by Working Plan although there is no specific prescription for the unallotted area.

#### 5.6.2. Short details of management:

The general object of management are:-

1. To protect and improve the forest cover for ensuring sustained yield.
2. To convert a part of the existing irregular forests into more or less regular ones by natural means.
3. To convert blanks, areas covered with grass and other inferior miscellaneous species through plantations of economic value.
4. To meet the bonafide requirement of the local people.
5. To manage Khair and Semul under suitable silvicultural prescriptions.

Short details of the Working Circle are:-

##### 1. Sal Conversion Working Circle:

Sal covers 60% of the crop in top canopy. Quality of Sal is mostly of Quality II/III and IV. There are six P.B'S of 20 years each. Regeneration of Sal is inadequate and unestablished. The average yield of fixaxyear P.B.I is 30 m<sup>3</sup>/ha. PB-I are-a is closed to grazing for five years after clearfelling. The exploitable diameter is 45 cm. and the conversion period is 120 years.

2. Sal Selection Working Circle:

Occurrence of Sal in this Working Circle varies from 30% to 50% in the top canopy. Sal and other species are exploited over a specified dia. (50.8 and 61 cm.) respectively) not exceeding 33% of such available diameter. Felling cycle is 15 years and average Sal quality is Quality III/IV. Fire and grazing control is prescribed but seldom it is enforced. Total annual yield is  $2797 \text{ m}^3$  of timber and fuelwood i.e.  $0.21 \text{ m}^3$  per hectare. (Source: Project Report of Forest Development Corporation PP-20 in the districts of Singbhum, Palamau & West Champaran, Department Of Forests, Bihar, January, 1974).

3. Miscellaneous Working Circle:

The crop consists of Asan, Semul, Haldu, Siris, Bahera, Sidha, Phaldu, Jhingan, Jaman etc. Prescription is selection cum improvement felling. Minimum exploitable diameter and felling cycles are as in Sal Selection Working Circle. Here also the yield prescribed by area is restricted to 33% of selection trees. The total annual yield is  $93 \text{ m}^3$ , which comes to  $0.12 \text{ m}^3$  per hectare.

4. Protection Working Circle:

It covers the hilly area with poor Sal forest of Quality IV to Quality V with density varying from 0.2 to 0.4 even the ground cover is also not adequate. The area is highly erodable. No felling, even of the nature of improved felling is prescribed.

5. Plantation Working Circle:

It covers planted up areas, grassy blanks, inferior miscellaneous forests with density varying from 0.2 to 0.3, mostly of shrub and trees of low economic value. Planted species are mostly Sissee, Khair and bamboo.

6. Overlapping Working Circle:

This is constituted for management of Semul and Khair bearing areas by selection system. Exploitable girth is 30 cm. for Khair and 60 cm. for Simul. Felling cycle is 15 years.



The total area of Champaran forests is 91051 hectare of which only 3575 hectare is under conversion to uniform system. An area of 46520 hectare is under Protection Working Circle where no forestry operation is carried out. An area of 13419 hectare is under Plantation Working Circle. Remaining area is under selection system. Thus the forests are basically under conservation form of management.

5.6.3 Exploitation:

The disposal of various forest produce is done by -

- (1) Auction of timber, pole and fire wood from the Government depots where the produce is collected and put into lots for sale by the Department.
- (2) Sale at concessional rate to local people from the Government depot where uprooted or naturally fallen trees are collected.
- (3) Sale at highly subsidised rate to the local people for allowing Charsa and Katihari rights.
- (4) Sal seed is collected departmentally and sold by auction from Government Godowns.
- (5) Auction of cane from the forest area.

The annual target of exploitation under present mode of working is fixed as below:-

- |  |            |
|--|------------|
| (a) Working in Sal conversion Working Circle | = 30 ha.   |
| (b) Clearfelling & Plantation                | = 2400 ha. |
| (c) Under planting                           | = 400 ha.  |

The expected annual outturn calculated was:-

- |   |                       |
|---|-----------------------|
| (a) From Sal Conversion Working Circle area | = 1200 m <sup>3</sup> |
| (b) From Clearfelling area                  | = 72000 "             |
| Total:                                      | = <u>73200 "</u> *    |

\* This figure of expected volumetric yield is very high as the plantations are being raised in blank, open and poor miscellaneous areas where average yield per hectare cannot be 30 m<sup>3</sup>.

40% of this outturn is expected in the form of timber and 60% as fuelwood.

5.6.4. Outturn of produce:

As per figures obtained from the Office of the Project Director, the yearwise actual outturn of timber and firewood are:- (it includes areas of all Working Circles).

Year	Worked area in ha	Timber in m <sup>3</sup>	Firewood in m <sup>3</sup>
1976-77	860	13654.40	48201
1977-78	1443	29542.50	114637
1978-79	1225	24856.00	112421
1979-80	849	22452.00	85907
1980-81	1079	29110.00	78964
1981-82	715	28928.00	68230
1982-83	518	20320.00	38334
1983-84	741	2655.00	4035
1984-85	650	7044.00	10245

This shows inconsistent figures ranging from 2,655 m<sup>3</sup> to 29,542 m<sup>3</sup> for timber and 4035 m<sup>3</sup> to 1,14,637 m<sup>3</sup> for firewood. It is stated by the local forest authorities that the recent fall in output per hectare is due to taking up working in inferior forest areas in last two to three years and restricting felling for selection and improvement working only.

Besides timber, firewood and bamboo, the forests of West Champaran also produce cane, khair, Sal seed, Sabai grass and other economic forest produces, whose exploitation for the year 1983-84 is given below. About 800 m<sup>3</sup> of timber is collected from the river flow of Gandak and its canals annually. Besides about 900 m<sup>3</sup> of drift wood is collected from the beds of rivers flowing through the forests.

Exploitation figure of Minor Forest Produce for the year 1983-84

Khair	-	1200 m <sup>3</sup>	
Bamboo	-	2,00,000 Nos.	
Sal Seed	-	1100 M.T.	
Cane	-	15,000 Bundles	
Subai grass	-	610 M.T.	
Thatch grass	-	2400 M.T.	
Cane fruit	-	Rs. 6600/-	Quantity not available.
Medicinal plants	-	Rs. 700/-	
Tarry fruits	-	Rs. 150/-	
Simal cotton	-	Rs. 1050/-	
Lotus leaf	-	Rs. 450/-	

6. Forest Resources information:

As per our inventory, the figures for resources are as follows:-

Stratum	Vol./ha. (m <sup>3</sup> /ha.)	Total volume (growing stock) (1000 m <sup>3</sup> )	Area (ha.)	Stems <i>La</i>
Sal	73.764	5148.358	69795.311	249.538
Misc.	46.929	997.523	21256.117	197.889
	<i>67.5</i>	<i>6145.881</i>	<i>91051.428</i>	<i>237.6437</i>

Considering that Champaran forests are mostly located in Siwalik hills, the growing stock cannot be considered very insignificant.

7. Maps and photographs:

Maps showing the following details have been given:-

- (1) Map of India showing Project area in Champaran District (Bihar)
- (2) Inventory design.
- (3) Map of West Champaran District (Bihar) based on visual interpretation of landsat imagery.
- (4) Forest map of West Champaran District (Bihar) showing working circles (as per present system of management)
- (5) Map of West Champaran District (Bihar) showing roads, rivers and forest areas.

8. Organisation and infrastructure:

At present the following numbers of Officers and staff are working for the management of the forests of West Champaran district:-

Organization- al Unit	Officers at Hqrs.	Range Officers	Foresters	Guards	Office Staff Mini- sterial	Other Lower Staff
Division-I	2	4	6	32	15	34
Division-II	3	5	16	54	16	36
Central	3	4	12	46	15	42
Circle	2	-	-	-	10	6
Total	10	13	34	132	36	118
Per head km <sup>2</sup>	91	70	26	7	16	8

Besides, there are two Saw Mills, a fleet of Trucks and Tractors for logging and planting operations. Actual number of Tractors at earlier was 22 and Truck 4 numbers, but now due to reduction of clearfelling and exploitation 11 Tractors have been sent to M.F.P. Project in other areas leaving 11 Tractors and four Trucks only for operation in the area.

Nurseries:

The Forest Corporation maintains 16 Nurseries over 44 ha. of land with more than 14,000 beds that produce about 30,00,000 of seedlings annually for planting in forest areas as well as for free distribution. The target is proposed to be increased gradually.

Roads:-

The metalled Road length maintained by P.W.D. and District Board are as follows:-

1. Maintained by P.W.D.(Ramnagar) - 210 km.
2. Maintained by P.W.D.(Bettiah) - 230 km.
3. Maintained by R.E.O.(Bettiah) - 400 km.

Out of the above roads, 63 km. Road length of P.W.D. and 24 km. of R.E.O. road pass through the forest area. In addition, there is 480 km. length of forest road existing in the area. Thus the total road inside the forest area is 567 km. (480 + 63+24). About 50% of the area falling under protection Working Circle do not have any road except foot tracks or cart tracks, which are also not maintained properly.

9. Forest based industries and markets:

Not much of timber or fuelwood based small or medium scale industries, except Saw Mills, are there in the district. However, a few thousand of artisans use forest produce for their livelihood. There are six sugar mills with crushing capacity ranging between 1000-3000 M.T. of sugar cane per day. They also use firewood at times when the sugar cane bagasse (the residue after extraction of juice), is not sufficient to meet their requirement of fuel.

9.1. Saw Mills:

Besides two Saw Mills set up by the Department for supplying sleepers, tram line coggings to Government or semi-Government Organisations, there are 44 Saw Mills with annual capacity of sawing ranging from 250 m<sup>3</sup> to 1500 m<sup>3</sup>. The total quantity of round timber utilised by these mills are to the tune of 22,500 m<sup>3</sup> per year of which about 20% remain as the sawn waste (i.e. firewood and saw dust) and 5% gets damaged during storage. Two Saw Mills using about 1100 m<sup>3</sup> of timber depend completely on privately owned tree sources. 12 Saw Mills using 7650 m<sup>3</sup> of timber depend completely on Government forests. The rest 30 mills draw their timber both from private and Government sources.

The number of persons employed on these Saw Mills are 59 skilled and 247 unskilled.

9.2. Markets:

Patna is the principal market for timber. Some quantity of timber is also utilised in local markets like Ramnagar, Bagha, Bettiah, Narkatiaganj etc. A percentage of timber is railed to Howrah, Varanasi and Gorakhpur. Besides, some quantity is also supplied to D.G.S. & D., New Delhi at various destination as per order. Sissoo timber has a great local demand for furniture and cart wheels. It replaces Teak for consumption in North Bihar. This is also used as decorative veneer. Anogeissus latifolia was used as cart axle locally prior to introduction of iron. Simal is used as match wood by WIMCO.

Firewood is mostly used by the right holders, a part of it is used by sugar mills and brick kiln owners. There is a small demand of charcoal also, but the conversion of charcoal being uneconomic the Corporation is not manufacturing charcoal now. Varanasi is the main market for Khair-Kattha.

Cane goes mostly to the contractors of Uttar Pradesh for basket supply to defence and for furniture. Sabai grass is used locally for ropes. Markat and Munj is used for mat and screens. Thatch is used mostly by the local people for roofing their cottages.

Tarry fruit is used in tanning industry. Simal cotton is collected by the local contractors after purchasing in auction. Sal, harra and bahera seeds are collected by the Department and sold by tender or auction locally. Small quantity of animal products like honey, wax, horns, hides etc. are also extracted from forests and mostly consumed locally.

## C H A P T E R - II

### INVESTIGATION AND METHODOLOGY.

#### 2.1. Objective:

The principal objective of the present inventory was to estimate the total growing stock of the area on a sound statistical footing. Besides, the following broad objectives were also within the purview of the inventory:-

- 1) to monitor periodically on 10 years cycle the changing pattern of land and forest resources of the area.
- ii) to serve the data needs of development planning including conservation and management of environment reserve, utilisation of forest resources information in various industries and also in formulation and implementation of Social Forestry Project.
- iii) the present data and its analysis is expected to catalyse the process of developmental planning and act as an assistance to the forestry planning cell of Central and State Government.

#### 2.2. Aerial reconnaissance:

No aerial reconnaissance work was carried out in the area.

#### 2.3. Photointerpretation and mapping:

No photointerpretation maps were available for the area. Ground inventory was based on the survey of India topographical sheets and the maps supplied by the Forest Department. The following topographical sheets were used:- (Scale 1: 50,000)

72A/3, 72A/4, 72A/7, 72A/8, 72A/11, 72 A/12, 63 M/15,  
63 M/16.

2.4. Inventory Design:-

✓ The inventory design adopted has been a systematic sampling with a cluster of two points. Each topographical sheet of 1: 50,000 scale was divided into  $2\frac{1}{2}' \times 2\frac{1}{2}'$  grid block where cluster of two points were selected randomly and in accordance with a fixed method.

2.4.1 Pilot Survey:

No pilot survey was conducted. The standard Forest Survey of India's inventory design has no provision for pilot survey.

2.4.2. Sample design:

The sampling design consisted of locating two sample points in each grid of  $2\frac{1}{2}' \times 2\frac{1}{2}'$ . Two random numbers were selected from random number table which formed the X and Y coordinates of the centres of first sample plot. The south-west corner of each grid is considered as the origin. The centre of the second sample plot is located by joining the first sample plot centre with the grid centre and extending it on the opposite direction to an equal distance. ✓

2.5. Field work:

The information collected in the field were properly filled on the following sets of forms:-

- i) Plot Approach.
- ii) Plot Description.
- iii) Plot Enumeration.
- iv) Bamboo weight.
- v) Sample Tree.

