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GOVERNMENT OF INDIA
MINISTRY OF AGRICULTURE & IRRIGATION
(DEPARTMENT OF AGRICULTURE)

REPORT ON
The Forest Resources of Manipur



PRE-INVESTMENT SURVEY OF FOREST RESOURCES

DEHRA DUN.

1976

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PREFACE

Manipur State, although rich in bamboo and forest resources, had no reliable data even with regard to the percentage of forest area versus the total area of the State which is 22,366 sq. km. The general impression was that the percentage of forest area is rather limited. Since bamboo is a conventional raw material for paper and pulp industry, and the State is industrially backward, it was decided that Preinvestment Survey of Forest Resources work be started in this State so as to identify surplus resources, if available, for industries. This survey work was, therefore, undertaken on top priority basis as a part of the intensification programme of forest surveys in the North-Eastern region of the country. The Central Zone team of Nagpur of the Pre-Investment Survey of Forest Resources was specially drawn for this work and a tight time bound programme was entrusted to them.

The surveys has revealed some very interesting features with regard to forestry. It is a matter of surprise even for the Forest Department of the State to learn that the percentage of total forest area in comparison to the geographical area of the State is 67.76% and surprisingly enough, out of the total area under forests more than 50% is under tree forests and nearly 22% is under bamboo brakes. This reflects rather a very good picture in the forestry sector, if we take the averages of the country as a whole.

The potential annual cut that has been calculated has brought out some very bright features because the total annual cut with regard to broad-leaved species is assessed at 110,468 m³ of plywood quality timber, 40,731 m³ of saw timber, 9,875 m³ of poles and 407,928 m³ of pulpwood and fuel, besides coniferous wood to the tune of 35,804 m³ per year, is available. Total bamboo yield expected annually is of the order of 14.48 lakhs tons (air dry).

Estimates of local consumption were also made and it has been found that this can be assessed at 2,90,000 m³ firewood, 30,700 m³ timber and poles and 1,61,000 tons (air dry) bamboos. On the basis of this it has been estimated that there will be a surplus of plywood class timber 110,000 m³, about 10,000 m³ of saw timber, approximately 11,730 m³ of pulpwood from broad-leaved species and 23,948 m³ of pine timber and 9,063 m³ of pine pulpwood and 12.87 lakhs tons of bamboos.

From these surpluses a very rosy industrial potential is reflected but as a modest start it can safely be recommended that feasibility studies may be organised with regard to the following :-

<u>Sl.No.</u>	<u>Type of Mill</u>	<u>Production</u>	<u>Requirement of wood/bamboos</u>
1.	Sawmill	16,000 m ³	33,948 m ³
2.	Plywood	1,37,500 sq. m.	1,10,000 m ³

3.	Integrated Pulp & Paper/Newsprint mill.	400 tons per day of newsprint or 250 tons per day of writing & printing paper.	400 tons hardwood Plus 390 tonnes bamboo per day or 600 tons of bamboo per day.
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All this has revealed a fantastic picture and indicates a big potential for industrial development in an essentially tribal region of the country.

It must be placed on record that the Central Zone team of the P.I.S. headed by Shri J.J. Dutta, Zonal Coordinator, Central Zone and assisted by S/Shri S. Prameshwarappa and R.B. Joshi Deputy Conservator of Forests did commendable work in doing this work under very difficult circumstances. They also followed the schedules very carefully and brought the work to a complete success and produced excellent results, which were not known to anyone so far.

Opportunity has also to be taken to thank S/Shri S.M. Krishnastry, Chief Secretary, Manipur, the Police organization of Manipur, who were very helpful in assisting our field crew to camp in the out of the way places and many a times in the camps of the outposts of the Police and the establishments of the B.S.F. and the Commandants of Manipur Rifles, Assam Rifles etc.

Special thanks are due to Shri B.S.K. Sharma, Conservator of Forests and to all his officers and staff who were very cooperative without whose cooperation this work could not have been completed.

The Botany Branch of the Forest Research Institute, Dehra Dun identified the leaf specimens collected by our team as a result of which we got the botanical names of the various species. Similarly, the Mensuration Branch of the F.R.I. sent a party with the Barr & Stroud dendrometer which helped us in getting the volumes of standing trees as we could not fell the trees due to objections by the tribals.

We are also deeply indebted to Dr. D.V. Bhalkar, Professor of Agricultural-Chemistry, Agriculture College, Nagpur, for permitting our organization to use the autoclaves for oven drying of bamboo specimens and the weighing etc.

Dated: 28/12/1976.

(Ramesh Chandra)
Chief Coordinator.

(1)

ACKNOWLEDGEMENTS

The Central Zone team of the Pre-Investment Survey of Forest Resources wish to place on record their gratitude to the officers of Manipur State for their kind help and guidance in the execution of our work.

Shri S.M. Krishnatry, I.A.S., Chief Secretary, Manipur took personal interest in our work and the safety of our field crew.

The D.I.G. Police, Manipur, the D.I.G., C.R.P., the D.I.G., B.S.F., the Commandants Manipur Rifles, Assam Rifles were all very helpful and permitted our field crew to camp in their outposts when on field work.

The Forest Department, headed by Shri B.S.K. Sharma, I.F.S., Conservator of Forests and all his officers and staff went all the way to give us all the cooperation and help that they could. Our stay in the base camp in the premises of the Timber Treating Plant at Mantripukhri was made very comfortable by Shri Brij Mani Singh, Officer-in-Charge of the Plant. He also helped us with the weighments of the bamboo samples for calculating dry weight.

The Botany branch of the F.R.I., Dehra Dun identified the leaf specimens collected by us from Manipur forests, and gave us their botanical names. The Mensuration branch sent their party with the Barr & Stroud dendrometer to give us volumes of standing trees as we could not fell trees (due to objections by the tribals). These data have been used by us to derive volume equations for the species.

We are also deeply indebted to Dr. D.V. Bhalkar, Professor of Agricultural-Chemistry, Agriculture College, Nagpur for permitting us the use of autoclaves for oven drying of bamboo specimens and their weighment.

J.J. Dutta
Zonal Coordinator.

SUMMARY

Although the State of Manipur has abundant forest wealth, quantitative information on them was meagre. The Central Zone team of Pre-Investment Survey of Forest Resources was asked to tackle this State as a rush job.

The total geographical area of state is 22,366 sq. kms. Elevations vary from 400-3000 metres. Climate range is from cool to tropical. Rainfall is fairly heavy. Apart from settled cultivation in the valleys, there is a large incidence of 'Jhum', by Naga & Kuki tribes.

Vegetation is semi-evergreen, sub-tropical wet hills, Pinus kesiya forests. Wet temperate forests, and Teak Gurjan forests, each quite distinct. Bamboo brakes are extensive, as a result of jhum cultivation.

Legal status of the forest is fluid. The tribal councils claim ownership even over Reserved Forests. Management is in a very primitive stage. Yield control etc. are not practiced. Greatest damage to forest is caused by jhum.

Stratification of the sampling frame was done by helicopter recce. Area assessment is also based on the same. Landuse, vegetation and Forest types were identified in helicopter recce. Photointerpretation helped only in landuse and vegetation assessment, and is based on 8 year old 1: 60,000 photos.

Tree forests occ-ur over 7621.44 sq.km. Bamboo brakes over 3268.43 sq. km. Annual jhum area is 1832.08 sq. km.

Pilot survey was done to determine variance 'within stratum' and number of plots for required precision $\pm 10\%$ at 95% probability level were assessed. However, due to inaccessibility and onset of rains, only a little more than half the number could be sampled. Precision levels have been worked out for each item in the data tables. The S.E. for total timber was 10.4%, and for forest area was 1%.

The sampling design was a stratified random sampling from a sample frame of $1\frac{1}{4}' \times 1\frac{1}{4}'$ grid intersection as Centre points for a 0.1 ha. square plot. Both trees and bamboos were studied on the plot.

The wet Temperate forests were found to have maximum volume per ha. i.e. 123.150 m³, followed by Semi-evergreen 98.095 m³, wet hills - 90.720 m³. Teak Gurjan - 71.392 m³, and Pine - 60.001 m³/ha. The open forests under these forest types show a stocking of between 4 to 14 m³/ha. and are unworkable. The average stocking of muli bamboo is 10827.4 culms/ha. and of clump forming bamboos is 1008.77 culms/ha. Green weight by diameter classes and driage factors have been assessed.

The potential annual cut is based on Smythies' safeguarding formula. Felling cycle is taken as 30 years and 't' i.e. time for passing from Class II to Class I is taken as 25 or 30 years, depending on forest type.

The total annual cut of broad leaved trees is assessed as 1,10,468 m³ of plywood size timber; 40,731 m³ of saw timber; 9875 m³ of poles, and 4,07,928 m³ of pulpwood & fuel. Total coniferous wood is 35,804 m³ per year. Total bamboo yield expected annually is 14.48 lakh tonnes air dry (10% moisture).

The local wood and bamboo consumption is assessed as 2,90,000 m³ firewood, 30,700 m³ timber and poles and 1,61,000 tonnes (air dry) bamboo.

The total cost of the survey was Rs. 3,90,685.74 or Rs. 25.77 per sq. km. of forest area.

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TABLE OF CONTENTS

Paragraph number	Contents	Pa-ge number
<u>CHAPTER - I - INTRODUCTION</u>		
1.1.	Origin of the Project ..	1
1.2.	Objectives ..	1
1.3.	Past studies ..	1
1.4.	Implementation ..	2
<u>CHAPTER - II - GENERAL DESCRIPTION OF AREA</u>		
2.1.	Physical description ..	5
2.1.1.	Area ..	5
2.2.	Geology ..	5
2.3.1.	Climate ..	6
2.4.	Land use ..	6
2.5.	Vegetation ..	7
2.5.1	Cachar Tropical Semi Evergreen Forests ..	7
2.5.2.	Khasi Sub Tropical wet Hill Forests ..	7
2.5.3.	Assam Sub Tropical pine Forests ..	8
2.5.4.	East Himalayan Wet Temperate Forests ..	8
2.5.5.	Sub Alpine ..	8
2.5.6.	Bamboo brakes ..	8
2.5.7.	Cane brakes ..	9
2.6.1.	Accessibility ..	9
2.6.2.	River Transport ..	10
2.7.	Legal position of forests ..	10
2.8.	Injuries to which the crop is liable ..	10
2.9.	People and Socio Economic background ..	12
2.9.1.	Labour supply ..	13
2.9.2.	Power. ..	13
2.9.3.	Industries ..	13

Paragraph number	Contents	Page number
5.4.	Volume equations ..	27
5.4.1.	Volume equations derived from dendrometer measurements. ..	28
5.5.	Tree volume ..	28
5.6.	Plot volume ..	28
5.7.	Stand and stock. ..	28
5.8.	Standard error ..	29
5.9.	Bamboo yield ..	29
5.10.	Muli Bamboo ..	29
5.11.	Clump forming bamboo ..	29
5.12.	Bamboo weight ..	30
<u>CHAPTER - VI - RESULTS OF SURVEY</u>		
6.1.	Area. ..	31
6.2.	Vegetation ..	31
6.3.	Area under bamboo ..	31
6.4.	Forest types ..	31
6.4.1.	Distribution of vol/ha. by forest types ..	32
6.4.2.	Distribution of stems/ha. ..	32
6.5.	Distribution of volume ..	32
6.6.	Bamboo ..	33
6.6.1.	Clump forming bamboo ..	33
6.6.2.	Area and growing stock of bamboo ..	33
6.6.3.	Air dry weight ..	34
<u>CHAPTER - VII - POTENTIAL ANNUAL CUT</u>		
7.1.	Present management ..	35
7.2.	Future management ..	35
7.2.1.	Smythie's formula ..	35
7.2.2.	Components of the formula ..	36
7.2.3.	Application of the formula ..	36
7.2.3.1.	Wet Temperate Forests ..	36
7.2.3.2.	Pine forests ..	38
7.2.3.3.	Wet Hill forests ..	40

Paragraph number	Contents	Page number
7.2.3.4.	The Semi Evergreen forests	42
7.2.3.5.	Teak - Gurjan forests	43
7.3.	Total annual cut - Timber	44
7.3.1.	Utilitywise availability of broad leaved species.	44
7.3.2.	Utilitywise availability of Pine	44
7.4.	Annual cut of Bamboos	44
7.4.1.	Muli Bamboos	45
7.4.2.	Clump forming Bamboos	46
7.5.	Total annual cut of Bamboos	47
7.6.	Overstocking in Bamboo	47
7.7.	Wood balance	47
	<u>CHAPTER - VIII - INDUSTRIAL POSSIBILITIES</u>	48-49
	BIBLIOGRAPHY	50

LIST OF APPENDICES

Appendix number	Description	Page number
I - a	Field manual ..	51-77
I - b	Code No. of Tree Species used in Manipur Survey ..	78-93
II - a	Plot approach form ..	94
II - b	Plot description form ..	95
II - c	Plot Enumeration form ..	96
II - d	Sample tree form ..	97
II - e	Sample tree card ..	98
II - f	Bamboo enumeration form ..	99
II - g	Bamboo weight form ..	100
II - h	Form for recording aerial observations..	101
III - a	Table 1.1. Distribution of area by land use. ..	102
III - b	Table 1.2. Distribution of Forest area by vegetation. ...	103
III - c	Table 1.3. Distribution of Tree forest and open forest area by forest type.	104
IV - a	Table 2.1. Vegetation tree forest Distribution of vol/ha. by forest type ..	105
IV - b	Table 2.2. Vegetation open forest. Distribution of vol./ha. by forest type.	106
V - a	Table 3.1.1. Vegetation tree forest, Forest type - Wet temperate. Distribution of stems/ha. by diameter .. classes and species.	107

Appendix number	Description	Page number
V - b	Table 3.1.2. Vegetation tree forest, forest type - Pine. Distribution of stems/ha. by diameter classes .. and species.	108
V - c	Table 3.1.3. Vegetation tree forest, forest type - wet Hill. Distribution of stems/ha. by diameter classes and species.	.. 109
V - d	Table 3.1.4. Vegetation tree forest, Forest type - Semi evergreen. Distribution of stems/ha. by diameter classes and species.	.. 110
V - e	Table 3.1.5. Vegetation - tree forest, forest type - Teak - Gurjan. Distribution of stems/ha. by diameter classes and species.	.. 111
VI - a	Table 3.2.1. Vegetation - open forest, forest type - Wet temperate. Distribution of stems/ha. by diameter classes and species.	.. 112
VI - b	Table 3.2.2. Vegetation - open forest, forest type - Pine. Distribution of stems/ha. by diameter classes and species.	.. 113
VI - c	Table 3.2.3. Vegetation-open forest, forest type - Wet Hills Distribution of stems/ha. by diameter classes and species.	.. 114
VII - a	Table 3.3. Vegetation-Bamboo brake Distribution of stems/ha. by diameter classes and species.	.. 115
VIII-a	Table 4.0.0. Vegetation-other than tree forest, open forest, and Bamboo brake. Distribution of vol/ha. by diameter classes and species.	.. 116
VIII-b	Table 4.1.1. Vegetation tree forest, forest type - Wet temperate Distribution of vol/ha. by diameter classes and species.	.. 117

