

REPORT ON INVENTORY OF FOREST

RESOURCES OF THE DISTRICTS

OF

**PURULIA, BANKURA, MIDNAPORE,
BURDWAN & BIRBHUM
OF
WEST BENGAL**

PART-I

(MAIN REPORT WITH MAPS, CHARTS & DIAGRAMS)



**FOREST SURVEY OF INDIA
EASTERN ZONE
CALCUTTA
1996**

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P R E F A C E

The five south western districts of West Bengal represent a distinct agro-ecological zone(hot, sub-humid eco-system) characterised by lateritic to shallow morrum red soil, relatively low rainfall with long dry periods, and generally undulating landscape. Alluvial soil is present in parts of Burdwan, Midnapore and Bankura districts but the forest resources are mainly confined to lateritic and red soils. An inventory of the forest resources in these districts was carried out in 1981-82. The present inventory has been undertaken during 1991-92 with the objective of evaluating the present status of forest resources in these districts and estimating the distribution, composition, density, growing stock and growth of the forest crop.

The report incorporates details of the area surveyed, methodology adopted, results/findings and comparison with the last survey. The recorded forest area of these districts totals to 4503 sq.km. which is about 11.60% of the geographic area. The total forest cover in these districts has been estimated to be in the region of 2400 sq.km. in the State of Forest Report, 1993 published by Forest Survey of India. This lower estimate may have resulted partly from the scattered nature of these forests and the composition of the crop comprising, in the main, coppice forests and young plantations, much of which are not detectable during interpretation of satellite imageries due to limitations of resolution of sensors.

The total growing stock of forests in the five districts has been estimated at 5.86 million cu.m. and the volume per ha. at 13.64 cu.m. The number of stems per ha. has been estimated as 538.78. District wise figures are available in the report.

Joint Forest Management was recently introduced in the south western Bengal forests (at the time of the field work in connection with the present inventory). Possible early effects of JFM on the forest crop of this area should be of interest to foresters and others. This has been analysed in the report and early effects of JFM have been discussed.

Officers and staff members of Eastern Zone of FSI who were entrusted with carrying out the inventory and bringing out the report in the present form, deserve much appreciation. A list of officials who have worked for the successful publication of the report has been included in the report. The cooperation and help extended by the State Forest Department of West Bengal is thankfully acknowledged.

I hope that the report will provide necessary inputs and facilitate forest resource management and planning in the State.

Dehra Dun
January, '96.

(Dr. S.N.Rai)
Director.

CONTENTS

CHAPTER: I

BACKGROUND INFORMATION

	<u>Para No.</u>	<u>Page No.</u>
Information	1.1	1
Land configuration	1.2	1
Situation and boundary	1.3	2
Soil	1.4	2
Climate	1.5	2
Drainage system	1.5.1	3
Mineral resources	1.6	4
Socio-economic condition	1.7	4

CHAPTER : II

DESIGN AND METHODOLOGY

General	2.0	6
Area selected for inventory	2.1	6
M a p s	2.2	6
Sampling design	2.3	7
Data collection	2.4	8

CHAPTER: III

DATA PROCESSING AND COMPILATION

General	3.0	9
Manual processing	3.1	9
Input for the computer	3.2	9
Processing on computer	3.3	9
Consistency checking	3.4	10
Construction of volume equations	3.5	10
General volume equation	3.5.1	10
Local volume equation	3.5.2	11
Local volume table-volume(in m ³)	3.5.3	12
Growing stock	3.6	12

CHAPTER : IV

RESULTS OF INVENTORY

General	4.0	13
Inventory coverage	4.1	13
Stratification	4.1.1	13
Analysis of plot description data	4.2	14
Description of forest area by land use classes	4.2.1	15
Distribution of forest area by topography	4.2.2	16
Distribution of forest area by aspect	4.2.3	16
Distribution of forest area by rockiness	4.2.4	17
Distribution of forest area by soil consistency	4.2.5	17
Distribution of forest area by soil texture	4.2.6	17
Distribution of forest area by soil erosion	4.2.7	18
Distribution of forest area by legal status	4.2.8	18
Distribution of forest area by regeneration	4.2.9	19
Distribution of forest area by injuries to crop	4.2.10	19

	<u>Para No.</u>	<u>Page No.</u>
Distribution of forest area by fire incidence	4.2.11	20
Distribution of forest area by grazing incidence	4.2.12	20
Distribution of forest area by plantation potentiality	4.2.13	20
Distribution of forest area by degradation	4.2.14	21
Tree density	4.3	21
Tree density - district Bankura	4.3.1	22
Tree density- district Purulia	4.3.2	24
Tree density - district Midnapore	4.3.3	26
Tree density - district Burdwan	4.3.4	27
Tree density - district Birbhum	4.3.5	28
Total stems	4.4	28
Volume studies	4.5	29
Volume studies - district Bankura	4.5.1	30
Volume studies - district Purulia	4.5.2	31
Volume studies - district Midnapore	4.5.3	33
Volume studies - district Burdwan	4.5.4	34
Volume studies - district Birbhum	4.5.5	35
Total volume	4.6	35
Error calculation	4.7	36
 <u>CHAPTER : V</u>		
<u>SUMMARY AND CONCLUSIONS</u>	-	37
 <u>COMPARISON WITH PAST SURVEY RESULTS</u>	-	39
 <u>B I B L I O G R A P H Y</u>	-	43
 <u>LIST OF TOPOSHEETS</u>	-	44
 <u>LIST OF PARTICIPANTS</u>	-	45

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LIST OF MAPS, DIAGRAMS AND CHARTS

<u>MAPS :</u>	<u>Page No.</u>
1. Map of India showing project area in Purulia, Bankura, Midnapore, Birbhum and Burdwan district.	47
2. Inventory design.	48
3. Map of Purulia, Bankura, Midnapore, Birbhum and Burdwan districts. (West Bengal) showing roads, rivers and important places.	49
4. Map of Purulia District showing distribution of grids by stratum.	50
5. Map of Purulia District showing distribution of grids by important land use classes.	51
6. Map of Bankura District showing distribution of grids by stratum.	52
7. Map of Bankura District showing distribution of grids of important land use classes.	53
8. Map of Midnapore District showing distribution of grids by stratum.	54
9. Map of Midnapore District showing distribution of grids by important land use classes.	55
10. Map of Birbhum district showing distribution of grids by important land use classes.	56
11. Map of Burdwan district showing distribution of grids by important land use classes.	57
12. <u>PIE-CHARTS :</u>	
i) Distribution of forest area by land use classes - district - Purulia	58
ii) - do - - district - Bankura	59
iii) - do - - district - Midnapore	60
iv) - do - - district - Birbhum	61
v) - do - - district - Burdwan	62
13. <u>BAR - CHARTS :</u>	
i) Total stems and total volume by diameter classes-district- Purulia Strata : Sal, Miscellaneous, Plantation.	63-65
ii) - do - - district - Bankura	66-68
iii) - do - - district - Midnapore	69-71
iv) Total stems and total volume - district - Birbhum	72
v) - do - - district - Burdwan.	73

N.B. Statistical tables have been separately published as Part II of the Inventory Report.

FOREST INVENTORY AT A GLANCE

		<u>District</u>				
SL.No.		Bankura	Purulia	Midnapur	Burdwan	Birbhum
1.	Geographical area(km2)	6882	6259	14081	7024	4545
2.	Forest area (km2)	1482	876	1709	277	159
3.a)	Forest area as percentage of geographical area	21.54	14.00	12.14	3.94	3.50
b)	Forest area as percentage of State forest area	12.47	7.37	14.38	2.33	1.34
4. a)	Dense forests as percentage of district forest area	3.52	2.11	2.18	6.38	2.27
b)	Moderate dense forests as percentage of district forest area	25.11	17.37	31.64	19.15	6.82
c)	Open forests as percentage of district forest area	19.82	26.84	18.91	31.91	20.45
d)	Scrub forests as percentage of district forest area	7.05	7.35	3.27	8.51	40.91
e)	Bamboo brakes	-	-	-	-	-
f)	Young plantations of forest spp. as percentage of district forest area	17.18	8.94	22.91	17.02	13.64
5.	<u>Tree data</u>					
	i) No. of stems/ha.	603.911	446.452	582.046	467.845	64.198
	ii) Total stems('000 No.)	86089.851	33942.854	97513.608	12959.300	1020.742
	iii) Volume/ha. (in m3)	14.219	12.139	15.227	10.376	4.663
	iv) Total volume ('000 m3)	2026.925	922.918	2551.015	287.415	74.146

BACKGROUND INFORMATION

1.1 Introduction:

The forest resources of the five districts of West Bengal, namely, Purulia, Bankura, Midnapore, Burdwan and Birbhum had been inventoried on sound statistical footing during 1981-82. Forests of the area of the districts were resurveyed during the period 1991-92 with the objective of estimating the total growing stock in the districts in conformity with the prevailing policy of inventory on ten year cycle.

The present inventory is expected to provide a sound data base and should prove to be invaluable in the assessment of the changing pattern of the forest stocking which had, in the past, been deteriorating very fast due to impending biotic interference that resulted in considerable recession and depletion of the forest capital presenting a dismal picture characterised by low stocking and a general absence of trees having higher girths. The obvious reason of the depletion was an extra-ordinarily heavy pressure on the forests of this tract owing to acute fuel hunger on one hand and a very heavy demand of poles from adjoining collieries of Bihar district as well as from collieries of adjacent districts. The dismal economic condition and lack of employment of the people residing in the vicinity of the forests further aggravated the situation. The protection status of these forests has reportedly registered marked improvement with the introduction of a joint forest management system which seeks to protect and improve the natural Sal forests of the area through participation between the Forest Department and registered Forest Protection Committees of neighbouring forest areas. The present inventory should be able to throw some light into the resultant change, if any, in the crop quality and density on account of such efforts on the part of Forest Department, West Bengal so far.

1.2 Land configuration:

The Bengal plains did not originate only in sedimental deposition. In many areas the sea and swamp area raised up in a complex physiographic way. The western boundary of the State of West Bengal is marked by the districts of Midnapore, Bankura and Purulia, Purulia being the western most district of West Bengal. The Districts of Burdwan and Birbhum fall in the Southern part of the State of West Bengal. The District of Bankura has a wide spread covering alluvial plains on the east and extending on the west to merge into the Chotonagpur plateau in the Western part of Purulia, characterised by undulating topography with hilly terrain that rises to a table land in Ajodhya. The general configuration of land in Midnapore is gently sloping which rises gradually from East to West in East Midnapore and West Midnapore Forest Division. The western part of Midnapore district is also characterised by a somewhat hilly terrain.

1.3 Situation and boundary:

The project area comprises five districts e.g Purulia, Bankura, Midnapore, Birbhum and Burdwan districts. The geographical location of the above five districts are as follows :

Sl.No.	District	Latitude	Longitude
1	Purulia	22°42' to 23°42'	85°48' to 86°55'
2	Bankura	22°39' to 23°39'	86°36' to 87°45'
3	Midnapore	21°36' to 22°57'	86°30' to 88°12'
4	Burdwan	22°57' to 23°51'	86°48' to 88°30'
5	Birbhum	23°33' to 24°35'	87°8' to 88°0'

The boundaries of the above five districts are shown in the map enclosed.

1.4 Soil :

The soil in Birbhum, Bankura vary between laterite, alluvial and red. As one moves from East to West a regular sequence from plains alluvium to pure laterite soil is noticed. The soil in Purulia has been formed by the weathering of *ARCHEAN* granite gneiss. The soil in the upland is lateritic and the soil in the valley, clayey. In Birbhum and Western parts of Bankura and Midnapore, laterite predominates. Here exposure of the laterite beds is a product of erosion of the undulating tracts by tiny rivulets.

The soil in Bankura, Purulia and Birbhum are of poor quality with very low fertility. Water table remains low during the dry period making irrigation difficult. This has greatly affected the agricultural production. Besides, poor site quality in the districts have rendered tree growth poor, particularly in the western tract.

In comparison, the soil in Burdwan district is rich with high fertility; this has resulted in high agricultural production.

1.5 Climate

Although the monsoon is the dominating feature as elsewhere in India, yet the onset of monsoon, the duration, the date of withdrawal and the intensity of rainfall in the districts differ from those in the upper gangetic plains, causing a marked difference in the two types of climate. There are three distinct seasons - hot and dry from March to early June, hot and humid to wet from mid June to September and cool from October to February. The annual rainfall in the five districts are as under :

(A) Rainfall (mm) :

Sl.No.	District	Normal	Actual:199	Actual:199
1	Birbhum	1234	1542	1348
2	Burdwan	1271	1557	1443
3	Bankura	1271	1640	1587
4	Purulia	1365	1811	1231
5	Midnapore	1428	2152	1584

(B) Temperature:

Maximum and minimum temperatures in celsius are as mentioned below :

Sl.No.	Station	Year 1991	
		Maximum	Minimum
1.	Burdwan	44	5
2.	Suri	42	8
3.	Bankura	39	7
4.	Midnapore	44	10
5.	Purulia	44	8

Source : State Report on West Bengal Forests, 1993-94.

1.5.1 Drainage System :

The districts are fortunate to have a good dranaige network. The Birbhum district is fed by rivers called Pagla, Bansoli, Brahma, Dwarka, Mayurakshi and Ajoy. These are all rain- fed streams which dwindle from mighty monsoon rivers to broad sand bed trickles in the leanest season of the year. The district of Midnapore is drained by three big rivers i.e. Rupnarayan, Kangsaboti and Subarnarekha as also by several small rivers and rivulets. Purulia is drained by rivers Kasai, Damodar and Dwarakeshwar. Besides, several small rivers and rivulets feed the district. The district of Bankura is fed by Damoder, Sali, Silabati, Berai, Kumari, Dwarakeshwar, Kangsabati(Kasai) and Bharabanki.

1.6 Mineral Resources:

Laterite rocks including laterites of minor types used mainly in road making is available in plenty in the districts, specially in South & North Midnapore and in Ghatal sub-division. Morrum of minor type is available in North and South Midnapore, Chandrakona, Jhargram and Kharagpur. Occurrence of Manganese ore has been reported from such areas as Birmahal, Jaipur, Labani, Banspahar, Simulpal and Sarisabasa. The reserves near Belpahari, some 16 kilometres away from Jhargram, is about 1 million tonne. A small iron ore has been found in Jhargram. Another important mineral is common salt.

The district of Burdwan is rich in mineral resources like coal and iron. Besides deposits of limestone, phosphate, barytes, quartz, & feldspar have been reported in the district.

In the district of Purulia minerals like china clay, coal, dolomite, mineral pigment, magnetite ore and mica are noticed.

The district of Purulia is endowed with deposits of a wide range of minerals which characteristically belong to non-metallic stratum. They include coal, limestone, phosphates, barytes, feldspar, quartz, quartzite and china clay.

The population of the five districts is given below for rural and urban sector :

Sl.	District	Total	Rural	Urba
1	Midnapore	8331912	7510917	82099
2	Bankura	2805065	2572587	23247
3	Purulia	2224577	2014571	21000
4	Burdwan	6050605	3927613	21229
5	Birbhum	2555664	2326101	22956

1.7 Socio-economic condition :

The economic condition of the people in the five district varies considerably. The people in the district of Purulia are very poor. Most of the people in the district live below the poverty line. Per capita income in agricultural sector is estimated to be Rs.267.20 as against Rs.799.00 in Burdwan and Rs.384.40 in Bankura during the period 1970-71.

The district of Bankura reflects a similar picture. In spite of the presence of rich mineral resources, the district is industrially backward. The district totally lacks any major industrial venture.

The economic condition of the people of the district of Midnapore is better and yet, far from satisfactory. Although agriculture is the mainstay of the population, the sector could not develop satisfactorily in the past and the low yield of agriculture has been primarily due to erratic rainfall in most of the years that lead to frequent crop failure. Since 1971, the district has witnessed an accelerated pace of industrial activity and the agricultural productivity has improved. Haldia and Kharagpur have come up as flourishing industrial agglomerations, accommodating several industries.

The district of Burdwan reflects a rosy scenario in comparison. The agricultural production of the district surpasses all the other districts in the project area. The industrial development in the district is also encouraging.

Asansol and Raniganj in the district of Burdwan are in the coal mining belt in West Bengal. Fire clay production was developed by Burn & Co. at Raniganj for pottery and sandstone. Durgapur is outstanding not only in its steel and alloy production but also in certain basic large and small scale industries. The Government of West Bengal has been encouraging the growth of industries in each of the districts and exploring possibilities of starting new units. The table below shows the trend of new registration of cottage and small scale industries in the five districts:

Sl. No.	District	Years (figures in number)		
		1986-87	1988-89	1990-19
1.	Burdwan	2177	2417	2736
2.	Birbhum	865	1099	713
3.	Bankura	683	1073	929
4.	Midnapore	1983	3214	3658
5.	Purulia	751	857	773

Ref: Introducing West Bengal, Govt. of West Bengal Publication.

From the table above, it is evident that there is an upward trend in the industrial scenario of Burdwan and Midnapore districts. The districts of Bankura, Purulia and Birbhum reflect a downward trend. However, it is expected that in coming years the districts will demonstrate an encouraging picture.

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CHAPTER:II

DESIGN AND METHODOLOGY

2.0 General :

Since the inventory entails a wide spectrum of information and data is collected for different parameters, an approved manual of instructions for field inventory by Forest Survey of India, Dehradun has been followed for carrying out the survey of Purulia, Bankura, Midnapore, Burdwan and Birbhum Districts of West Bengal.

2.1 Area selected for inventory:

Following areas are treated as forest areas for the purpose of forest inventory.

- i) Area shown in green wash on the Survey of India toposheets.
- ii) All such areas in which woods such as thick jungle, open forests, bamboos etc. are printed.
- iii) All those areas indicated by dotted line or spotted line or a pillar line as forest areas.
- iv) Any other areas reported to be forested areas by local forest department.

2.2 M a p s :

The following Survey of India toposheets in the scale of 1:50,000 were used during the present inventory:

<u>Sl.No.</u>	<u>Name of the district</u>	<u>Toposheet No.</u>
1.	Birbhum	1. 72P/4, 8, 11,12, 14, 15, 16 2. 73M/1, 2, 5, 6, 9, 10, 13 14
2.	Bankura	1. 73I/14, 15, 16, 12 2. 73J/9, 10, 13, 14 3. 73M/2, 3, 4, 6, 7, 8, 11, 12 4. 73 N/1, 2, 5, 9
3.	Burdwan	1. 73 I/13, 14 2. 73 M/1, 2, 6, 7, 10, 11, 12, 13, 14, 15, 16 3. 73 N/9, 13 4. 79 A/1, 2, 3, 4, 6, 7, 8 5. 79 B/1
4.	Purulia	1. 73E/15, 16 2. 73I/2, 3, 4, 6, 7, 8, 10, 11, 12, 14, 15, 16 3. 73 J/1, 5, 6, 9, 10
5.	Midnapore	1. 73J/9, 10, 12, 14, 15, 16 2. 73 N/1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12,14,15,16. 3. 73 O/1, 5, 6, 9, 10, 13, 14 4. 73B/4 5. 73C/1

2.3 Sampling design :

a) **Gridding of maps :** The design is systematic with grid distance of 2.5' x 2.5' of latitude and longitude with two sample plots selected from each grid, one at random and the other linked to the first in the opposite direction at an equal distance from the grid centre (Ref. Diagram - 2). These form the basic sampling unit. Thus, 72 plots are laid out in a toposheet with 36 grids on 1:50,000 scale. One sample plot of 0.1 ha. represents about 10 sq.km. on the ground and the intensity of sampling is 0.01%. The length of each side of the square shaped sample plot is 31.62 meter on the ground and 0.6324 mm. (say 0.6 mm.) on the toposheet of scale 1:50,000.

b) **Precision and accuracy of the survey :** The result of the survey would be at the precision level of 95% probability with error limit of $\pm 10\%$ at the state level.

c) **Marking of plot centre :** The method of marking of the plot centres of these two sample plots on the map in each grid of 2.5' x 2.5' is shown in diagram at the end of the report

First, the length and width of each grid are measured to the smallest convenient scale. The length of the side of the plot on the map corresponding to a 0.1 ha square plot on the ground is calculated. Let X and Y be the length and width of the grid and S the side of the plot. Subtract side S from both sides i.e. find $(X-S)$ and $(Y-S)$. Let, these numbers be X' and Y' . Two random numbers, one in the range of 0 to X' and the other in the range of 0 to Y' are selected. These numbers are called x and y respectively. Half of the side of the plot ($S/2$) each are added to find $x + S/2$ and $y + S/2$. Then $x + S/2$ and $y + S/2$ will be the co-ordinates of the centre of the first plot in the grid, considering the left hand bottom corner (SW corner) of the grid as the origin of the axes. The centre of the second plot is located by joining the centre of the first plot with the grid (sampling unit) centre and extending this line in the opposite direction. A point at an equal distance from the grid centre in the opposite direction is marked which will be the centre of the second plot.