2.5.1. Instruction for field work:

A detailed field manual was prepared laying down the procedures for collecting field information and also for filling in the aforesaid set of forms.



C H A P T E R - III

DATA ANALYSIS.

3.1. General:

There are three broad component of data processing system namely manual processing, processing on unit record machine and processing on computer.

3.2. Manual processing:

It involves the following steps:-

- i) Proper documentation of the field forms and checking of the existence of all forms with reference to the muster list of samples.
- ii) Coding the information in the forms that has not already been incorporated.
- iii) Manual checking for validity of codes used in various columns of information.
- iv) Reconciliation of discrepancies in consultation with the Field Officers.

3.3. Processing on Unit Record Machine:

Following steps were carried out on Unit Record Machine:-

- i) Punching the information on cards.
- ii) Verification of punched cards.
- iii) Sorting + collating the cards for proper input to Computer.
- iv) Listing the punched data for detecting any omission/duplication.

3.4. Processing on Computer:

On completion of preparation of input, the following operations were carried out on Electronic Computer:-

- i) Loading of the data in magnetic tape.
- ii) Consistency checking of the data.
- iii) Correction of the data
- iv) Calculation of tree and plot volume.
- v) Preparation of growing stock tables for various strata as per design.

Suitable computer programme were developed for processing the aforesaid items of work on Computer.

### 3.5. Calculation of Area:

In absence of aerial photo-interpretation, the extent of forest area has been taken from the record supplied by the State Forest Department. As per Working Plan, the distribution of forests under various Working Circles are as follows:-

Sl.No.	Working Circle	Area(ha.)
1	Sal Working Circle	69795.311
2	Misc. Working Circle	7482.641
3	Plantation Working Circle	13418.971
		<u>90696.923</u>

Our inventory reveals that the miscellaneous stratum encompasses the plantation working circle. Thus the area estimate for Sal and Miscellaneous stratum is as below:-

Sl.No.	Stratum	Area(ha.)
1	Sal	69795.311
2	Miscellaneous	21256.117
Total:		<u>91051.428</u>

### 3.6. Tree volume study:

No trees were felled for construction of volume equation, as in a decoit infested area felling of trees and its sound could have attracted the attention of the decoit and made completion of field work difficult. Since the vegetation of Champaran and West Nepal exhibit great resemblance, the volume equation developed for West Nepal has been applied on the sample tree data of Champaran to develop the local volume equation.

### 3.7. Volume study:

#### 3.7.1 General volume equations:

The general volume equation developed in West Nepal inventory are as below:-

Species	Equation
1. <u>Shorea robusta</u>	$\text{Log } V = -1.85614 + 1.99578 \text{ Log } D + 1.21786 \text{ Log } H$
2. <u>Terminalia tomentosa</u>	$V = + 0.00962 + 0.28661 D^2 H$
3. <u>Anogeisus latifolia</u>	$V/D^2 H = + 0.298862 + 0.008169/D^2 H$
4. Others	$V/D^2 H = + 0.298862 + 0.008169/D^2 H$

### 3.7.2. Local Volume Equations

The above general volume equations were applied on the sample tree data to develop the local volume equation.

The following are the best fitted local volume equations:-

Species	Equation
1. <u>Shorea robusta</u>	$V/D^2 = 11.90581 - 2.45104/D + 0.1563/D^2$
2. <u>Terminalia tomentosa</u>	$V/D^2 = 10.24871 - 1.51685/D + 0.08565/D^2$
3. <u>Anogeisus latifolia</u>	$V/D^2 = 5.07688 - 0.01777/D^2$
4. Others	$V = 0.05396 - 0.82031 D + 6.17975 D^2$

Where V = Total volume (m<sup>3</sup>) underbark of tree including branch.

D = Diameter (cm.) at b.h.

H = Height of the tree

### 3.7.3. Volume of trees enumerated

With the help of local volume equation and diameter of enumerated trees, under bark volume of each tree was completed.

### 3.7.4. Plot Volume

The volume of each tree in a plot when added up gives the tree volume of a plot.

### 3.8. Tree density study

The trees enumerated in the plots were classified by diameter and species and the estimates per ha. and the total area were separately derived for each stratum i.e. Sal and Misc.

3.8.1. Sal Stratum:

The distribution of trees by species and diameter class is given in the Table No.1.1.1. The number of stems/ha. in the stratum is 249.538.

Shorea robusta is the predominant species and comprises of 33.9% of the total stock in the area followed by Buchanania latifolia 8.0%, Anogeissus latifolia 5.8% and Terminalia crenulata 4.2%. Acacia catechu is also common in the stratum and forms 2.5% of the total stock.

It is observed that the stems are almost evenly distributed over all diameter classes. Mature trees in the stratum comprise of about 3% of the total stock.

Maximum concentration pertain to the diameter class (10-19 cm.) which is 52.3% of the total stock. Trees in diameter class (20-29 cm.) is 24.9%, 12% in diameter class (30-39 cm.), 6% in diameter class (40-49 cm.), 2.9% in dia. class (50-59 cm.), 0.9% in diameter class (60-69 cm.), 0.8% in diameter class (70-79 cm.), 0.02% in diameter class (80-89 cm.)

3.8.2. Miscellaneous stratum:

The number of stems per ha. by species and diameter class in the stratum is given in Table Nos.1.2.1.

The number of stems/ha. in the stratum is 197.889.

It is quite interesting to note that Shorea robusta grows in abundance in mixture with miscellaneous species. It constitutes about 18.6% of the stock.

Dalbergia sissoo is most predominant among miscellaneous species and comprises of 11% followed by Acacia catechu 8.8%, Buchanania latifolia 6.4%, Mallotus philippinensis, 5.4%, Adina cordifolia 6.17%.

Regarding the distribution of stems by diameter class, it is observed that trees above 60 cm. diameter is very less and comprises of 1% of the stock only. The distribution of stems by diameter class is as under:-

<u>Diameter(cm.)</u>	<u>Percentage</u>
10-19	60.90
20-29	21.01
30-39	10.37
40-49	3.99
50-59	2.39
60 +	1.33

3.9 Stand and stock tables:

Trees enumerated over all the plots give the stems per hectare. The product of stems/ha. and the area gives the estimate of total stems in the area. The distribution are given in Table No. 1.2.2.

Similarly, the volume per hectare and the total volume is given in Table numbers 2.2.1 and 2.2.2.

3.9.1. Sal Stratum:

The volume per hectare by species and diameter classes is given in table no. 2.1.1.

The volume/ha. in the stratum is  $73.76 \text{ m}^3$ . Shorea robusta is the principal volume contributing species and contributes 49.9% of the volume followed by Terminalia crenulata 10.2%, Adina cordifolia 3.9% and Syzygium cumini 3.2%.

Volume is more or less evenly distributed over all the diameter class. Distribution of volume by diameter class is as under:-

<u>Diameter class</u>	<u>Percentage</u>
10-19	11.3
20-29	18.3
30-39	20.0
40-49	18.6
50-59	14.2
60-69	7.1
70 +	10.5

3.9.2 Miscellaneous stratum:

Volume by species and diameter class is given in table numbers 2.2.1 & 2.2.2.

Volume per hectare in the strata is  $46.929 \text{ m}^3$ . Shorea robusta in admixture with miscellaneous species contributes maximum volume and is 33.64% of the total volume.

Among miscellaneous species, Bombax ceiba contributes 7.3% followed by Lannea coromandelica 5.9% and Acacia catechu 4.3%.

Regarding the distribution of volume by diameter class, it is seen that volume above 80 cm. diameter is absent in the stratum.

Volume contribution by various diameter classes is as below:-

<u>Diameter class</u>	<u>Percentage volume</u>
10-19 cm.	16.3
20-29 "	19.4
30-39 "	22.8
40-49 "	14.6
50-59 "	14.5
60-69 "	9.4
70-79 "	3.0

3.9.3 Standard Error:

Standard error for the estimates of volume per hectare in Sal and Miscellaneous stratum is given as under:-

<u>Stratum</u>	<u>Vol./ha.</u>	<u>S.E.</u>
Sal	73.764	7.52
Miscellaneous	46.929	16.04

C H A P T E R - IV.

GROWING STOCK & YIELD.

4.1. General:

During survey 96 plots were inventoried in the total project area, of which 77 plots belonged to Sal stratum and 19 plots to the Miscellaneous stratum. The Sal stratum encompasses the protection, Sal selection and Sal conversion Working Circle while the miscellaneous stratum includes the plantation, and miscellaneous Working Circle including overlapping Khair and Simal Working Circle of the present management.

4.2. Area considered exploitable as per present management:

The total areas considered to be exploitable under present management is furnished below:-

Working Circle	Area (ha.)	Remarks
Sal conversion	3574.990	For overlapping
Sal Selection	13033.308	(Khair & Simal)
Protection	46520.625	Working Circle no
Miscellaneous	7482.641	area can be fixed
Plantation	13418.971	as the same is
		distributed over
		other Working
		Circles.

4.3. Annual Yield:

84020.274 Rr

An attempt has been made to estimate the annual volumetric yield available in the area on the basis of findings of our inventory data following present system of management where the project area is covered under five Working Circles. In the Protection Working Circle, no forestry operation is prescribed. Accordingly, no yield will be available from this Working Circle.

To arrive at the growing stock for a Working Circle, the plots surveyed in the present inventory have been grouped according to the Working Circles. The distribution of plots in the Working Circles are as under:-

Working Circle	No. of plots
Sal Selection Working Circle	15
Sal Conversion Working Circle	8
Miscellaneous Working Circle	10
Plantation Working Circle	11
Protection Working Circle	52
Total:	96

Based on the number of plots falling under such Working Circle; the volume per hectare for such Working Circle is calculated.

Regarding the rotation period and the limit of exploitable girth, the present system of management prescribed in the Working Plan has been adopted.

a) Sal Conversion Working Circle:

Volume/ha.	= 98.25 m <sup>3</sup>
Area of the Working Circle(ha.)	= 3574.990
Total stock(m <sup>3</sup> )	= 351242.770 m <sup>3</sup>

To arrive at the annual yield, volume upto 20 cm. diameter is considered as advance growth and is deducted from the total stock of the Working Circle. It is estimated that about 11.3% of the stock pertains to this diameter class. Thus, the total stock available for yield estimation works out as:-

351242.8 - Total stock

(-) 39690.4 - Ad. growth (11.3%)

Stock available for yield estimate = 311552.4 m<sup>3</sup>



Considering rotation to be of 150 years, the annual yield for the Working Circle works out to =  $\frac{311552.4}{150}$   
= 2077.02 m<sup>3</sup>

b) Sal Selection Working Circle:

Volume/ha.	= 80.4 m <sup>3</sup>
Area(ha.)	= 13033.308 m <sup>3</sup>
Total stock	= 104787.0 m <sup>3</sup>

The exploitable diameter fixed for Sal is 51 cm. and for Miscellaneous species it is 61 cm. It is estimated that about 16% of the Sal crop and 9% of Miscellaneous crop is above exploitable limit.

Thus, the total yield available is as below:-

Sal crop	-	167660.5 m <sup>3</sup>
Misc. crop	-	94309.0 m <sup>3</sup>
Total:	-	<u>261969.5 m<sup>3</sup></u>

Considering the felling cycle to be 15 years, the annual yield works out to be:-

$\frac{261969.5}{15} = 17464.6$

From silvicultural point of view 66% of the stock is kept as a reserve. Thus the annual yield is estimated to be 5937.9 m<sup>3</sup>.

c) Miscellaneous Working Circle:

Vol./ha.	= 51.1 m <sup>3</sup>
Area (ha.)	= 7482.641
Total stock	= 382362.96

It is estimated that 27% of the stock belongs to the exploitable diameter class of 50 cm. and above.

Thus, the stock available for yield estimation is  $103238.0 \text{ m}^3$ . As per Working Plan only  $1/3^{\text{rd}}$  of this stock will be available for felling and accordingly the total stock available for yield calculation is  $34412.7 \text{ m}^3$ , considering the felling cycle to be 15 years, the annual yield is  $\frac{34412.7}{15} = 2294.2 \text{ m}^3$ .

d) Plantation Working Circle:

No yield is prescribed for the Working Circle since most of the plantations in the Working Circle is yet to achieve the exploitable size.

4.4. Total yield:

As explained above, the total annual yield for the project area available from the Working Circles under present system of management are as under:-

<u>Working Circle</u>	<u>Annual Yield(<math>\text{m}^3</math>)</u>
Sal Conversion Working Circle	2077.0
Sal Selection Working Circle	5937.9
Misc. Working Circle	2294.2
Plantation Working Circle	No yield is expected at this stage.
Total:	<u>10,309.1 <math>\text{m}^3</math></u>

Conclusion:

It will thus be seen that the total growing stock of the area is  $6145881 \text{ m}^3$  and the growing stock prescribed for removal annually is  $10,309.1 \text{ m}^3$  which is only 0.17% of the total growing stock. The forest is, therefore, under conservation oriented management system.

## C H A P T E R - V

### LOGGING AND ACCESSIBILITY STUDIES.

#### 5.1. Objectives:

The study was undertaken to analyse the cost of logging in this district which includes felling, cross cutting, billetting, stacking, siding of timber and transportation to depots.