Appendix number	Description	Page number
VIII-c	Table 4.1.2. Vegetation Tree forest, Forest type - Pine. Distribution of vol/ha. by diameter classes and species.	.. 118
VIII-d	Table 4.1.3. Vegetation-tree forest, Forest type - Wet Hills Distribution of vol/ha. diameter classes and species.	.. 119
VIII-e	Table 4.1.4. Vegetation tree forest, Forest type-Semi evergreen Distribution of vol/ha. by diameter classes and species.	.. 120
VIII-f	Table 4.1.5. Vegetation-tree forest, Forest type - Teak Gurjan Distribution of vol/ha. by diameter classes and species.	.. 121
IX - a	Table 4.2.1. Vegetation-open forest, forest type - Wet temperate Distribution of vol/ha. by diameter classes and species.	.. 122
IX - b	Table 4.2.2. Vegetation-open forest, forest type - Pine Distribution of vol/ha. by diameter classes and species.	.. 123
IX - c	Table 4.2.3. Vegetation open forest, forest type - Wet Hills Distribution of vol/ha. by diameter classes and species.	.. 124
X - a	Table 4.3. Vegetation - Bamboo brake Distribution of vol/ha. by diameter classes and species.	.. 125
XI - a	Table 5.1.1. Vegetation - Tree forest, Forest type - Wet temperate Distribution of total stems by diameter classes and species.	.. 126
XI - b	Table 5.1.2. Vegetation-Tree forest, Forest type - Pine Distribution of total stems by diameter classes and species.	.. 127

Appendix number	Description	Page number
XI - c	Table 5.1.3. Vegetation-tree forest, forest type - Wet Hills. Distribution of total stems by diameter classes and species.	.. 128 .. 128
XI - d	Table 5.1.4. Vegetation-tree forest, Forest type - Semi evergreen Distribution of total stems by diameter classes and species.	.. 129
XI - e	Table 5.1.5. Vegetation-tree forest, forest type - Teak - Gurjan Distribution of total stems by diameter classes and species.	.. 130
XII - a	Table 5.2.1. Vegetation open forest, forest type - Wet temperate. Distribution of total stems by diameter classes and species.	.. 131
XII - b	Table 5.2.2. Vegetation-open forest, forest type - Pine. Distribution of total stems by diameter classes and species.	.. 132
XII - c	Table 5.2.3. Vegetation-open forest, Forest type - Wet Hills. Distribution of total stems by diameter classes and species.	.. 133
XIII-a	Table 6.1.1. Vegetation - Tree forest, Forest type - Wet temperate Distribution of total volume by diameter classes and species.	.. 134
XIII- b	Table 6.1.2. Vegetation-Tree forest, Forest type - Pine Distribution of total volume by diameter classes classes and species.	.. 135
XIII- c	Table 6.1.3. Vegetation - Tree forest, Forest type - Wet Hills Distribution of total volume by diameter classes and species	.. 136
XIII- d	Table 6.1.4. Vegetation-tree forests, Forest type - Semi -evergreen Distribution of total volume by diameter classes and species.	.. 137

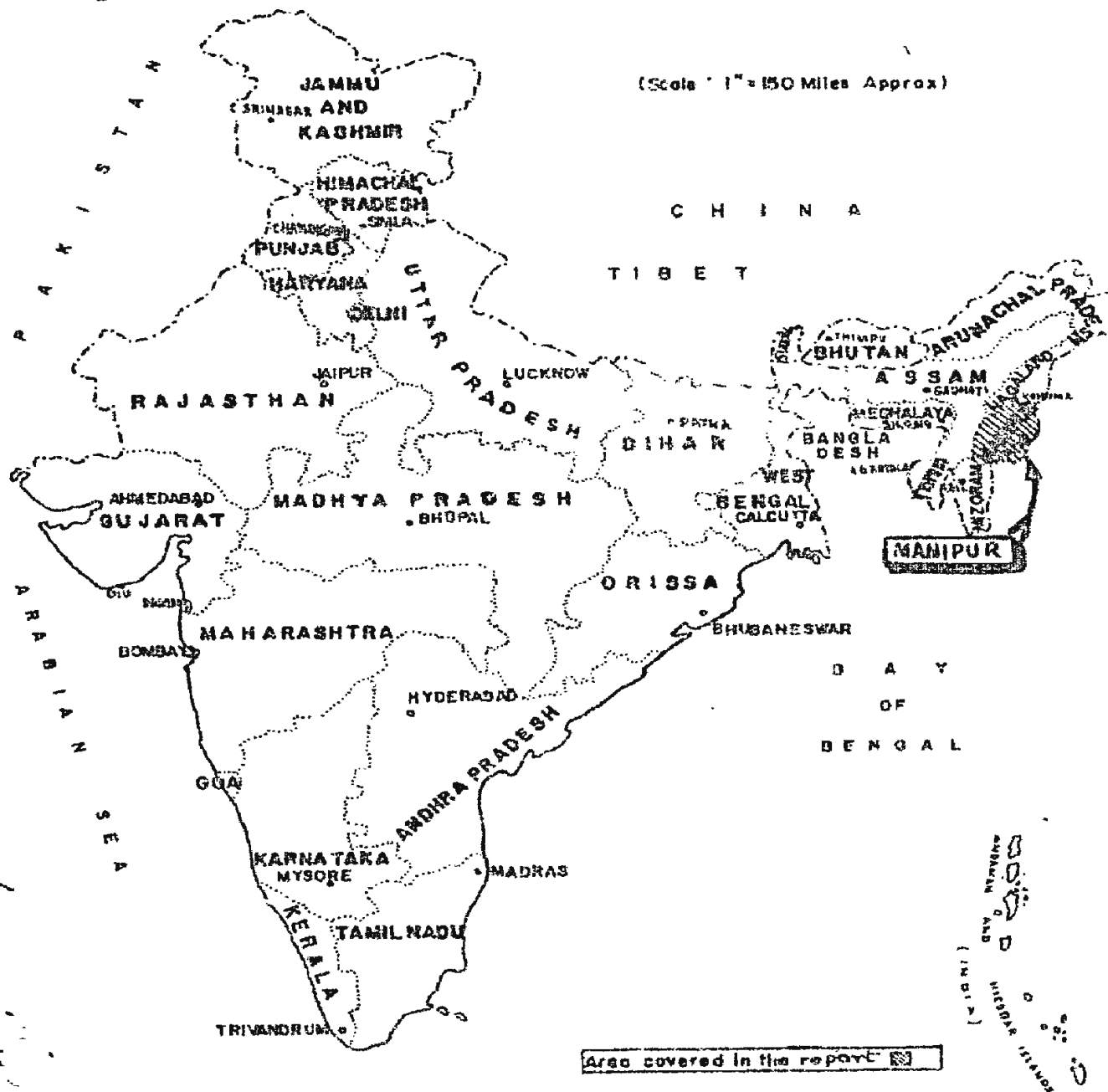
(x)

Appendix number	Description	Page number
XIII-e	Table 6.1.5. Vegetation-Tree forests, Forest type - Teak - Gurjan Distribution of total volume by diameter classes and species.	.. 138
XIV - a	Table 6.2.1. Vegetation - Open forest, Forest type - Wet temperate Distribution of total volume by diameter class-es and species.	.. 139
XIV - b	Table 6.2.2. Vegetation - Open forest, Forest ty-pe - Pine Distribution of total volume by diameter classes and species.	.. 140
XIV - c	Table 6.2.3. Vegetation-open forest, forest type - Wet Hills Distribution of total volume by diameter classes and species.	.. 141
XV - a	Table 7.0 Bamboo survey results	.. 142
XV - b	Table 7.1. Distribution of No. of culms/ha. by age and soundness	.. 143
XV - c	Table 7.2. Bamboo dry weight/ha. in tonnes	.. 144
XV - d	Table 7.3. Area claculation for clump forming bamboo.	.. 145
XVI	Cost of survey.	.. 146

LIST OF MAPS AND ILLUSTRATIONS

	<u>Page No.</u>
I. Location Map on 1" = 150 miles scale indicating the location of the survey area under report.	(Before Chapter I)
II. Map of the Project area on 1" = 4 miles scale showing the existing and proposed roads.	(After Map 1)
III. Map on 1" = 32 miles showing the physiography of Manipur.	4
IV. (Diagram No. 1 (Illustration showing the layout of the (grids at 1½' x 1½' for a ½" sheet	21
V. Diagram No. 2,3 & 4 - Illustrations showing layout of the sample plot, sample studies for clump forming and non-clump forming bamboos and tree species.	23

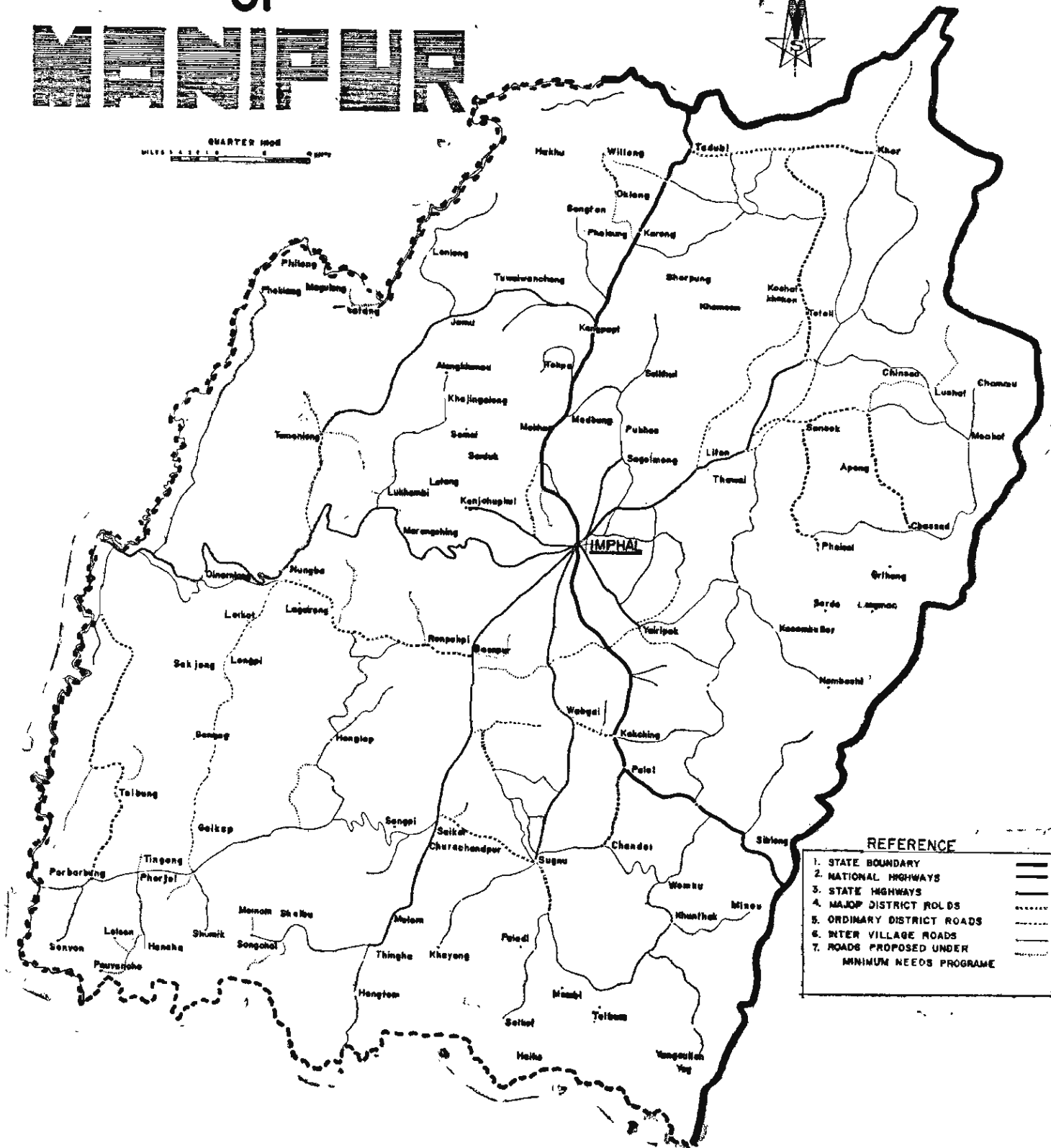
MAP OF INDIA SHOWING PROJECT AREA (MANIPUR.)



ROAD MAP OF MANIPUR



CHARTER ROAD
MILES 1 2 3 4 5 6 7 8 9 10



REFERENCE

1. STATE BOUNDARY
2. NATIONAL HIGHWAYS
3. STATE HIGHWAYS
4. MAJOR DISTRICT ROADS
5. ORDINARY DISTRICT ROADS
6. INTER VILLAGE ROADS
7. ROADS PROPOSED UNDER
MINIMUM NEEDS PROGRAMME

CHAPTER - I
INTRODUCTION.

1.1. Origin of Project:

Manipur is an isolated, hill bound, frontier State in North Eastern Part of India adjoining Burma (See Map No.1). As this part of the country lacks in a dependable road or other means of communication which constitute an important infrastructure for economic development, the pace of progress in the region in general and Manipur in particular has been very slow, over the years. Therefore, the Government of India with a view to giving priority for the economic development of the region, wanted to know the 'forest resource' picture. The assessment of forest resources in which this region abounds, was allotted to the Central Zone team of the Preinvestment Survey of Forest Resources Project, in a meeting held on 4-7-1974 under the Chairmanship of Inspector General of Forests at New Delhi.

1.2. Objectives:

The main objective of the survey were to assess the wood and bamboo potential to examine the possibility of establishing forest based industries in the State at the earliest. In pursuance of this decision, the survey work in Manipur was taken up from 1st March, 1975, after the Central Zone team was free from the field work in Tripura which was conducted from November 1974 to February 1975.

1.3. Past studies:

No studies of any kind have been done in the past to assess the growing stock for the whole of state. The very ownership of the forests being under dispute, the exact area under forest was also not known. However, the State Forest Department has prepared two working plans. The one for the Reserved Forests of Western Forest Division, covering an area of 324.26 Sq.Kms., was based on the enumerations carried out in 4" diameter classes. The second plan for the Reserved and Protected forests of Eastern Forest Division, covering an area of 318.56 sq.kms. was based on stock-maps only.