Thus, it may be seen that the sampling design adopted was a random sampling with grids as sampling units having a cluster of two plots.

d) **Laying out of the plot:** The plot centre is the intersection of diagonals of the 0.1 ha. plot. Diagonals are aligned NW-SE and NE-SW measuring 44.72 m each. After having approached the plot centre with the help of toposheet and reference point, corners of the plot are fixed with respect to the plot centre by measuring 22.36 m. in each of the directions viz. North-West, South-East, North-East and South-West directions respectively from the plot centre. The North, East, South and Western extremities of the plot are fixed by measuring 15.81 m from plot centre in each of these directions (See Diagram-3).

2.4 Data Collection :

Data in the field is collected by an inventory crew (team) headed by a crew leader. To visit a plot, a prominent reference point is selected in the vicinity of the plot centre. The reference point must be clearly visible on the map as well as on the ground e.g. a *nala* junction or an identifiable natural feature on the spot and is marked by a peg with appropriate markings. For collection of information in codified form from each sample plot, the following forms are used:

a) **Plot approach form:** It gives an account of details regarding the approach to the plot. All the details from camp site to the plot centre are recorded. Prominent reference point along with bearings is recorded which serves as an aid to reach the plot at a future date.

b) **Plot description form :** The description of several parameters such as topography, soil, land use class, forest type, regeneration, crop data etc. are collected and recorded in this form for an area of 2 ha. around the plot.

c) **Plot enumeration form:** This form is filled up for each plot. The details recorded are the name of the species, its code and diameter. Trees less than 10 cm. d.b.h. and utility less than 70% are not recorded usually. But in South Bengal trees down upto 5 cm.D.B.H.(OB) were also recorded as a special case to take into account poles from coppice growth which form the major crop in Sal forests of this tract. Border trees are counted 'IN' when they touch NW-NE and NW- SW boundaries and considered 'OUT' when they touch NE - SE and SW-SE boundary lines.

d) **Sample tree form :** Data for trees with diameter 10 cm. and above at breast height are collected from the North West quadrant of the plot. In this form, additional data e.g. tree height, bark thickness, length of clear bole, shape of the tree etc. are recorded.

e) **Bamboo enumeration form:** This form is designed for enumeration of bamboo culms per clump by age of culms and soundness of culms by clump size. Separate forms are used for clump forming and non-clump forming bamboos.

f) **Bamboo weight form:** To determine the green weight and dry weight of bamboo, this form is maintained. Mature bamboos are selected from each diameter class and for each species; 30 cm. long pieces from the bottom, middle and top are selected and their green weights recorded. These pieces are properly documented and kept in the base camp and weighed every 30 days till a constant weight is obtained.

Since bamboos did not occur widely (over large areas or with conspicuous presence) in South Bengal districts covered by the present survey, the details of the kind of data collected there, have not been elaborately tabulated. Hence the use of form (e) and (f) were very limited.

CHAPTER - III

DATA PROCESSING AND COMPILATION

3.0 General :

Data processing is carried out in two phases, viz. manual processing and processing on computer.

3.1 Manual processing:

It involves the following steps :

- i) Proper documentation of the field information received.
- ii) Codification of the information in the field forms which has not already been incorporated.
- iii) Manual checking of the information filled in the forms.
- iv) Reconciliation of the discrepancies with the help of the field officers.

3.2 Input for the computer :

After manual checking the information of the field forms were transferred on the magnetic tape. The following data is stored in the tape for onward processing.

- i) Plot description data.
- ii) Plot enumeration data.
- iii) Sample tree data.

3.3 Processing on computer :

Processing on computer includes the following stages:

- i) Loading of the field data in Computer. Verification and correction of data for the creation of clean file and then transference of the same to hard /floppy disk.
- ii) Consistency checking of the data on computer.
- iii) Correction of the data to remove discrepancies noticed during consistency checking.
- iv) Tabulation of Stem distribution plotwise and for the district as a whole.
- v) Preparation of tables of volume distribution.
- vi) Analysis of plot description data.
- vii) Calculation of standard error.

3.4 Consistency checking :

Suitable computer programmes were developed for checking the consistency of the data. The discrepancies discovered were resolved in consultation with the field officers. Listing of the data from the floppy/hard disk was taken to verify if the corrections have been incorporated or not.

3.5 Construction of volume equations:

No trees were felled during the survey for the areas. The general volume and local volume equations developed for Purulia, Midnapore and Bankura Districts in earlier surveys were used to calculate the volume of different species.

3.5.1 General volume equation:

General volume equations were used for the following important species in the present survey:

1. Shorea robusta.
2. Anogeissus latifolia.
3. Syzygium cuminii.
4. Adina cordifolia.
5. Terminalia tomentosa.
6. Boswellia serrata.
7. Rest of the species.

The equations given below have been used to estimate the tree volume from the present survey :-

Sl.No.	Species Name	Equations
1.	Anogeissus latifolia	$V/D^2 H = 0.45110 + 0.0161/D^2 H$
2.	Syzygium cuminii	$V/D^2 H = 0.3750 - 0.001154/D^2 + 0.0077689/D^2 H$
3.	Adina cordifolia	$V/D^2 H = 0.55615 - 0.0052355/D^2 H$
4.	Shorea robusta	$V/D^2 H = 0.37802 + 0.0041834/D^2 H$
5.	Boswellia serrata	$V/D^2 H = 0.43527 - 0.0018469/D^2 + 0.0057489/D^2 H$
6.	Terminalia tomentosa	$V/D^2 H = 0.42823 - 0.002149/D^2 H$
7.	Rest of the species	$V/D^2 H = 0.50894 - 0.0019764/D^2 + 0.0078117/D^2 H$

V = Total under bark volume in cu.m. including branches.

D = Over bark diameter (m) at breast height.

H = Height of the tree (m).

3.5.2 Local volume equation:

The following local volume equations have been used in the present inventory:

Sl.No.	Species Name	Equations
1.	Anogeiss latifolia	$V = 0.28653 - 0.97687D + 11.024D^2$
2.	Syzygium cuminii	$V/D^2 = 6.2214 - 0.49647/D + 0.016042/D^2$
3.	Adina cordifolia	$V/D^2 = 13.437 + 0.04472/D^2 - 1.3527/D$
4.	Shorea robusta	$V/D^2 = 8.714 - 0.70158/D + 0.022585/D^2$
5.	Boswellia serrata	$V/D^2 = 10.306 - 1.124/D + 0.03356/D^2$
6.	Terminalia tomentosa	$V/D^2 = 94721 - 0.84158/D + 0.022389/D^2$
7.	Rest of the species	$V/D^2 = 9.5879 - 0.89224/D + 0.025584/D^2$

V = Total underbark volume of tree including branches (in m³).

D = Over bark diameter (m) at breast height.

H = Height of the tree (m).

3.5.3 Local volume Table - Volume(U.B.) in m³ :

Dia. class (in cm.)	Anogeissus latifolia	Syzygium cuminii	Adina cordifolia	Shorea robusta	Boswellia serrata	Terminalia tomentosa	Other species
05-09	0.014	0.011	0.018	0.016	0.005	0.009	0.010
10-19	0.118	0.074	0.131	0.104	0.087	0.099	0.097
20-29	0.451	0.267	0.519	0.373	0.376	0.384	0.382
30-39	1.003	0.585	1.177	0.817	0.872	0.859	0.858
40-49	1.776	1.027	2.103	1.435	1.574	1.523	1.527
50-59	2.770	1.593	3.298	2.228	2.481	2.377	2.387
60-69	3.984	2.284	4.762	3.195	3.595	3.420	3.438
70-79	5.419	3.099	6.494	4.336	4.916	4.652	4.682
80-89	7.074	4.039	8.496	5.651	6.442	6.074	6.117
90+	8.950	5.102	10.765	7.141	8.174	7.685	7.744

3.6 Growing stock:

Analysis of growing stock was carried out from plot data and per hectare figures worked out for each stratum distributed into various diameter classes. Stems per hectare and total stems were calculated and distribution into various diameter classes were done. Similar calculations i.e. volume per hectare and total volume distributed over different diameter classes were also computed.

Following are the important tables generated for each stratum:

- Stems/ha. for individual species and distribution into diameter classes as earlier.
- Total stems by species and diameter classes 5-9, 10-19 cm., 20-29 cm., 30-39 cm., 40-49 cm., 50-59 cm., 60-69 cm., 70 cm and above.
- Corresponding volume/ha. by species and diameter class.
- Total volume by species and diameter class.

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CHAPTER - IV

RESULTS OF INVENTORY

4.0 General :

In the present inventory data has been analysed at the district level separately for each stratum with a view to highlighting the type, composition and distribution of the tree vegetation in the area.

4.1 Inventory coverage :

Inventory area comprises the districts of Midnapore, Bankura, Purulia, Birbhum and Burdwan districts of West Bengal. The geographical and forest areas of the above districts are given below:

Sl.No.	District	Geographical area (km ²)	Forest area (km ²)
1.	Bankura	6882.00	1482.00
2.	Purulia	6259.00	876.00
3.	Midnapore	14081.00	1709.00
4.	Birbhum	4545.00	159.00
5.	Burdwan	7024.00	277.00

4.1.1 Stratification :

Stratification was based on proportional distribution of the forested plots as per forest composition and land use class. 'Plantation' has been kept as a separate stratum. The forest plots composing barren land, grass land, and blank are merged and included in 'Barren land' stratum. On such basis, the following strata have been formed for the above districts for analytical purposes.

Sl.No.	District	Stratum	No. of plots	Forested area(sq.km.)	Percentage
1.	Bankura	Sal	109	769.23	51.90
		Miscellaneous	34	239.94	16.19
		Plantation	59	416.37	28.10
		Barren land	8	56.46	3.81
		TOTAL	210	1482.00	100.00
2.	Purulia	Sal	31	170.79	19.50
		Miscellaneous	82	451.77	51.57
		Plantation	25	137.72	15.72
		Barren land	21	115.72	13.21
		TOTAL	159	876.00	100.00

Sl.No.	District	Stratum	No. of plots	Forested area (km2	Percentage
3.	Midnapore	Sal	167	1123.64	65.75
		Sal with Misc.	26	174.93	10.24
		Plantation	56	376.79	22.05
		Barren land	5	33.64	1.96
		TOTAL	254	1709.00	100.00

In view of the very few number of plots surveyed and the low forest areas in Birbhum and Burdwan districts, stratification was neither necessary nor possible. The distribution figures of geographical and forest areas and number of plots surveyed are given below :

Sl.No.	District	Geographical are (km2)	Forested area (km2)	No. of plots surveyed
1.	Birbhum	4545.00	159.00	44
2.	Burdwan	7024.00	277.00	47

The results of the inventory are discussed in detail by analysing the Plot Description Form by districts and the data on Plot Enumeration Form by strata.

4.2 Analysis of plot description data :

In the analysis of plot description data, the percentage occurrence of various description parameters are worked out and the required information generated. The plot data collected during inventory in respect of soil, terrain condition, crop etc. were analysed. The results of the same are summarised below :

4.2.1 Description of forest area by land use classes:

Sl. No.	Land use	Description	Percentage of occurrence				
			Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	Dense tree forest	Forest with canopy density 70% and above	2.11	3.52	2.18	2.27	6.38
2.	Moderately dense tree forest.	Forest with canopy density 30% to 69%.	17.37	25.11	31.64	6.82	19.15
3.	Open tree forest	Forest with canopy density 5% to 29%	26.84	19.82	18.91	20.45	31.91
4.	Scrub forest	Forest with canopy density less than 5%	7.37	7.05	3.27	40.91	8.51
5.	Bamboo brakes	Areas completely covered with bamboo.	-	-	-	-	-
6.	Shifting cultivation	Areas under current as well as previous year's shifting cultivation.	-	-	-	-	-
7.	Young plantation of forest species		8.94	17.18	22.91	13.64	17.02
8 to 10	Trees in line	Trees along forest road, canal banks, railway lines and Govt. grass land etc.	1.06	0.44	0.73	-	-
11.	Barren land		11.05	3.08	1.09	6.82	2.13
12.	Agriculture land without trees		12.11	4.41	3.63	-	-
13.	Agricultural land with trees.		1.05	1.32	0.73	-	2.13
14.	Non-forest plantation		-	-	-	2.27	-
15.	Habitation		3.15	1.32	3.27	2.27	-
16.	Water bodies		-	0.88	-	-	-
18.	Young crop of natural or artificial regeneration		8.95	15.87	11.64	4.55	12.77
TOTAL:			100.00	100.00	100.00	100.00	100.00

The above table reveals that in most of the districts, the bulk of forests are moderately dense and open tree forests. In Birbhum district, however, the percentage of scrub forests and open forests are much higher. There is a preponderance of young plantations of forest species in Midnapore district followed by Bankura, Burdwan, Birbhum and Purulia in that sequence.

4.2.2 Distribution of forest area by topography :

The percentage of forest area by topography is given below :-

Distribution in percentage						
Code.	Topography	Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	Flat	35.22	77.62	75.20	97.67	80.85
2.	Gently rolling	19.50	17.62	18.90	2.33	19.15
3.	Hilly	40.25	4.29	4.33	-	-
4.	Vcry Hilly	3.77	0.47	-	-	-
	Unrecorded	1.26	-	1.57	-	-
	TOTAL	100.00	100.00	100.00	100.00	100.00

As expected the forests in Purulia district occupy more hilly and gently rolling topography whereas Bankura has a higher percentage of forests in flat land and gently rolling land. 75% of Midnapore forests are in flat land and about 19% are in gently rolling land, presumably in the western part of the district. Burdwan district also has some gently rolling topography towards the north whereas Birbhum has forests mostly in flat land.

4.2.3 Distribution of forest area by aspect :

The distribution of forest area by various aspect classes for the five districts is stated below:-

Distribution in percentage						
Code.	Aspect	Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	Northern	11.32	2.86	3.15	2.32	2.12
2.	North-Eastern	8.80	5.24	2.76	-	4.25
3.	Eastern	6.29	2.38	0.79	-	-
4.	South-Eastern	6.29	3.81	2.76	-	4.25
5.	Southern	7.55	3.81	4.72	-	-
6.	South-Western	11.95	1.90	3.94	-	10.64
7.	Western	3.15	0.95	1.18	4.65	-
8.	North-Western	10.06	2.38	1.18	-	2.12
9.	No aspect	33.33	76.67	77.55	93.03	76.62
	Unrecorded	1.26	-	1.97	-	-
	TOTAL	100.00	100.00	100.00	100.00	100.00

The above table is self explanatory.

4.2.4 Distribution of forest area by rockiness :

The percentage of area by rockiness classes is as under :-

Distribution in percentage						
Code.	Rockiness	Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	High	-	-	-	-	-
2.	Medium	10.06	0.95	-	2.33	2.13
3.	Low	17.61	3.33	0.39	11.63	29.78
4.	No rock	71.07	95.72	98.03	86.04	68.09
	Not recorded	1.26	-	1.58	-	-
	TOTAL	100.00	100.00	100.00	100.00	100.00

The above table reveals medium to low rockiness in Purulia forests to the extent of 28% which is slightly higher in Burdwan viz. about 32% and much lower in Birbhum (14%),whereas Bankura and Midnapore forests have negligible rockiness.

4.2.5 Distribution of forest area by soil consistency:

The soils in the surveyed area are found to be under the following categories :

Distribution in percentage						
Code.	Soil consistency	Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	Friable	14.46	4.76	4.73	-	36.17
2.	Slightly compact	69.19	71.91	85.43	97.67	59.57
3.	Compact	15.09	23.33	8.27	2.33	4.26
4.	Cemented	-	-	-	-	-
5.	No soil	-	-	-	-	-
	Unrecorded	1.26	-	1.57	-	-
	TOTAL	100.00	100.00	100.00	100.00	100.00

An analysis of the table reveals that soil in Purulia and Burdwan district are friable to the extent of 14.46% and 36.17% respectively. Balance portion in these districts have mostly slightly compact to compact soil. The other three districts also have slightly compact to compact soil in the forest areas.

4.2.6 Distribution of forest area by soil texture :-

Distribution in percentage						
Code.	Soil texture	Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	Clayey	0.63	0.48	0.39	-	-
2.	Clayey loam	16.35	24.76	24.02	6.98	4.25
3.	Loam	59.75	66.19	65.35	81.39	42.55
4.	Sandy loam	21.38	8.57	8.66	11.63	53.20
5.	Sandy	0.63	-	-	-	-
6.	No soil	-	-	-	-	-
	Un-recorded	1.26	-	1.58	-	-
	TOTAL:	100.00	100.00	100.00	100.00	100.00

The soil texture in the five districts as apparent from the above table ranges between clay loam and sandy loam while loamy soil prevails largely with its percentage of occurrence varying between 42 and 82%. Burdwan has a substantial portion of its forests viz. 53.2% in sandy loam soil. The soil in Purulia forests are almost entirely clayey loam to sandy loam soil and that in Bankura and Midnapore is clayey loam and loamy soil. The percentage of clayey soil and sandy soil are negligible in all the five districts.

4.2.7 Distribution of forest area by soil erosion:

The extent of soil erosion in the five districts is given below :

Code.	Soil erosion type	Distribution in percentage				
		Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	Heavy erosion	18.24	6.67	8.66	-	2.13
2.	Moderate erosion	27.67	6.19	7.87	6.97	2.13
3.	Mild erosion	45.91	37.62	38.58	37.20	59.57
4.	No erosion	6.91	49.52	43.31	55.83	36.17
	Unrecorded	1.27	-	1.58	-	-
	TOTAL	100.00	100.00	100.00	100.00	100.00

Mild erosion is marked in all the five districts varying between 37.2% in Birbhum and about 60% in Burdwan. Clubbing moderate erosion and heavy erosion together, Purulia forests soil occupy the highest position viz. 45.91%. Added to that is another 45.91% of mild erosion. It indicates that erosion in forest soil is maximum in Purulia district among the five districts under review. The situation in Birbhum is best among the five districts with no erosion in about 56% of forest soil.