#### 5.2. Extraction routes:

Extraction of forest produce is carried out by Trucks, Tractors & Bullock carts from the road side or from the coupe where possible. Generally Trucks and Tractors bring the produce to the depots. Bullock carts carry the produce up to a convenient distance for further transport by Tractors or Trucks. Department has their own Trucks and Tractors. Bullock carts are used on hire basis. From the Government depot, produces are transported to the destination either by road or by rail. River transport is not there. Main rail heads are Ramnagar, Bagha, Narkatiaganj, Gaunaha and Amalwa.

#### 5.3. Existing logging practices:

Felling is done by saws and axes. Cross cutting is done with the help of cross cut saws by the local labourers. The rate for different operations of logging in practice are as follows:-

<u>Sl.No.</u>	<u>Particulars</u>	<u>Rate</u>
1.	<u>Timber</u>	
a.	Marking and lay out	Rs. 30/- per ha.
b.	Felling, logging and stacking.	Rs. 18/- per m <sup>3</sup> .
c.	Extraction path	Rs. 4/- for chain
d.	Siding of timber	Rs. 10/- per m <sup>3</sup> .
e.	Loading and unloading	Rs. 5/- per m <sup>3</sup> .
f.	Transportation to depot	Rs. 70/- per m <sup>3</sup> .
g.	Fire protection	-

Sl.No.	Particulars	Rate
	h. Depot charges (Coupe)	Rs. 6.50 per m <sup>3</sup> .
	i. Contingencies	Rs. 4/- per m <sup>3</sup> .
	j. Weift and Drift wood collection	Rs. 105/- per m <sup>3</sup> .
	k. Dahtar collection	Rs. 200/- per m <sup>3</sup> .
2.	<u>Fuel and pulpwood</u>	
	a. Billetting, stacking and coppicing	Rs. 5/- per m <sup>3</sup> .
	b. Loading and unloading	Rs. 2/- per m <sup>3</sup> .
	c. Transportation to depot	Rs. 25/- per m <sup>3</sup> .
	d. Depot expenses and contingencies	Rs. 8/- per m <sup>3</sup> .

Thus, from the above chart the cost per m<sup>3</sup> of timber collection up to the depot come to about Rs. 135/- for standing trees and Rs. 105/- & Rs. 200/- for weift and Drift wood and Dahtar wood respectively. For fuelwood it comes to about Rs. 40/- per m<sup>3</sup>.

#### 5.4. Terrain classification:

The terrain in the forest exhibit variety of slopes. The slope % as observed in the plots are as follows:-

Sl.No.	Slope class	No. of plots	%
1.	Below 10%	34	35.4
2.	10% - 25%	20	20.8
3.	26% - 40%	24	25.0
4.	41% - 60%	8	8.4
5.	Above 60% +	10	10.4
Total:		96	100%

Classification of plots as per position on slopes are as follows:-

Sl.No.	Classification	Sal stratum	Misc. stratum
1.	Ridge top	2	-
2.	Upper one third	13	-
3.	Middle one third	18	1 No.
4.	Lower one third	19	1 No.
5.	Valley bottom	1	5 Nos.
6.	Flat land	24	10 Nos.
7.	Plateau	-	-
8.	Shallow ravine (depth of ravine less than 5 meters)	-	1 No.
9.	Deep ravine (depth of ravine over 5 meters)	-	1 No.
Total:		77	19 Nos.

Position of plots in different altitudinal zones has been given in para 2.2.1 of Chapter-I.

#### 5.5. Proposed logging practice:

Since the present trend of working is towards conservation forestry, the existing logging practice may continue as this is good for providing employment to the local labourers, and the urgency for quicker and more efficient logging is not there.

#### 5.5.1. Road communication:

Since the forests of Champaran are basically on Siwalik hills susceptible to soil erosion, the forests should better be conserved than exploited. Thus though there is hardly any road over the hilly terrain, existence of about 560 km. of road in the foot hills is considered adequate for present system of working which is almost entirely restricted to the flat lands along rivers or

undulating terrain in the foot hills. There is a proposal for creation of a Tiger Reserve in the area so further opening of the forests by construction of new roads is not considered at this stage.

## CHAPTER - VI.

### WOOD CONSUMPTION STUDY

#### 6.1. Objectives:

Present study was done with the following objectives:

- (i) to assess the actual quantum of consumption of wood and other fuels by the population of the district.
- (ii) to find out the source of supply of wood in the district.
- (iii) to work out the wood balance in respect of supply and demand of timber and fuelwood etc.

#### 6.2. Sampling design:

Two stage stratified random sampling was adopted. Sampling units were first stratified into urban and rural sectors. Households in both the sectors constituted the second stage of sampling. Villages were selected at random by selecting random numbers from random table with the compulsion of at least one from each block. Number of households were selected at random with the obligation of taking at least one each from pacca, semi-pacca and kachha houses in the selected villages. Number of households were decided so as to cover at least 1% and .5% population from rural and urban sectors respectively as per table below:-

Sl. No.	Strata	Total population.	Household	Household sampled	Sample covering population	% of intensity of sampling
1.	Urban	1,44,559	20081	105	682	0.5
2.	Rural	18,23,020	256818	209	1909	0.1

#### 6.3. Consumption by small scale industries:

Saw Mills in the district give an outturn of about 17600 m<sup>3</sup> of sawn timber annually. Various kinds of local timbers mainly Sissoo grown in the private land of the district and timber from the forest of the district meet the local demand.

The entire quantity of Sal seed produced in the district is consumed by the solvent oil extraction plants of Jhargram, Tatanagar etc.

<sup>4</sup>  
6.5. Household consumption:

Per capita consumption of different forest produces of the district was calculated on the basis of the above sample household study.

Following points have been taken into consideration while calculating consumption of wood under various categories:-

a) House construction

Major portion of the houses in rural areas are kachha or semi-kachha built with mud wall and thatch roofs. Bamboo and poles are used mostly for roof frame and support for wall. Wooden beams are used for supporting the bamboo or pole frames. Besides, door, window frames and shutters are made of wood.

b) Furniture:

The furniture items generally used are wooden Cots, Chairs, Tables, Chowkies, Almirahs, Benches etc. Bamboo is also used for making these furnitures in some rural areas.

c) Fencing:

In rural areas almost every householder has a tendency to fence the premises around their houses. In fencing they generally utilize the bamboo or small sized poles of any species found suitable for the purpose and easily available to them.

d) Agricultural implements:

Items like plough pieces, yokes, rice pounders, Bullock cart wheels, tool handles etc. utilized in agricultural work have been considered. These implements are mostly used by the rural population and their use in urban areas are comparatively less.



The per capita and total consumption figures for different forest produces like wood, bamboo, firewood etc. in respect of items like house construction, furniture, fencing, agricultural equipments, fuelwood etc. are given in the following tables:-

Total quantity of wood annually consumed at present for various purpose was estimated to be as follows:-

Sl.No. Items	Rural areas population 18,23,020		Urban areas population 1,44,559		Grand total (4+6)
	Per capita	Total	Per capita	Total	
1. House construction in m <sup>3</sup>					
a) Timber	0.003766	6866.70	0.007747	1119.85	7986.55
b) Pole	0.013182	24031.30	0.004236	612.31	24643.62
2. Furniture in m <sup>3</sup>	0.001213	2212.00	0.004466	645.70	2857.70
3. Fencing(pole) in m <sup>3</sup> .	0.00013878	251.21	0.000098	14.10	265.31
4. Agri. implements in m <sup>3</sup> .	0.00766	13964.40	0.001600	231.40	14195.80
Total	-	-	-	-	49948.97
5. Firewood & Saw Mill waste in M.T.	0.73067	315503.69	0.136452	19725.29	335228.98

In converting pole in m<sup>3</sup>, one pole has been taken as 0.0333 m<sup>3</sup>. The life of timber for house construction and furniture has been taken as 30 years while the same for agricultural implement has been taken as five years, and the life of pole has been considered as ten years, on the basis of the enquiry carried out in the area at the time of consumption study. Species used for the purposes are mostly Sal and Sissoo which are quite durable wood.

Total quantity of fuel consumed annually by the population of the district is given below:-

Sl. No.	Items of fuel	Urban area		Rural area		Total (4+6)
		Per capita	Total	Per capita	Total	
1.	Firewood & Saw Mill waste (Kg.)	136.4515	19725.292 (M.T.)	173.0665	315503.69 (M.T.)	335228.982
2.	Agri. Waste and dry leaves (Kg.)	18.035	2607.1215 (M.T.)	68.1215	124186.85 (M.T.)	126793.9715
3.	Cowdung (Kg.)	26.7155	3861.9659 (M.T.)	87.4961	159507.14 (M.T.)	163368.1059
4.	K.Oil (Litre)	12.922	1867991.3 (Litre)	6.4872	11826295 (Litre)	1369.4286
5.	KWH Electricity	101.906	14731.429 (KWH)	13.1011	23883.567 (KWH)	38614.996
6.	LPG CYLINDER	0.5718	82659	-	-	-
7.	Coal (Kg.)	50.3372	7276.695 (M.T.)	-	-	-

#### 6.5. Consumption of bamboo:

Quantity of consumption of bamboo in the district is estimated as 1,01,318 & 39,44,777 numbers respectively for urban and rural areas for the purpose of house construction, furniture making, agricultural implements like baskets, bullock carts etc. and in fencing court yard, gardens and cattle sheds.

Although a small quantity of bamboo is grown in the forest but almost the entire demand is met from the bamboo grown in private land.

#### 6.6. Wood balance:

In order to estimate the quantum of wood available to the local population of the area, an attempt has been made to ascertain the total supply of wood to the Government/ Semi Government department as per available records of the Forest department. Thus, the total forest produce reduced by the supply to Govt./Semi Govt. department gives an idea about the wood available for local population.

The following table shows the net wood balance available in the area:-

Sl. No.	Type of wood	Local demand in m <sup>3</sup>	Estimated availability of forest produce after supplying to Govt./Semi Govt. Departments.	Balance	Remarks
1.	Timber in m <sup>3</sup> .	49948	7632	(-) 42316	
2.	Fuelwood (N.T.)	335229	13898	(-) 321331	
3.	Bamboo (No.)	4046095	160000	(-) 3886095	

The data given above shows that the recorded supply from forests meets only 15% of the local demand of timber, 4% of the local demand of fuelwood and bamboo. Thus the bulk of the supply of timber, fuelwood and bamboo to the local people comes from other sources. It is reported by the Project Director, Bettiah that about 1,000 m<sup>3</sup> of timber and about 80,000 m<sup>3</sup> of fuelwood is collected by local people annually through admitted customary rights like "Harsanga", "Gharsanga" and "Kathiary". Even accounting this major portion of supply to local people come from sources other than the reserved forests of Champaran. The probable source of balance timber and firewood includes (i) collection and purchase of timber and firewood from Nepal (ii) collection of drift firewood flowing down the Gandak river and (iii) timber and firewood grown in private land. Since the timber and firewood grown in private land is not under the control of Forest Department and the source is likely to dry up in near future, it is very much necessary to increase the per hectare production of wood from the project area by raising plantations in all barren and low productive areas. Large scale launching of Social Forestry programme in the district is also required to increase the wood production in private and other holdings.

C H A P T E R - VII

ECOLOGICAL CHANGE AND STATUS OF FLORA AND FAUNA.

7.0 Present status of flora and fauna:

In historic past the forest occupied a large portion of the district with rich population<sup>of</sup> Elephant, Bison and Rhinoceros. The demand of growing population and their cattle had gradually shifted the boundary of the forest only to the hills and on the depression areas along the river Gandak by the time the Government of independent India took its charge.

At present beds of rivers, nallas and valley bottoms contain riverine and miscellaneous forests respectively. Sal is lofty on well drained soil but becomes poor on high hills. Forests around the villages are some times depleted though the Department is gradually replenishing them by planting with commercial and economic species.

The common species of animals found are Tiger (*Panthera tigris*), Leopard (*Panthera pardus*), Jungle Cat (*Felis chaus*), Bison, Sloth bear, Blue bull, Sambar, Barking deer, Spotted deer, Wild bear, Hyena, Hog deer, Wild dog, Langur, Red faced monkey etc.

Among avifauna bustard quail, button quail, waders, Kaleej pheasant and green pigeon are more notable. Others are tree green pigeon, ashy headed green pigeon, purple wood pigeon, Green imperial pigeon, peafowl, jungle fowl, barbets, fly catcher, crane, stork, heron, ibis spoon bills, plovers, babblers, bulbuls, crows, sun bird, wood peckers and cuckoos etc.

Gharials or alligator, snubnosed crocodile, crab and tortoise are common in Gandak. Reptiles are python, cobra, king cobra, krait, dhaman, banded krait and iguana.

7.1. Degree of disturbance:

Injuries to which the crop is liable are man, fire, grazing, climbers, frost, insects, wind, flood etc. In general, the damages are not extensive. The damage by man, fire and grazing is localised along the southern border of the forests and in narrow belts of forests in the extreme West and East. The damage by climbers are localised in low lying patches and valleys. The damage by flood is localised on the banks of river only. Damage by insects is also mostly located in areas having impeded drainage. In addition, some death of Sal trees have also been noted by choking along the winding course of streams through deposition of sand and silt.