A rapid survey of Muli bamboo resources was carried out by the State Forest Department in the year 1972. The survey was done by a rough stock-mapping of the bamboo areas into three strata and then taking a few samples from each stratum and counting the number of bamboos by species, age etc.

The total area under bamboo in this survey area was 1470 sq.kms. in a geographical area of 5523 sq.kms. The average no. of Muli bamboo per acre in pure bamboo stratum varied from 4,500 to 5,500; in mixed rich bamboo forests from 1,270 to 2,250; and in mixed poor bamboo forests from 500 to 750. The average weight of a muli bamboo (dry) was taken as 2.5 kg. One sixth of the total growing stock was considered as annual yield which was assessed as 0.7 million (air dry) tonnes.

1.4. Implementation:

Maps of Manipur State were not available either with the M.R.I.O., Dehra Dun or with the Eastern Circle of Survey of India at Calcutta. After a protracted procedure of Defence-clearance etc., the maps were issued by the Army Map Depot trimming off 1.5 km. along the international (Burma) border. The maps were old (editions of 1932) and were on $\frac{1}{2}$ " scale containing very little details. There was no alternative but to use the same. The field parties after completing the work in Tripura moved to Manipur and established the base camp in the premises of Timber Treating Plant at Mantripukri, Imphal on 1st March 1975.

Efforts were made to procure the aerial photographs of Manipur from 73 party of Survey of India for interpretation and study before starting of the field work. The photographs were not readily available. Hence the Helicopter of the Project was made full use of for area calculation and stratification from 6th March, to 25th March 1975. For this purpose, the total area was divided into grids of $1\frac{1}{4}$ minute interval and the intersection points of grids were studied for stratification of land use, vegetation and forest type. In each flight 3 intersection points, one right below the aircraft and the other two on either side at every $1\frac{1}{4}$ ' intervals were studied by a crew of 3, one sitting with the pilot and the other two sitting on either side at the rear.

A pilot survey was carried out by selecting certain no. of random plots, in each stratum to arrive at the exact no. of total plots to be studied for the entire area. Each plot was 0.1 hectare in extent and was laid at the intersections of grids. Each grid of $1\frac{1}{4}$ ' represented an area of 4.8855 sq.km. A precision of $\pm 10\%$ at 95% probability for the total volume was aimed at. For this a total of 350 grids were to be tackled over the entire area. Eight field parties each consisting of 1 Junior Technical Assistant, 1 Deputy Ranger and 2 Fieldman were formed and deployed to different parts of the State. Regular field work commenced in the last week of March 1975 and was completed in June 75. The implementation of the work was in some cases made difficult by the hostile attitudes of the hill people who considered our work as a prelude to loss of their rights over the forest produce. But in some cases, especially amongst the educated, the benefits expected from industrial developments were better appreciated and our parties were helped and assured full cooperation.

In one case only, one party was attacked at night and two of the members of the staff were injured and others shocked. The matter was taken up with the administration and steps were immediately taken to prevent any recurrence of such incidents and to boost the morale of the field staff who had been out in the field continuously for over six months at a stretch.

However, inspite of this sensitivity the field parties took the whole work as a challenge and worked with a lot of vigour and enthusiasm. From the beginning of May 1975, there were intermittent rains, which impeded the speed of the work considerably besides causing innumerable difficulties to field crew, as they had to contend with an army of leeches after onset of rains, and extreme cold, as some of them had to work at 2000 to 2500 metres elevation. Braving all these impediments, the field staff continued to work with great dedication and by the end of May 1975, 202 grids were tackled, completing more than 50% of the required no. of grids in all the strata.

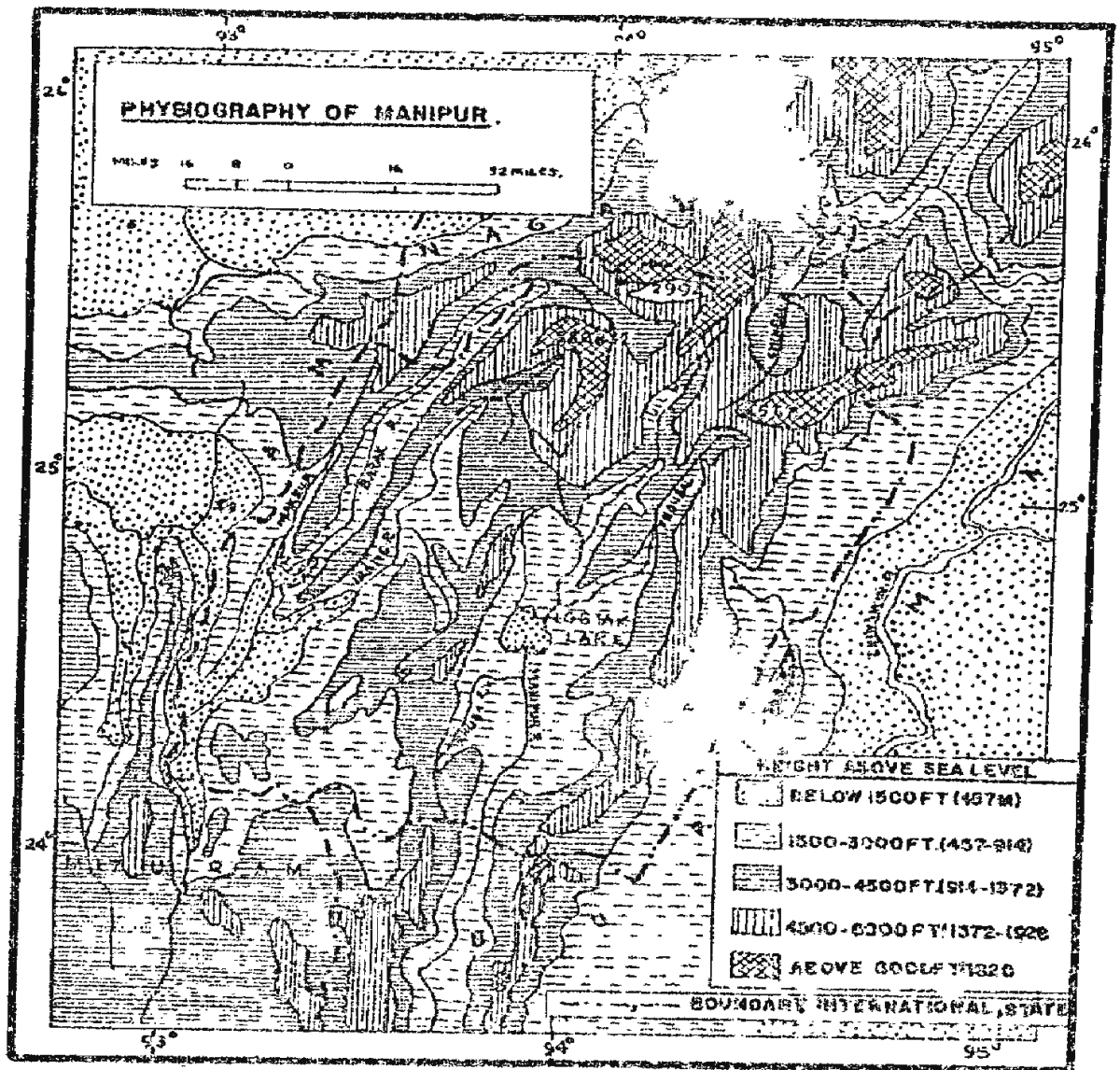
At this stage it was decided to close the work except the volume data work - Barr and Stroud carried out in collaboration with the F.R. I. mensuration work, although it was apparent that the desired precision levels may not be achievable with this smaller number of samples.

It was also found impossible to fell any trees whatsoever for volume studies as the local people who claimed rights over the forests invariably objected to any such felling. Even bamboo felling for weight samples was not allowed in many cases, and in one instance, the Dy. Conservator of Forests in-charge who personally met the local people for this purpose but received a cold shoulder.

The assessment of volume and utility break-up was then attempted with Barr and Stroud Dendrometer by a mensuration party from the Forest Research Institute, but this instrument has serious limitations in case of broad leaved species and especially in dense evergreen forests with poor visibility. It was finally decided to apply the volume data from Tripura Survey for broad leaved species and derive equation for *Pinus kesiya* from the dendrometer readings. This was not the best arrangement, but in view of the absence of any other alternative we had to be contented with this.

The sampling errors have been assessed, but no indication is possible of the systematic errors due to adoption of volume equations from a different area, albeit similar in some respects. Tripura forests do not have the Wet Temperate type, though Manipur has a sizeable area under it. The use of Tripura volume tables will therefore lead to an under estimation which is alright because it is safer.

SOURCE: TECHNO ECONOMIC SURVEY OF MANIPUR BY
N.C.A.E.R 1961



CHAPTER - II

GENERAL DESCRIPTION OF THE AREA

2.1. Physical Description:

Manipur State is an isolated, hill bound and geographically a distinct entity. It is bounded on the North by the Naga Hills of Nagaland, on the East by Somra Tract and upper Chindwin areas of Burma, on the South by the Chin Hills of Burma and Mixo Hills of Mizoram, and on the west by the Cachar and north Cachar Hills of Assam.

The entire State of Manipur has been considered as a unit for assessment of Forest Resources. The tract dealt with lies between $94^{\circ} 30'$ and $94^{\circ} 78'$ East longitude and $23^{\circ} 83'$ and $25^{\circ} 68'$ North latitude.

The principal rivers in the catchment are (1) the Imphal (Manipur) river draining the Manipur valley, the hills immediately surrounding it, and also the southern hills and (ii) Barak river draining the northern and the western hills. The Imphal river flows through the southern hills into Chindwin river of Burma and Barak flows through Cachar Hills to join the Surma river which drains in to the lower Brahmaputra.

2.1.1. A r e a

The area of the State is $22,366 \text{ km}^2$ of which $1,813 \text{ km}^2$ from the broad central valley of Manipur, the remaining area consisting of hilly and mountainous terrain, the highest of which rises upto 3000 metres above sea level. The Central valley has an average altitude of 850 metres, draining from North to South. The valley of Manipur as one approaches from the air can be seen dotted with lakes and marshes, the largest of them being the Loktak Lake about 12 km. in length and 8 km. in width, which incidentally is the refuge of the famous and fast dwindling of deers the "Brow antlered deer" (Thamin).

2.2. Geology

Not much is known about the prevalent geological status of this part of the world in ancient times, but in the upper tertiary periods, a shallow lake is thought to have covered, what is now the central valley of Imphal, a great part of which is till under water forming the Loktak Lake.

No detailed Geological survey has been carried out in the area except for traverso mapping by earlier workers like R.D. Oldam (1835) and brief reports of Survey of India in 1943-44. The Imphal valley consists of alluvium with the argillaceous rocks of Disang series as underlying rocks. The greater part of the hills on the Western side has Eocene sand-stone, slates and shales as underlying rocks; resultant soil being clayey loam, deep in places. The rest of the hills surrounding the Imphal valley have argillaceous rocks yielding alluvium that fills the valley. Pure calcareous rocks are also met with towards the east on the Oinamlong hills and laterite out crops can be seen towards south east at Moreh. Brine wells are met with around Ukhrul. There are also indications of oil in the Imphal valley.

2.3. Climate

Manipur State clearly falls within the Monsoon belt of India. The climate in the western part can be called tropical as also in the south east corner around Moroh, but favourable elevation, pattern of precipitation, and absence of frost, except on high hill tops, has resulted in a climate of Sub-tropical type in the rest of the area, with distinct winter, warm and rainy seasons. The period from November to February is characterised by low temperature and heavy dew at night. Frost occurs on winter nights at high elevations only. In April & May the day temperature rises but often cools off towards the afternoons because of thunderstorms and light showers. The period from June to September is characterised by heavy rain fall. The range of temperature for the State is 2.3° (36° F) to 34.5°C (94°F). The average rainfall is about 131 cm. (51.6").

<u>Year</u>	<u>Rainfall data</u>	
	<u>Imphal</u> (in cms.)	<u>Churachandpur</u> (in cms.)
1956	139.50	
1957	102.26	128.01
1958	107.52	128.50
1959	155.52	141.63
1960	111.51	126.56
1961	136.02	132.87
1962	128.68	124.08

(Source: Working Plan for the Eastern Forest Division, Manipur, by N. Kunja Singh)

Average rainfall at Jiribam in cms.

<u>Year</u>	<u>Cm.</u>
1968	544.15
1969	208.20
1970	245.10
1971	250.91

(Source: Working Plan for the Western Forest Division, by S. Tomchou Singh).

2.4. Land Use:

Land use details were not available for the State as a whole. But some information is available for the Imphal valley. According to village records, the total geographical area of the valley in 1957-58, was 139,862.31 hectares, out of which 14,839.83 ha. were not available for agriculture, being unculturable waste put to non-agricultural use. The culturable waste, permanent pastures and grazing land was 31,552.15 ha. and fallow land 170.77 ha. The net area sown during 1957-58 was about 66.7 percent of the total geographical area of the valley. The per capita cropped area in the valley was only 0.22 ha.

Cultivation is carried out in the hills also, but the exact figures of area under permanent cultivation and crop pattern in the hills is not known. Of late cultivation of pine apple as a horticulture crop and *Quercus serrata* for Tassar sericulture is gaining importance in the hills. The exact area under these two items is not known.

The exact area under forest cover excluding the Reserved and Protected Forests was also not known. So far the State authorities were under the impression, that the percentage of land area under forests was only 27%. But this survey has revealed much more area under forests and the exact area under forests as per our survey is given in Chapter III. The land use details obtained as a result of our aerial survey are also discussed in Chapter III.

2.5. Vegetation

The forests in Manipur are sharply stratified by altitude. From the foot hills, upto an elevation of 900 metres, the climax forest is of a semi-evergreen type comprising of *Laurus-Melia-Bauhinia* association. Lauraceae is represented by *Phoebe lanceolata*, *Cinnamomum coccidodaphne*, *C. obtusifolium*, *Actinodaphne sikkimensis*, *A. obovata*, *Machilus macrantha*, *M. parviflora*, *Litsaea salicifolia*, *Lindora molastomaea*.

Meliaceae includes *Amoora rohituka*, *A. wallichii*, *Toona ciliata*, *Cedrela febrifuga*, *Dysoxylum binectariferum* and *D. hamiltonii*.

Bauhinia as a codominant is represented by *B. purpurea* and *B. variegata*.

In addition to these, *Artocarpus chaplasha*, *Palaquium polyanthum*, *Cynometra polyandra*, *Tetrameles nudiflora*, *Eugenia*, *Vitex*, *Gmelina*, *Adina*, *Pasania* sp., *Alanthus grandis*, *Schima wallichii*, *Ilex khasia*, *Sapium baccatum*, *Evodia moliaefolia*, *Eleocarpus lancifolia*, *E. aristata*, *Morus laevigata* are also found in abundance.