4.2.8 Distribution of forest area by legal status:-

The following table shows the distribution :-

Code.	Legal status	Distribution in percentage				
		Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	Reserved forest	8.81	0.95	3.15	9.30	2.13
2.	Protected forest	78.62	98.09	90.94	88.37	93.61
3.	Unclassed Govt. Forest	8.81	-	3.94	2.32	-
4.	National Park	-	-	-	-	-
5.	Private forest	-	-	-	-	2.13
6.	Private land with-trees owned by Govt.	-	-	-	-	-
7.	Undetermined	0.63	0.48	0.39	-	-
	Unrecorded	3.13	0.48	1.58	-	2.13
	TOTAL	100.00	100.00	100.00	100.00	100.00

The legal status of forests in the five districts appears to be satisfactory with protected forests occupying most of the plots.

4.2.9 Distribution of forest area by regeneration:

Degree of regeneration in the five districts is as under :-

Distribution in percentage						
Code.	Intensity of regeneration	Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	Adequate	47.16	37.62	57.48	11.62	78.26
2.	Inadequate	35.85	50.48	37.80	41.86	17.40
3.	Absent	3.14	7.14	0.79	32.56	-
	Unrecorded	13.85	4.76	3.93	13.96	4.34
	TOTAL	100.00	100.00	100.00	100.00	100.00

The status of regeneration appears to be satisfactory in Burdwan district from the above table. The regeneration status here works out to more than 78% in 'adequate' category. The regeneration status is poorest in Birbhum district with regeneration 'inadequate' to 'absent' in about 75% of the forests. There is adequate regeneration to the extent of about 57.48% in Midnapore, 47.16% in Purulia and 37.62% in Bankura district whereas the percentages of inadequate regeneration are about 38%, 36% and 50% respectively in these three districts. The overall position of regeneration is thus not encouraging.

4.2.10 Distribution of forest area by injuries to crop:

Major injuries to crop as noticed during the course of inventory is as follows :-

Distribution in percentage						
Code.	Injuries to crop	Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	Borer attack, damage by other pest epidemic	-	-	-	-	-
2.	Top drying	-	-	-	-	-
3.	Illicit felling	68.55	72.86	91.73	65.11	93.48
4.	Scaring of trees	0.63	-	-	-	-
5.	Lopping for fodder	-	1.90	-	9.30	-
6.	Wind & flood damage.	-	0.48	-	-	-
7.	i) Wildlife ii) Lightning	-	0.48	-	-	-
8.	No injury	18.24	20.00	4.33	13.96	4.35
	Unrecorded	12.58	4.28	3.94	11.63	2.17
	TOTAL	100.00	100.00	100.00	100.00	100.00

Analysis of the table above reveals that illicit felling is still the major source of injury to crop.

4.2.11 Distribution of forest area by Fire Incidence:-

Percentage of area affected by fire in the five districts is as under :-

		Percentage of distribution				
Code	Fire Incidence	Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	Heavy	-	-	-	-	-
2.	Moderate	15.72	8.09	14.96	-	26.09
3.	Occasional	28.93	17.62	24.02	23.26	30.43
4.	No fire	42.77	70.48	57.09	72.09	41.30
	Unrecorded	12.58	3.81	3.93	4.65	2.18
	TOTAL	100.00	100.00	100.00	100.00	100.00

Fire incidence is not abundant in the five districts. Relatively higher incidence of fire is noticed in Burdwan district followed by Purulia district.

4.2.12 Distribution of forest area by grazing incidence:

The intensity of grazing for the five districts is as follows:-

		Percentage of occurrence				
Code.	Grazing incidence	Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	Heavy grazing	10.06	21.43	15.75	39.53	60.88
2.	Moderate "	39.62	39.52	50.79	25.58	26.09
3.	Light "	30.19	27.62	25.20	23.26	8.69
4.	No "	7.55	8.09	4.33	6.98	2.17
	Unrecorded	12.58	3.34	3.93	4.65	2.17
	TOTAL	100.00	100.00	100.00	100.00	100.00

'Heavy grazing' varies between 10% in Purulia forests and about 61% in Burdwan forests. Moderate to light grazing are preponderant in all the five districts.

4.2.13 Distribution of forest area by plantation potentiality:

Plantation potentiality can be judged by the following table:

		Percentage of distribution				
Code.	Plantation potentiality	Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	Plantable	50.94	27.14	25.20	58.14	36.96
2.	Unplantable	2.51	3.33	-	-	-
3.	Not applicable	40.88	69.53	72.83	37.21	63.04
	Unrecorded	5.67	-	1.97	4.65	-
	TOTAL	100.00	100.00	100.00	100.00	100.00

Purulia and Birbhum have highest plantable areas in forests followed by Burdwan, Bankura and Midnapore districts.

4.2.14 Distribution of forest area by degradation :

The degradation status of forest is reflected in the following table:-

Percentage of distribution

Code.	Degraded status	Purulia	Bankura	Midnapore	Birbhum	Burdwan
1.	Grazing, fire, pollarding, illicit cutting, lopping					
11	Heavily degraded	53.46	30.95	30.31	62.79	52.17
12	Moderately degraded	16.98	23.81	43.31	16.28	36.96
13	Mild degraded	11.32	27.14	20.47	6.98	6.52
14	Not degraded	13.21	15.71	3.94	13.95	4.35
2.	Other natural calamity such as landslide, glaciers, rainfall etc.					
21	Heavily degraded	-	-	-	-	-
22	Moderately degraded	0.63	-	-	-	-
23	Mild degraded	-	0.48	-	-	-
24	Not degraded	-	-	-	-	-
	Unrecorded	4.40	1.91	1.97	-	-
	TOTAL	100.00	100.00	100.00	100.00	100.00

Degradation on account of biotic interference is easily discernible from the above table. Heavy to moderate degradation has been noticed in the forest plots over all the five districts. These two categories have the highest occurrence in Burdwan districts (about 89%) and lowest in Bankura district (about 54%).

4.3 Tree density study :

The distribution of stems/ha by species and diameter classes in different strata and in different districts have been calculated which are given in Table No. 1.1.1 to 5.1.1. (vide Part II of this report). The number of stems/ha. by stratum and district are summarised below:-

District : Bankura

Stratum	Description	No.of Stems/ha
I	Sal	719.724
II	Miscellaneous	383.823
III	Plantation	516.778
IV	Barren land	-
Total for the district		603.911

District : Purulia

Stratum	Description	No.of Stems/ha
I	Sal	853.549
II	Miscellaneous	348.780
III	Plantation	262.000
IV	Barren land	-
Total for the district		446.452

District : Midnapore

Stratum	Description	No.of Stem/ha.
I	Sal	693.291
II	Sal with Miscellaneous	641.923
III	Plantation	222.499
IV	Barren land	-
Total for the district		582.046

District:	Description	No.of stems/ha.
Burdwan	District as a whole	467.845
Birbhum	District as a whole	64.19

A relative analysis reveals that the number of stems per hectare in the Sal stratum varies between 693 and 853. The overall stem/ha. for all strata works out to about 580 in Bankura followed by 570, 467 and 387 in Midnapore, Burdwan and Purulia forests respectively. The tree density is too much low in Birbhum district with only 64 stem/ha.

4.3.1. Tree density, District - Bankura:

At the onset it is worth mentioning that the natural Sal and Miscellaneous forests in the tract under inventory have for very long been managed under the coppice system and as such very few higher diameter trees above 30 cm. d.b.h. are expected to occur.

(a) Sal Stratum :

The following observations can be made from the table No.1.1.1(vide Part II of this report) of the Stem Table of this stratum.

- (1) The number of stems/ha. is 719.724 in this stratum. Concentration of trees in the lower diameter classes i.e. 5-9 cm. is maximum which accounts for 85.52% of the total trees of this stratum followed by 13.91% in diameter class 10-19 cm. It is possible that the new protection strategy has resulted in abundance of tree in lower diameter classes which used to be removed even before attaining pole sizes.
- (2) It is also noted that only 0.57% of the trees is above 20 cm. diameter class.
- (3) The number of stems/ha. with percentage of some of the important species are furnished below:-

Species name	No.of stems/ha.	Percentage
Shorea robusta	633.761	88.06
Madhuca latifolia	15.963	2.22
Buchanania lanzan	12.294	1.71
Terminalia tomentosa	8.624	1.20

Sal is decidedly the main species . *Mahua* and *Pial* are found in some sizeable quantity.

(b) Miscellaneous stratum :

The following observations can be made for this stratum from Table No.1.1.2.vide Part-II of this report.

- (1) Number of stems/ha. is 383.823.
- (2) Stems are mostly concentrated in the lower diameter classes i.e. 5-9 cm. which constitute 86.44% followed by 10-19 cm.diameter class having 11.95% of stems.
- (3) Stems/ha. above 20 cm. diameter is only 6.177 in number which constitute 1.61% of the total stems per hectare.
- (4) Some of the important species with their percentage distribution in this stratum are given below.

Name of the species	No. of Stems/ha.	Percentage
Shorea robusta	102.353	26.67
Accacia auriculiformis	61.470	16.02
Butca monosperma	30.00	7.82
Terminalia tomentosa	27.353	7.13
Buchanania lanzan	20.588	5.36
Eucalyptus hybrid	20.588	5.36

(c) Plantation :

Salient features of this stratum are enunciated below :-

- (1) Number of stems/ha. is 516.778.
- (2) Trees are present up to 60 cm. diameter class but bulk of these are in 5-19cm. diameter classes amounting to 80.58% in 5-9 cm. diameter class followed by 18.83% in 10-19 cm. diameter class.
- (3) Important species with stems per ha. and percentage distribution are as follows :-

Name of the species	Stem/ha.	Percentage
<i>Accacia auriculiformis</i>	280.677	54.31
<i>Eucalyptus hybrid</i>	162.881	31.52
<i>Eucalyptus species</i>	52.712	10.20
<i>Shorea robusta</i>	8.475	1.64

Most plantations are of *Acacia auriculiformis* and *Eucalyptus*.

4.3.2 Tree density, Purulia district :

(a) Sal stratum

Number of stems/ha. is 853.549. The diameter class distribution of stems/ha. with percentage are summarised below:-

Diameter class(in cm)	Stems/ha.(in No.)	Percentage
5-9	723.871	84.80
10-19	119.678	14.02
20-29	7.419	0.87
30+	2.581	0.31
Total	853.549	100.00

The density and percentage of some of the major species are as below:

Name of the species	Stems/ha.	Percentage
<i>Shorea robusta</i>	544.517	63.79
<i>Terminalia tomentosa</i>	51.936	6.08
<i>Buchanania lanzan</i>	33.871	3.97
<i>Diospyros melanoxylon</i>	24.839	2.91
<i>Cleistanthus collinus</i>	24.516	2.87

It is clear that Sal is gregarious in this stratum.

(b) Miscellaneous stratum:

The number of stems/ha. is 348.780. The diameter class distribution of stems/ha. with density and percentage of important species in this stratum are furnished in the following two tables:

Diameter class (in cm.)	Stems/ha. (in No.)	Percentage
5-9	275.487	78.99
10-19	67.439	19.34
20-29	4.146	1.19
30+	1.708	0.48
Total	348.780	100.00

Name of the species	No.of Stems/ha.	Percentage
Shorea robusta	48.658	13.95
Anogeissus latifolia	34.390	9.86
Cleistanthus collinus	24.268	6.96
Terminalia tomentosa	24.146	6.92
Lannea coromandelica	19.268	5.52

(c) Plantation Stratum :

The stems/ha. is only 262.00. The species mostly planted in this stratum is Acacia auriculiformis which account for 77.40% of the total stems density. The diameter class distribution of the stems with percentage and important species in this stratum are furnished below :-

Diameter class (in cm.)	No.of Stems/ha.	Percentage
5-9	243.600	92.98
10-19	16.800	6.41
20-29	0.800	0.31
30+	0.800	0.30
Total	262.000	100.00

The low density combined with almost total absence of trees of higher diameter classes point toward irregular removal of marketable trees from plantations.

Name of the species	Stems/ha.	Percentage
Acacia auriculiformis	202.800	77.40
Shorea robusta	19.600	7.48
Cassia siamea	11.200	4.27
Eucalyptus hybrid	7.200	2.75
Eucalyptus species	5.200	1.98

4.3.3. Tree density, District - Midnapore

(a) Sal Stratum :

The number of stems/ha. is only 693.291. Shorea robusta is the main species in this stratum and accounts for 89.95% of the stems in this stratum. Trees above 30 cm. diameter class are rare.

The diameter class distribution in terms of stems / ha. for all species and the no. of stems/ha. and percentage of some important species are given in the two following tables.

Diameter class (in cm.)	Stems/ha.	Percentage
5-9	610.058	87.98
10-19	77.724	11.21
20-29	3.293	0.48
30+	2.216	0.18
Total	693.291	100.00

Name of the species	No. of Stems/ha.	Percentage
Shorea robusta	623.590	89.95
Buchanania lanzan	11.437	1.65
Terminalia tomentosa	10.719	1.55
Madhuca latifolia	7.485	1.08

The crop consists almost entirely of Sal below 20 cm. dia. The high density of trees below 10 cm. dia. may be due to protection afforded by Forest Protection Committees formed recently.

(b) Sal with Miscellaneous Stratum :

Number of stems/ha. is 641.923 only. The distribution of stems/ha. by diameter class and important species in this stratum are furnished below in the two tables that follow :

Diameter class (in cm)	Stems/ha.	Percentage
5-9	519.999	81.01
10-19	113.077	17.62
20-29	5.769	0.89
30+	3.078	0.48
Total	641.923	100.00

Name of the species	Stems/ha.	Percentage
<i>Shorea robusta</i>	236.154	36.79
<i>Terminalia tomentosa</i>	70.000	10.90
<i>Anogeissus latifolia</i>	60.000	9.35
<i>Eucalyptus species</i>	46.538	7.25
<i>Diospyros melanoxylon</i>	30.385	4.73
<i>Cleistanthus collinus</i>	42.308	6.59
<i>Buchanania lanzan</i>	21.923	3.42

(c) **Plantation Stratum :**

Number of stems/ha. is 222.499 only. *Acacia auriculiformis* and *Eucalyptus species* are the main species in this stratum. Diameter class distribution of stem density and major species are summarised below :

Diameter class (in cm.)	Stems/ha.	Percentage
5-9	159.642	71.75
10-19	61.607	27.69
20-29	1.071	0.48
30+	0.179	0.08
Total	222.499	100.00

Name of the species	No. of Stems/ha.	Percentage
<i>Acacia auriculiformis</i>	75.000	33.71
<i>Eucalyptus species</i>	106.428	47.83
<i>Anacardium occidentale</i>	18.750	8.43
<i>Shorea robusta</i>	9.643	4.33

Trees in higher diameter classes (20cm. and above) are conspicuously absent.

4.3.4. **Tree density, Burdwan District :**

The following observation can be made from the Table No. 4.1.1. (Vide Part II of this report)

- (i) The number of stems/ha. is only 467.845.
- (ii) Concentration of trees in lower diameter class i.e. 5-9 cm. is maximum which accounts for 82.62% followed by 16.87 % and 0.51% in 10-19 cm. and 20-29 cm. diameter classes respectively.
- (iii) The number of stems/ha. with percentage of some of the important species are furnished below :

Name of the species	Stems/ha.	Percentage
<i>Shorea robusta</i>	249.140	53.25
<i>Acacia auriculiformis</i>	101.743	21.75
<i>Eucalyptus hybrid</i>	30.436	6.51
<i>Cassia siamea</i>	13.696	2.93
<i>Buchanania lanzan</i>	13.044	2.79

4.3.5. Tree density, Birbhum District :

Salient features of this stratum are given below.

- (i) Number of stems/ha is 64.198 only.
- (ii) Trees are mostly concentrated in 5-9 cm. diameter class accounting for 52.17%, followed by 42.75% in diameter class 10-19 cm.
- (iii) Important species with stems/ha. and percentage of distribution are as follows :-

Name of the species	No of Stems/ha.	Percentage
Acacia auriculiformis	27.447	42.75
Eucalyptus hybrid	18.608	28.99
Shorea robusta	8.606	13.41
Madhuca latifolia	6.048	9.42

The very low density of trees is obviously the result of past ravages by biotic interference.

4.4 Total Stems :

The total number of stems in different districts by species and diameter classes in different strata are given in Table No. 1.2.1 to 5.2.1.(vide at Part II of this report.) These are summarised below :

(a) **District : Bankura**

Stratum	Description	Total stems('000 No.)
I	S a l	55363.320
II	Miscellaneous	9209.441
III	Plantation	21517.090
IV	Barren land	-
Total		86089.851

(b) **District : Purulia**

Stratum	Description	Total Stems ('000)
I	S a l	14577.770
II	Miscellaneous	15756.820
III	Plantation	3608.264
IV	Barren land	-
Total		33942.854

(c) District : Midnapore

Stratum	Description	Total Stems ('000 No.)
I	S a l	77900.900
II	Sal with Miscellaneous	11229.150
III	Plantation	8383.558
IV	Barren land	-
Total		97513.608

(d) District : Burdwan

District as a whole	Total Stems ('000 No.)
	12959.300

(c) District : Birbhum

District as a whole	Total Stems ('000 No.)
	1020.742

4.5 Volume Studies :

The distribution of volume/ha. by species and diameter classes in different stratum and in different district has been determined and given in Table No. 1.3.1 to 5.3.1. (Vide Part II of this report). The volume/ha. by stratum and district is summarised below :-

(a) District : Bankura

Stratum	Description	Volume/ha.(m ³)
I	S a l	16.863
II	Miscellaneous	9.678
III	Plantation	11.949
IV	Barren land	-
Total for the district		14.219

(b) District : Purulia

Stratum	Description	Volume/ha.(m ³)
I	S a l	21.785
II	Miscellaneous	10.698
III	Plantation	4.904
IV	Barren land	-
Total for the district		12.139

(c) District : Midnapore

Stratum	Description	Volume/ha.(m ³)
I	Sal	17.197
II	Sal with Misc.	21.995
III	Plantation	6.207
IV	Barren land	
Total for the district		15.227

Volume/ha.(m³)

(d) District : Burdwan District as a whole - 10.376

(e) District : Birbhum District as a whole - 4.663

4.5.1 Volume studies , District - Bankura :

(a) Sal Stratum :

The volume/ha is only 16.863 m³. The distribution of volume/ha. by diameter class and major volume contributing species are summarised below :

Diameter class (in cm)	Volume/ha (m ³)	Percentage
5-9	8.768	52.00
10-19	6.302	37.37
20-29	1.249	7.41
30+	0.544	3.22
Total :	16.863	100.00

Name of the species	Volume/ha (m ³)	Percentage
Shorea robusta	14.070	83.44
Terminalia belerica	0.538	3.19
Bombax ceiba	0.334	1.98

(b) Miscellaneous Stratum :

The volume/ha is 9.678 m³ only. The distribution of volume/ha. by diameter class and major volume contributing species are summarised below :-

Diameter class(in cm.)	Volume/ha.(m ³)	Percentage
0-5	3.722	38.46
10-19	2.637	27.25
20-29	1.519	15.69
30+	1.800	1.860
Total	9.678	100.00

Name of the species	Volume/ha.(m ³)	Percentage
Shorea robusta	3.151	32.56
Butea monosperma	1.875	19.37
Acacia auriculiformis	0.820	8.72
Diospyros melanoxylon	0.617	6.37

c) Plantation stratum :

Volume/ha. is 11.949 m³ only. Volume is mostly concentrated in 10-19 cm. diameter classes which accounts for 42.98% of the total volume of the stratum. The volume/ha. with percentage for some of the volume contributing species are furnished below :

Name of the species	Volume/ha(m ³)	Percentage
Acacia auriculiformis	3.933	32.91
Eucalyptus species	5.326	44.57

4.5.2 Volume studies, District - Purulia :

(a) Sal Stratum :

The volume /ha. is only 21.785 m³. Shorea robusta is the main volume contributing species which accounts for 56.58% of the total volume in this stratum followed by Diospyros melanoxylon & Terminalia tomentosa which account for 9.20% and 8.56% respectively.