7.2. Quantitative and qualitative assessment:

The inventory study results for fire, grazing, presence of weed, intensity of regeneration, soil erosion and injuries to crop as observed from plot data are given below:-

e) Chart showing plots by intensity of regeneration.

Sl.No.	Intensity of regeneration.	Sal stratum		Misc. stratum	
		No.of plots	%	No.of plots	%
1	Profuse	4	5.2	-	-
2	Adequate	4	5.2	1	5.2
3	Inadequate	46	59.7	11	57.9
4	Absent	9	13.0	6	31.7
5	Damaged regeneration	14	16.9	1	5.2
Total:		77		19	

b) Chart showing plots by fire incidence:

Sl.No.	Fire incidence	Sal stratum		Misc. stratum	
		No. of plots	%	No. of plots	%
1	Heavy	-	-	-	-
2	Frequent	11	14.28	3	15.79
3	Occasional	63	81.82	13	68.42
4	No fire	3	3.9	3	15.79
Total:		77		19	

c) Chart showing plots by grazing incidence:

Sl.No.	Grazing incidence	Sal stratum		Misc. stratum	
		No. of plots	%	No. of plots	%
1	Heavy grazing	3	3.9	1	5.26
2	Medium "	19	24.67	6	31.58
3	Light "	36	46.75	9	47.37
4	No "	19	24.67	3	15.79
Total:		77		19	

d) Chart showing plots by injuries to crop:

Sl.No.	Injuries to crop	Sal stratum		Misc. stratum	
		No. of plots	%	No. of plots	%
1	Borer attack, leaf defoliator or other damage	1	1.3	1	5.26
2	Girdling or illicit felling	6	7.79	4	21.05
3	Wind damage	24	31.17	2	10.52
4	Other injuries	24	31.17	9	47.37
5	No injuries	22	28.57	3	15.79
Total:		77		19	

e) Chart showing plots by presence of weeds:

Sl.No.	Presence of weeds	Sal stratum		Misc. stratum	
		No.of plots	%	No.of plots	%
1	Dense (where 25% to 50% covered by weeds)	5	6.49	2	10.52
2	Moderate (where 10% to 25% surface covered by weeds)	25	32.47	8	42.10
3	Scanty (where less than 10% covered by weeds)	43	55.84	8	42.10
4	Absent (No weeds)	4	5.2	1	5.26
Total:		77		19	

f) Chart showing classification of plots showing soil erosion:

Sl.No.	Soil erosion	Sal stratum		Misc. stratum	
		No.of plots	%	No.of plots	%
1	Mild erosion	29	37.66	14	73.68
2	Moderate erosion	37	48.05	2	10.52
3	Heavy erosion	11	14.28	3	15.79
Total:		77		19	

The observations given above indicate that the forests are subjected to various degrees of soil erosion, regeneration status is mostly inadequate, existence of undergrowth is moderate to scanty, occurrence of fire is occasional and grazing incidence is mostly medium to light. In general the forests are reasonably well protected but that may be due to the existence of dacoits in the area and the large number of armed Police personnel deployed to keep the dacoits under control.

In absence of regular census of all wild animals in past and present, it is difficult to compare the general status of wild life in the region. Information collected from various sources, however, indicate that there has been a steady increase in the population of Tiger in the area over past two decades. Existence of numerous pug marks of Tiger over the areas also indicate their abundance in the locality. Recent census carried out in the matter has revealed the following population of Tiger and Leopard:-

Male Tiger	-	22
Female Tiger	-	31
Cub	-	8
Leopard	-	25

A proposal for creation of a Tiger Reserve in the area is pending with the Government Of India.



C H A P T E R - V I I I

PHOTO-INTERPRETATION AND REMOTE SENSING STUDIES.

8.1. Photo-interpretation & Remote sensing studies:

The entire forests of Champaran district were covered by landsat imageries for the period 1981-83. The vegetation map based on visual interpretation of these imageries is given in the appendix showing the forest cover and the extent of closed and open forests.

Area computation of different types of forests as worked out from the vegetation map comes as under:-

Closed forest	=	604 km <sup>2</sup>
Open forest	=	297 "
Total forest	=	<u>901 km<sup>2</sup></u>

The recorded area of Champaran forests under the control of forest management is 910.51 km<sup>2</sup>. Thus the forest area reflected by the vegetation map of the district closely tally with the recorded forest area. It may be mentioned here that in one grid falling in riverain area the volume of forests was noted to be only 1 m<sup>3</sup>/ha. being grassy blank. This may account for the difference of about 9 km<sup>2</sup> less forest area recorded by the imagery.

Analysis of the volume data of the inventory plots indicate that 65% of the area has got volume over 50 m<sup>3</sup>/ha., and 35% of the area has got volume less than 50 m<sup>3</sup>/ha. 65% of 910.5 km<sup>2</sup> works out to 591.82 km<sup>2</sup> and 35% of the same works out as 318.67 km<sup>2</sup>. Higher volume yielding area will normally have better crop and lower volume yielding area will generally have inferior crop (other conditions being equal).

It can therefore be seen that the area containing high volume largely tally with the area containing closed forest. Similarly, area having medium and low volume tally greatly with the area under open forest. Thus, the findings of ground inventory are broadly compatible with the forest area and its condition reflected for the district by the vegetation map prepared by Forest Survey Of India based on visual interpretation of landsat imageries.

C H A P T E R - I X

PLANTATION ACTIVITIES IN THE FORESTS AND URBAN  
AREAS WITH SPECIAL REFERENCE TO SOCIAL FORESTRY.

9.1. Introduction:

There was no systematic plan of raising plantations prior to taking <sup>over</sup> of the forests by the Government Of Bihar. During the period of Raj, of course, plantation activity was there, but it was limited to some places like roadside, forest locations or in small areas of forests around forest establishments. Records of plantations raised since 1955-56 are given in a table separately. Plantations up to 1959-60 were not successful due to lack of experience and poor supervision as the Headquarters of the afforestation division was at Purnea.

Initial plantations were raised with species like Teak, Sissoo, Khair, Seemal, Chakundi, Bakain, Sal, Kaju etc. Sal, Kaju and Bakain did not come up well in low alluvium and grassy blanks where most of the plantations were raised, so, the species given stress subsequently were Sissoo, Teak, Bamboo and Eucalyptus. In 1964, Teak was dropped due to its retarded growth. Eucalyptus also did not come up well. Khair and Sissoo however came up well in low alluvium and bamboo in open high alluvium either in blanks or as understorey of Sal and Miscellaneous species. Poplar was introduced in 1970-71 (P.casale).

Growth of Sissoo in Triveni block is 20 -25 cm. d.b.h. and 40' height in 14 years while the same for Teak in Madanpur block is 10-12 cm. d.b.h. and 25' height only in 14 years. Plantations did not suffer any major insect or fungal attacks except Seemal shoot borer. In young plantations eating of tender shoots by Monkeys are noticed. Wild boars also do some damage to young succulent rhizomes of bamboo. Fire and grazing are also two inhibiting factors to plantation. Areas where plantations have been raised include Grassy blanks, low areas, and inferior miscellaneous forests.

9.2. Growth statistics:

Figures of growth of Sissoo and Khair in better sites as given in the Working Plan are appended below:-

Sl.No.	Species	Age in years	O.B.Dia. (in cm.) at b.h./t.	Remarks
1	Sissoo	10	13.716	
		20	22.733	
		30	30.149	
		40	36.830	
		50	43.789	
		60	50.800	
		70	55.372	
2	Khair	10	7.874	
		20	16.510	
		30	23.266	
		40	31.750	
		50	42.672	

9.3. Yearwise plantation:

Areas of plantations raised in different years are given in the following tables:-

(Figures for the present division-II were not available for the years 1975-76 and 1983-84)

Chart showing the plantations raised by North Bihar Afforestation Division in the forests of Champaran during 1955-56 to 1974-75.

Sl.No.	Year of plantation	Net area planted
1	1955-56	34.01
2	1956-57	202.43
3	1957-58	76.92
4	1958-59	101.22
5	1959-60	118.83
6	1960-61	47.67
7	1961-62	130.36

Sl.No.	Year of plantation	Net area planted
8	1962-63	331.70
9	1963-64	151.62
10	1964-65	198.58
11	1965-66	249.36
12	1966-67	198.00
13	1967-68	338.00
14	1968-69	601.62
15	1969-70	582.60
16	1970-71	1560.83
17	1971-72	887.12
18	1972-73	731.17
19	1973-74	717.03
20	1974-75	508.45

Total:- 7771.52

Source: Working Plan of Champaran Forest Division, period 1971-72 to 1980-81.

Approximate area under Sissoo plantation during this period was 4580 ha., Bamboo 1900 ha., Khair 550 ha., Teak 300 ha. and balance belonged to other species.

Chart showing the plantations raised by Bihar State Forest Dev. Corporation in the forests of Champaran during the period from 1975-76 to 1984-85 (in ha.)

Sl.No.	Year of plantation	Net area planted in Division			
		I	II	Central	Total
1	1975-76	336.00	-	100.00	436.00
2	1976-77	424.34	19.20	175.72	619.26
3	1977-78	426.58	206.40	310.81	943.79
4	1978-79	466.86	505.13	400.35	1372.34
5	1979-80	335.74	471.71	229.60	1037.05
6	1980-81	141.57	424.92	270.11	836.60
7	1981-82	161.43	314.98	197.30	673.71
8	1982-83	166.05	224.00	140.55	530.60
9	1983-84	202.95	-	185.60	388.55
10	1984-85	160.03	373.00	190.00	723.03
Grand Total:		2821.55	2520.94	2199.94	7542.43

Approximate area under Siassoo plantation during the period is 3900 ha., Khair 2000 ha., Bamboo 1000 ha., Teak 170 ha. and rest belonging to other species.

The figures of plantations given above show that the highest acreage of plantation for any year was raised in the year 1970-71 prior to the formation of Corporation. The average yearly progress of plantation during the last five years of departments working was also to the tune of 800 hectares. Against this the maximum area of plantation raised in a year during Corporation's working was in the year 1978-79 which is about 200 hectare less than the figure of 1970-71. The average yearly plantations raised during the last five years of Corporation working is only 700 ha. Thus in quick conversion of inferior areas, open, blank and swampy land, the Corporation has not been able to make much headway. According to the Managing Director of Forest Development Corporation, the reduced area of plantation activity in recent years is due to the fact that not much of suitable land is available for planting now - the balance open and swampy areas being too low or sandy for successful planting.

9.4. Plantation under social forestry programme:

Not much have so far been done in the district under the programme except distribution of seedlings. However, the programme for next two years include the following:-

- (a) Plantation along canal bank - 150 km.
- (b) Plantation along Railway line - 40 Km.
- (c) Conservation and maintenance of old 416 Km. of canal bank plantation.
- (d) Raising of 30 lakhs of seedlings annually for free distribution.

The scheme aims at the social and economic benefit to the local people, so there is no provision for recovery of the expenditure on the scheme. The plantations thus established will become asset to the society and will yield fuelwood, timber and fodder to the local population.

C H A P T E R - X

RESULTS AND CONCLUSIONS

10.1. Main results and conclusions:

- (a) Present study of the vegetation of Champaran district indicates that the forests of Champaran, though occur as an isolated patch in North Bihar area, are reasonably well protected and have got fair to good density crop. The maximum number of stem per ha. in Sal stratum has been noted up to 610 and the same for Miscellaneous stratum up to 480.
- (b) Shorea robusta forms principal crop in the area. It constitutes about 50% of the total volume in Sal stratum and about 34% of the total volume in the miscellaneous stratum.
- (c) The quality of the crop varies between II/III to V but the density is reasonably good to very good except some fringe areas in southern portion of the forests or in narrow strips in western and eastern portion of the district.
- (d) Volume per hectare varies from place to place being as low as 1 m<sup>3</sup> per hectare in riverine areas near Madanpur to over 200 m<sup>3</sup> per hectare in the well drained flats in the foot hills.
- (e) The average volume per hectare in the Sal stratum is 74 m<sup>3</sup> and the same for miscellaneous stratum is 47 m<sup>3</sup>. The average number of stems per ha. in Sal stratum is 250 and the same for Miscellaneous stratum is 198. The total growing stock of the forest is 6145881 m<sup>3</sup>

...55...

- (f) The annual consumption of timber in the district for various purpose is  $49,948 \text{ m}^3$  and the same for firewood is  $3,35,229 \text{ m}^3$ . The forests being managed under conservation oriented system, the current annual recorded availability of timber from the forests is only about  $7000 \text{ m}^3$  and the same for firewood is about  $10,000 \text{ m}^3$  including timber and firewood collected by right holders. Thus, there is a huge gap between the demand and supply.
- (g) The people in general use lot of bamboos for their day to day use, which is common man's timber and bamboo is grown in sufficient quantity in the private land as it is associated with the social status of the local people. Similarly, lot of Sissoo, Mango and Tamarind trees are grown by the local people around their household location and these in a large way meet the demand of timber, fuelwood and bamboo of the local people.
- (h) The area is quite rich in wild life specially the population of Tiger which according to the latest Census is 61 in number. In addition, there are 25 numbers of Leopard in this forests.
- (i) Major portion of the forests being located in Siwalik slopes require complete protection from soil conservation point of view, the forests are therefore proposed to be worked under conservation oriented management system.

10.2 Variation from past studies:

- (a) The present inventory indicates that a number of good plantations have been raised in the erstwhile open and blank areas of the district, which have converted a part of the low productive area by high yielding commercially important species.