- 2.5.1. These forests are found in the western part of Manipur adjoining Cachar, and correspond to Champion and Seth's "Cachar Tropical Semi-evergreen" i.e. 2 B/C2. These forests have been subjected to heavy "jhuming" (shifting cultivation). One can see a lush brake of Muli bamboo (*Molocanna basifera*) in the old abandoned 'jhums'. Falling in the same altitudinal zone, there is a belt of Teak - Gurjan forests (*Tectona grandis* - *Dipterocarpus tuberculatus*) along the Burma border, together with *D. turbinatus*, *Molaneorrhoea usitata*, *Dillenia*, *Xylia*, *Lagerstroemia*, *Terminalia*, *Gmelina* & *Bombax* spp. which have a different and distinct floristic composition. This type too has not escaped 'jhuming'.

- 2.5.2. At altitudes of 900 to 1800 metres, we find wet hill forests on the upper slopes of hills including hill tops corresponding to Champion and Seth's "Khasi sub-tropical wet hill forests" i.e. 8 B/C2. Here we can find the *Saurauja-Beilschmiedia-Phoebe* association, dominated by *Saurauja nopalensis*, *S. panduana*, *S. roxburghiana*, *Phoebe lanceolata*, *P. paniculata*, *Beilschmiedia assamica*, *B. roxburghiana*, *Schima wallichii*, *Quercus* sp., *Nyssa sessiliflora*, *Cinnamomum coccidodaphne*, *C. pauciflora*, *Eriobotrya bengalensis*, *Echinocarpus dasycarpus*, *Morus laevigata*, *Litsaea panamonja*, *L. schifera*, *Cryptocarya andersoni*, *Machilus odoratissima*, *M. parviflora*, *M. bombycina*, *Ostodes paniculata*, *Lithocarpus spicatus*, *Engelhardtia* sp., *Vaccinium dominianum*, *Castanopsis* spp.

2.5.3 Coming within the same altitude zone are the forests of *Pinus kesiya* occurring in the hills in the North Eastern and Southern part of the State along with *Quercus* spp., *Pasania*, *Castanopsis* spp. These correspond to Champion and Seth's "Assam sub-Tropical Pine Forests" i.e. 9/C2.

2.5.4 Between the altitude of 1700 to 2700 metres, forests of *Quercus-Magnolia-Acer* association are met with. These correspond to Champion and Seth's "East Himalayan Wet temperate forests" i.e. 11 B/C1. The dominant characteristic species are *Quercus lanellosa*, *Q. lineata*, *Q. glauca*, *Pasania xylocarpa*, *P. pachyphylla*, *P. truncata*, *Michelia lanuginosa*, *M. campbelli*, *Rhoeo paniculata*, *Schima khasiana*, *Alseodaphne dumicola*, *Castanopsis tribuloides*, *Evodia fraxinifolia*, *Acer campbelli*, *Betula alnoides*, *Prunus ceratoides*, *Pyrus pashia*, *Rosa gigantia*, *Molima manipurensis*, *Manglietia insignis*, *Illicium griffithii*, *Bucklandia populnea*, *Michelia manipurensis*.

The small bamboo *Arundinaria maling* is also met with, in these forests.

2-5-5 Above 2700 metres, sub alpine vegetation is observed, with characteristic species of *Prunus*, *Pyrus*, *Ligustrum*, *Taxus*, *Ilex*, *Ternstroemia*, *Bucklandia populnea*, *Acer campbelli*, *Magnolia campbelli*, *Castanopsis tribuloides*, *Rhododendron nadinii*, *R. johnstonianum*, *R. manipurensense*, *R. wattii*, *R. elliotii* and *Primula* spp. Such areas are of very limited extent.

2.5.6 Bamboo Brakes:

Bamboo brakes of large extent occur in the Western, South-western and North-western parts of the State. Smaller areas of bamboo brakes occur almost all over except at altitudes above 1700 metres. Most of the Cachar Tropical semi-evergreen type of forest in the western parts of the State has been hacked down for 'jhum' and the tree species have given way to a dense growth of *Molocanna basifera* interspersed with some clump forming bamboos, and a rare tree here and there. The Khasi sub-tropical Wet Hill Forests have also suffered from 'jhum' and have degenerated into bamboo brakes over large areas. In our aerial observations we found a sharp altitudinal limit to all 'jhum' cultivation at about 1700 metres, which also seemed to be the starting level for the East Himalayan Wet Temperate Forest in Manipur. Whether it be for the elevation or the soil characteristics of the wet temperate forests, they seem to have been spared the ravages of shifting cultivation.

Bamboos also occur as an understorey in tree forests. About 15 species of bamboos occur in Manipur State viz. *Molocanna basifera* (Muli), *Polystachyum dullooa* (Duloo), *Bambusa balcooa* (Pulka bamboo), *Bambusa pallida* (Kala sundi), *Dendrocalamus hamiltonii* (Petcha bamboo Unop, or Wanop), *Molocanna humilis* (Noli handi) *Cephalostachyum fuchsianum*, *Cephalostachyum pergracile*, *Bambusa khasiana*, *Bambusa kingiana*, *Bambusa vulgaris*, *Bambusa arundinacea*. Except for Muli, Duloo, and Petcha, other bamboos occur in small quantities and in patches. It is seen that muli is intrusive by nature being a runner type of bamboo and has a remarkable capacity to hold its own eliminating all other competitors, once the overwood is removed as in the case of 'jhuming', thus resulting in bamboo brakes over extensive areas.

2.5.7. Cane Brakes:

In places where the soil is wet over a long period, and is an ill drained clay, rich in humus, various species of Canes can be found. They form an impenetrable thorny thicket, sometimes with a few trees standing over them. The stems are typically trailing and may go as far as 70-75 metres. A few palms such as *Livistonia*, *Licuala* etc., and Duloo Bamboo are found to occur with the canes. The important species of cane found occurring are *Calamus tenuis*, *Calamus leptospadix*, *Calamus floribundus* and *Calamus erectus*. Some of these cane brakes are being cleared for cultivation notably for 'Pan' cultivation reducing the availability of commercially important canes.

2.6.1. Accessibility.

Manipur is very poorly served with Roads or any other means of transport. In fact, the only all weather land route linking this territory with the rest of India is Imphal-Dimapur road (National Highway No.39) connecting Imphal the capital of Manipur, with the rail head at Dimapur 215 kms. to the north. This road passes through Karang and Mao in Manipur and Kohima in Nagaland. As it passes through some treacherous hilly terrain, it is always liable to interruption due to land slides particularly during monsoons (see road map of Manipur Map No.3).

Imphal is connected to Calcutta by Air, with one flight a day. This facility is also at times disrupted due to bad weather during monsoons. The air route overflies Bangladesh in normal times, as per agreement. There are no railways in Manipur. If the passage of goods is allowed through Bangladesh by rail, to Calcutta, much of the goods, both finished and raw can be available both ways at much cheaper rates, as Bangladesh Railway is just about 100 km. away, near Karimganj in Assam. The western part of Manipur, which is endowed with very rich forests of bamboo can be served by the railhead at Silchar which is only about 60 km. from the Manipur border and another 40 km. away is Karimganj.

The road communication within the State is still worse, as new roads and bridges connecting Imphal with important towns in the State, are yet under construction, and the feeder roads from the interior villages connecting the State highways are still at the proposal stages. The forests are not served by any road system. There are no 'forest roads' maintained by forest department. Haulage from stump to road side is by human or bullock power. Owing to lack of road facilities, the goods brought in from neighbouring States cost much more at the consuming points, while local products fetch much less than they should to the producers.

The Border Road Organisation is doing good work both for construction of new roads and maintenance of the important existing roads. They have almost completed the construction of the New Cachar road of 222 kms. connecting Imphal with Silchar in Assam, through very hilly terrain.

The State has 232 kms. of national highway, and 580 kms. of State highways, which are bitumenised, i.e. a road density of a mere .04 km. per sq.km. of area. It has 339 kms. of district roads which are of water bound macadam, and fair weather roads. It also has 1142 kms. of other district roads and inter village roads, (i.e. .08 km. per sq.km.) most of which are not even jeepable. The infrastructural development, so far as roads and rails go are very unsatisfactory and in one of the main causes of the slow development of the area.

2.6.2. River Transport:

River communication has a limited possibility for timber transport in the State. The Manipur river is not fit for floating due to shallow water and rapids. The Borak river is useful only in the lower reaches i.e., below Jirimukh on the western border of the State. The section from Jirimukh to Tipaimukh in the south-west is useful for floating bamboos and timber rafts, but it serves only a small fringe of the forest. However, the utility of Borak river as a means of water transport can be greatly enhanced by blasting the big boulders here and there along the river course, which impede the smooth flow of bamboo and timber rafts. These impediments are locally called 'Hatiyas' and the ones at Bora Hatiya and Sofa Hatiya in particular need to be attended to. If this is done, Borak river can be a very effective means of communication leading in a southerly direction for the inaccessible Tamenglong and Jiribam subdivisions.

2.7. Legal position of forests:

The total area of Reserved Forests is 1,32,936 ha. An additional area of 9,765 ha. has been proposed as Reserved Forest. 4,12,259 ha. has been notified as protected forests without abridging the rights of individuals and communities. However, a large part of the forests are still under village council ownership and they jealously guard their forests from exploitation. The protected, and in some cases the Reserved Forests too, are claimed as village council property. The forests are not properly demarcated and our survey parties could not in many cases determine whether an area was R.F. or not, and even local people and forest beat guards were of no help in this respect.

This uncertainty about the legal status of the forests is a great constraint on the possibilities of development in Manipur. Before any large scale forest based industries can be attracted to the State, a satisfactory solution to the question of ownership of the forests needs to be administratively worked out.

2.8. Injuries to which the crop is liable.

Biotic - Man :-

The greatest damage, that is inflicted on the forests of these areas is by Man. The hill people clear vast stretches of well wooded areas, and waste good quality timber by burning for shifting cultivation, locally called Jhum. They cultivate the land thus clear felled and burnt for a period of 2 - 3 years, and once the land becomes sterile after losing the fertile top soil, they take up new areas for destruction. This has been going on over a long period and vast stretches of accessible areas which once supported a luxurious tree growth, have been reduced to scrub and grassy blanks. The only forests that are comparatively free from the ravages of shifting cultivation are the Wet Temperate forests, because of their inaccessibility.

The other form of cultivation is 'Pan Jhum'. Here the people grow 'Pan' vines after clearing the undergrowth and lopping the branches of trees big and small and using the trees for supporting the 'Pan' vines. Most of the low lying areas, with good tree growth are taken up for 'Pan' Jhuming. The repeated clearance of undergrowth in such areas has greatly affected the natural regeneration of tree species.

Birds:- Among the birds, parrots do much damage to the seeds of Gondroi (*Cinnamomum cecidodaphne*), Sundi (*Machillus villosa*) and Champs (*Michalia champaca*). Pheasants are fond of eating pulpy fruits of Gondroi. Of all the birds, Horn bills are responsible for most of the ficus infestation of various trees.

Insects:- Damage by insects is also known to have occurred, mostly in plantation areas. *Galalaphyla*, defoliating *Gamari*, *Hyblaea puera* defoliating Teak, *Hypspyla robusta* attacking Poma (*Cedrela* spp.) and *Margaromia cadesalis* boring Jam (*Eugenia* spp.) shoots, *Phassus carvumus* attacking Teak saplings and roots of living jhalna (*Terminalia myriocarpa*) are also encountered. Besides these Bole (*Somocarpus anacardium*) and several species are attacked by defoliators. Weevils are found to destroy seeds of Sundi, Champa and Gondroi. Shoot borer attack in young pine plantations is also reported.

Fire:- Although fire is not much of a problem due to sub-tropical conditions of forest, the burnings for 'Jhum' do considerable damage to adjoining forests also.

Irregular felling:- There is no premarking and approval of marked trees before felling. Thus there can be little control on the location or extent of fellings or enforcement of workman like operation by contractors. Much useful timber is wasted.

Climate:

Forest:- Except on rare occasions, frost has not caused severe damage to forest as most of the local species are frost hardy. But it definitely restricts the introduction of frost tender species in the hills.

Drought:- Drought is uncommon. The precipitation pattern is very favourable to tree growth.

Storms:- Damage to trees by storms by way of uprooting and top breaking is common in the premonsoon windy days. Damage to standing trees by lightning during monsoon is also common.

Parasites:- Semi parasitic plants, Epiphytes and Ferns have been causing considerable damage to forests. *Loranthus scurrula*, particularly has proved deadly in *Gamari* (*Gmelina arborea*) plantations. The attack of *Loranthus* on Jarul, Jam and Teak is fairly heavy. Ficus bound trees are a very common sight in forests.

Climbers like *Dioscorea*, *Shilax*, *Ipomea*, and in particular *Miania macrantha* a new immigrant to this region has caused heavy damage both in plantations and in natural forests. A Fungus of polyporus species is found to attack Nageswar (*Mesua ferrea*) sporadically. Root and Stem rot is very common in most of the older trees.

2.9. People and Socio-economic Background:

The State divides itself into two distinct regions viz. the valley and the hills for any socio-economic study. Socio-economically there is vast difference between the valley and the hills, in every respect. The valley is inhabited by the Manipuris, known as "Meitai" and the hills by the Naga, Kuki and other hill tribes.

The population of Manipur is 1,073,000 the average density of population being 48 sq.km. However, the valley with 8% of the land area supports 70% of the population and the hills forming 92% of the land area support the balance 30% of the population. The isolation of the hills has resulted in serious lack of employment opportunities in the hills and poor infrastructure with regard to schools, hospitals etc.

Manipur has essentially an agrarian economy with 80% of people dependent on agriculture. Though rice production is surplus, 80% of this comes from the valley, where there is increasing pressure of population on the limited land available. Some wheat is now also being cultivated as a second crop by some enterprising cultivators.

In the valley, much needs to be done to relieve the pressure of 70% of the State population depending on 8% of the land area, which has resulted in extremely small holdings, and low yields per hectare, as no modern agricultural techniques can be adopted on these tiny and fragmented holdings.

To relieve pressure on agriculture in the valley, all out encouragement should be given to the people to develop their handloom industry, which has already established a name for itself. More and more people should be induced to take up horticulture, animal husbandry, piggy and poultry farming. As 90% of the population of Manipur are fish eaters, development of fisheries holds vast opportunities for the people of the valley in the large number of 'beels' (swamps) and tanks that exist and also in the Imphal river and the many streams that flow into it.