The diameter class distribution of volume/ha. and important species in this stratum are given hereunder :

Volume/ha (in m ³)	Percentage
9.812	45.04
7.327	33.63
2.464	11.31
2.182	10.02
21.785	100.00

Name of the species	Volume/ha(in m ³)	Percentage
Shorea robusta	12.326	56.58
Diospyros melanoxylon	2.004	9.20
Terminalia tomentosa	1.866	8.56
Buchnanania lanzan	1.455	6.68

(b) Miscellaneous Stratum :

The volume/ha. is 10.698 m³ only. The distribution of volume/ha. by diameter class and important volume contributing species are furnished below:-

Diameter class (in cm.)	Volume/ha. (in m ³)	Percentage
5-9	2.973	27.79
10-19	4.293	40.13
20-29	1.505	14.07
30+	1.927	18.01
Total	10.698	100.00

Name of the species	Volume/ha.(in m ³)	Percentage
Shorea robusta	1.506	14.07
Anogeissus latifolia	0.927	8.66
Lannea coromandelica	0.851	7.95
Butea monosperma	0.710	6.64
Terminalia tomentosa	0.669	6.25

(c) Plantation Stratum :

The volume/ha. is 4.904 m³ only. Acacia auriculiformis and Madhuca latifolia are the volume contributing species. The distribution of volume/ha. by diameter class and important volume contributing species in this stratum are furnished below :-

Diameter class (in cm.)	Volume/ha. (in m ³)	Percentage
5-9	2.240	45.66
10-19	0.937	19.11
20-29	0.206	4.20
30+	1.521	31.03
Total	4.904	100.00

Name of species	Volume / ha.(m ³)	Percentage
Acacia auriculiformis	2.352	47.96
Madhuca latifolia	1.531	31.22

The low volume/ha. figures are presumably due to biotic interference.

4.5.3 Volume studies, District - Midnapore :

(a) Sal Stratum :

Volume/ha. is only 17.197m^3 . Sal is the only volume contributing species in this stratum. The diameter class distribution of volume/ha. and important volume contributing species are given hereunder :

Diameter class (in cm.)	Volume/ha (in m^3)	Percentage
5-9	8.585	49.93
10-19	4.742	27.57
20-29	1.059	6.16
30+	2.811	16.34
Total	17.197	100.00

Name of the species	Volume/ha.(m^3)	Percentage
Shorea robusta	13.628	79.25
Diospyros melanoxylon	0.813	4.73
Madhuca latifolia	0.671	3.90
Diospyros species	0.320	1.86

(b) Sal with Miscellaneous Stratum:

The volume/ha. is 21.995m^3 only. The distribution of volume/ha. by diameter class and important volume contributing species in this stratum are furnished below :

Diameter class (in cm.)	Volume/ha. (m^3)	Percentage
5-9	6.491	29.52
10-19	7.078	32.18
20-29	2.003	9.11
30+	6.423	29.19
Total	21.995	100.00

Name of the species	Volume/ha.(m^3)	Percentage
Shorea robusta	6.607	30.04
Tamarindus indica	2.805	12.75
Diospyros melanoxylon	1.930	8.77
Madhuca latifolia	1.822	8.28
Terminalia tomentosa	1.470	6.68
Eucalyptus species	1.012	4.60

(c) Plantation Stratum :

Volume/ha. is only 6.207 m³. The diameter class distribution of volume/ha. and important volume contributing species are given hereunder :

Diameter class (in cm.)	Volume/ha. (m ³)	Percentage
5-9	1.690	27.23
10-19	3.687	59.40
20-29	0.323	5.20
30+	0.507	8.17
Total	6.207	100.00

Name of the species	Volume/ha (m ³)	Percentage
Eucalyptus species	3.355	54.06
Acacia auriculiformis	0.993	16.00
Anacardium occidentale	0.806	12.98
Madhuca latifolia	0.507	8.17

4.5.4 Volume studies, District - Burdwan :

Volume/ha. is only 10.376 m³. Shorea robusta, Cassia siamea, Acacia auriculiformis are the important volume contributing species.

The diameter class distribution of volume/ha. and important volume contributing species with percentage are summerised below:-

Diameter Class (in cm.)	Volume/ha. (in m ³)	Percentage
5-9	4.556	43.90
10-19	5.153	49.66
20-29	0.667	6.44
30+	-	-
Total	10.376	100.00

Name of the species	Volume/ha.(m ³)	Percentage
Shorea robusta	5.518	53.18
Cassia siamea	1.257	12.11
Acacia auriculiformis	1.252	12.06

4.5.5 Volume studies, District - Birbhum :

The volume/ha. is 4.663 m³ only. The diameter class distribution of volume/ha. and important volume contributing species are given here under :-

Diameter class (in cm.)	Volume/ha. (in m ³)	Percentage
5-9	0.461	9.88
10-19	1.891	40.56
20-29	0.603	12.93
30+	17.08	36.63
Total	4.663	100.00

Name of the species	Volume/ha(m ³)	Percentage
Madhuca latifolia	1.621	34.76
Eucalyptus hybrid	1.042	22.35
Acacia auriculiformis	0.895	19.19

4.6 Total Volume :

The total volume in different strata by species and diameter class are given in Table No.1.4.1. to 5.4.1. (Vide Part II of this report). These are summarised below:-

(a) District - Bankura :

Stratum	Total Volume('000m ³)
Sal	1297.183
Miscellaneous	232.221
Plantation	497.521
Barren land	-
Total	2026.925

(b) District - Purulia :

Stratum	Total volume ('000m ³)
Sal	372.060
Miscellaneous	483.321
Plantation	67.537
Barren land	-
Total :	922.918

(c) District - Midnapore :

<u>Stratum</u>	<u>Total Volume ('000m³)</u>
Sal	1932.376
Sal with Miscellaneous	384.751
Plantation	233.888
Barren land	-
<hr/>	
Total :	2551.015
<hr/>	

(d)	<u>District : Burdwan</u>	<u>Total volume ('000m³)</u>
	District as a whole	287.415

(e)	<u>District : Birbhum</u>	<u>Total volume ('000m³)</u>
	District as a whole	74.146

4.7 Error calculation :

The standard error percentage (i.e. S.E.%) has been calculated by ratio method of estimation for the growing stock of various districts which are furnished below :-

<u>District</u>	<u>S.E. %</u>
Bankura	13.29
Purulia	16.05
Midnapore	12.29
Burdwan	21.05
Birbhum	23.81

It is worthwhile to mention that for larger area i.e. at the State level, the error percentage is expected to be within 10% precision limit at 95% probability level.

CHAPTER - V

SUMMARY AND CONCLUSIONS

Summary :

1. Forest area in Bankura district is 1482.00 km² whereas the same in Purulia district is 876.00 km². The forest area in Midnapore, Burdwan and Birbhum district is 1709.00 km.², 277.00 km². and 159.00 km² respectively.
2. Bankura district occupies 21.54% of the forest area while Purulia district occupies 14.00% forest area of the total geographical area of the district. The percentage of forest area to geographical area in Midnapore, Burdwan and Birbhum district is 12.14%, 3.94% and 3.50% respectively.
3. The forest has been categorised into 4 strata namely Sal, Miscellaneous, Plantation and Barren land in Bankura, Purulia and Midnapore district. No crop is found in 'Barren land' areas. No strata have been formed in Burdwan and Birbhum district.
4. Per hectare estimated stems and volume in various strata has been computed as follows :-

District	Stratum	No. of stems/ha.	Volume/ha.(in m ³)
Bankura	Sal	719.724	16.863
	Miscellaneous	383.823	9.678
	Plantation	516.778	11.949
	Barren land	-	-
Purulia	Sal	853.549	21.785
	Miscellaneous	348.780	10.698
	Plantation	262.000	4.904
	Barren land	-	-
Midnapore	Sal	693.291	17.197
	Sal with Miscellaneous	641.923	21.995
	Plantation	222.499	6.207
	Barren land	-	-
Burdwan	District as a whole	467.845	10.376
Birbhum	District as a whole	64.198	4.663

5. The total number of stems in Bankura, Purulia, Midnapore, Burdwan and Birbhum districts are 86.089 million, 33.942 million, 97.513 million, 12.959 million and 1.020 million respectively.
6. The total volume in Bankura, Purulia, Midnapore, Burdwan and Birbhum district is 2.026 , 0.922, 2.551, 0.287 and 0.074 million cubic meter respectively.

7. Out of the total forest area in Bankura district only 3.52% area is covered with dense tree forest. The moderately dense tree forest constitute 25.11% and the open tree forests constitute 19.82%. The scrub forest covers an area of 7.05%. In Purulia district the percentages of dense, moderate, open and Scrub forests are 2.11%, 17.37%, 26.84% and 7.37% respectively. In Midnapore district, the above percentages are 2.18%, 31.64%, 18.91% and 3.27% respectively. In Burdwan district the percentage of dense tree forest is 6.38%, moderately dense forests 19.15%, open tree forest 31.91% and scrub forests, 8.51%. Birbhum district has only 2.27% dense forests, 6.82% moderately dense forests, 20.45% open forests and 40.91% scrub forests.

8. The regeneration is profuse in 6.67% forest area in Bankura district while the same is 8.80% in Purulia district. The percentage of area in profuse regeneration in Midnapore, Burdwan and Birbhum district is 9.45%, 56.52% and 4.65% respectively.

9. Fire incidence is not very heavy in the above five districts, but frequent to moderate in 25.71%, 22.01%, 38.98%, 56.52% and 23.26% area in Bankura, Purulia, Midnapore, Burdwan and Birbhum district respectively.

10. 30.95% of the forest area is heavily degraded in Bankura district while it is 53.46% in Purulia district. The percentages of heavily degraded forests in Midnapore, Burdwan and Birbhum district are 30.31%, 52.17% and 62.79% respectively. 15.71%, 13.21%, 3.94%, 4.35% and 13.95% of the forest areas are free from degradation in Bankura, Purulia, Midnapore, Burdwan and Birbhum district respectively.

COMPARISON WITH PAST SURVEY RESULTS

Earlier survey was carried out in Bankura, Purulia and Midnapore districts. The findings from the previous survey carried out by Forest Survey of India in the year 1981-82 were compared with the present inventory so far as the number of stems per hectare in different diameter classes and strata are concerned.

Table - A

District : Bankura

Diameter class (in cm.)	No.of stems/ha. Stratum : Sal Area surveyed in		No.of stems/ha. Stratum Misc. Area surveyed in		No.of stems/ha. Stratum:Plantation Area surveyed in	
	1981-82	1991-92	1981-82	1991-92	1981-82	1991-92
5-9	337.500	615.504	383.598	331.764	125.162	416.440
10-19	57.052	100.092	23.634	45.882	27.929	97.288
20-29	5.946	3.761	11.817	4.118	2.414	1.695
30+	1.139	0.183	9.090	1.765		0.847
40-49	0.253	0.292	1.818	0.294		0.169
50-59	0.253	-	-	-	-	0.339
60-69	-	0.092	-	-	-	-
70+	0.127	-	-	-	-	-
Total	402.270	719.724	429.957	383.823	155.505	516.778

Table - B**District : Purulia**

Diameter class in cm.	No. of stems/ha. Stratum - Sal		No. of stems/ha. Stratum - Miscellaneous		No. of stems/ha. Stratum - Plantation	
	Area surveyed in		Area surveyed in		Area surveyed in	
	1981-82	1991-92	1981-82	1991-92	1981-82	1991-92
5-9	298.750	723.871	414.014	275.487	136.552	243.600
10-19	88.250	119.678	101.595	67.439	26.199	16.800
20-29	9.750	7.419	16.845	4.146	3.795	0.800
30-39	2.250	2.258	2.895	1.098	0.690	0.400
40-49	0.250	0.323	2.369	0.488	-	-
50-59	0.750	-	-	0.122	-	0.400
60-69	0.250	-	0.263	-	-	-
70+	0.250	-	-	-	0.345	-
Total	400.500	853.549	537.981	348.780	167.581	262.000

Table - C**District - Midnapore**

Diameter class(in cm.)	Stem/ha. Stratum:Sal		Stem/ha. Stratum :Plantation	
	Area surveyed in		Area surveyed in	
	1981-82	1991-92	1981-82	1991-92
5-9	436.189	597.925	80.840	159.642
10-19	68.001	82.486	28.336	61.607
20-29	3.716	3.626	1.250	1.071
30-39	1.597	1.088	1.250	-
40-49	0.197	0.829	-	-
50-59	0.222	0.155	-	0.179
60-69	-	0.103	-	-
70+	0.086	0.155	-	-
Total	510.008	686.367	111.676	222.499

N.B. Number of stems/ha. by diameter class for 'Sal' and 'Sal with Miscellaneous' strata for the year 1991-92 have been merged into 'Sal' stratum in order to make comparison with the year 1981-82 possible as no separate stratum for 'Sal with miscellaneous' in Midnapore district was formed in the earlier inventory.

From the preceding tables the following conclusions may be drawn districtwise.

A close perusal and examination of the above tables 'A', 'B' and 'C' leads to some interesting conclusions. These are reiterated below.

1. From Table 'A' we get a comparative picture of the change in the growing stock character of Bankura district in the course of a decade, from 1981-82 to 1991-92. It transpires from the figures that the tree density in terms of number of stems per hectare has registered substantial augmentation in 'Sal' and 'Plantation' strata to the extent of 78.92% and 232.32% respectively while a slight fall in the density to the tune of 10.73% is noticed in the 'Miscellaneous' stratum. The tell-tale increase in tree density in a decades time points towards a positive effect of the introduction of joint forest management in this tract. The fact that the best part of the increase is in the lowest diameter class i.e. for trees below 10 cm. diameter, is significant because protection by forest protection committees has been afforded only recently and protected trees have not yet reached the higher diameter classes. One reason for the momentous leap in the stems/ha. in the Plantation stratum may be the expansion of plantation programmes in the recent years which also explains the much larger increase in the lower diameter classes. Moreover, the joint forest management in the State is primarily aimed at protection of Sal forests and plantations; perhaps the miscellaneous forests are not receiving the same kind of attention so far.

2. A similar picture emerges for Purulia district from Table 'B'. Here the percentage increase in the tree density in the three strata stand respectively at 113.12% and 56.34% for 'Sal' and 'Plantation' strata respectively while the decline in the 'Miscellaneous' stratum works out to 35.16%. The bulk of the increase is again in the lowest diameter classes viz. below 10 cm. and 10-19 cm. classes.

3. Table 'C' pertains to Midnapore district. Here also the tree density has increased but not to the extent as in Bankura or Purulia district. The percentage increase in the 'Sal' stratum in this district is 34.57% and that in the 'Plantation' stratum, 99.24%. While the increment of density in the Plantation stratum is sizeable, the reason behind the relatively lower increment in the Sal stratum is likely to be two fold; firstly, the original density in 1981-82 was not as dismally low as in the two other districts; secondly, the clubbing of strata for the sake of attaining comparability may have given rise to an aberration and the net increase may be the resultant of a larger increase in the 'Sal' crop and a decrease in the number of stems per ha. though the extent of such miscellaneous forests is not of very great significance in this district.

Comparison of volume / ha. :

The volume/ha. from earlier survey and from othe present survey are furnished below :-

District	Volume/ha. (in m ³)		Volume/ha. (in m ³)		Volume/ha.(in m ³)	
	Stratum - Sal		Stratum - Plantation		Stratum - Misc.	
	Inventory in		Inventory in		Inventory in	
	1981-82	1991-92	1981-82	1991-92	1981-82	1991-92
Bankura	14.636	16.863	4.335	11.949	22.205	9.678
Purulia	20.045	21.785	7.497	4.904	25.280	10.698
Midnapore	14.680	17.843	3.976	6.207	-	-

As far as volume per hectare is concerned, marginal increase is noticed in Sal Stratum in Bankura, Purulia and Midnapore districts. In Plantation stratum, volume/ha. has increased in Bankura and Midnapore district but a shortfall is noticed in Purulia district. In Miscellaneous stratum, the picture is very gloomy. There is a sharp decline in both Bankura and Purulia district. The decline in the density in Purulia district is likely to be resuslt of large scale destruction of plantation crop in this district during the intervening decade. The same reason perhaps apply to the dismal picture in the 'Miscellaneous' stratum in the districts of Bankura and Purulia. However, the enormous 175.64% increase in the tree density in Bankura district in terms of volume / ha. points towards a much better protection status of the plantations of this district combined with substantial expansion of young plantations as would also be evident from Table 'A' in the last paragraph as already discussed.

It is expected that the advent of joint management strategy , integrated with sound silvicultural management would boost up the stocking in these forests which should be reflected in a more balanced distribution of trees in the various diameter classes at a future date.

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LIST OF TOPOSHEETS

Scale : 1:50,000

- Purulia :**
- 1) 73 E/15,16
 - 2) 73 I/2,3,4,6,7,8,10,11,12,14,15,16
 - 3) 73 J/1,5,6,9,10
- Bankura :**
- 1) 73 I/14,15,16,12
 - 2) 73 J/9,10,13,14
 - 3) 73 M/2,3,4,6,7,8,11,12
 - 4) 73 N/1,2,5,9
- Midnapore:**
- 1) 73 J/9,10,12,14,15,16
 - 2) 73 N/1,2,3,4,5,6,7,8,9,10,11,12,14,15,16,
 - 3) 73 O/1,5,6,9,10,13,14
 - 4) 73 B/4
 - 5) 73 C/1
- Birbhum :**
- 1) 72 P/4,8,11,12,14,15,16
 - 2) 73 M/1,2,5,6,9,10,13,14
- Burdwan:**
- 1) 73 I/13,14
 - 2) 73 M/1,2,6,7,10,11,12,13,14,15,16
 - 3) 73 N/9,13
 - 4) 79 A/1,2,3,4,6,7,8
 - 5) 79 B/1

=====

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The following officials of Eastern Zone, Forest Survey Of India were associated in the project of inventory of forest resources of South Western districts of West Bengal and in preparation of the report thereof :

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Shri R. Sharma, J.T.A.
Shri P.S. Banerjee, J.T.A.
Shri D.K. Das, J.T.A.
Shri D.K. Roy, J.T.A.
Shri C.D. Burman
Shri A.K. Hossain, J.T.A.
Shri T.K. Dam, J.T.A.
Shri S.C. Dutta, Dy. Ranger
Shri R.C. Chakraborty, Dy. Ranger
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Miss M.Chakrabarti, Jr.Stenographer.
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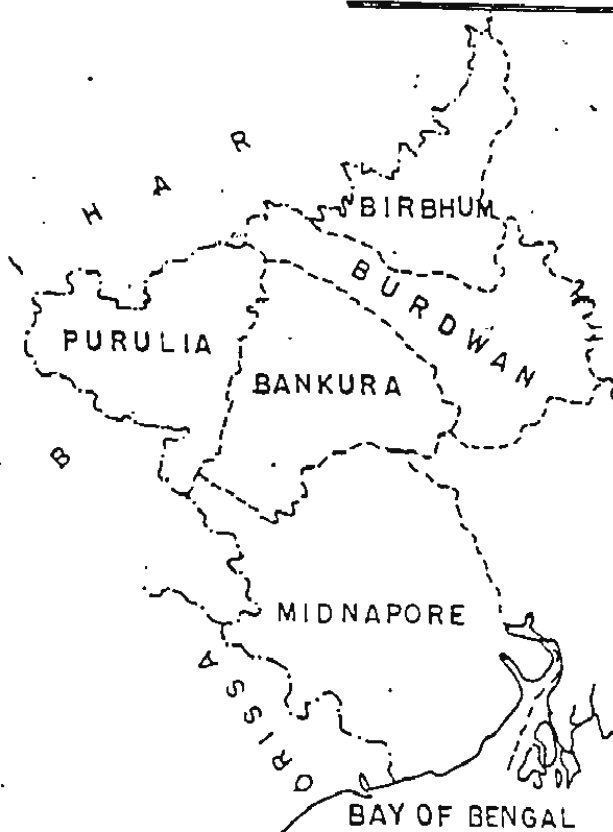
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Shri S.Sardar.
Shri A.K.Das.
Shri S.K.Ghosh.
Shri P.Bhattacharya.
Shri Amit Kr.Ghosh.