- (b) Though Rhinoceros and Elephants, which were once in existence in the area, have vanished from the forests in recent years still there has been a definite rise of Tiger population in the forests which has increased from a low number of 30 twenty years back to double the number at present.
- (c) The exploitation of forests which was fairly heavy in recent past has now been reduced to minimum and is restricted within the limits of prescription of Working Plan.

10.3. Final recommendation and proposals:

Considering the status of forests, socio-economic condition of the local people and the general need of environmental preservation in our country, following recommendations are made with respect to Champaran forests:-

- 1) The forests of Champaran should be maintained under conservation oriented system, the exploitation of forests being restricted to the flat areas, valley lands and undulating terrain in the foot hills. Siwalik hills particularly the ridges and slopes should be rigidly protected for conservation of soil and water.
- 2) All unproductive, barren and damaged forest land should be planted in a phased manner with commercially important species particularly Sissoo whose success has been noted to be good to extraordinary depending upon site factor.
- 3) Since the forests contain a rich population of Tiger, establishment of a Tiger Reserve in the area is essential with augmentation of protection personnel including installation of wireless system. This is /has all the more necessary as the areas /got for quite some times almost a resident dacoit population for which lot of outlying forest locations had to be abandoned.



- 4) Social Forestry activity should be intensified in the district to meet the local demand of various types of wood. This may not pose much of a problem in the district as the holdings are often fairly large and the people have got some knowledge about the value of trees and its raising.
- 5) It is necessary to make an inventory of the trees growing in private lands in order to assess the total growing stock of tree species over the entire district including its current rate of felling and removal. This is necessary for proper study of wood balance in the district and over all planning and management of future social forestry programme.

BIBLIOGRAPHY

1. Bihar District Gazetteers - Champaran - 1960
2. Working Plan for Champaran Forest Division - 1971-72 to 1980-81.
3. Project Report for Forest Department in the districts of Singhbhum, Palamou & West Champaran, Department Of Forests, Bihar - January, 1974
4. Project of Social Forestry under Rural (Project period from landless Employment Guarantee Programme April, 1984 to June, 1985). In East and West Champaran - Bihar State Forest Development Corporation Ltd., Patna.
5. Census 1981 - District Census Handbook - West Champaran - Directorate of Census Operation - Bihar.

TABLE NO. 1.1.1  
STEMS PER HECTARE BY SPECIES AND DIAMETER CLASSES ( IN CM.)  
STRATUM - SAL - WEST CHAMPARAN

Species name & code	Diameter class (in cm.)										Total
	05-10	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+
	09										
Acacia catechu(006)	-	4.287	1.559	0.130	0.260	0.390	0.390	0.390	-	-	6.235
Adina cordifolia(024)	-	1.689	1.039	1.039	0.650	0.390	0.390	-	-	-	5.196
Aegle marmelos((028)	-	0.130	0.130	0.390	0.130	-	-	-	-	-	0.779
Albizzia procera(045)	-	-	0.130	-	-	-	-	-	-	-	0.130
Alstonia scholaris(052)	-	0.130	-	-	-	-	-	-	-	-	0.130
Anogeissus latifolia(063)	-	11.042	2.858	0.390	0.130	-	-	-	-	-	14.419
Bauhinia purpurea(096)	-	0.390	2.399	-	-	-	-	-	-	-	0.390
Bauhinia retusa(098)	-	0.390	2.399	-	0.130	0.390	-	-	-	-	0.520
Bauhinia species(099)	-	2.988	0.520	-	-	-	-	-	-	-	3.507
Bombax ceiba(109)	-	-	0.130	0.520	-	-	0.130	-	-	-	0.779
Bridelia retusa(114)	-	0.260	-	-	-	-	-	-	-	-	0.260
Buchananian latifolia(116)	-	15.718	3.507	0.779	-	-	-	-	-	-	20.005
Callicarpa arborea(121)	-	0.260	0.130	-	-	-	-	-	-	-	0.390
Careya arborea(143)	-	2.468	1.559	0.390	0.130	-	-	-	-	-	4.547
Cassia fistula(151)	-	0.130	-	-	-	-	-	-	-	-	0.130
Cedrela toona(162)	-	0.130	-	-	-	0.130	-	0.130	-	-	0.390
Dalbergia latifolia(220)	-	0.260	0.650	-	-	-	-	-	-	-	0.909
Dalbergia sissoo(222)	-	0.130	0.520	0.650	0.130	0.130	-	-	-	-	1.559
Dillenia pentagyna(230)	-	1.039	0.260	0.130	-	-	-	-	-	-	1.429
Embllica officinalis(267)	-	0.260	0.260	-	-	-	-	-	-	-	0.520
Eriobotrya bengalensis (272)	-	0.390	-	-	-	-	-	-	-	-	0.390
Euginea species(289)	-	-	0.130	-	-	-	-	-	-	-	0.130
Ficus species(308)	-	1.169	0.390	-	0.260	-	-	-	-	-	1.819
Flacourtia indica(310)	-	0.130	-	-	-	-	-	-	-	-	0.130
Garuga pinnata(319)	-	1.039	1.039	0.520	-	0.130	-	-	-	-	2.728
Grevia tielaefolia(336)	-	0.130	-	-	-	-	-	-	-	-	0.130
Heynea trijuga(350)	-	0.130	-	-	-	-	-	-	-	-	0.130
Holarrhena antidysenterica (353)	-	2.208	0.390	0.130	-	-	-	-	-	-	2.728
Hymenodictyon excelsum(370)	-	0.130	0.260	-	-	0.130	-	-	-	-	0.520

[illegible]

Species name & code	Diameter class (in cm.)											Total
	05-10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+		
	09											
Zizyphus Mauratlana (732)	-	-	-	0.130	-	-	-	-	-	-	-	0.130
{ 824 }	-	0.130	-	-	-	-	-	-	-	-	-	0.130
{ 881 }	-	-	0.130	-	-	-	-	-	-	-	-	0.130
Unidentified trees (924)	-	16.497	3.767	0.779	0.390	-	-	-	-	-	-	22.213
(Others)	-	-	-	-	-	-	-	-	-	-	-	-
Total:	-	130.420	62.352	30.007	15.068	7.274	2.468	1.299	0.390	0.130	0.130	249.538

**TABLE NO. 1.1.2**

[illegible]

Species name with code	Diameter classes (in cm.)										Total
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	
Cedrela toona (162)	9.104	-	-	-	9.104	-	9.104	-	-	-	27.311
Dalbergia latifolia(220)	18.207	45.518	-	-	-	-	-	-	-	-	63.725
Dalbergia sissoo latifolia(222)	9.104	36.414	45.518	9.104	9.104	-	-	-	-	-	109.243
Dillenia pentagyna(230)	72.829	18.207	9.104	-	-	-	-	-	-	-	100.139
Emblia officinalis(267)	18.207	18.207	-	-	-	-	-	-	-	-	36.414
Eriobotria bengalensis(272)	27.311	-	-	-	-	-	-	-	-	-	27.311
Eugenia spp. (289)	-	9.104	-	-	-	-	-	-	-	-	9.104
Ficus species (308)	81.932	27.311	-	18.207	-	-	-	-	-	-	127.450
Flacourtia indica(310)	9.104	-	-	-	-	-	-	-	-	-	9.104
Garuga pinnata (319)	72.829	72.829	36.414	-	9.104	-	-	-	-	-	191.175
Grewia tiolarifolia(336)	9.104	-	-	-	-	-	-	-	-	-	9.104
Heynoa trifuga (350)	9.104	-	-	-	-	-	-	-	-	-	9.104
Holarrhena antisyriaca(353)	154.761	27.311	9.104	-	-	-	-	-	-	-	191.175
Hymenodictyon excelsum(370)	9.104	18.207	-	-	9.104	-	-	-	-	-	36.414
Kydia calycina (393)	27.311	-	-	-	-	-	-	-	-	-	27.311
Lagerstroemia parviflora(397)	309.522	163.865	36.414	45.518	-	-	-	-	-	-	555.319
Lannea coromandelica(400)	191.175	91.036	63.725	18.207	27.311	18.207	-	-	-	-	109.661

[illegible]



Species name with code	Diameter classes (in cm.)										Total
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	
Strychnos potatorum (658)	18.207	-	-	-	-	-	-	-	-	-	18.207
Syzygium cumini (665)	682.769	218.486	91.036	18.207	9.104	-	-	-	-	-	1019.602
Tectona grandis (673)	9.104	9.104	-	-	-	-	-	-	-	-	18.207
Terminalia belerica (676)	91.036	-	27.311	27.311	9.104	-	-	-	-	-	154.761
Terminalia chebula (679)	100.139	-	-	-	9.104	-	-	-	-	-	109.243
Terminalia citrina (680)	18.207	-	-	-	-	-	-	-	-	-	18.207
Terminalia crenulata (681)	234.900	209.382	109.243	27.311	63.725	27.311	18.207	9.104	-	9.104	728.287
Terminalia procera (685)	-	9.104	-	-	-	-	-	-	-	-	9.104
Tetrameles nudiflora (688)	27.311	9.104	-	18.207	-	-	-	-	-	-	54.622
Toona ciliata (691)	91.036	36.414	54.622	18.207	-	-	-	-	-	-	200.279
Trewia nudiflora (695)	-	9.104	9.104	-	-	-	-	-	-	-	18.207
Wendlandia noni (716)	9.104	-	-	-	-	-	-	-	-	-	9.104
Zizyphus maurandia (732)	-	-	-	9.104	-	-	-	-	-	-	9.104
(824)	9.104	-	-	-	-	-	-	-	-	-	9.104
(881)	-	9.104	-	-	-	-	-	-	-	-	9.104
Unidentified trees (924) - others	1156.156	264.004	54.622	54.622	27.311	-	-	-	-	-	1556.713
Total:	9140.001	4369.722	2102.929	1056.016	509.801	172.968	91.036	27.311	9.104	9.104	17487.990

Table No. 1.2.1.

STEMS PER HECTARE BY SPECIES AND DIAMETER CLASSES ( IN CM.)

STRATUM : MISCELLANEOUS

DIST. : CHAMPARAN

Species name with code	Diameter Classes ( in cm.)										
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	Total
Acacia catechu(006)	12.105	4.737	0.526	-	-	-	-	-	-	-	17.368
Adina cordifolia(024)	7.368	3.684	0.526	0.526	-	-	-	-	-	-	12.105
Adina sessilifolia(025)	0.526	-	-	-	-	-	-	-	-	-	0.526
Aegle marmelos (028)	1.053	-	0.526	0.526	-	-	-	-	-	-	2.105
Albizia procera (045)	1.053	-	0.526	-	-	-	-	-	-	-	1.579
Bauhinia purpurea (096)	-	-	-	-	-	-	-	-	-	-	-
Bombax ceiba(109)	8.947	-	-	-	0.526	1.053	-	-	-	-	10.526
Buchnanania latifolia(116)	15.789	1.053	-	-	-	-	-	-	-	-	16.842
Butea monosperma (117)	-	-	0.526	-	-	-	-	-	-	-	0.526
Callicarpa arborea(121)	1.053	-	-	-	-	-	-	-	-	-	1.053
Careya arborea(143)	1.579	-	-	-	-	-	-	-	-	-	1.579
Dalbergia sissoo(222)	1.579	0.526	-	-	-	-	-	-	-	-	2.105
Ficus species(308)	4.210	0.526	0.526	0.526	-	-	-	-	-	-	5.789
Gatuga pinnata(319)	3.684	1.053	-	-	-	-	-	-	-	-	4.737
Holarrhena antidysenterica(353)	3.684	0.526	-	-	-	-	-	-	-	-	4.210
Hymenodictyon excelsum(370)	1.579	-	-	-	-	-	-	-	-	-	1.579
Lagerstroemia parviflora(397)	3.150	1.579	-	-	0.526	-	-	-	-	-	5.263
Lannea coromandelica(400)	2.105	1.053	2.105	0.526	0.526	-	-	-	-	-	6.315
Madhuca latifolia(437)	-	0.526	-	-	-	-	-	-	-	-	0.526
Mallotus khasianus (440)	-	-	-	-	-	-	-	-	-	-	-
Mallotus philippinensis(441)	10.526	3.684	-	-	-	-	-	-	-	-	3.684
Mitragyna parviflora(476)	1.053	-	-	-	-	-	-	-	-	-	1.053
Pajanelia longfolia(510)	-	-	-	0.526	-	-	-	-	-	-	0.526

Species name with code	Diameter classes (in cm.)										
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	Total
Seecarpus anacardium (630)	-	0.526	-	-	-	-	-	-	-	-	0.526
Shorea robusta(633)	9.473	13.684	7.895	2.632	2.105	0.526	0.526	-	-	-	36.841
Glourea assemica(636)	-	-	-	-	0.526	-	-	-	-	-	0.526
Spondias pinnata(642)	0.526	-	-	-	-	-	-	-	-	-	0.526
Syzygium cumini(665)	1.579	0.526	2.105	1.579	0.526	-	-	-	-	-	6.315
Terminalia belerica(676)	0.526	-	0.526	-	-	0.526	-	-	-	-	1.579
Terminalia bisalata(677)	0.526	-	-	-	-	-	-	-	-	-	0.526
Terminalia crenulata(681)	2.105	1.053	0.526	-	-	-	-	-	-	-	3.684
Tetrameles nudiflora (688)	0.526	-	-	-	-	-	-	-	-	-	0.526
Toona ciliata(691)	1.579	-	0.526	-	-	-	-	-	-	-	2.105
Tsuga dumosa (697)	0.526	-	-	-	-	-	-	-	-	-	0.526
Unidentified Trees(others)(924)	22.105	6.842	3.684	1.053	-	-	-	-	-	-	33.684
Total :	120.523	41.578	20.526	7.895	4.737	2.105	0.526	-	-	-	197.889