In the hills the tribals resort to a destructive process of shifting cultivation, which poses a serious problem of soil erosion and denudation of forests. These people put in enormous labour for cutting and burning of forests, to get a small quantity of food grains. It is very essential to divert and utilise this energy and manpower for better and productive uses by providing an alternate source of employment as a means of living. This will also have the valuable forest resources from destruction, which can be utilised for establishing forest based industries, thereby generating economy, which in turn will increase the economic power of people in the hills. This is the only way to usher in an allround development in the hills. Horticulture, as a variety of fruits can be grown in the hills, and Sericulture, as cultivation of Tassar silk on *Quercus semiserrata* as the host, is found to be successful and should be encouraged in the hills as a source of living. This also will result in settled establishment and permanent cultivation, as against the present semi-nomadic habit and shifting cultivation of hill people, so that community development work like, roads, housing, health, education and electricity could be provided for their settled villages.

2.9.1. Labour supply:

Labour supply in the Manipur valley is plentiful. As per the report of Agricultural Labour Enquiry, an average male worker has no work for 120 days in a year, a female is employed only for 33 days on agricultural labour.

The hills however present a different picture. No statistics are available, but the sparse nature of the population - only about 15 persons per sq.km. suggests a great paucity of labour for work in those areas. The valley people are reluctant to work in the hills for multiplicity of reasons. Large scale forest working thus would require much planning and organisation in the Manipur Hills.

2.9.2. Power:-

Manipur State is starved for power. There are only some small power plants run by diesel for domestic supplies mostly. The shortage of power has been a great hurdle to industrialization.

The Loktak hydel project which is now well on way, is capable of producing 40,000 KW of electricity. This will be a great boost to development. The plant may start producing in two years' time.

2.9.3. Industries:-

There are no large scale industries in the State. There are hardly any small industries either, except for a stainless steel sheet processing factory and a few saw mills in Imphal, catering to local needs only. Cottage industries like cloth weaving, basket making, embroidery cater only to the local demands. Agro industries like rice mills, oil mills, one sugar factory and one pineapple canning factory exist, mostly catering to the local demands.

A small timber treatment and seasoning plant has been put up by the Forest Department in Imphal as a trial project to popularise seasoned and treated timber. The purchasers are mostly Government Departments.

CHAPTER - III

PHOTO INTERPRETATION, MAPPING, AREA ASSESSMENT.

1. Aerial reconnaissance

The Bell Jet Ranger helicopter of the organisation was first used for a general reconnaissance over the forests. It was found that there were clearly discernible forest types usually over large areas. Jhum cultivation, pine forests, wet temperate forests, bamboo brakes etc. were sharply differentiated.

As aerial photographs were not available in time, it was decided to do stratification by aerial flights.

The entire area was divided into $1\frac{1}{2}' \times 1\frac{1}{2}'$ grids by latitude and longitude and the grids marked on the $\frac{1}{2}" = 1$ mile topo sheets. Each grid intersection was observed by flying at an average height of 300 m. above the canopy. Three grid lines could be observed at one flight as one observer in front navigated and recorded and two in the rear recorded their own strips.

The interval between the grid intersection on the ground was approximately 2 km. and it was found quite easy to see that distance as the air was crystal clear. In some rare cases the plot fell on the other side of a hill, which could be seen from another point. Initial flights were at about 100 km/h. but after the first sortie we could identify the grids even at 160-170 km/h. and that speed was maintained for the remaining sorties.

The grid points were studied for an area of about 2 ha. i.e. a circle of 80 m. radius. The characters observed were landuse, vegetation and forest type.

The following land uses were identified.

1. Forest.
2. Agricultural tree land.
3. Current Jhum (shifting cultivation of the year).
4. Pasture and barren lands.
5. Agricultural crop land.
6. Others.

In vegetation, the following types were recognised. Vegetation break up was done for land use 'Forest' only.

1. Tree Forests (20% stocking and above).
2. Open Forest (Below 20% stocking).
3. Bamboo brakes (Resulting from abandoned jhums).
4. Grass banks (caused by degeneration of repeatedly jhumed area or natural formations).

Vegetation types 'tree forest' and 'open forest' were further classified by forest types into the following six categories.

1. Wet temperate.
2. Pine
3. Wet hill.
4. Semi evergreen
5. Teak-Gurjan, and
6. Undetermined.

The total area of the State was covered by 4578 grid points. Of these, 393 points were not classified by aerial observation as some were omitted in flying, due to smoke or fog, unobservable in flying and also because the topo maps were trimmed at the international boundary.

3.2. Photointerpretation.

Aerial photos were obtained in March 1975. The specifications were as below.

<u>Task No.</u>	<u>Scale.</u>	<u>Period of photography.</u>
637 A	1:40,000	21.10.72 to 28.2.72
652 A	1:40,000	27.1.72 to 28.12.72
Area/20/60	1:50,000	9.3.61 to Sept. 61.
"	"	22.11.61 to 23.1.62
497 A	"	17.12.60 to 8.4.67
636 A	"	16.3.70 to 18.3.70

The A.Ps under Area 20/60, strip nos. 32,33,46 and 49 were not very useful. On scanning the photos the following conclusions emerged.

1. The land use pattern as adopted in aerial reconnaissance could be distinguished.
2. Forest type identification was difficult, except for Khasi pine which is clear by its crown, shape, tone and image. All others had to be clubbed together.
3. Density classification could be done into good (over 60%) medium (20-60%) and poor (5-20%).
4. Volume classification was not possible.

In view of the above, a key for photointerpretation was prepared, based on land use classification as in the field manual, and is given below:

1. Forest
2. Open Forest.
3. Blanks, barren land, grassy land-also includes regrowth and shrubs.
4. Bamboo brake.
5. Current Jhum and Old Jhum.
6. Cultivation, Agricultural tree land & habitation.

1. Forest :- Forest areas with tree crown density more than 20%, and where land surface is not used primarily for purpose other than forestry. The minimum area should be more than 2 hectares. It includes plantations, area temporarily under stocked due to clear cutting, regeneration fellings, shifting cultivation with regrowth on abandoned sites with scattered trees and bamboos.
2. Open Forest :- Forest areas with density from 20% to a lower limit of 5% with undergrowth of tree species or shrubs of any density and stunted tree growth. This type of forest comes generally in exposed barren areas due to poor soil or due to heavy biotic interference.
3. Bamboo brakes:- Bamboos of exploitable stage appearing in the past jhumming areas with isolated tree density less than 20%. Bamboo brakes are common along North-west and Western boundary of the survey area.
4. Blank:- Open areas with tree density below 5%; it includes barren land, grassy land, shrubs and tree regrowth due to repeated jhumming.
5. Jhum :- The practice of shifting cultivation locally called jhum is very common in this area. The old jhums appear on the A.Ps in a grey tone due to tree and bamboo regrowth. The current jhums appear in whitish tone which can be easily recognised on A.Ps. Areas under the old and current jhums have been put under category shifting cultivation "S".
6. Cultivation and Habitation:- Land used primarily for cultivation, areas set aside mainly for residential or industrial purposes viz. villages towns cities and factories.

Symbols used.

1. Tree forest	..	F
2. Open forest	..	f
3. Blanks, barren land, grassy land, also includes tree regrowth & shrubs	..	B
4. Bamboo brakes	..	Bb
5. Current jhums & old jhums (shifting cultivation)	..	S
6. Cultivation & Habitation	..	C
7. Tree Forest with Khasi pine	..	P/T
8. Open Forest with Khasi pine	..	P/f
9. Tree Forest with bamboo undergrowth	..	FB
10. Open Forest with Bamboo undergrowth	..	fB

Density Classification.

Density has been classified into three categories. This could not be correlated with the field classification of 5 categories due to scale limitations of A.Ps.

Density Code has been given to Forest "F" and open Forest "f" only.

<u>Density</u>		<u>Code</u>	<u>Forest type</u>
5 to 20%	poor	1	f
21 to 60%	medium	2	F
61% & up	good	3	F

Density code 1 used in case of open forest "f", 2 and 3 in case of Forest areas "F".

Example No.1

FP

2

Numerator

F = Forest

P = Khasi Pine

Denominator 2 = density 21% to 60%.

Example No.2

F.B

3

Numerator

F = Forest

B = Scattered bamboos under tree growth.

Denominator

3 means tree density 61% and above.

On the above key, 100% photointerpretation of all the area was done except some gaps for which no photos were available.

The 393 unrecorded grid points of aerial reconnaissance were marked on the A.Ps. by matching topo features of map and A.Ps and were then interpreted for the attributes of land use, vegetation and forest type where possible. In those grids where forest types were not identifiable, use was made of the grid reference map prepared on the basis of point reconnaissance and the grid was allotted to the forest type of the surrounding grids.

3.3. Mapping.

The maps on which field work was done were of old survey on $\frac{1}{2}$ " = 1 mile scale. Fresh mapping by the survey of India was well underway on 1:50,000 scale. The details of interpreted aerial photographs have been transferred on to the base maps on 1:50,000 scale for 36 map sheets. For the remaining 11 map sheets modern style maps are under different stages of preparation and will be supplied later.

Forest type map on 1 : 50,000 scale showing different land use and forest cover types viz Khasi pine in hatchures will be prepared on Koda line prints. As limited copies of Forest type maps are required, Ammonia prints can be made out of the Koda line negative.

The forest type map is based on photographs taken at widely separated periods of time. This causes some discrepancies as the forests are liable to be cut down for 'Jhum' in the intervening period. Also, for the area for which no photos were available, no interpretation has been done. The assessment of area from A.Ps therefore is only of topical interest, and cannot be used for estimation of volume out-turns.

3.4. Area Assessment:

The assessment of area, in view of what has been detailed above, is not possible by planimetric methods.

It was therefore decided to assess area from the grid point interpretation by aerial reconnaissance supported by photointerpretation of unobserved points.

The total geographical area of Manipur State is 22,366 sq.km. This was covered by 4578 points. Therefore each point is given a value of 4.8855 sq. kms.

The distribution of the points and the area by land use classes is as below:-

Land use	No. of points.	Area in Sq.kms.	Percentage to total geographical area.
Forest	3102	15,154.94	67.70
Agricultural Tree Land	69	337.10	1.51
Crop Land	649	3,170.72	14.18
Pasture & barren	323	1,578.03	7.05
Urban sites	60	293.13	1.31
Current jhum	375	1,832.08	8.19
	4578	22,366.00	100

The area under forest is thus estimated at 15,154.94 sq.km. forming 67.76% of the land area of the state (The impression of the forest department was that the State has 27% area under forest). The annual area under jhum cultivation is estimated at 1,832.08 sq.km. or 8.19% of the total area of the State or almost the same area as that of the Imphal valley.

The area under forest is further classified into 4 types as below:-

Vegetation Type.	No. of points.	Area in sq.km.	Percentage to forest area	Percentage to total land area
Tree forests	1560	7,621.44	50.29	34.08
Open forests	843	4,118.51	27.18	18.41
Bamboo brakes	669	3,268.43	21.56	14.61
Grass banks	30	146.57	0.97	0.66
	3102	15,154.95	100	67.76

CHAPTER - IV
FIELD INVENTORY

4.1. The main object of this survey was to assess the growing stock by species and utility and to arrive at the annual cut expected from the area. The precision aimed at was $\pm 10\%$ at 95% probability level for the total growing stock.

4.2. There are in all 18 Map sheets covering the Manipur survey area. 15 of them are $\frac{1}{2}$ " sheets, 2 of them are 1" sheets and one is a $\frac{1}{4}$ " sheet. Each of these sheets was given a code number for identification, as below.

<u>Sheet No.</u>		<u>Code No.</u>
83 G SW	=	41
83 G NE	=	42
83 G SE	=	43
83 H NW	=	44
83 SW	=	45
83 NE	=	46
83 SE	=	47
83 K NE	=	48
83 NW	=	50
83 SW	=	51
83 L NW	=	52
83 L SW	=	53
84 E NW	=	54
84 I NW	=	55
83 L/9	=	56)
83 L/10	=	57) 1"
84 E	=	58 $\frac{1}{4}$ "

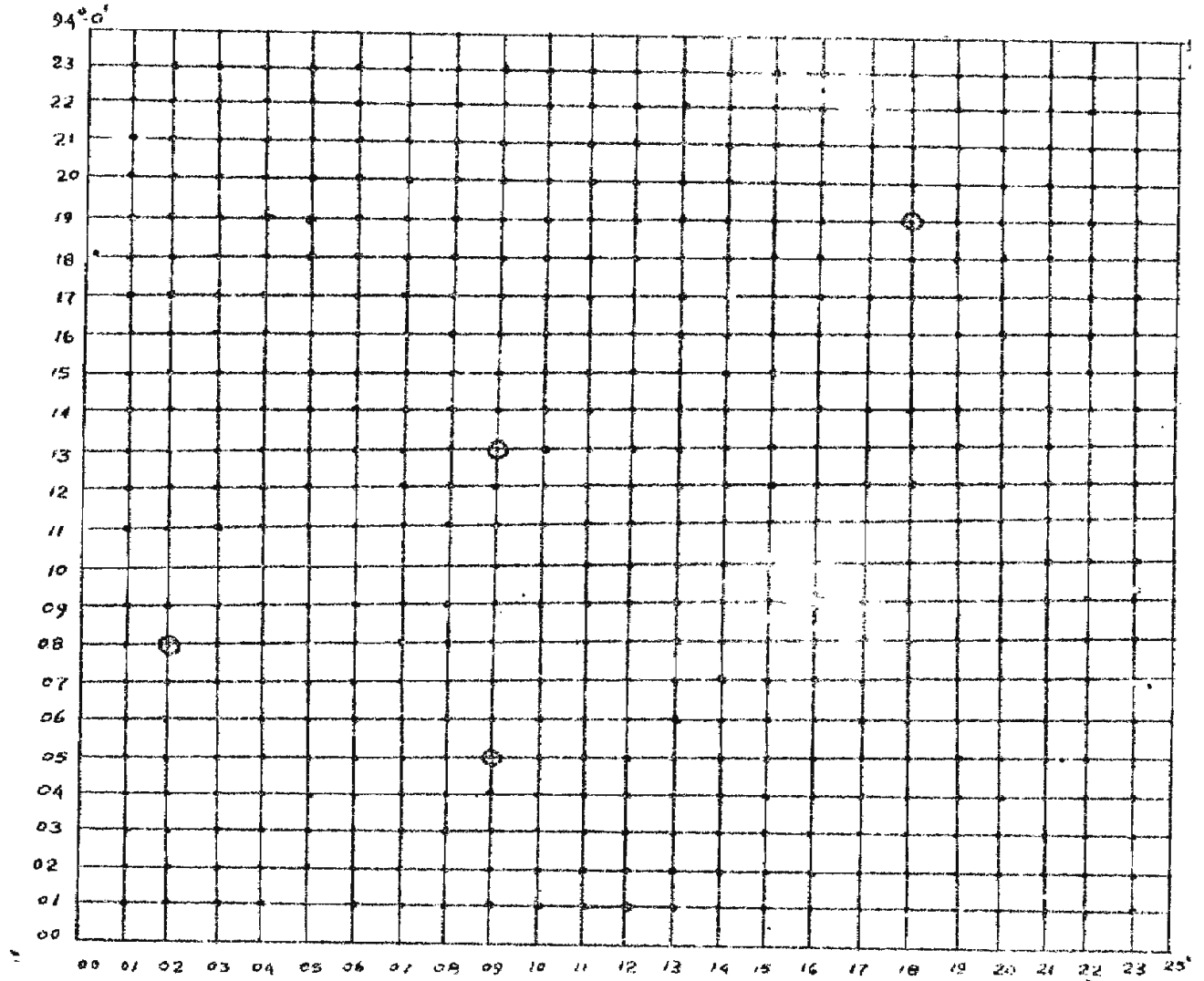
Each $\frac{1}{2}$ " sheet has been divided into 24 x 24 squares of grids at $1\frac{1}{4}'$ interval. Each intersection point or grid point is given a number for identification. For this purpose the left bottom corner of the sheet i.e. the S.W. corner will be numbered as 00 latitude as well as 00 longitude. Each longitude thereafter is given a number from 01 to 23. Similarly, the subsequent latitude lines are also numbered from 01 to 23 as shown in diagram No.1.