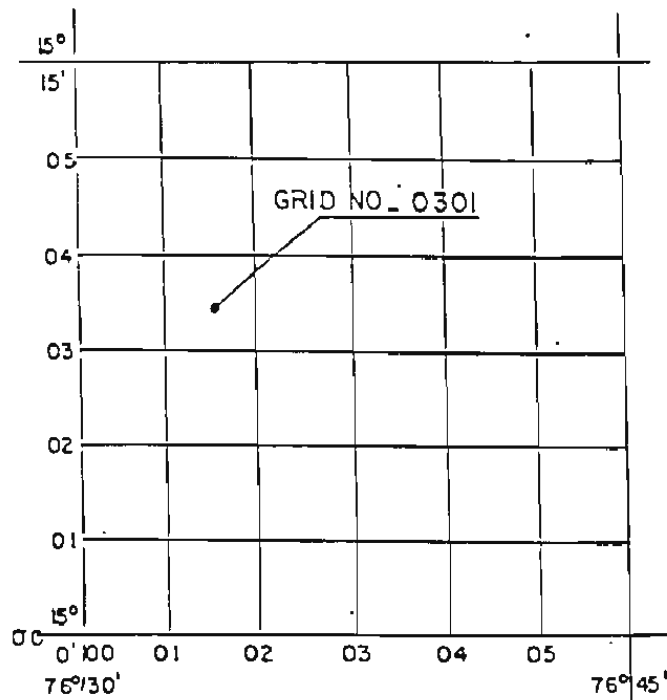
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PROJECT MAP OF PURULIA, BANKURA, MIDNAPORE,
BURDWAN AND BIRBHUM DISTRICT OF WEST BENGAL

SCALE 1:1,000,000



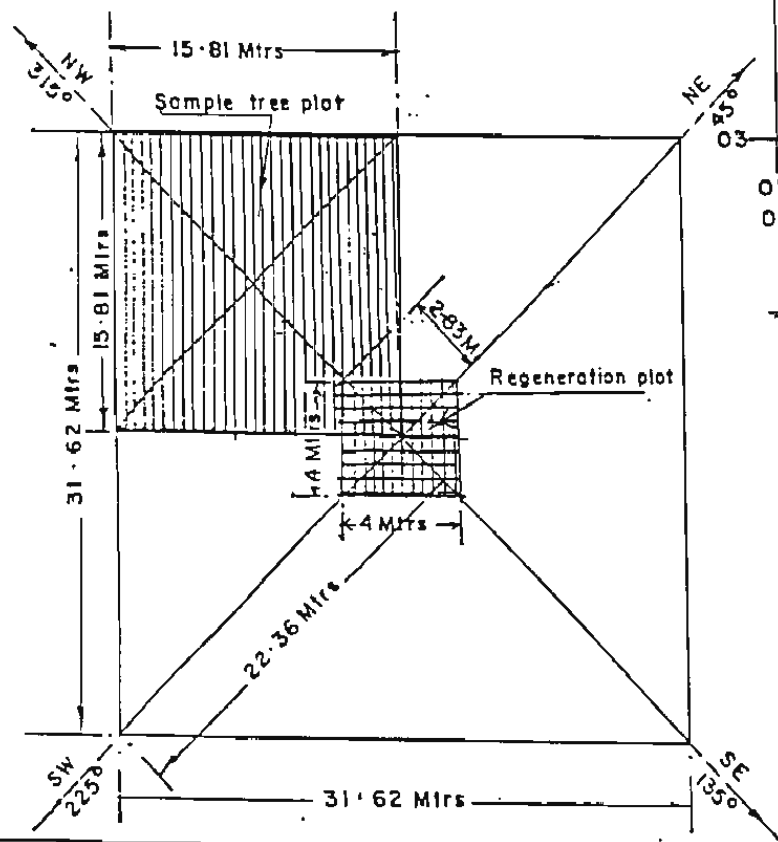
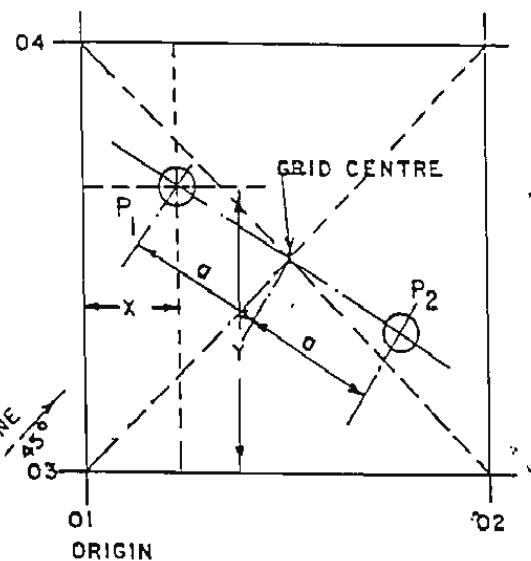


DIAGRAM_1

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

DIAGRAM_2

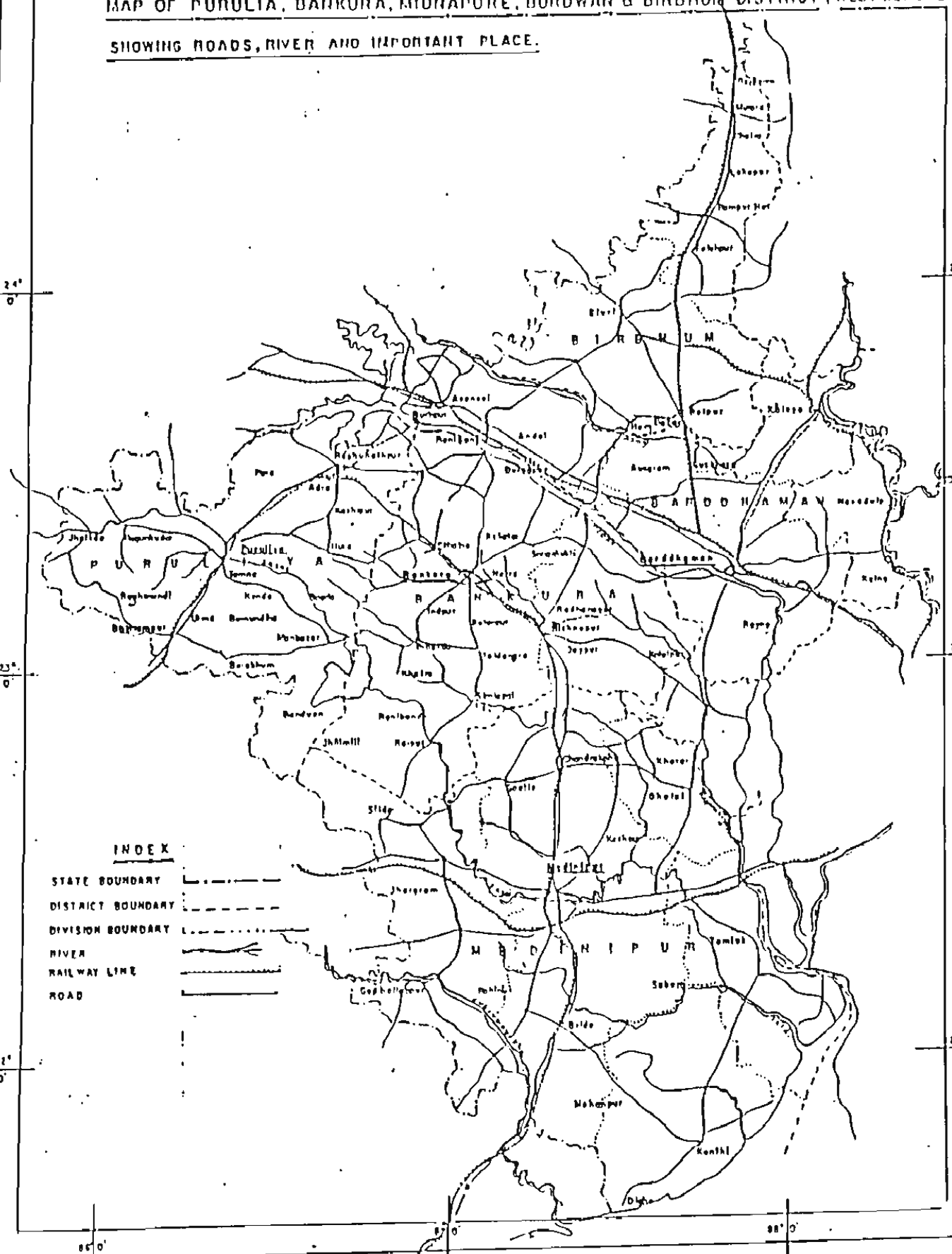
DIAGRAM SHOWING MARKING
OF PLOT IN $2\frac{1}{2} \times 2\frac{1}{2}$ GRID
'X' & 'Y' ARE THE DISTANCES ALONG
'X' & 'Y' AXES WITH S.W. CORNER AS
THE ORIGIN.



DIAGRAM_3

DIAGRAM SHOWING
LAY OUT OF PLOT

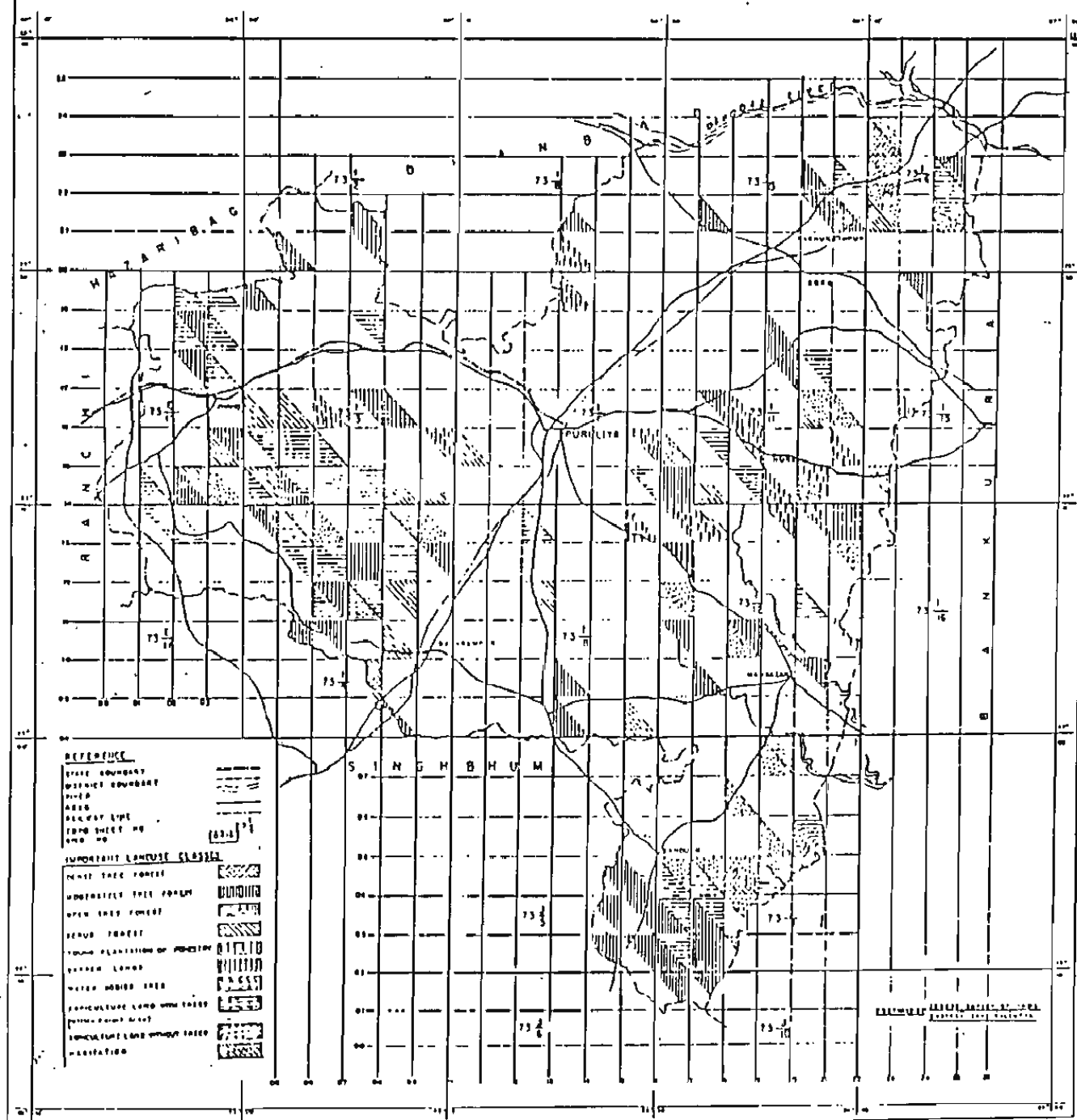
MAP OF PURULIA, BANKURA, MIDNAPORE, BURDWAN & BIRDHUM DISTRICT (WEST BENGAL)
SHOWING ROADS, RIVER AND IMPORTANT PLACE.



INDEX

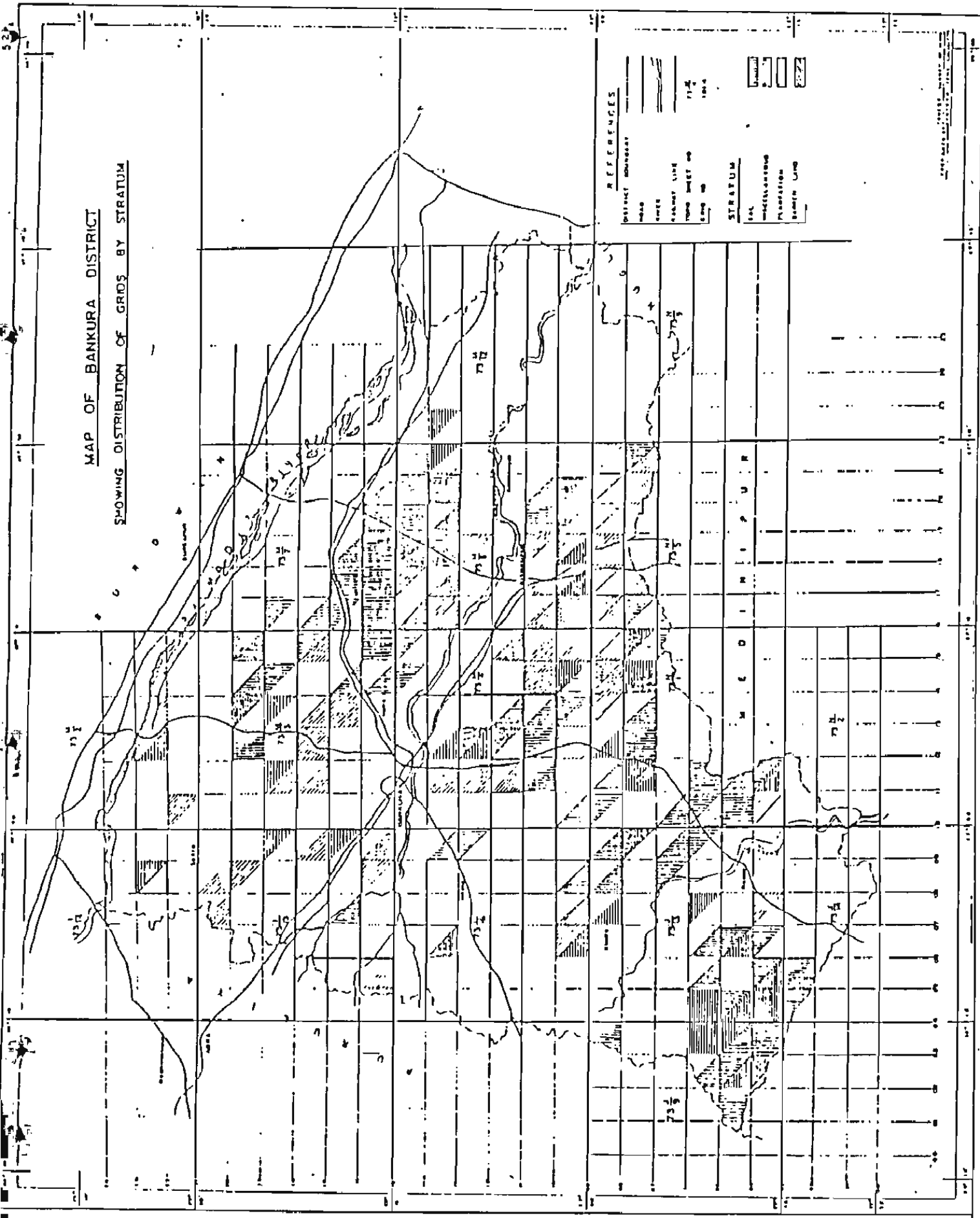
- STATE BOUNDARY
- DISTRICT BOUNDARY
- DIVISION BOUNDARY
- RIVER
- RAILWAY LINE
- ROAD