Table 1.2.2.  
TOTAL STEMS (IN 000 UNIT) BY SPECIES AND DIAMETER CLASSES (IN CM.)  
STRATUM : MISCELLANEOUS  
DIST. : CHAMPARAN

Species name with code	Diameter classes (in cm.)										
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	Total
Acacia catechu (006)	253.832	99.326	11.036	-	-	-	-	-	-	-	364.194
Adina cordifolia (024)	154.507	77.253	11.036	11.036	-	-	-	-	-	-	253.832
Adina sesellifolia (025)	11.036	-	-	-	-	-	-	-	-	-	11.036
Aegle marmelos (028)	22.072	-	11.036	11.036	-	-	-	-	-	-	44.145
Albizia procera (045)	22.072	-	11.036	-	-	-	-	-	-	-	33.109
Bombax ceiba (109)	187.615	-	-	-	11.036	22.072	-	-	-	-	220.724
Buchanania latifolia (116)	331.086	22.072	-	-	-	-	-	-	-	-	353.158
Butea monosperma (117)	-	-	11.036	-	-	-	-	-	-	-	11.036
Callicarpa arborea (121)	22.072	-	-	-	-	-	-	-	-	-	22.072
Careya arborea (143)	33.109	-	-	-	-	-	-	-	-	-	33.109
Dalbergia sissoo (222)	33.109	11.036	-	-	-	-	-	-	-	-	44.145
Ficus species (308)	88.290	11.036	11.036	11.036	-	-	-	-	-	-	121.398
Gatuga pinnata (319)	77.253	22.072	11.036	-	-	-	-	-	-	-	99.326
Holarrhena antidysenterica (353)	77.253	11.036	-	-	-	-	-	-	-	-	88.290
Hymenodictyon excelsum (370)	33.109	-	-	-	-	-	-	-	-	-	33.109
Lagerstroemia parviflora (397)	66.217	33.109	-	-	11.036	-	-	-	-	-	110.362
Lannea coromandelica (400)	44.145	22.072	44.145	11.036	11.036	-	-	-	-	-	132.434
Madhuca latifolia (437)	-	11.036	-	-	-	-	-	-	-	-	11.036
Mallotus philippinensis (441)	220.724	77.253	-	-	-	-	-	-	-	-	297.977
Mitragyna parviflora (476)	22.072	-	-	-	-	-	-	-	-	-	22.072
Pajanelia longifolia (510)	-	-	-	11.036	-	-	-	-	-	-	11.036

Species name with code	Diameter classes (in cm.)									
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+ Total
Secocarpus ancardium (630)	-	11.036	-	-	-	-	-	-	-	11.036
Shorea robusta (633)	198.652	286.841	165.543	55.187	44.145	11.036	11.036	-	-	772.534
Sloanea assamica (636)	-	-	-	-	11.036	-	-	-	-	11.036
Spondias pinnata (642)	11.036	-	-	-	-	-	-	-	-	11.036
Syzygium cumini (665)	33.109	11.036	44.145	33.109	11.036	-	-	-	-	132.434
Terminalia belerica (676)	11.036	-	11.036	-	-	11.036	-	-	-	33.109
Terminalia bialata (677)	11.036	-	-	-	-	-	-	-	-	11.036
Terminalia orenulata (681)	44.145	22.072	11.036	-	-	-	-	-	-	77.253
Tetrameles nudiflora (688)	11.036	-	-	-	-	-	-	-	-	11.036
Toona ciliata (691)	33.109	-	11.036	-	-	-	-	-	-	44.145
Tsuga dumosa (697)	11.036	-	-	-	-	-	-	-	-	11.036
Unidentified Trees (Others) (924)	463.520	143.471	77.253	22.072	-	-	-	-	-	706.317
Total :	2527.289	871.859	430.412	165.543	99.326	44.145	11.036	-	-	4149.610

TABLE NO. 2.1.1  
VOLUME PER HECTARE BY SPECIES AND DIAMETER CLASSES ( IN CM.)  
DISTT. WEST CHAMPARAN

## STRATUM : SAL

Species name with code	Diameter classes (in cm.)										Total
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	
Acacia catechu(006)	0.281	0.307	0.059	0.245	-	-	-	-	-	-	0.892
Adina cordifolia(024)	0.121	0.237	0.537	0.623	0.522	0.851	-	-	-	-	2.891
Aegle marmelos(028)	0.006	0.040	0.185	0.093	-	-	-	-	-	-	0.324
Albizia procera(045)	0.005	-	-	-	-	-	-	-	-	-	0.005
Alstonia scholaris (052)	0.008	-	-	-	-	-	-	-	-	-	0.008
Anogeissus latifolia (063)	0.701	0.528	0.170	0.116	-	-	-	-	-	-	1.514
Bauhinia purpurea (096)	0.023	-	-	-	-	-	-	-	-	-	0.023
Bauhinia retusa(098)	0.032	-	-	0.128	-	-	-	-	-	-	0.159
Bauhinia spp.(099)	0.203	0.151	-	-	-	-	-	-	-	-	0.344
Bombax ceiba(109)	-	0.020	0.267	-	-	0.286	-	-	-	-	0.573
Bridellia retusa(114)	0.018	-	-	-	-	-	-	-	-	-	0.018
Buchanania latifolia (116)	0.907	0.728	0.350	-	-	-	-	-	-	-	1.985
Callicarpa arborea (121)	0.021	0.022	-	-	-	-	-	-	-	-	0.044
Careya arborea(143)	0.152	0.313	0.194	0.098	-	-	-	-	-	-	0.757
Cassia fistula(151)	0.005	-	-	-	-	-	-	-	-	-	0.005
Cedrela toona(162)	0.012	-	-	-	0.224	-	0.357	-	-	-	0.593
Dalbergia latifolia (220)	0.014	0.182	-	-	-	-	-	-	-	-	0.196
Dalbergia sissoo(222)	0.008	0.133	0.321	0.093	0.161	-	-	-	-	-	0.716
Dillenia pentagyna(230)	0.070	0.042	0.073	-	-	-	-	-	-	-	0.185
Emblia officinalis (267)	0.010	0.066	-	-	-	-	-	-	-	-	0.076
Eriobotria bengalensis (272)	0.022	-	-	-	-	-	-	-	-	-	0.022
Eugenia spp.(289)	-	0.020	-	-	-	-	-	-	-	-	0.020
Ficus spp.(308)	0.059	0.081	-	0.225	-	-	-	-	-	-	0.365
Flacourtia indica (310)	0.005	-	-	-	-	-	-	-	-	-	0.005
Garuga pinnata(319)	0.078	0.232	0.213	-	0.224	-	-	-	-	-	0.747

Species name with code	Diameter classes (in cm.)										Total
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	
<i>Grewia tielaefolia</i> (336)	0.005	-	-	-	-	-	-	-	-	-	0.005
<i>Heynoa trijuga</i> (350)	0.008	-	-	-	-	-	-	-	-	-	0.008
<i>Holarrhena antidys-</i> <i>enterica</i> (353)	0.137	0.071	0.068	-	-	-	-	-	-	-	0.275
<i>Hymenodictyon excelsum</i> (370)	0.016	0.040	-	-	0.224	-	-	-	-	-	0.280
<i>Kydia calycina</i> (393)	0.024	-	-	-	-	-	-	-	-	-	0.024
<i>Lagerstroemia</i> <i>parviflora</i> (397)	0.273	0.520	0.246	0.560	-	-	-	-	-	-	1.598
<i>Lannea coromandellica</i> (400)	0.175	0.302	0.494	0.233	0.584	0.573	-	-	-	-	2.360
<i>Lyonea ovalifolia</i> (424)	0.004	-	-	-	-	-	-	-	-	-	0.004
<i>Madhuca latifolia</i> (437)	0.036	0.104	0.077	-	-	-	-	0.447	-	-	0.665
<i>Malilotus philippi-</i> <i>nensis</i> (441)	0.187	0.171	0.059	-	-	-	-	-	-	-	0.418
<i>Mangifera indica</i> (444)	0.012	-	0.051	-	-	-	-	-	-	-	0.063
<i>Nelia azadirachta</i> (454)	0.033	0.064	-	-	-	-	-	-	-	-	0.097
<i>Mitragyna parviflora</i> (476)	0.137	0.101	0.214	0.221	0.224	-	-	-	-	-	0.896
<i>Morindia tinctoria</i> (478)	0.012	-	-	-	-	-	-	-	-	-	0.012
<i>Nyctanthus</i> <i>arborescens</i> (496)	0.017	-	-	-	-	-	-	-	-	-	0.017
<i>Cugenia dalbergioides</i> (509)	0.233	0.104	0.059	-	-	-	-	-	-	-	0.397
<i>Pajanelia longifolia</i> (510)	-	0.025	0.135	-	-	-	-	-	-	-	0.160
<i>Pinus roxburghii</i> (536)	-	-	-	0.093	-	-	-	-	-	-	0.093
<i>Randia dumetorum</i> (596)	0.030	0.018	-	-	-	-	-	-	-	-	0.047
<i>Randia species</i> (598)	0.006	-	-	-	-	-	-	-	-	-	0.006
<i>Schleicheria trijuga</i> (628)	0.151	0.260	0.136	0.251	0.224	-	-	-	-	-	1.022

Species name with code	Diameter classes (in cm.)										Total
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	
<i>Secocarpus anacardium</i> (630)	0.147	0.105	-	-	-	-	-	-	-	-	0.252
<i>Shorea robusta</i> (633)	1.691	6.218	8.472	8.451	5.773	2.663	2.480	0.496	0.561	-	36.806
<i>Stereospermum</i> <i>suaveolens</i> (653)	0.035	-	-	-	-	-	-	-	-	-	0.035
<i>Strychnos potatorum</i> (658)	0.015	-	-	-	-	-	-	-	-	-	0.015
<i>Syzygium cuminii</i> (665)	0.611	0.622	0.658	0.240	0.191	-	-	-	-	-	2.323
<i>Tectona grandis</i> (673)	0.007	0.028	-	-	-	-	-	-	-	-	0.034
<i>Terminalia belerica</i> (676)	0.084	-	0.196	0.329	0.199	-	-	-	-	-	0.808
<i>Terminalia chebula</i> (679)	0.088	-	-	-	0.191	-	-	-	-	-	0.280
<i>Terminalia citrina</i> (680)	0.018	-	-	-	-	-	-	-	-	-	0.018
<i>Terminalia crenulata</i> (681)	0.267	0.637	0.769	0.366	1.250	0.8742	0.725	0.509	-	2.146	7.510
<i>Terminalia procera</i> (685)	-	0.034	-	-	-	-	-	-	-	-	0.034
<i>Tetrameles nudiflora</i> (688)	0.025	0.034	-	0.269	-	-	-	-	-	-	0.328
<i>Toona ciliata</i> (691)	0.076	0.117	0.346	0.256	-	-	-	-	-	-	0.796
<i>Trewia nudiflora</i> (695)	-	0.022	0.047	-	-	-	-	-	-	-	0.070
<i>Wendlandia notoniiana</i> (716)	0.007	-	-	-	-	-	-	-	-	-	0.007
<i>Zizyphus mauratiana</i> (732)	-	-	-	0.122	-	-	-	-	-	-	0.122
(824)	0.006	-	-	-	-	-	-	-	-	-	0.006
(881)	-	0.020	-	-	-	-	-	-	-	-	0.020
Unidentified trees (924 - Others)	0.980	0.819	0.365	0.712	0.514	-	-	-	-	-	3.390
Total:	8.311	13.527	14.761	13.724	10.504	5.215	3.561	1.453	0.561	2.146	73.764



TABLE NO. 2.1.2  
TOTAL VOLUME (IN '000M<sup>3</sup>) BY SPECIES AND DIAMETER CLASSES (IN CM.)