The intersections of the last latitude on the northern border and the last longitude on the eastern border of the sheet are not given any numbers of the adjacent sheets. /as they will correspond to 00 numbers

For referring to a grid, it is necessary to give the numerical code of the map sheet and the grid number, for example 49/0207. In giving the reference number, the latitude will be read first and then the longitude.

DIAGRAM NO - 1.

LAY-OUT OF THE GRIDS $1\frac{1}{4} \times 1\frac{1}{4}$ FOR A HALF INCH SHEET. HALF INCH SHEET NO. 03 $\frac{K}{SW}$



0 RANDOMLY SELECTED FOR SAMPLING.

Pilot Survey

A pilot survey was carried out after stratification of survey area by aerial reconnaissance, by taking certain number of grids in each stratum to find out the variation in volume under different Forest types. In all 41 grids were sampled in pilot survey distributed in different forest types. With the help of results of the pilot survey, it was decided that 350 grids in different forest types are to be sampled for a precision $\pm 10\%$ at 95% probability level.

4.4. Sampling Design.

The sampling design was a random sampling after stratification. The sampling frame consisting of grids was laid out on the map at $1\frac{1}{2}$ minute interval as already explained. Each square or grid represents an area of 4.8855 sq.km. in all 350 grids (excluding bamboo brakes) were selected after generating random numbers with help of random tables distributed under different forest types. The break up of total no. of forested grids and the no. of grids to be sampled under each forest type is as below.

Strata	Total grids in the strata.	No. of grids to be sampled in each strata.
Wet temperate	297	50
Pine	500	80
Wet Hill	1349	190
Semi evergreen	132	20
Teak Gurjan	125	15
Bamboo brakes	669	20

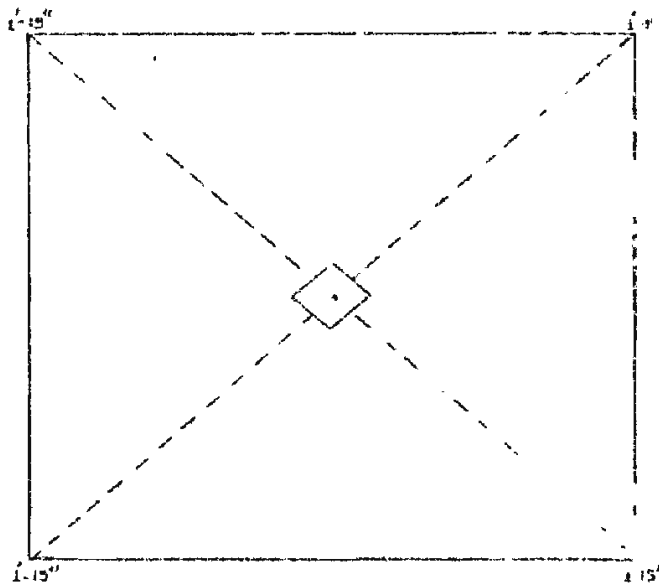
4.4.1. At each grid point (the intersections) randomly selected a plot of 0.1 ha. was laid out, having the grid point as its centre (see diagram 2). The plot was laid out from its centre (keeping the grid point as centre of the plot) by taking 22.4 metres (horizontal) in, North, South, East and West directions, by compass and tape and joining the ends. Slope corrections were made on sloping grounds.

4.4.2. The entire plot was enumerated for total number of trees by diameter classes and number of bamboo clumps by size classes. In case of non-clump forming bamboos, like Muli (*Melocanna basifera*) each culm was taken as a clump.

4.4.3. All trees above 40 cms. diameter were measured in the entire plot as sample trees for height/diameter ratio. Trees from 10 to 39 cms. diameter were measured as sample trees for height/diameter ratio in the N.W. quadrant only.

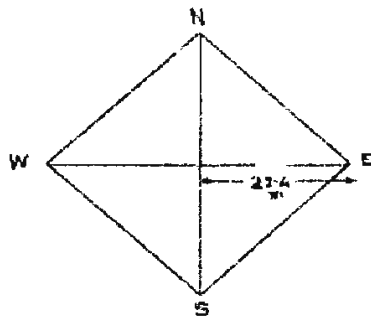
4.4.4. Data for volume of Khasi pine was collected with the help of Barr & Stroud Dendrometer, without felling to trees. An attempt was made to study volumes of broad leaved species also, but the instrument had its limitations the measuring branch wood especially in poor visibility in dense forests. Therefore for the broad leaved species the volume data collected for Tripura survey was adopted as the forests are of a very similar nature and quality. Bamboo clump enumeration was carried out in the entire plot by clump size classes. Muli was enumerated only over the

DIAGRAM NO - 2.

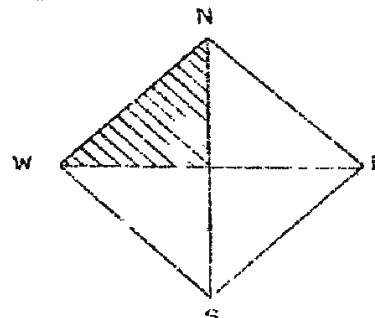


POSITION OF THE SINGLE SAMPLE PLOT WITHIN A 1'-15"X1'-15" GRID

DIAGRAM NO - 3.

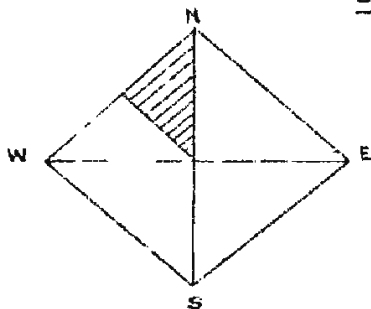


LAYING OUT OF THE SAMPLE PLOT OF Q.1 NA.

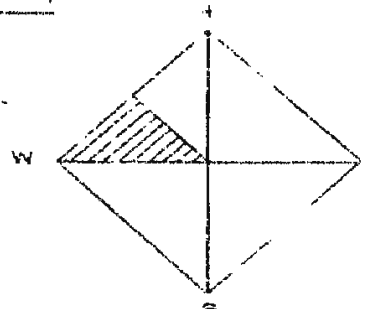


SUB-SAMPLING IN THE NORTH WEST QUADRANT
CLUMP FORMING DANBOGS.

DIAGRAM NO - 4



SUB SAMPLING IN THE NORTHERN HALF OF
THE NORTH-WEST QUADRANT.



SAMPLE TREE STUDY IN THE SOUTHERN
HALF OF THE NORTH-WEST QUADRANT.

northern half of the plot. Studies in detail in respect of culm size, growth condition, quality and measurements were confined to N.W. quadrant only in case of clump forming bamboos and to Northern half of N.W. quadrant in case of Muli bamboos. (See Diagram Nos. 3 and 4).

- 4.4.5. The information collected through ground sampling was recorded in five forms drawn up for the purpose viz. Plot Description form, Plot Enumeration form, Sample Tree form, Bamboo Enumeration form and Bamboo Weight Form. Samples of these forms are given in appendix. The forms were designed for data punching on the usual 80 column punch cards.

4.5. Implementation

The survey was implemented in the manner outlined below.

4.5.1. Lay out of samples.

The map sheet showing the lay out of grids and the randomly selected grid points or plot centres were prepared in the base camp and allotted to Crew Leaders. For each plot to be tackled, a conspicuous and unmistakable reference point was selected by the crew leaders, from where the plots could be reached with the help of Compass bearing, and distance measurement by chain, tape or nylon rope. After reaching the grid point which is also the centre of the plot, the plot was laid out from the Centre by taking 22.4 metres (horizontal) in North, South, East and West directions by compass and tape and effecting slope corrections as already explained.

4.5.2. Recording of Field data.

The plot approach form, which is meant for time study, and help in check visits later, was filled in by the crew leader as he proceeded from the camp to the plot, and as he returned from the plot to the camp. This is merely descriptive and the information is not coded.

The plot description form too is qualitative, but is coded for punching on cards. This form includes information on administrative divisions, land use, legal status of forests, topography, altitude, terrain, aspect, soil, vegetation, bamboo occurrence, quality and regeneration, biotic influences, past treatment of the forest and proposed treatment, incidence of Grass and fire.

The plot enumeration form is for recording trees by species and diameters and was coded.

The bamboo enumeration form, which too is, coded, was for recording occurrence by density, species, regeneration, flowering etc. It also gives details of number of culms by size (d.f.a.) and age. Damaged, burnt and rotten culms were recorded separately. Culm lengths and diameters were recorded for a sub sample of two culms from each clump.

In the sample tree form all the tree data are filled in. One form is used for 10 trees. This form is also coded for punching.

4.5.2.1. Border Trees & clumps

The trees, the stems of which touched the N.W. and S.W. borders of the plot were treated as 'IN' trees and were enumerated. Those which touched the N.E. and S.E. borders were considered as 'OUT' trees and were not enumerated.

4.5.2.2. Tree Data

For the general enumeration of the trees in the entire plot, only species and diameter were recorded. Sample trees were studied only in southern half of the N.W. quadrant, (See diagram No.4). For these, the following details were recorded.

1. Species
2. Dominance
3. D.B.H.
4. Double bark thickness
5. Total height
6. Clear bole
7. Form longitudinal
8. Form sectional
9. Defects
10. Height.

(Measured with the help of Blume Leiss Hypsometer).

4.5.2.3. Bamboo data.

Bamboo data was collected as detailed under para 4.4.4.

In case of current years culms of both Muli and clump formers, the diameter classification was not done, as the growth of culms would not have been completed.

In the case of border clumps, those which were more than half inside the plot were included and those which were more than half outside the plot were excluded.

~ Bamboo weight data.

Bamboos were enumerated according to the following diameter classes:-

- 2 to under 5 cm.
- 5 -do- 8 cm.
- 8 cm. and over.

Apart from counting the bamboos under 3 diameter classes, it was felt necessary to collect the weight data also to arrive at the green to dry weight ratio.

The weight of the bamboo culms was determined by length and diameter classes. The weight of switchy culms i.e. below 2 cm. diameter was not collected as they were not to be exploited. From each diameter class of each species 2 mature culms were selected and cut at 25 cm. above the ground and weighed on the spot to the nearest 5 grammes and recorded in the bamboo weight form. These are numbered sample culm No.1 and 2. From sample culm No.1 and 2. From sample culm No.1 of each diameter class a sub-sample of 1 metre length is cut from the portions of lower $\frac{1}{3}$, middle $\frac{1}{3}$ and top $\frac{1}{3}$. The weight of these sub-samples was also taken to the nearest 5 grammes, and recorded in the form on the spot. These samples were brought back to the camp and their weight recorded at intervals till their air dry weight was reached. A further sub-sample by halving the lengths of each piece was brought to the Zone headquarters at Nagpur and was oven dried to 0% moisture and the ratio of oven dry weight to green weight was calculated. The results are given in a subsequent chapter.

CHAPTER - V

DATA PROCESSING

5.1. General

The data received in the field forms was properly documented in the Data Processing Unit and codes filled in where-ever these were needed. The forms were manually checked for any inconsistency before the data were transferred on the punch cards. After correcting the forms the data were punched on punch cards, verified and arranged in proper sequence for further processing. The data on cards were then loaded on to magnetic disk packs for facilitating the calculations of tree and plot volumes and preparation of stock and stand tables.

5.2. Input for the computer

After correcting the field forms, the information of the forms was transferred on to the punch cards. These cards were verified on the verifying machine and arranged in proper sequence with the aid of card sorter and collator. The total number of cards punched in each card design is given below:-

<u>Card Design</u>	<u>Number of cards</u>
(1) Plot Description (CD 01)	202
(2) Plot Enumeration (CD 02)	626
(3) Bamboo Enumeration (CD 03)	281
(4) Sample Tree (CD 04)	1294

5.3. Area

The break up of the total geographical area of 22366 sq.km. into the various land use classes, vegetations and forest types was done from the results of aerial reconnaissance supplemented by photo interpretation. The area under various land uses, vegetations and forest types together with their S.E. % are given in Tables 1.1, 1.2 and 1.3.

5.4. Volume equations

The local conditions in Manipur did not allow felling of the trees. It was decided that general volume equation developed for "rest of the species" of Tripura be used to derive a local volume equation for all the species with the help of sample tree data except for Pinus kesiya. In case of Pinus kesiya the tree volume obtained from Barr and Stroud Dendrometer measurements by Forest Research Institute were used for deriving a general volume equation. The following forms of equations were tried for general volume equation.

$$(1) V = a + b D^2 H$$

$$(2) V/D^2 H = a + b/D^2 H$$

The following equations were selected.

$$(1) \text{ Pinus kesiya } \frac{V}{D^2 H} = -0.013767/D^2 H + 0.254694$$

$$(2) \text{ Rest species (Tripura) } V = -0.0000282 + .314933 D^2 H$$

Diameter over bark at breast height and height of sample trees were substituted in the above equations to estimate sample tree volumes.