MAP OF PURULIYA DISTRICT SHOWING DISTRIBUTION OF GRIDS BY IMPORTANT LAND USE CLASSES

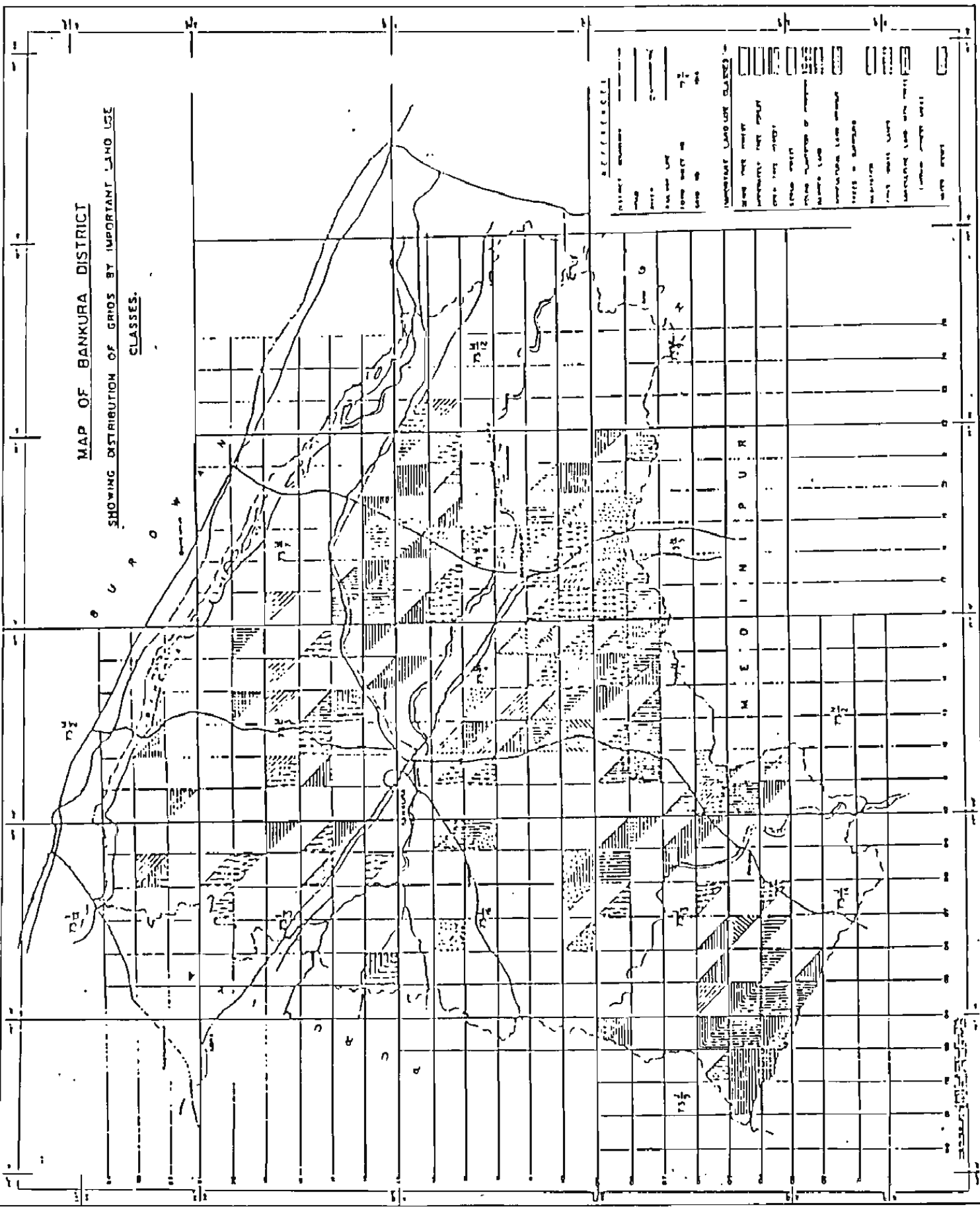


MAP OF BANKURA DISTRICT

SHOWING DISTRIBUTION OF GRIDS BY STRATUM



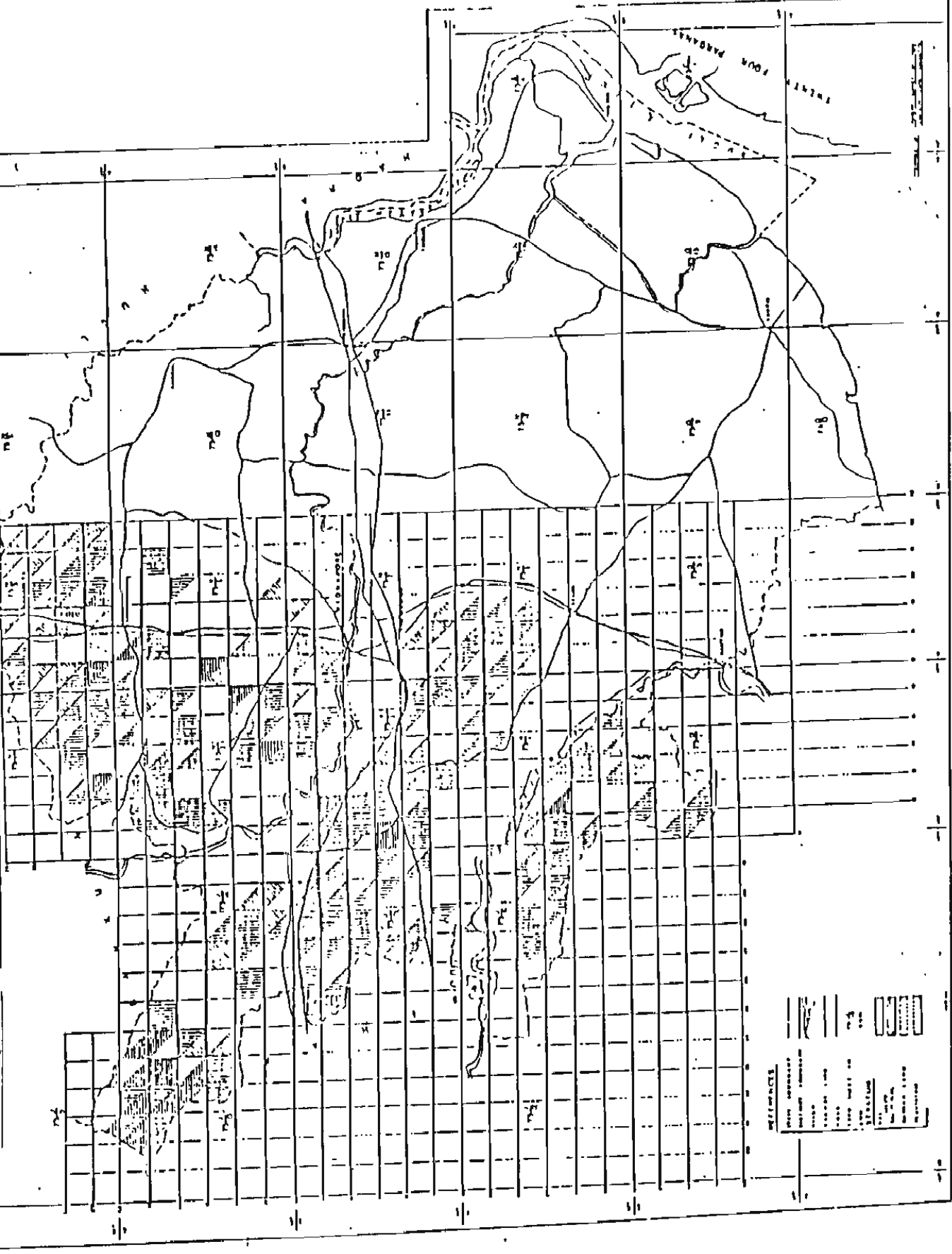
MAP OF BANKURA DISTRICT
SHOWING DISTRIBUTION OF GRIDS BY IMPORTANT LAND USE
CLASSES.



LEGEND	
[Symbol]	Barren land
[Symbol]	Culturable land
[Symbol]	Forest land
[Symbol]	Water bodies
[Symbol]	Settlements
[Symbol]	Transportation
[Symbol]	Other

MAP OF MIDNAPORE DISTRICT

SHOWING DISTRIBUTION OF GRIDS BY STRATUM



LEGEND

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SHOWING DISTRIBUTION OF BIRDS BY IMPORTANT LAND USE CLASSES

LEGEND

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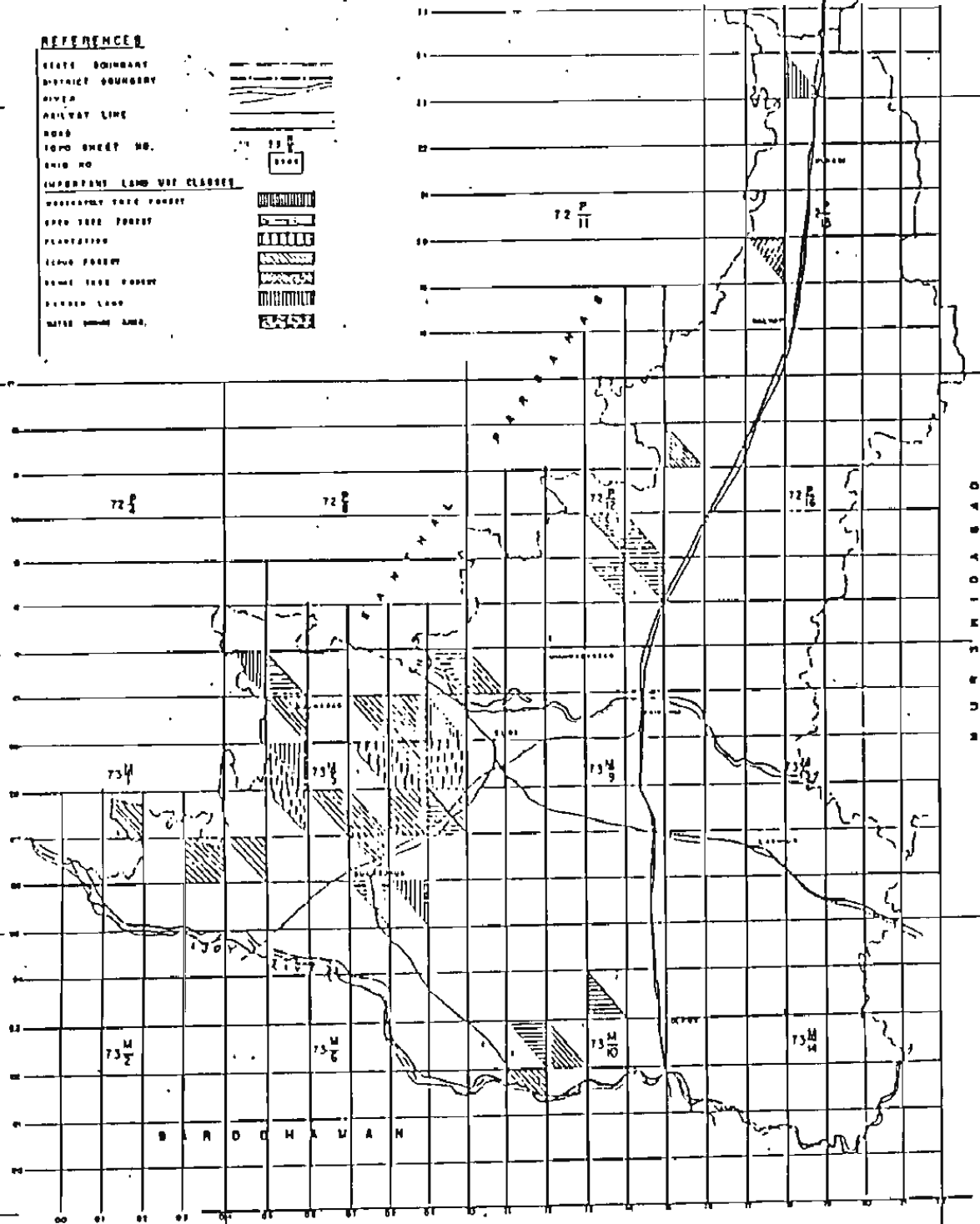
MAP OF BIRBHUM DISTRICT SHOWING DISTRIBUTION OF GRIDS BY IMPORTANT LAND USE CLASSES

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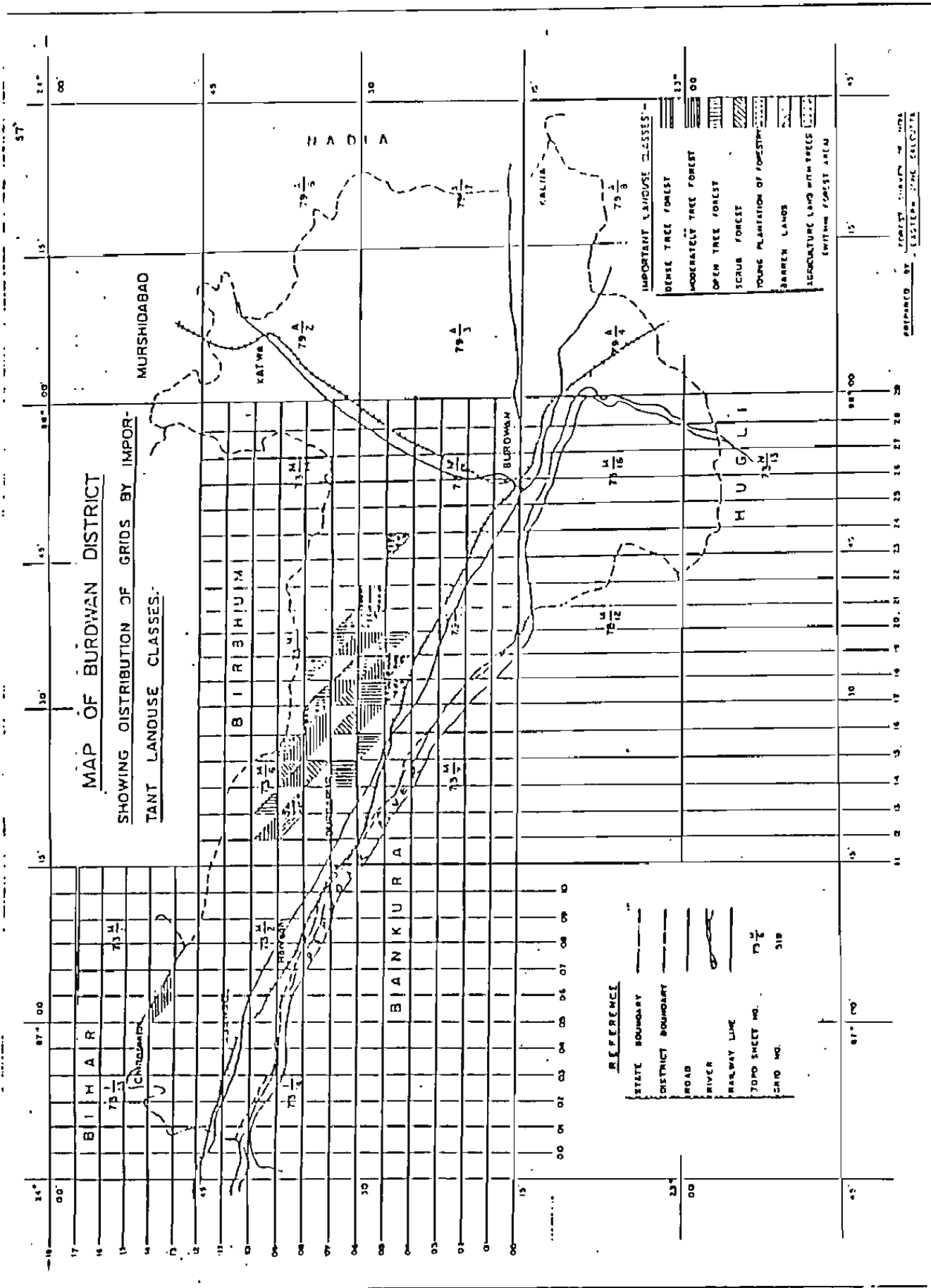
STATE BOUNDARY
DISTRICT BOUNDARY
RIVER
RAILWAY LINE
ROAD
TOMO SHEET NO.
GRID NO.

IMPORTANT LAND USE CLASSES

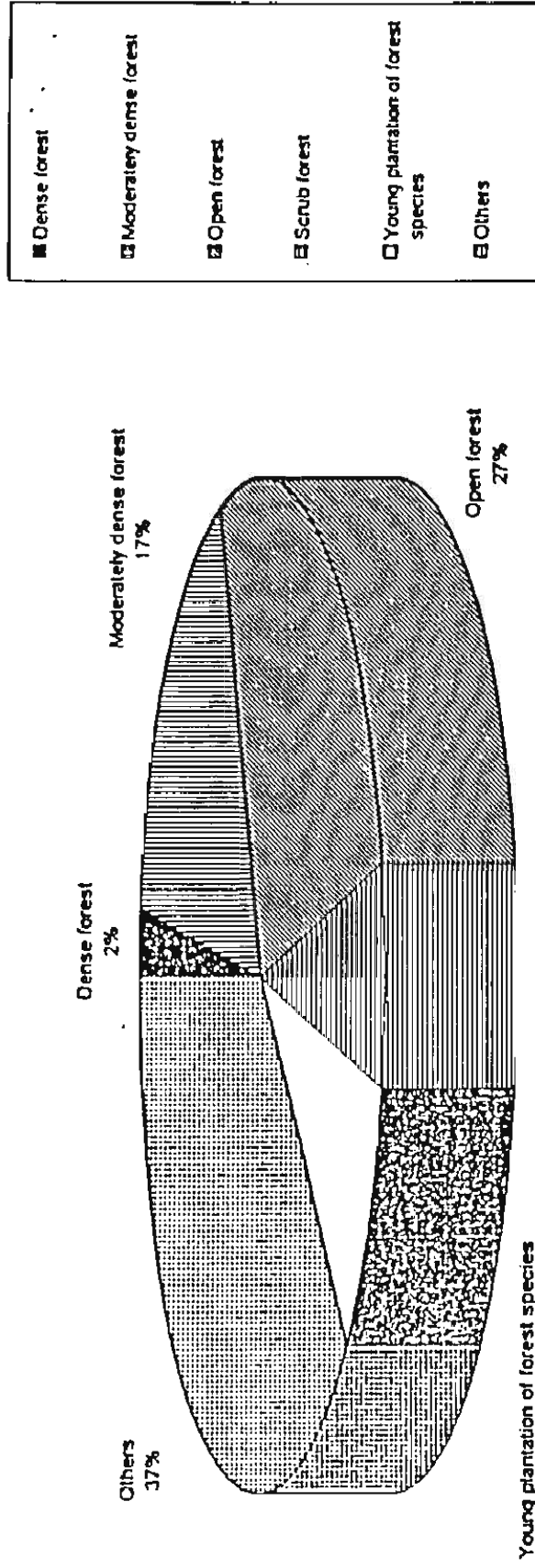
UNCULTIVATED FOREST
OPEN TREE FOREST
PLANTATION
TAMU FOREST
TAMU TREE GROVE
BARREN LAND
WATER BODIES AND



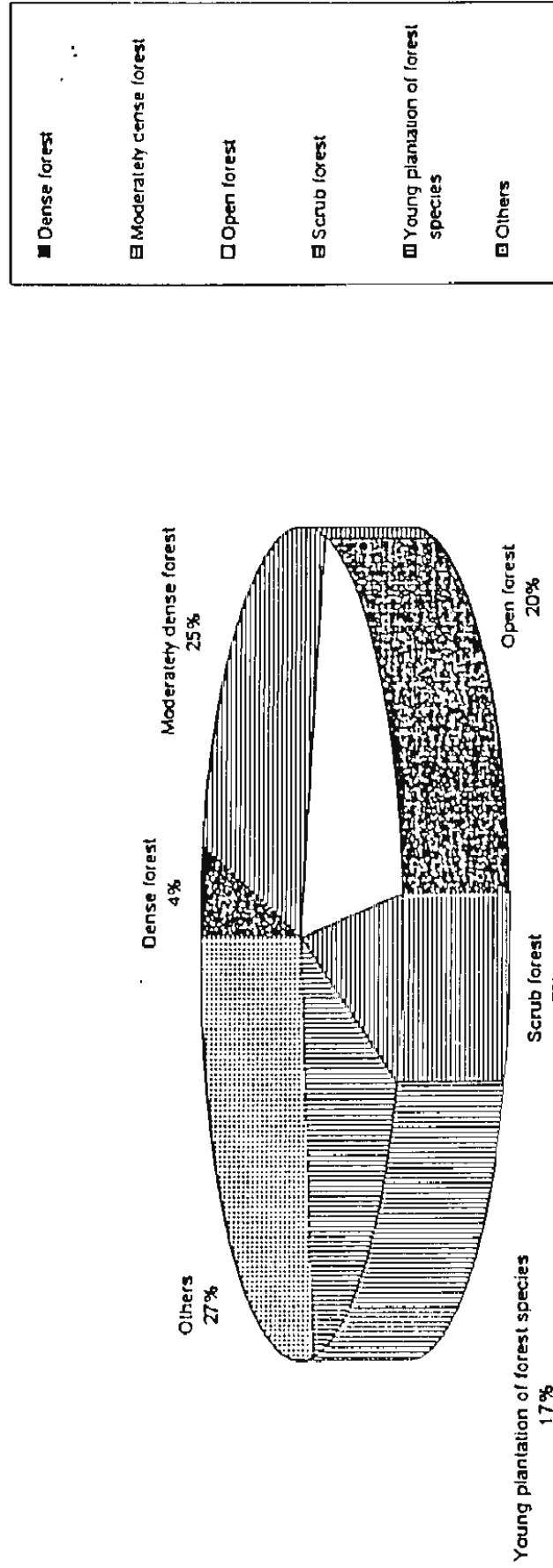
PREPARED BY: ENGINEER, BIRBHUM DISTRICT
DATE: 1954