STRATUM: SAL		DIST. - WEST CHAMPARAN										
Species name	with code	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	Total
Acacia catechu												
(006)	19.692	21.501	4.153	17.147	-	-	-	-	-	-	-	62.494
Adina(024)	8.466	16.635	37.606	43.670	36.594	59.611	-	-	-	-	-	202.581
cordifolia												
Aegle(028)	0.405	2.811	12.954	6.505	-	-	-	-	-	-	-	22.675
marmelos												
Albizzia(045)	0.351	-	-	-	-	-	-	-	-	-	-	0.351
procera												
Alstonia(052)	0.548	-	-	-	-	-	-	-	-	-	-	0.548
scholaris												
Anogeissus	49.136	37.004	11.889	8.097	-	-	-	-	-	-	-	106.127
latifolia(063)												
Bauhinia(096)	1.603	-	-	-	-	-	-	-	-	-	-	1.603
purpurea												
Bauhinia	2.211	-	-	-	8.960	-	-	-	-	-	-	11.172
retusa(098)												
Bauhinia	14.254	9.880	-	-	-	-	-	-	-	-	-	24.134
species(099)												
Bombax ceiba	1.404	1.404	18.697	-	-	20.069	-	-	-	-	-	40.170
(109)												
Bridellia	1.277	-	-	-	-	-	-	-	-	-	-	1.277
retusa(114)												
Buchananla	63.588	51.025	24.496	-	-	-	-	-	-	-	-	139.109
latifolia(116)												
CalliCARpa	1.484	1.571	-	-	-	-	-	-	-	-	-	3.056
arborea(121)												
Careya arborea	10.625	21.916	13.603	6.886	-	-	-	-	-	-	-	53.031
(143)												
Cassia	0.351	-	-	-	-	-	-	-	-	-	-	0.351
fistula(151)												
Cedrela toona	0.848	-	-	-	-	15.669	-	25.020	-	-	-	41.536
(162)												

[illegible]

Species name with code	Diameter classes (in cm.)										Total
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	
Madhuca (437) latifolia	2.527	7.304	5.430	-	-	-	-	31.353	-	-	46.614
Mallothus philippinensis (441)	13.138	12.006	4.153	-	-	-	-	-	-	-	29.298
Mangifera indica (444)	0.848	-	3.583	-	-	-	-	-	-	-	4.430
Melia (454) azadirachta	2.291	4.493	-	-	-	-	-	-	-	-	6.784
Mitragyna (476) parviflora	7.103	7.103	14.968	15.466	15.669	-	-	-	-	-	62.773
Morinda (478) tinctoria	0.822	-	-	-	-	-	-	-	-	-	0.822
Nyctanthus (496) arborescens	1.185	-	-	-	-	-	-	-	-	-	1.185
Ougenia (509) dalbergioides	16.334	7.303	4.153	-	-	-	-	-	-	-	27.791
Pajanelia (510) longifolia	-	1.750	9.450	-	-	-	-	-	-	-	11.200
Pinus (536) romburghii	-	-	-	6.505	-	-	-	-	-	-	6.505
Randia (596) dumetorum	2.071	1.248	-	-	-	-	-	-	-	-	3.319
Randia spp. (598)	0.405	-	-	-	-	-	-	-	-	-	0.405
Schleichera trijuga (628)	10.611	18.206	9.550	17.618	15.669	-	-	-	-	-	71.653
Semecarpus anacardium (630)	10.325	7.335	-	-	-	-	-	-	-	-	17.659
Shorea (631) robusta	118.492	435.772	593.739	592.284	404.607	186.598	173.779	34.790	39.339	-	2579.401

Species name with code	Diameter classes (in cm.)										Total
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	
Stereosporium suaveolens (653)	2.446	-	-	-	-	-	-	-	-	-	2.446
Strychnos potatorum (658)	1.044	-	-	-	-	-	-	-	-	-	1.044
Syzygium cumini (665)	42.787	43.597	46.137	16.845	13.402	-	-	-	-	-	162.768
Tectonia grandis (673)	0.471	1.939	-	-	-	-	-	-	-	-	2.411
Terminalia belerica (676)	5.854	-	13.748	23.092	13.952	-	-	-	-	-	56.645
Terminalia chebula (679)	6.198	-	-	-	13.402	-	-	-	-	-	19.600
Terminalia citrina (680)	1.277	-	-	-	-	-	-	-	-	-	1.277
Terminalia crenulata (681)	18.684	44.628	53.863	25.648	87.588	59.016	50.792	35.677	-	150.381	526.277
Terminalia procera (685)	-	2.353	-	-	-	-	-	-	-	-	2.353
Tetrameles nudiflora (688)	1.756	2.353	-	18.863	-	-	-	-	-	-	22.971
Toona ciliata (691)	5.334	8.182	24.272	17.966	-	-	-	-	-	-	55.754
Trewia nudiflora (695)	-	1.571	3.314	-	-	-	-	-	-	-	4.885
Wendlandia notodana (716)	0.471	-	-	-	-	-	-	-	-	-	0.471
Zizyphus mauratiensis (722)	-	-	-	8.523	-	-	-	-	-	-	8.523
Lindera (824)	He (824)	-	-	-	-	-	-	-	-	-	0.405
Unidentified trees (Others) (924)	68.672	57.395	25.560	49.906	36.022	-	-	-	-	-	1.404
Total:	582.448	948.006	1034.455	961.815	736.138	365.475	249.591	101.821	39.329	150.381	5169.469

Table No. 22.1

VOLUME PER HECTARE BY SPECIES AND DIAMETER CLASSES (IN CM.)  
STRATUM : MISCELLANEOUS  
DIST. : CHAMPARAN

Species name with code	Diameter classes (in cm.)									
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+ Total
Acacia catechu (006)	0.804	1.041	0.192	-	-	-	-	-	-	2.037
Adina cordifolia (024)	0.575	0.729	0.276	0.376	-	-	-	-	-	1.956
Adina sesilifolia (025)	0.018	-	-	-	-	-	-	-	-	0.018
Aegle marmelos (028)	0.069	-	0.207	0.468	-	-	-	-	-	0.744
Albizia procera (045)	0.086	-	0.314	-	-	-	-	-	-	0.400
Bombax ceiba (109)	0.549	-	-	-	0.654	2.206	-	-	-	3.409
Buchanania latifolia (116)	0.808	0.193	-	-	-	-	-	-	-	1.001
Butea monosperma (117)	-	-	0.334	-	-	-	-	-	-	0.334
Callicarpa arborea (121)	0.060	-	-	-	-	-	-	-	-	0.060
Careya arborea (143)	0.127	-	-	-	-	-	-	-	-	0.127
Delbergia sissoo (222)	0.112	0.112	-	-	-	-	-	-	-	0.225
Ficus species (308)	0.320	0.177	0.314	0.376	-	-	-	-	-	1.186
Gatuga pinnata (319)	0.172	0.300	-	-	-	-	-	-	-	0.472
Holarrhena antidysenterica (353)	0.223	0.112	-	-	-	-	-	-	-	0.335
Hymenodictyon excelsum (370)	0.102	-	-	-	-	-	-	-	-	0.102
Lagerstroemia parviflora (397)	0.237	0.389	-	-	0.683	-	-	-	-	1.310
Lannea coromandelica (400)	0.144	0.300	1.280	0.421	0.626	-	-	-	-	2.770
Lathuca latifolia (437)	-	0.149	-	-	-	-	-	-	-	0.149
Mallotus philippinensis (441)	0.837	0.648	-	-	-	-	-	-	-	1.485
Mitragyna parviflora (476)	0.098	-	-	-	-	-	-	-	-	0.098
Pajanelia longifolia (510)	-	-	-	0.544	-	-	-	-	-	0.544

Species name with code	Diameter classes (in cm.)										
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	Total
Sedecarpus anacardium (630)	-	0.101	-	-	-	-	-	-	-	-	0.101
Shorea robusta (633)	0.694	2.996	3.973	2.345	3.176	1.199	1.404	-	-	-	15.787
Sloanea asseamica (636)	-	-	-	-	0.775	-	-	-	-	-	0.775
Spondias pinnata (642)	0.020	-	-	-	<del>0.020</del>	-	-	-	-	-	0.020
Syzgium cumini (665)	0.081	0.177	0.948	1.484	0.906	-	-	-	-	-	3.595
Terminalia belerica (676)	0.043	-	0.334	-	-	1.011	-	-	-	-	1.388
Terminalia bialata (677)	0.018	-	-	-	-	-	-	-	-	-	0.018
Terminalia crenulata (681)	0.144	0.172	0.314	-	-	-	-	-	-	-	0.630
Tetrameles nudiflora (688)	0.056	-	-	-	-	-	-	-	-	-	0.056
Toona ciliata (691)	0.053	-	0.276	-	-	-	-	-	-	-	0.329
Tsuga dumosa (697)	0.027	-	-	-	-	-	-	-	-	-	0.027
Unidentified Trees (Others) (924)	1.166	1.508	1.948	0.820	-	-	-	-	-	-	5.441
Total :	7.641	9.105	10.708	6.834	6.820	4.416	1.404	-	-	-	46.929



Species name with code	Diameter classes (in cm.)									
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+ Total
Pajanelia longifolia (510)	-	-	-	11.406	-	-	-	-	-	11.406
Secocarpus nocardium (630)	-	2.121	-	-	-	-	-	-	-	2.121
Shorea robusta (633)	14.542	62.820	83.321	49.175	66.608	25.145	29.433	-	-	331.044
Sloanea assamica (636)	-	-	-	-	16.247	-	-	-	-	16.247
Spondias pinnata (642)	0.425	-	-	-	-	-	-	-	-	0.425
Syzygium cumini (665)	1.690	3.706	19.869	31.120	18.995	-	-	-	-	75.380
Terminalia belerica (676)	0.893	-	7.004	-	-	21.199	-	-	-	29.096
Terminalia bialata (677)	0.372	-	-	-	-	-	-	-	-	0.372
Terminalia crenulata (681)	3.022	3.607	6.583	-	-	-	-	-	-	13.211
Tetrameles nudiflora (688)	1.176	-	-	-	-	-	-	-	-	1.176
Toona ciliata (691)	1.117	-	5.782	-	-	-	-	-	-	6.898
Tsuga dumosa (697)	0.571	-	-	-	-	-	-	-	-	0.571
Unidentified Trees (Others)	24.448	31.614	40.839	17.200	-	-	-	-	-	114.101
(924)										
Total :	160.238	190.918	224.542	143.313	143.016	92.607	29.433	-	-	984.067