From the sample tree volumes and the breast height diameter (O.B) of the corresponding trees, local volume equations of the following form were tried.

$$(1) V = a + bD^2$$

$$(2) \frac{V}{D^2} = a + b/D^2$$

$$(3) \sqrt{V} = a + bD$$

The following equations were selected.

$$(1) \text{ Pinus kesiya } \sqrt{V} = -0.200251 + 2.927166 D \text{ (Diameter in metres)}$$

$$(2) \text{ Rest of species } \sqrt{V} = -0.226400 + 2.935870 D \text{ (Diameter in metres)}$$

The Barr and Stroud Dendrometer reading in respect of the undermentioned species were enough to derive volume equations. However these did not cover sufficiently large number of trees and therefore could not be used for volume assessment in general. They are given here to be of help in arriving at volumes of single trees, whose diameter and height is known.

$$1. \text{ Dipterocarpus turbinatus } V = .018666 + 0.405198 D^2 H$$

$$2. \text{ Dipterocarpus tuberculatus } V = -0.011395 + 0.398462 D^2 H$$

$$3. \text{ Duabanga sonneratioides } V = 0.089102 + 0.315044 D^2 H$$

$$4. \text{ Melanorrhoea usitata } V = 0.080219 + 0.306333 D^2 H$$

(Both height and diameter are in metres in these equations).

Tree volume

The underbark volume of each enumerated tree was calculated from the selected local volume equation and the over bark breast height diameter of the tree.

Plot Volume

The plot volume was obtained by adding under bark volumes of all the enumerated trees in a plot.

Stand and Stock

While enumerating the plot, each tree was classified in five availability classes viz. Silviculturally and Economically available, economically not available, silviculturally not available and dead but available. Stems and Volume per hectare by diameter and species were estimated for each availability, vegetation and forest type. However, it was found that due to lack of experience of this type analysis our crew had misjudged the availability status in many cases. As such the analysis of availability

was given up. The stems and volumes per hectare are given in Tables 3.0.0 to 3.4.5. and 4.0.0. to 4.3. respectively. Total number of stems and total volume for each vegetation (tree forest and open forest) and forest type were also derived. These are given in Tables 5.1.1. to 5.2.3. and 6.1.1. to 6.2.3. No trees of 'Dead but available' class were encountered.

5.8. Standard Error

Standard errors expressed as percentage for the estimates of area are given in Tables 1.1., 1.2. and 1.3.

Standard errors for the estimates of volume in different forest types of tree forest and open forest are given in Table 2.1. and 2.2.

5.9. Bamboo Yield

The occurrence of clump forming bamboo was given in 53 plots only. Hence the calculations for clump forming bamboo are based on 53 plots.

Occurrence of muli was noticed mainly in bamboo brakes. Area under bamboo brake was taken as the area under Muli.

5.10. Muli Bamboo

Total number of muli culms were recorded in the Northern half of each plot. These figures provided estimate of the total muli culms over the entire bamboo bearing area.

The detailed enumerations of muli culms occurring in the Northern half of the North-West quadrant were done by age (current seasons, 1-2 seasons and over 2 seasons), soundness, and diameter (less than 2 cms., 2-5 cms. & 5-8 cms.). This data over all the bamboo plots provided the proportion of culms in different age classes, soundness classes and diameter classes. These ratios were applied to the total number of muli culms enumerated over the entire area, to estimate the number of muli culms in different classes. The no. of culms/ha. by age and soundness are given in Table 7.1.

5.11. Clump forming

The total number of clumps in each plot were enumerated along with tree enumeration. The data over all plots provided the estimate of number of clump/ha. All the clumps in the North-west quadrant of each plot were enumerated in detail by age (current seasons, 1-2 seasons and over 2 seasons) and soundness (Green sound and green damaged, Dry sound and dry damaged, and decayed) and diameter (less than 2 cms, 2 to less than 5 cms, 5 to less than 8 cms and 8 cms and above). This data provided the number of culms per clump in different categories. These figures when multiplied by the number of clumps/ha. gave the number of culms/ha. in the various categories. Standard error expressed as percentage of muli culms/ha., clumps/ha. and green weight of culms have also been derived and are given in Table 7.0.

Manipur

5.12. Weight.

Green weight of bamboo culm in diameter classes 2 to 5 cms., 5 to 8 cms. and 8 cms. and over was available from the felled culms of these classes. The green weight of a culm was converted to air dry weight by applying the following percentages. The air dry weight = oven dry weight + 10%, and the table below gives the figures of air dry weight percent.

	2-5 cms	5-8 cms.	8 cms. +
Muli	63.82	57.73	-
Clump forming	52.03	50.34	40.77

The following weightages were given to the different conditions of the culm for determining the weight of a culm.

Green sound	1.0
Green damaged	0.5
Dry sound	2.0
Dry damaged	1.0
Decayed and fire damaged	0.0

From the above weightages, the average air dry weight of a culm and the no. of culms/ha. the average air dry weight of bamboo culms per hectare was determined.

The results of bamboo dry weight per hectare by age and soundness are given in Table 7.2.

Consolidated results on Muli and clump forming bamboo are given in Table 7.0.

CHAPTER - VI

RESULTS OF SURVEY

6.1. Area:

The total area of the State is 22,366 sq.kms. of which agricultural crop land constitutes 14.18% or 3,170.72 sq.kms. and agricultural tree land constitute 1.51% or 337.10 sq.kms., the extent of current jhum is 8.19% of the total area or 1,832.08 sq.kms. Forests, which includes tree forests, open forest, bamboo brakes and grass banks within forest, constitute 67.76% of the area of 15,154.94 sq.kms. Other land uses are given in table 1.1 along with the standard error percents in the estimates.

6.2. Vegetation:

Landuse - 1, i.e. forest has been subdivided into 4 vegetational types and the break up is given in Table 1.2. Tree forest with density over 20% occurs in 34.08% of the total land area or 50.29% of the area under landuse - forest. The total extent is 7,621.44km². Open forests i.e. having density between 5 to 20% constitute 18.41% of the total land area or 27.18% of the forest area. They extend over 4,118.51 sq.kms. Bamboo brakes which are results of shifting cultivation constitute 14.61% of the total area or 21.56% of the area under forest. They extend over 3268.43 sq.kms. Grass banks occur to the extent of 146.57 sq.kms. They appear to be a further degradation of the bamboo brakes due to continuous jhuming.

6.3. It is interesting to compare the total current jhum of 1832.08 sq.kms. with total area of bamboo brakes i.e. 3268.43 sq.kms. It is understood that a jhum area is cultivated for about 2 years before a new area is taken up, it therefore appears that the 'jhum cycle' is approximately 6 years, and the people probably come back to the same place for jhuming near about the 7th year. The hypothesis is further strengthened by the analysis of age class of bamboo which is given later in the chapter.

6.4. Forest Types:

Table 1.3. shows the distribution of tree forest and open forest by forest types. 5 types of forests have been recognised as described in the earlier chapter. The wet temperate forests constitute 16.86% of the total area under tree forest and 4.03% of the total area under open forest. The khasi pines occur over 51.41% of the tree forest and 64.41% of the open forest. This constitutes the major type of forest in the State. Semi-evergreen forest occurs over 5.77% of the tree forest and 4.98% of the open forest. Teak-Gurjan type of forest is found over 6.05% of tree forest and 3.8% of the open forests. The area details may be seen in table 1.3. The percentage of semi-evergreen forest is low because most of it apparently has been converted into bamboo brakes due to repeated jhuming.

Although a forest type called Teak-Gurjan has been identified in this area according to Champion and Seth's classification, our crew did not come across a single tree of naturally grown teak in this stratum.

/ 14.94% of the tree forest area and 22.42% of the open forest area.
Wet Hill type of forests occur over ..

6.4.1. Distribution of Volume/ha. by forest types

Table No. 2.1. gives the analysis of volume/ha., standard error percent and area estimates under each forest type, and total volume in the forest types with standard error of the total volume. The wet temperate forests contain the maximum volume/ha. i.e. 123.150 m^3 . The next in volume are the semi-evergreen forests with $98.095 \text{ m}^3/\text{ha.}$ followed by wet hills having $90.720 \text{ m}^3/\text{ha.}$ and Teak-Gurjan having $71.392 \text{ m}^3/\text{ha.}$ with a standard error of 10.2%. The total volume in the tree forest is $6,80,77,800 \text{ m}^3$ with a standard error percent of 10.4.

The open forest type of vegetation shows a volume of only $5.663 \text{ m}^3/\text{ha.}$ in wet temperate, $5.342 \text{ m}^3/\text{ha.}$ in pine forest, $14.018 \text{ m}^3/\text{ha.}$ in wet hills forest, and $10.522 \text{ m}^3/\text{ha.}$ as the weighted average over the entire open forest stratum. The figures are quite indicative of the vast difference in the volume/ha. between the tree forest and the open forest strata. It is apparent from the volume figures that the open forest type is unsuitable silviculturally and economically for working as productive forest and therefore in subsequent considerations they have not been considered as productive forests.

How to develop these open forest areas for forestry production is the domain of Forest Manager, and hence it is not dealt with here. The soil and climate are so good that any of the fast growing species could be grown without much difficulty. The biggest bottleneck is likely to be the objection from the tribals, which would need extensive publicity of a highly convincing nature.

6.4.2. Distribution of stems/ha.

Table No. 3.0.0. to 3.3. give the distribution of stems/ha. by diameter classes and species for various vegetational and forest types. Vegetation type 'grass banks' contains a mere 4.705 trees per hectare. The wet temperate forests bear 331.102 trees per hectare in the tree forests, but only 58/ha. in open forests (below 20% density). The pine forests bear a total of 259.993 trees/ha. in Tree Forest and 39.999/ha. in open forests. For the Wet Hill type the figures are 323.483 and 38.179/ha. respectively. Teak-Gurjan forests have 317.775 trees/ha. No samples of open forest appeared in this forest type. The open forest stratum with density less than 20% is not amenable to working as a whole except under schemes of plantations. The stratum is therefore not considered in assessment of the cut.

6.5. Distribution of volume:

Table Nos. 4.0.0. to 4.3. give the distribution of volume/ha. by diameter classes and species for various forest type in the two density classes. The volume in the open forest is very low compared to that in tree forests. The standing volume in Grass banks is $4.869 \text{ m}^3/\text{ha.}$ A comparison of the volumes in tree forest and open forest has been given in an earlier para in this chapter.

Distribution of total stems by diameter classes and species and distribution of total volume by diameter classes and species are also given for each forest type in the table nos. 5.1.1. to 5.2.3. and 6.1.1. to 6.2.3.

only 69,001 m³/ha. The weighted average volume/ha. for the whole of the tree forest is 89,324 m³/ha. . .

6.6. Bamboo:

Both clump forming and non clump forming bamboos are available in Manipur State. Muli bamboo (*Melocanna basifera*) which does not form clumps is found mostly in bamboo brakes extending over 326,843 ha. The average stocking of Muli bamboo in the bamboo brakes is 10,827.4 culms/ha. The break up of this number by age and soundness is given in table No.7.1. The S.E. for no. of culms/ha. is 23.29%.

A perusal of this table will show that 14.2% of the total culms are the current year's recruitment in sound condition and 0.9% are damaged i.e. the annual recruitment is 15.1% of the total growing stock. Muli between one and two seasons old in sound condition constitutes 28.3% of the growing stock and 38.4% are over 2 seasons old. In addition 4.9% green and damaged bamboos belong to one to two seasons age group, and 11.6% dry sound and dry damaged bamboo may be presumed safely to belong to the over 2 seasons age group. The age class distribution therefore is the year's culms 15.1%, 1 to 2 seasons 33.3% and over 2 seasons 50%. Unusable make up the rest.

If we assume that the life period of Muli bamboo is approximately 6 to 7 years, it will be seen that the annual recruitment is in, almost, correct proportion to the total growing stock. This would mean that the annual increment itself could safely be taken as the annual yield of bamboo. The jhum cycle in the case of muli forests has also been calculated at approx. 6 to 7 years which coincides with the life period of muli.

6.6.1. Clump forming bamboo.

The following are the common clump forming bamboos in Manipur:-

1. *Dendrocalamus hamiltonii*
2. *Dendrocalamus strictus*
3. *Dendrocalamus longispathus*
4. *Teinostachyum dullooa*
5. *Bambusa balcooa*

Dendrocalamus hamiltonii is the most common species among the clump forming bamboos.

6.6.2. Area and Growing Stock

Calculation of area for clump forming bamboo is detailed in table 7.3. This has been arrived at from the proportion of grids in which clump forming bamboos occur out of the total grids sampled in each forest stratum. The total area of clump forming bamboos came to 459,439 ha. The average number of clumps/ha. is 64.151 with a standard error of 18.09%. The number of culms/clump work out to 15.725 with standard error 12.36%. The total number of culms of clump forming bamboo are 1008.77/ha. with standard error percent 21.91. The average green weight of muli culms of 2-5 cm. diameter class is 3913.333 gms. and the standard error was 1.65%. For the 5-8 cm. diameter class of muli the weight was 9158.4091 gms. with standard error of 4.96%. The average green weight/culm for clump forming bamboo was 5635.490 gms. for class 2-5 cms., 14129.784 gms. for diameter class 5-8 cms., and 34842.307 gms. for diameter class of 8 cms. and over. The S.E. percent for culm weights were 6.48, 5.18 and 7.74 respectively.

A perusal of table No. 7.1 for clump forming bamboo shows that 15.1% of the total culms are the year's recruitment in sound condition and 1.5% are in damaged condition i.e. total recruitment is 16.6% of the total growing stock. The sound culms of 1 to 2 seasons age are 19.6% and damaged culms formed 9.8%, i.e. a total of 29.4% culms belong to this age class. The dry sound and dry damaged add up to 16.4% and may be classified together with over 2 seasons old culms of which green and sound culms constitute 32.4% of the total growing stock. Thus the age-wise composition of the clump is current year's 16.6%, 2nd year 29.4%, and over 2 seasons 48.8%. The life period of clump forming bamboos also varies from 6 to 7 years and again the annual recruitment appears to be in correct proportion to the growing stock and the life period. As such even in this case the annual recruitment can safely be taken as the annual cut.

In the 1 to 2 seasons age class the slight over stocking appears to be due to wrong classification of over 2 seasons culms in this category in the field. Normally the two year old culms should have been nearly same or slightly less than the recruitment of the year, because there is mortality.

6.6.3. Air Dry Weight

As the result of experiments carried out by us the percentage air dry weight (oven dry + 10% moisture) to green weight at time of felling was found to be as below:-

	2 to 5 cms.	5 to 8 cms.	8 cms. +
Muli	63.82%	57.83%	-
Clump forming	62.03%	50.34%	40.77%

CHAPTER - VII

POTENTIAL ANNUAL CUT

7.1. Present Management.

Because of the peculiar legal position of the forests, the working of the forests is in a very rudimentary stage. Management systems are usually of selection-cum-Improvement type, but that also cannot be correctly followed. Only selection of the most desirable tree is the usual method of harvesting. No data is available on the theoretical rotations, rate of growth etc. of any species.