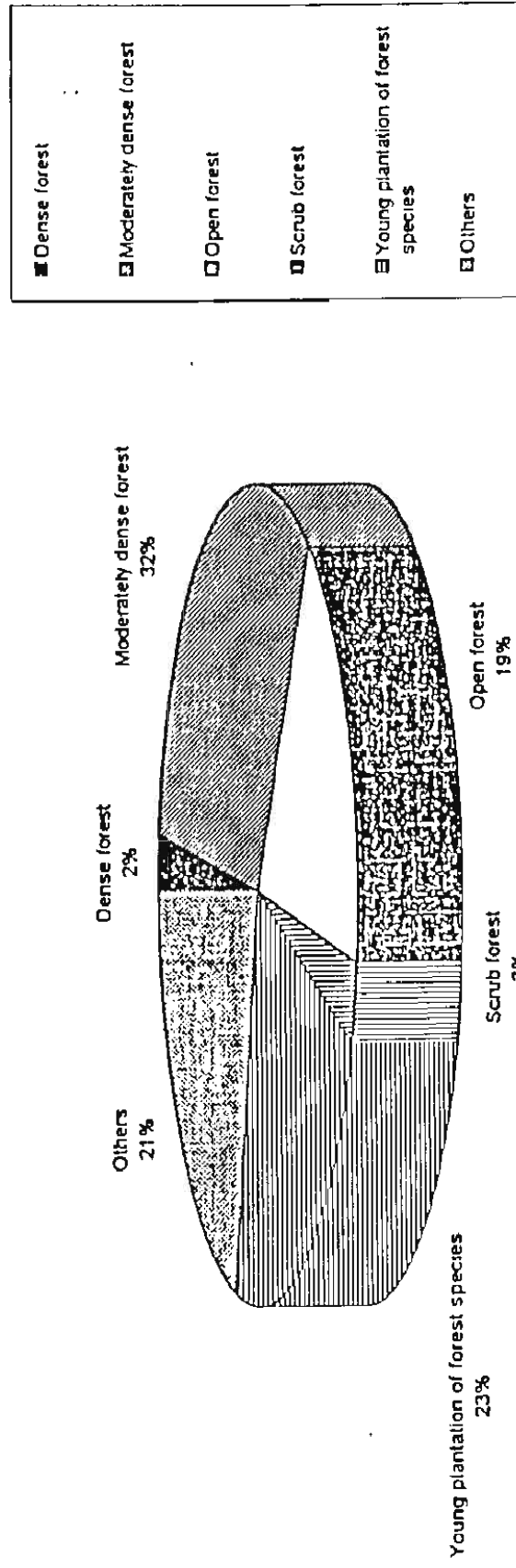
DISTRIBUTION OF FOREST AREA BY LAND USE.



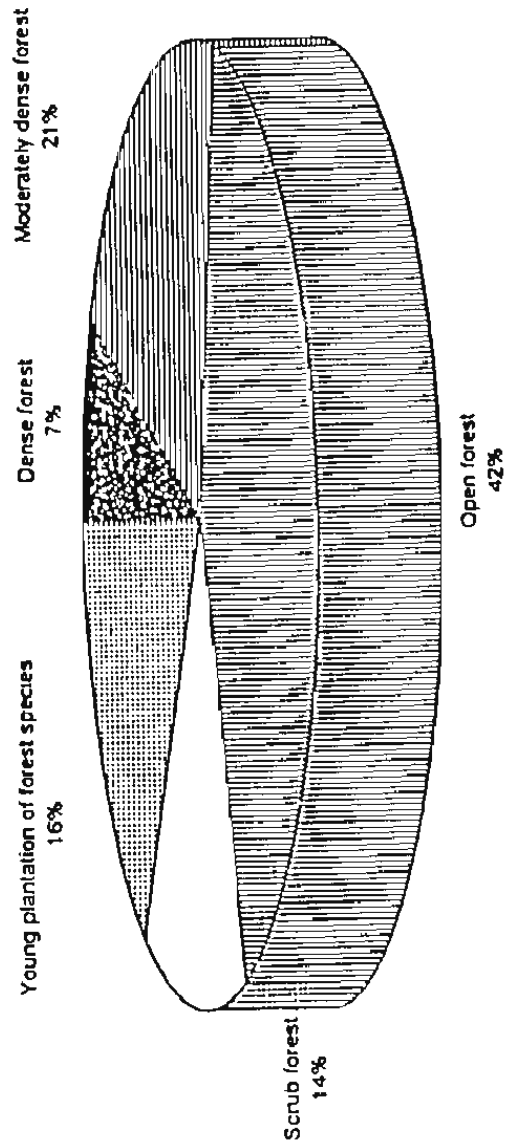
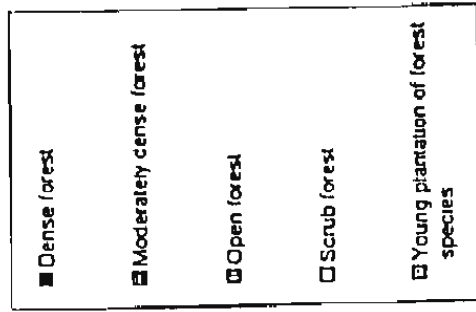
DISTRIBUTION OF FOREST AREA BY LAND USE.



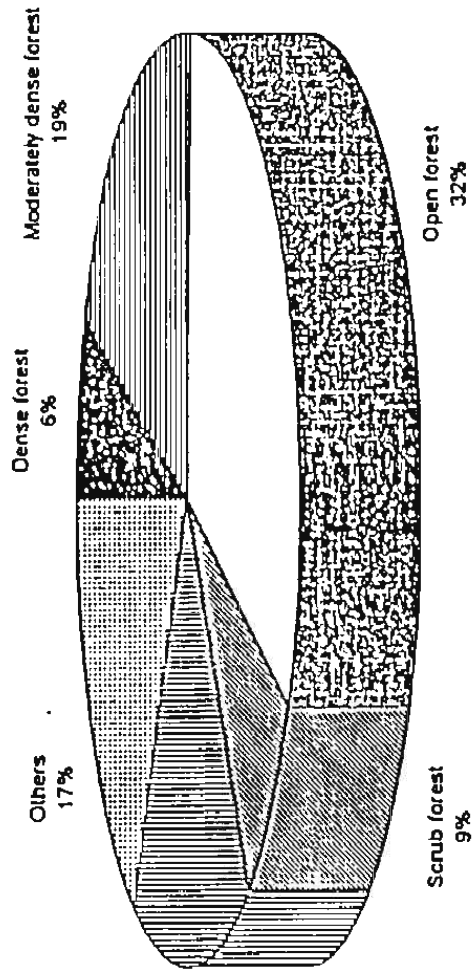
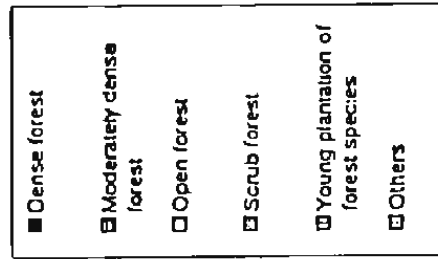
DISTRIBUTION OF FOREST AREA BY LAND USE.



DISTRIBUTION OF FOREST AREA BY LAND USE.

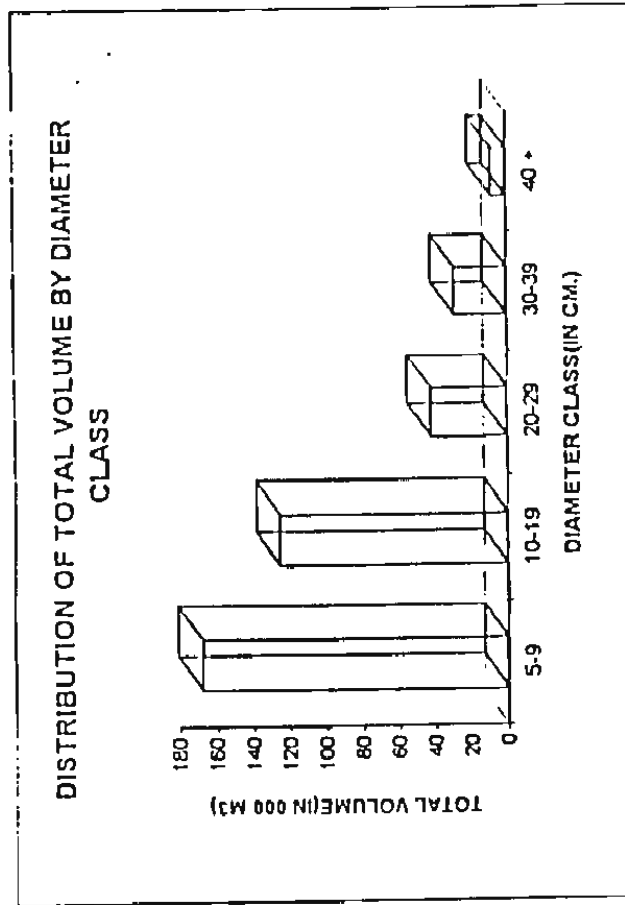
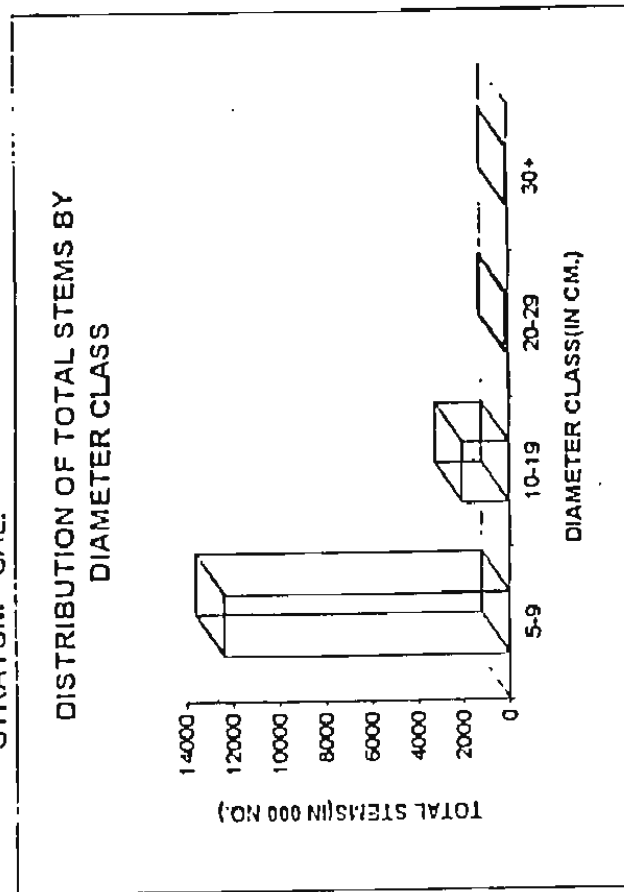


DISTRIBUTION OF FOREST AREA BY LAND USE.



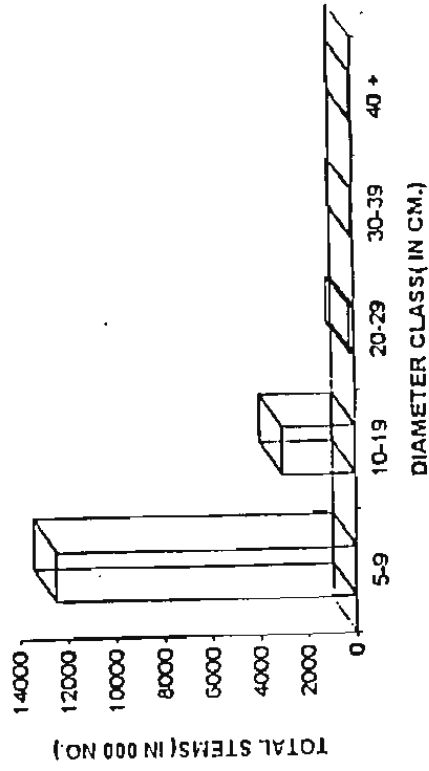
Young plantation of forest species
17%

DISTRICT - PURULIA
STRATUM - SAL.

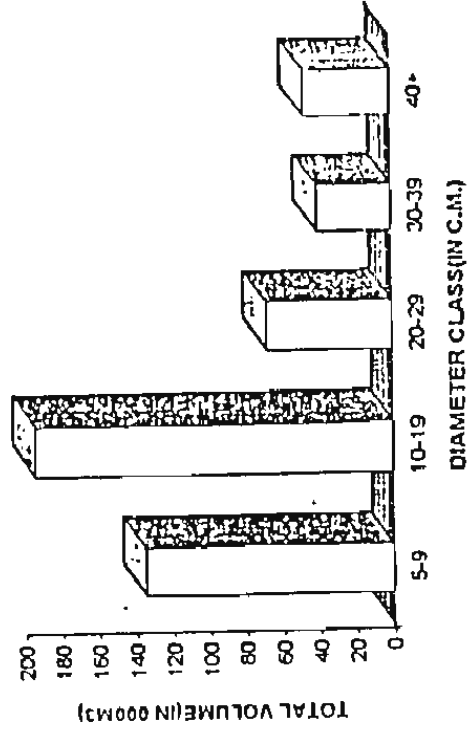


DISTRICT - PURULIA
STRATUM - MISCELLANEOUS

DISTRIBUTION OF TOTAL STEMS BY
DIAMETER CLASS

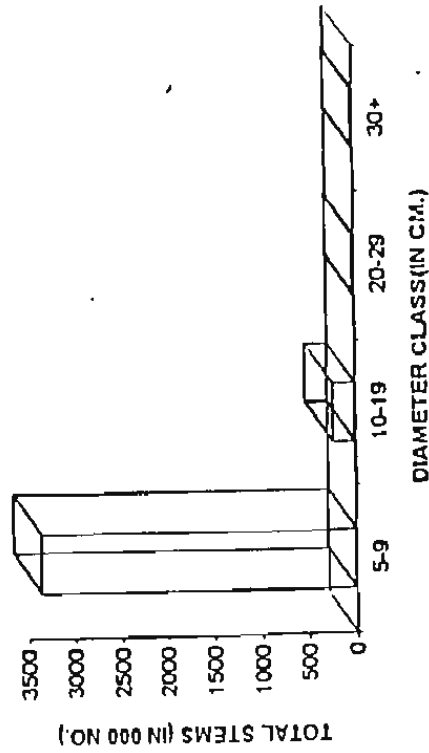


DISTRIBUTION OF TOTAL VOLUME BY
DIAMETER CLASS

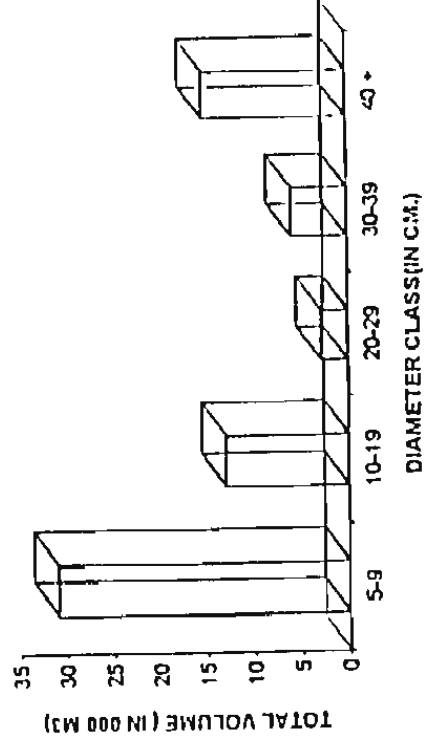


DISTRICT - PURULIA
STRATUM - PLANTATION

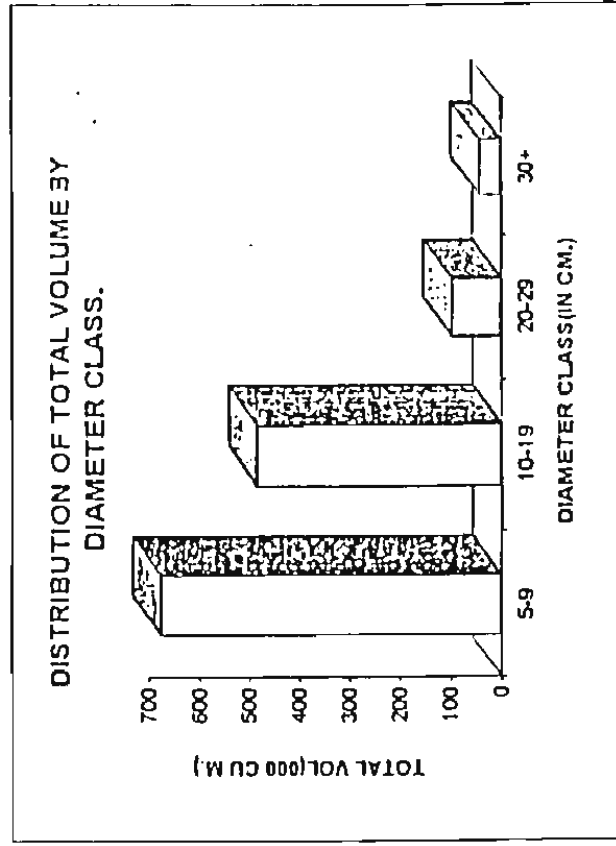
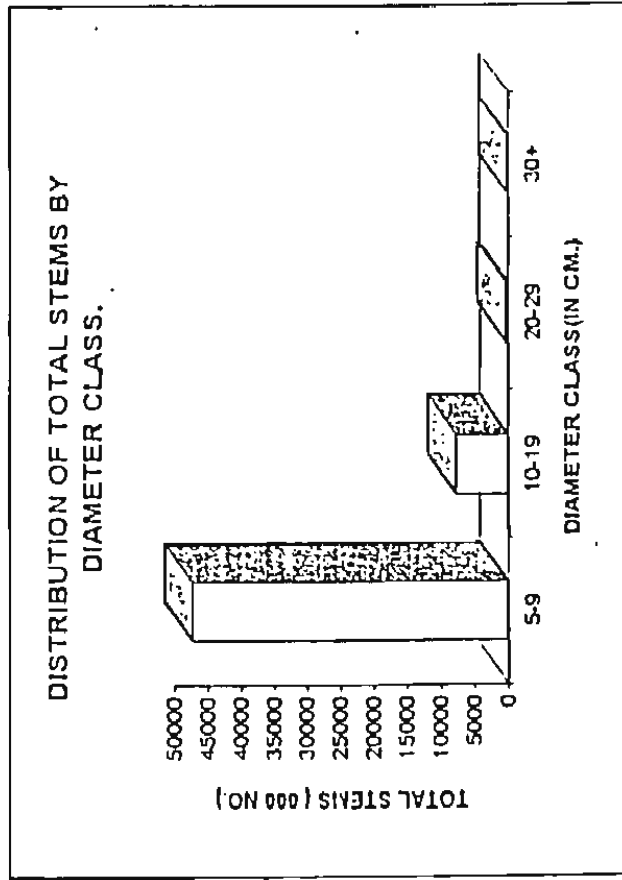
DISTRIBUTION OF TOTAL STEMS BY
DIAMETER CLASS