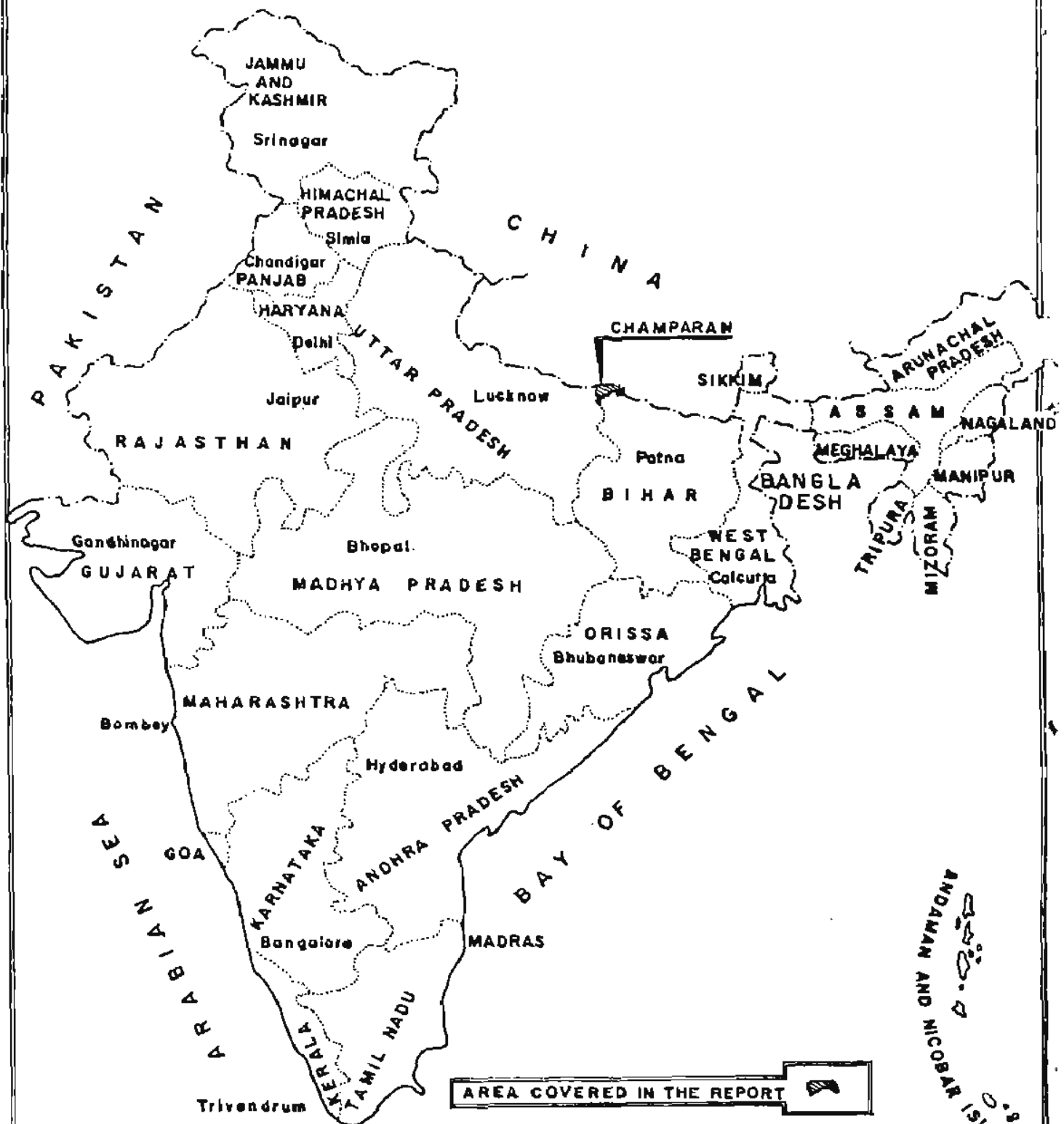


# MAP OF INDIA

SHOWING PROJECT AREA IN CHAMPARAN DISTRICT

BIHAR

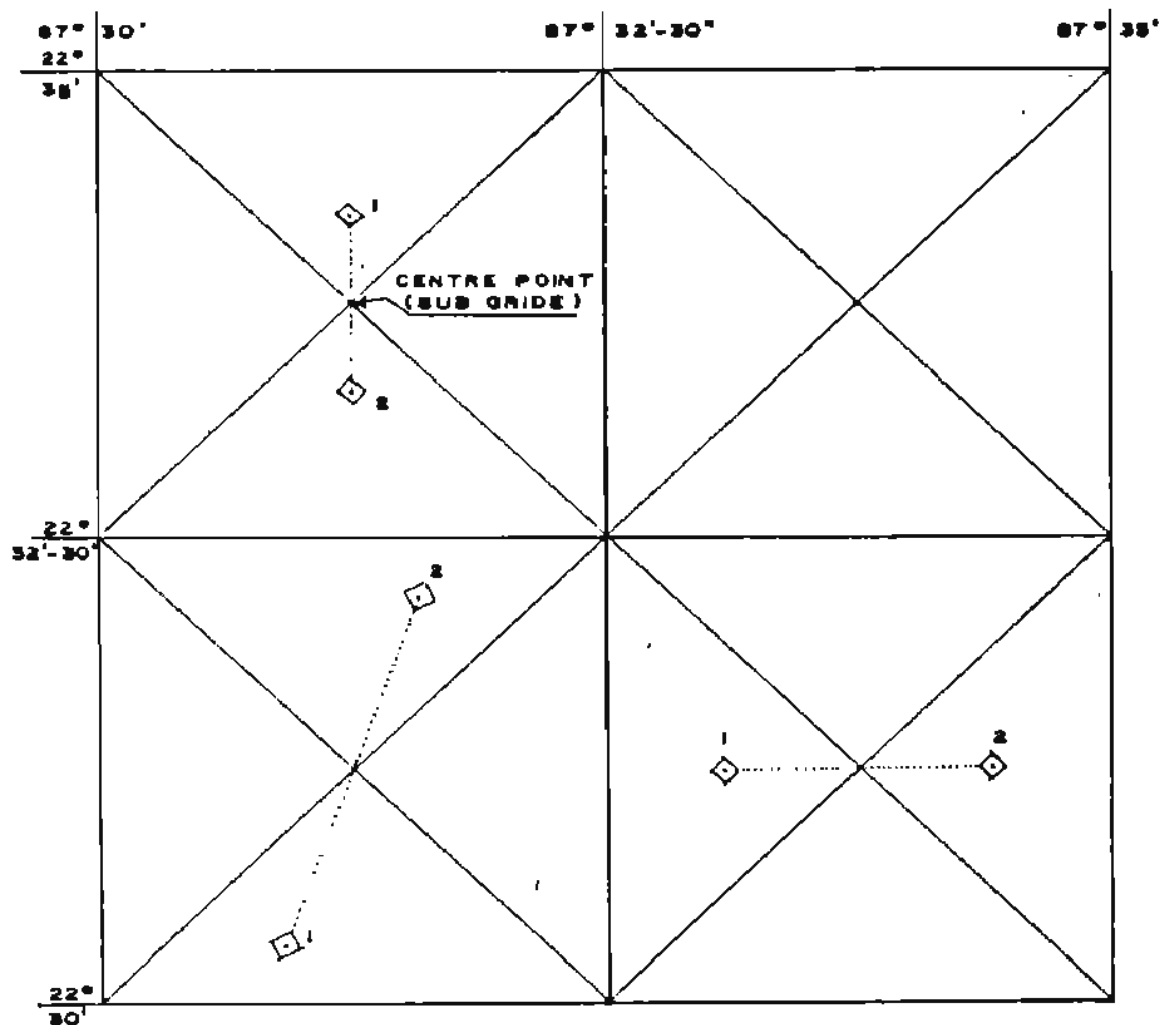
SCALE - 1:15 000 000



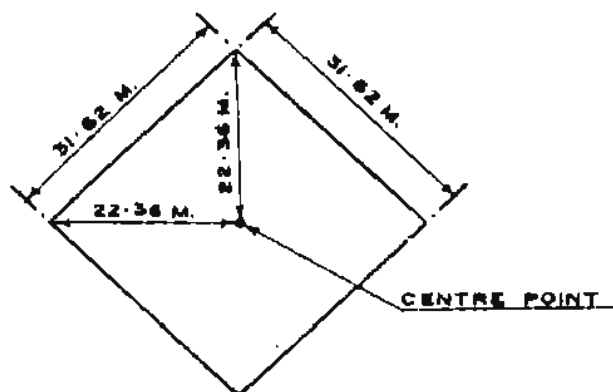
DRAWN BY - RIMAL BHATTACHARYA, Jr. D/man

# FOREST SURVEY OF INDIA

## INVENTORY DESIGN



FIRST PLOT IS SELECTED RANDOMLY AND THE SECOND PLOT IS SITUATED AT AN EQUAL DISTANCE FROM THE CENTRE OF THE FIRST PLOT TO THE CENTRE OF 2'-30" x 2'-30" SUB GRID AND IS JUST IN THE OPPOSITE DIRECTION.



DETAILS OF PLOT

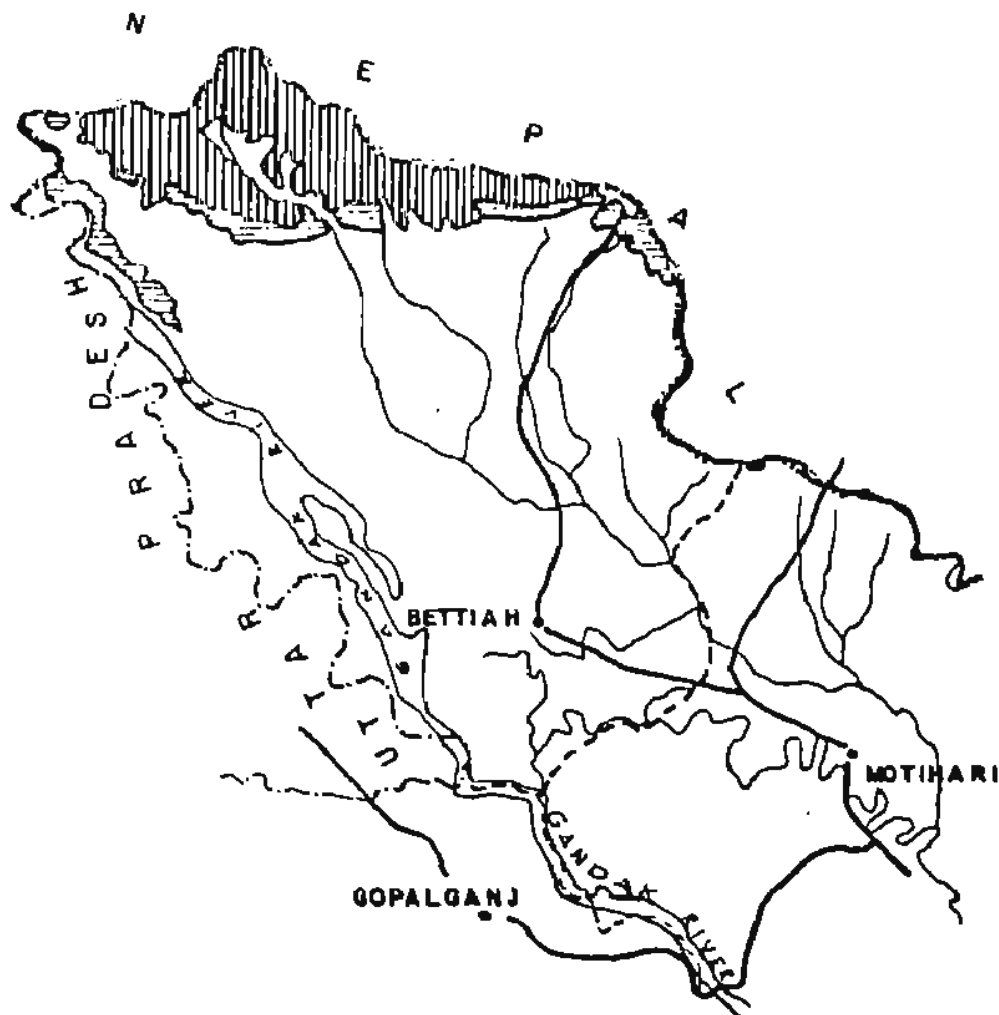
DRAWN BY - Suman Bhattacharjee, Jr.D/man

# MAP OF WEST CHAMPARAN DISTRICT (BIHAR)

BASED ON VISUAL INTERPRETATION OF LANDSAT IMAGERY

PERIOD:- 1981 - 83.

SCALE:- 1:1,000,000

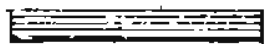


## R E F E R E N C E S

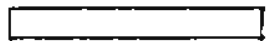
Closed Forest (crown density above 40%)



Open Forest (crown density 10 - 40%)



Non Forest



International Boundary



State Boundary



District Boundary



District Head Quarter



River

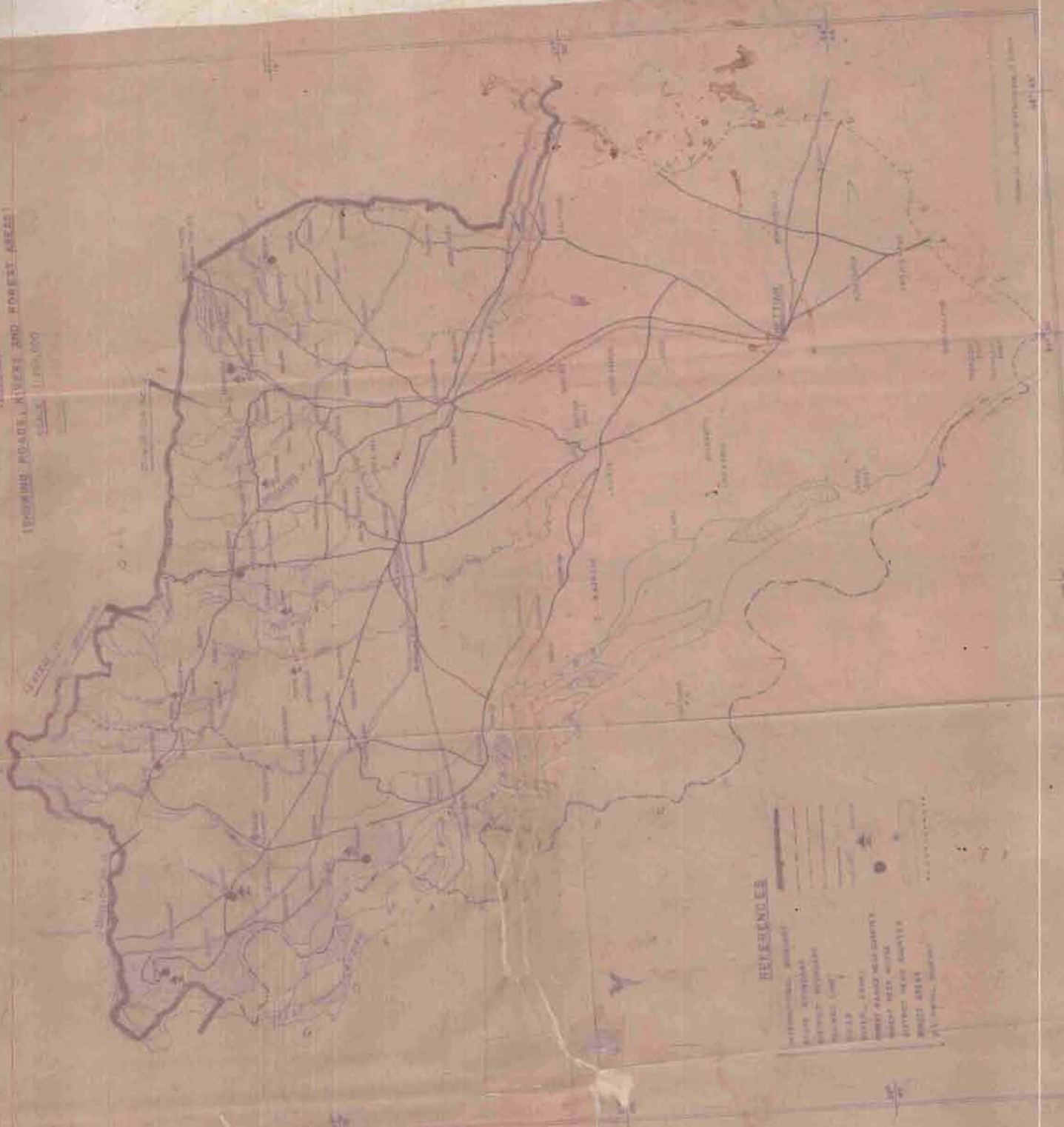


Road



**MAP OF WEST CHAMPARAN DISTRICT**  
**(BIHAR)**

SHOWING ROADS, RIVERS AND FOREST AREAS  
 SCALE 1:100,000



**REFERENCES**

- 1. Survey of India
- 2. District Maps
- 3. District Gazetteers
- 4. District Census
- 5. District Forest
- 6. District Revenue
- 7. District Education
- 8. District Health
- 9. District Industries
- 10. District Agriculture
- 11. District Commerce
- 12. District Transport
- 13. District Public Works
- 14. District Social Services
- 15. District Miscellaneous