DISTRIBUTION OF TOTAL VOLUME BY DIAMETER
CLASS

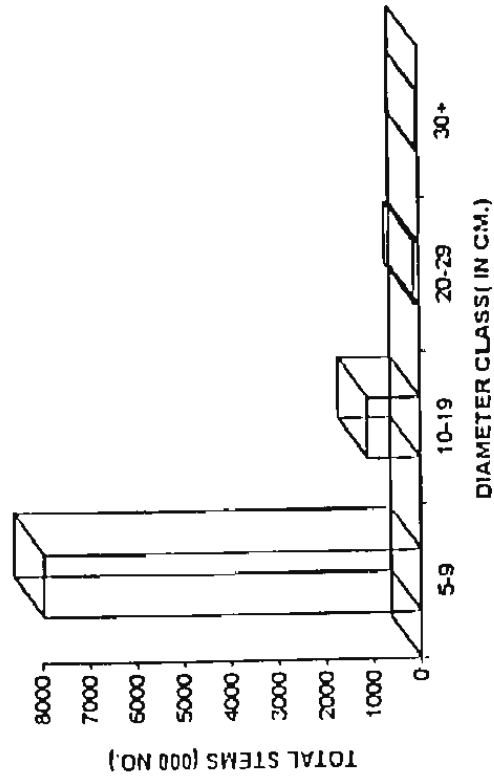


DISTRICT - BANKURA.
STRATUM - SAL

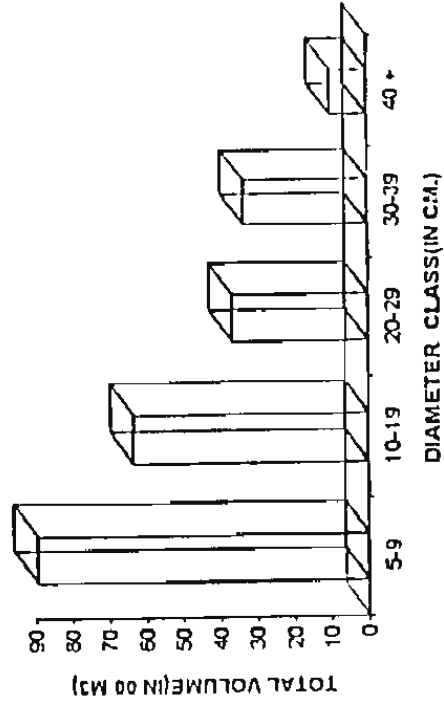


DISTRICT - BANKURA
STRATUM - MISCELLANEOUS

DISTRIBUTION OF TOTAL STEMS BY
DIAMETER CLASS.

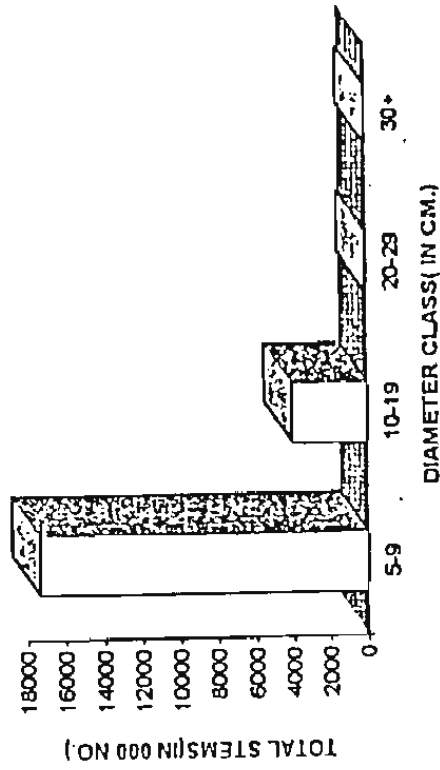


DISTRIBUTION OF TOTAL VOLUME BY
DIAMETER CLASS.

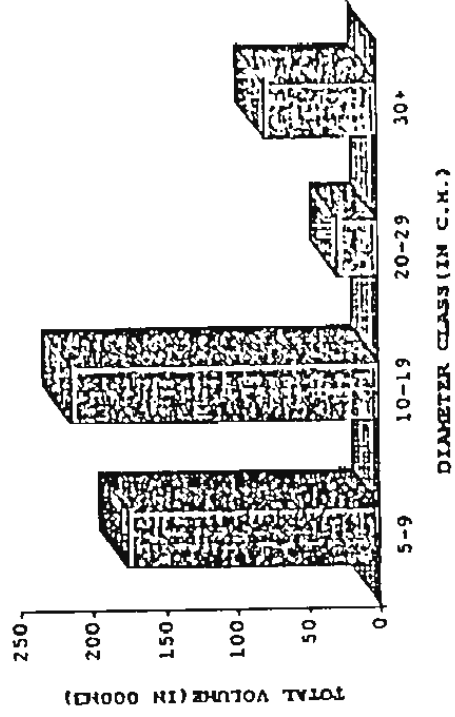


DISTRICT - BANKURA
STRATUM - PLANTATION

DISTRIBUTION OF TOTAL STEMS BY
DIAMETER CLASS

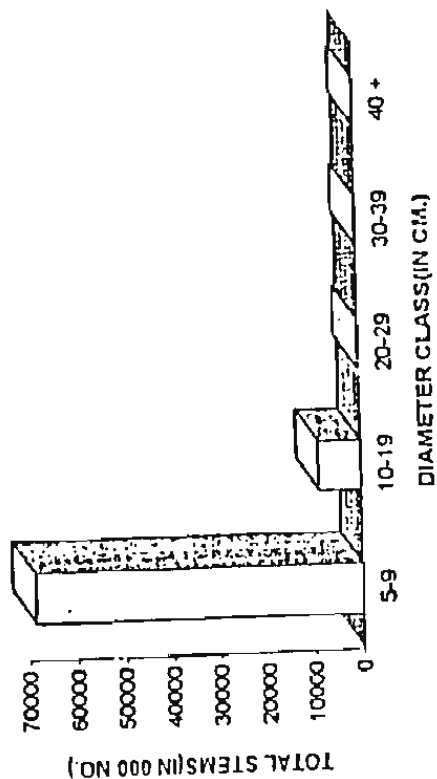


DISTRIBUTION OF TOTAL VOLUME BY
DIAMETER CLASS

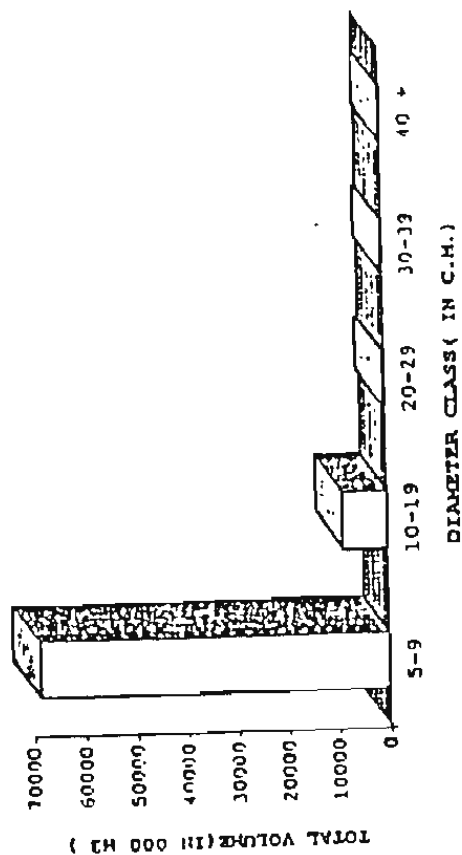


DISTRICT - MIDNAPUR
STRATUM - SAL

DISTRIBUTION OF TOTAL STEMS BY
DIAMETER CLASS

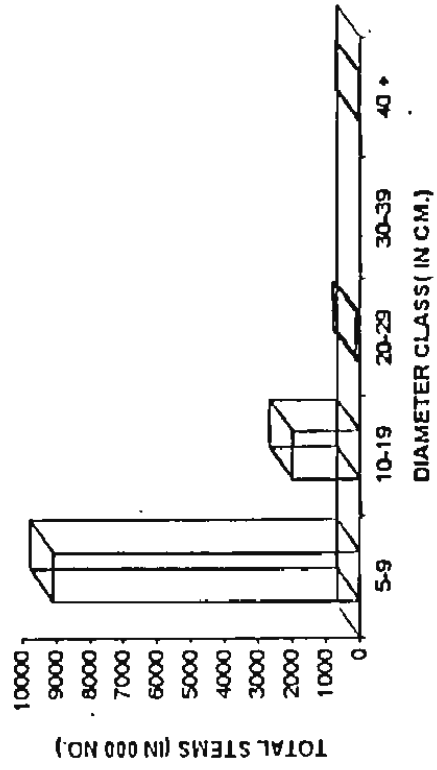


DISTRIBUTION OF TOTAL VOLUME BY
DIAMETER CLASS

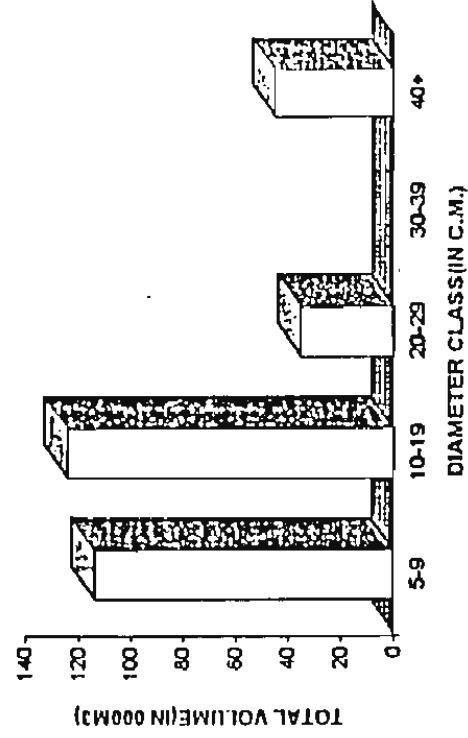


DISTRICT - MIDNAPUR
STRATUM - MISCELLANEOUS

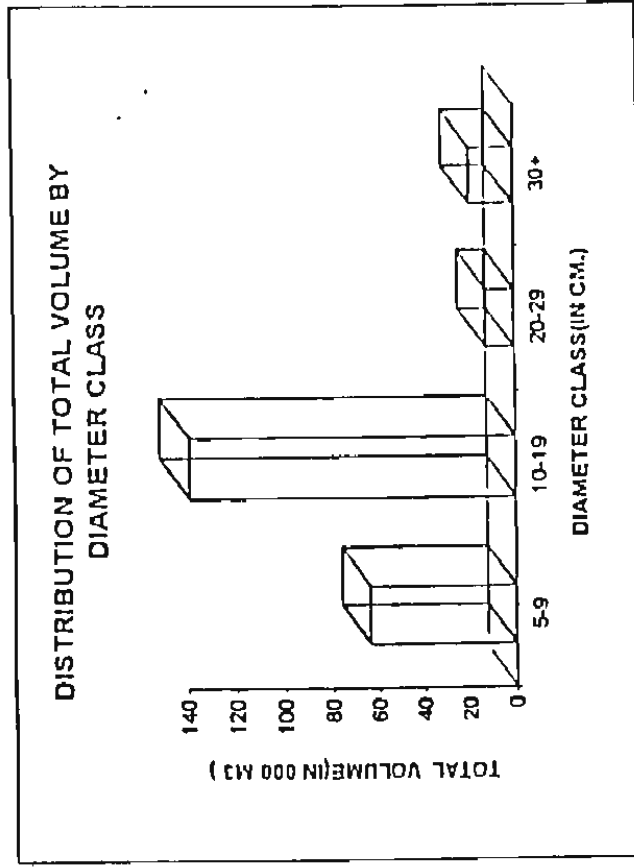
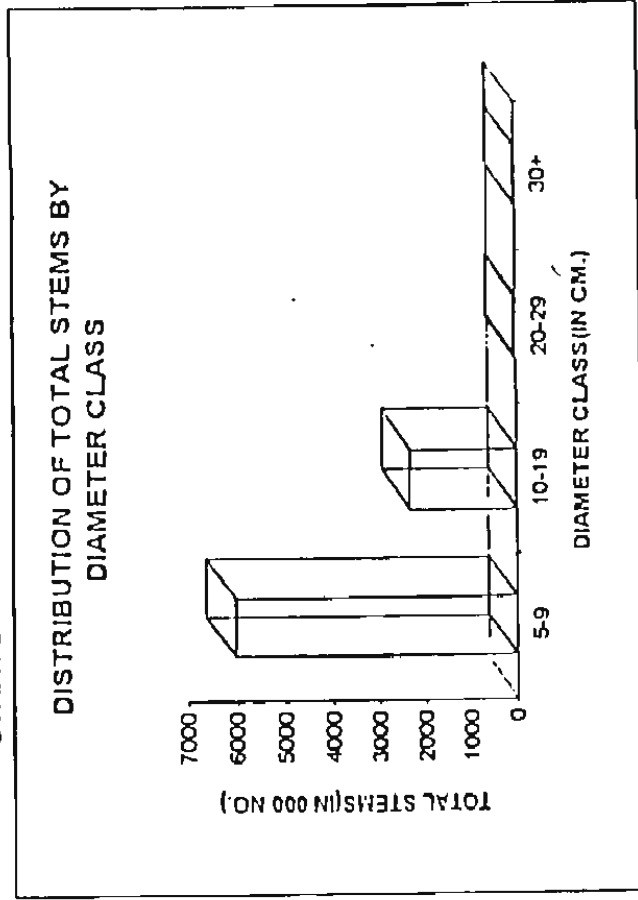
DISTRIBUTION OF TOTAL STEMS BY
DIAMETER CLASS



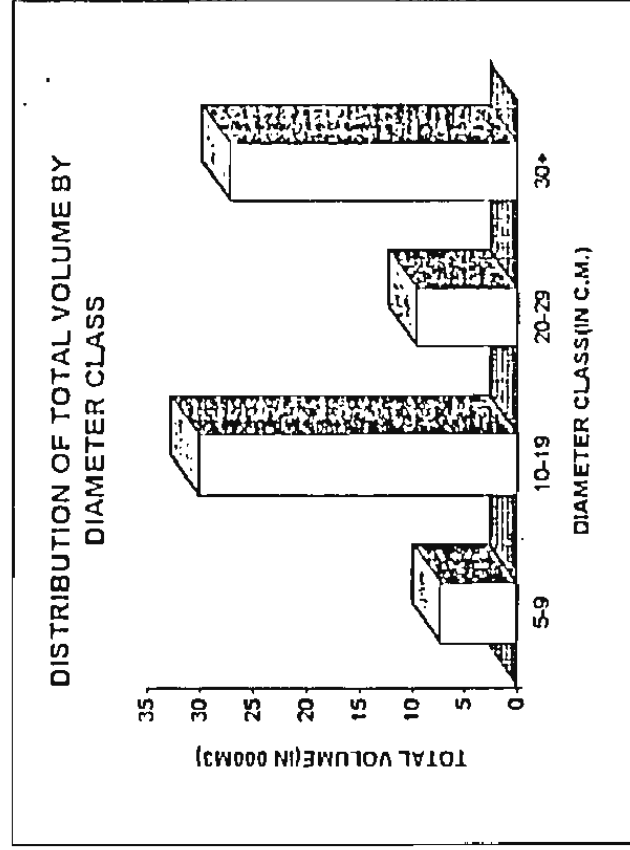
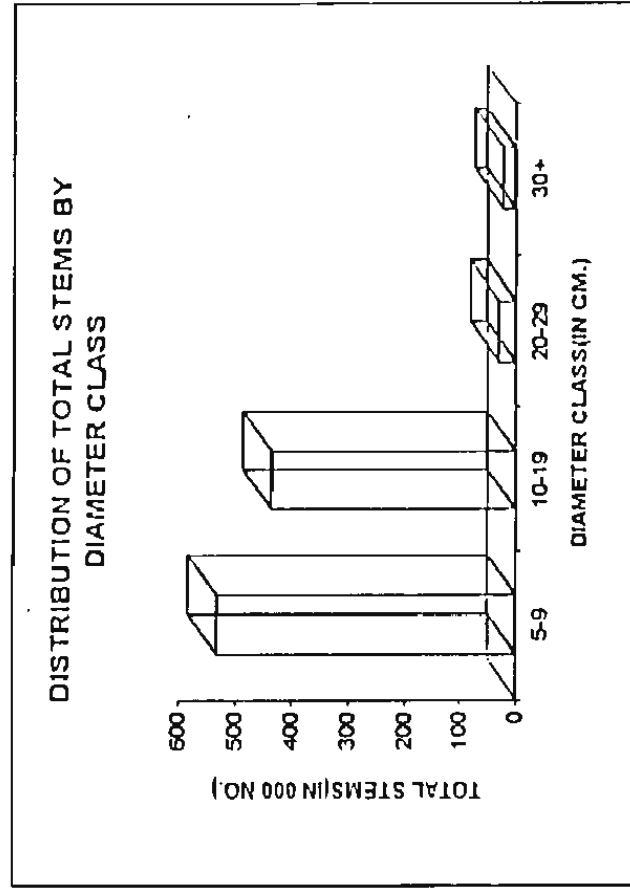
DISTRIBUTION OF TOTAL VOLUME BY
DIAMETER CLASS



DISTRICT - MIDNAPUR
STRATUM - PLANTATION

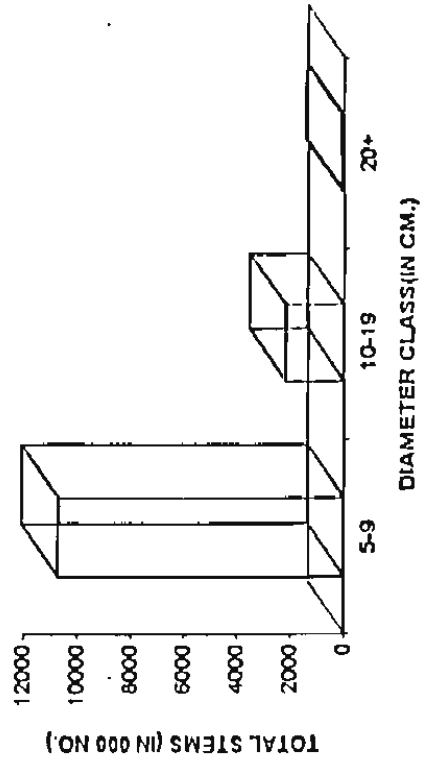


DISTRICT - BIRBHUM



DISTRICT - BURDWAN

DISTRIBUTION OF TOTAL STEMS BY DIAMETER CLASS



DISTRIBUTION OF TOTAL VOLUME BY DIAMETER CLASS