The forests are well stocked, are uneven-aged and there is district fall in the number of trees per hectare at 40-49 cm. diameter in all forest types except wet temperate which is the result of exploitation in the past and present for local needs. The fall occurs at 50-59 cms. dia. in the wet temperate forests which are found at higher elevations.

7.2. Future Management.

It is not expected that the manpower resources of the State will permit any intensive management of the forest in a big way. Selection will remain the system in vogue may be for the next ten to twenty years over most of the area. Our proposed cut is, therefore, worked out on this model.

For determining the potential annual cut Smythies' safeguarding formula has been used. In this formula, the rotation is not involved, as there is no guide to the acceptable rotations in these forests.

There is also no guide to the number of years needed for the pre-selection girth class to pass into the selection girth class, in respect of Manipur. But for the forests of Tripura 20 years has been considered as the period in the local working plans. In Manipur 25 to 30 years has been assumed as the forests are much denser than Tripura, and soils somewhat poorer.

There is no rule as to the length of the felling cycle. Generally a 20 to 30 year cycle is adopted in selection forests. It is considered that in Manipur 30 years may be an acceptable period for the forests to be gone over.

- 7.2.1. Smythies' formula takes into consideration the imbalance in the distribution of trees in diameter classes. The economics of exploitation at present allows only the removal of the largest diameters. The working plans of Manipur have prescribed a 60 cm. dia. for semi evergreen and wet hill types of forests. The wet temperates are longer lived species and can grow to larger sizes hence the diameter for class I may be placed at 70 cms. for the wet temperate forests and 50 cms. for the other forest types. The next lower diameter class will be the pre-selection class.

The mortality percent is assumed as 25%, in passing from pre-selection to selection diameters.

t = 30 or 25 years i.e. time taken for class II trees to go into Class I.
 f = 30 years felling cycle.
 I = no. of class I tree-s.
 Z = 25% i.e. mortality percent due to deaths, illicit fellings, and silvicultural retentions.

7.2.2. On the assumption of 30 year felling cycle the percentage of trees that passes from Class II to Class I during the following cycle is

$$x = \frac{f}{t} (\text{II} - Z\% \text{ of II})$$

$$\text{or } \frac{30}{30} (\text{II} - 25\% \text{ of II})$$

$$\text{or } x = 75\% \text{ of II}$$

If 't' is 25 years

$$\text{then } x = \frac{6}{5} (75\% \text{ of II})$$

The formula then is

$$\text{Yield} = \left(\frac{x}{\text{Class I} + \frac{x}{2}} \right) \text{ of N.}$$

When N = no. of class I trees ~~...~~ Felling cycle.

The potential cut has been worked out on this formula. The total no. of trees in each girth class is given in tables 5.1.1 to 5.1.5.

7.2.3. On the above said premises, the potential annual cut from the forests is worked out below.

7.2.3.1. Wet Temperate Forests.

Total Selection trees above 70 cm. dia.

= 998,752 i.e. Class I.

Pre-Selection tree 60-69 cm. dia.

= 856,513 i.e. Class II

$$x = \frac{f}{t} (\text{II} - Z\% \text{ of II})$$

$$\text{or } x = \frac{30}{30} (856513 - 29\% \text{ of } 856,513)$$

$$\text{or } x = 642385$$

$$\begin{aligned}
 \text{Yield} &= \frac{x}{\text{Class I} + \frac{x}{2}} \times N. \\
 &= \frac{642385}{998752 + 321192} \times N \\
 &= \frac{642385}{1319944} \times 33292 \\
 &= 0.4867 \times 33292 \\
 &= 16203
 \end{aligned}$$

or say 16200 trees per year.

Most of these trees would come from the 100-109, 90-99 and 80-89 cm. dia. classes during the first felling cycle and in 30 years a total of 486000 trees would be available. This means all trees of 100-109, all of 90-99 and about half of 80-89 cm. dia. trees will be harvested during the cycle. The effective selection diameter therefore will be 80 cm. o.b.

The annual cut is distributed in accordance with the percentage of these diameters in the crop.

	Vol/tree m ³	Total m ³ volume.
i.e. 100-109 = 2376 trees	7.508	17839.22
90-99 = 9512 trees	6.389	60776.49
80-89 = 4312 trees	4.931	21262.92
16,200 trees		99,878.64

Thus the total out-turn in this forest type is 99,878 m³ per year. This is broken up into the various utility classes as below, based on percentage of each utility class in the trees.

As no tree fellings were possible in Manipur, we have adopted the utility percentage from the Tripura studies. From the total volume of each utility in each dia. class above 60 cm. we have arrived at the following percentages of each utility in total trees over 60 cm. dia. o.b.

Plywood	17.9%	i.e. logs over 40 cm. mid dia. under bark.
Timber	6.6%	i.e. logs 20-40 cm. mid-dia. u.b.
Pole	1.6%	i.e. 10-20 cm. -do-
Pulp + Fuel	66.1%	down to 5 cm. dia. o.b.
No utility	7.8%	Generally stump + rotten parts i.e. cull volume.
	100.0	

Applying the above percentages to the total volume yield we get the following volumes in each utility class in this forest type.

Plywood	:	17878.276 m ³
Timber	:	6591.990 m ³
Pole	:	1598.058 m ³
Pulpwood	:	66019.781 m ³
no utility	:	7790.533 m ³

Checking the yield of 99,878 m³ against the total standing volume of 158,23,504 m³ for this stratum, the theoretical Rotation by Von Mantel's formula ($y = \frac{2GS}{R}$) works out to 316 years. Thus

the yield is in no way an overestimate. The safety margin is also necessary in view of the Silvicultural requirements of these high level forests as many trees otherwise harvestable have to be retained on silvicultural grounds.

7.2.3.2. The Pine Forests.

In the forests of Pinus kesiya, which are at a lower elevation than the Wet Temperate Forests and which are also a little more open, the 't' i.e. time for all trees to pass from pre-selection to selection class is assumed as 25 years. The felling cycle remains the same i.e. 30 years, and Z% is also the same i.e. 25% including losses by fellings etc. and retentions due to silvicultural non-availability.

$$\therefore x = \frac{30}{25} \text{ (II-25\% of II)}$$

$$\text{or } \frac{6}{5} \text{ (75\% of II)}$$

Class I are 50 cm. & over.

Pre-selection dia. class: Class II is 40-49 cm. This assumption is based on the observations in the field that trees beyond 50 cm. dia. are very few. The yield is calculated separately for Pinus kesiya and the rest of the species in pine stratum.

Pinus kesiya

$$x = \frac{6}{5} \left(\frac{723540}{4} \times 3 \right)$$

$$= 651186$$

$$y = \frac{x}{\text{Class I} + \frac{x}{2}} \times N.$$

$$N = 578741 \div 30 = 19291$$

$$= \frac{651186}{578741 + 325593} \times 19291$$

$$= 13,891$$

i.e. 13891 trees of 50 cm. and over will be available every year.

Of these 17.36% will be of dia. class 80-89 and 82.64% of dia. class 50-59. Two intermediate dia. classes have not appeared in the sample.

The average volume/tree for 80-89 dia. class is 5.508 m^3 and for 50-59 cm. dia. - 1.962 m^3 . Thus the total volume available will be

$$2411 \times 5.508 = 13279.788 \text{ m}^3$$

$$11480 \times 1.962 = 22523.760 \text{ m}^3$$

$$\text{Total} = 35,803.548 \text{ m}^3$$

The total g.s. under *P. kesiya* being 4717745 m^3 the rotation for this by Von Mantel's formula works out to 262 years. This confirms that there is no over estimation. The actual rotation would be much lower than this.

No information is available about the utility break up of the total volume under *Pinus kesiya*. Studies on *P. armandii* done by the East Zone of this organisation indicate that in 50-59 cms. dia. class, the percentage of pulpwood (i.e. under 30 cm. dia) to total usable volume is 32%; and for 80-89 cms. dia. class it is 20.5%. The no utility volume is found to be 7.8% in our studies constant over a wide range. Applying these percentages to the total volume under each dia. class the following breakup is arrived at :

$$\begin{array}{ll} \text{Timber utility i.e.} & = 23947.612 \text{ m}^3 \\ \text{wood over 30 cm. diam. u.b.} & \end{array}$$

$$\begin{array}{ll} \text{Pulpwood utility i.e. under} & = 9063.260 \text{ m}^3 \\ \text{30 cm. dia. and down to 5 cm.} & \\ \text{d.o.b.} & \end{array}$$

$$\begin{array}{ll} \text{No utility} & = 2792.676 \text{ m}^3 \end{array}$$

$$\begin{array}{ll} \text{Total} & = 35803.548 \text{ m}^3 \end{array}$$

Broad leaved trees in *Pinus kesiya* forests.

P. kesiya forms 23.6% of the total no. of trees in the Pine stratum but in volume it constitutes 51.8% of the total. The utilization of broad leaved species in this stratum is similar to that in other strata but very different from that of *P. kesiya*. It appears that the broad leaved trees in this stratum also are very few in the upper diameters and so the same diameter i.e. 50 cms. is taken as selection diameter. In class I there are 289,296 trees and in class II i.e. 40-49 cms. there are 361,619 trees.

Applying Smythies' safeguarding formula the no. of trees to be cut are as follows :

$$x = \frac{6}{5}x \left(\frac{3}{4} \times 361619 \right) = 325,457$$

$$\text{and } y = \frac{325457}{289296 + 162728.5} \times 9643.2$$

$$= 6943 \text{ trees.}$$

The distribution of these trees into diameter classes in harvesting is as below for the whole felling cycle.

90-99 cm.	72324 trees
70-79 cm.	135996 trees

and therefore per year

90-99 cm.	2411 trees	} Total 6943 trees.
70-79 cm.	4533 trees	

The effective selection diameter is therefore 70 cm. o.b.

The volume per tree is 6.126 m³ in 90-99 cm. dia. class and 3.848 m³ in 70-79 cm. dia. class. The total volume available annually is thus 32212.770 m³. The utilitywise breakup of this volume is as below:

Plywood	17.9%	5765.948 m ³
Timber	6.6%	2125.992 m ³
Pole	1.6%	515.392 m ³
Pulp	66.1%	21292.132 m ³
No utility	7.8%	2512.536 m ³
Total	100	32212 m ³

By Vom Mantel's formula the rotation at this level of exploitation for broad leaved trees in Pine stratum works out to 273 years, as against 262 years for Pine.

7.2.3.3. The Wet Hills Forest.

These are luxuriant forests at the same elevation as the Pine forests. The diameter for the class I trees is assumed at 50 cms. and the time to pass into this class from the next lower class is assumed as 25 years.

2% = 25 i.e. mortality etc. in passing to next class.

The total no. of trees above 50 cms. dia. are

$$3,123,594 = \text{Class I}$$

The total no. of trees of 40-49 cms. dia. are

$$3,634,918 = \text{Class II}$$

$$N = 3123594 \div 30 = 104119.8$$

$$x = \frac{6}{5} \left(\frac{3}{4} \times 3634918 \right) = 3271426.2$$

$$y = \frac{3271426}{3123594 + 1635313} \times 104119.8 = 715.69 \text{ trees}$$

The total yield in 30 years will be 2,147,070 trees, which will consist of all trees above 70 cm. dia. and 329,414 trees from 60-69 dia. class out of a total 624,562 trees in that class or nearly 50%. The actual exploitable dia therefore works out to be 60 cm. o.b. although Class I included trees of 50-59 cm. also.

The annual yield will therefore be

100 +dia class	-	11363 trees	av. vol.	13.837 m ³
90-99 " "	-	13256 "	av. "	6.123 m ³
80-89 " "	-	15150 "	av. "	4.824 m ³
70-79 " "	-	20819 "	av. "	3.594 m ³
60-69 " "	-	10981 "	av. "	2.616 m ³

The total volume available is therefore 415,093 m³ which is broken up into the utility classes as below, on the same proportions as used for other types :

Plywood	74301.647 m ³
Timber	27396.138 m ³
Pole	6641.488 m ³
Pulp	274376.473 m ³
No utility	32377.254 m ³
Total	<u>415,093 m³</u>

The total volume in this stratum is 35545935 m³ and annual yield is 415093 m³. On Von Mantel's formula the rotation works out to 171 years which confirms that our yield is not excessive. The actual rotation silviculturally may be near 150 years.

7.2.3.4. The Semi-Evergreen Stratum.

This stratum occurs at the lowest elevations and the original forest is left in a very few localities. The vegetation is quite good and rate of growth may be same as in the Wet Hill type. Therefore 'f' and 't' remain the same as also the Z %.

Class I trees are taken as the trees above cm. dia. as in previous stratum.

$$\begin{aligned}
 \text{Class I trees} &= 608,763 \\
 \text{Class II (40-49)} &= 338,216 \\
 N &= 20292 \\
 x &= \text{works out to } 30,594.4 \\
 \text{and } y &= \frac{304394.4}{608763 + 152197.2} \times 20292.1 \\
 &= 18,117 \text{ trees.}
 \end{aligned}$$

The yield in 30 years will be 243515 trees, which can be harvested by removing all trees of 100 +, 80-89 and 70-79 cm. dia. classes, and 6,779 trees only out of 236,734 trees of 60-69 cm. dia. The effective selection dia. therefore is 60 cm. o.b., which is also the prescribed diameter in working plan for the Western division where these forests occur.

The annual yield will be as follows :

Dia. class cm.	No. of trees.	Av. volume/ tree m ³	Total Vol. m ³
100-109	3383	6.312	21353.496
80-89	1127	5.419	6107.213
70-79	3381	3.605	12188.505
60-69	226	2.818	636.94
Total	8117 trees		40,286 m ³

Checked by Von Mantel's formula with the total volume in this stratum, the rotation works out to 214 years. The actual silvicultural rotation may be about 175 years or so and again our yield is not excessive.

The utilitywise breakup of the total volume is as below :

Plywood	-	7211.194
Timber	-	2658.876
Pole	-	644.576
Pulp	-	26629.046
No utility	-	3142.308
Total	-	40,286 m ³

7.2.3.5. Teak Gurjan Stratum.

This is the poorest of all broad leaved strata. No trees of larger diameters than 80 cm. were found. No teak tree was found in the stratum.

The 'f' and 't' and Z% are as in the previous strata. The class I trees are taken as from 50 cm. dia. and over and class II as 40-49 cm.

Total class I	=	408174
" " II	=	663327
N	=	13606
x	=	596994.3
and y	=	596994.3
		x 13606
		408174 + 298497.15
or y	=	11,494

In 30 years 344829 trees will be available i.e. all of 70-79 and 60-69 and about 60% of 50-59 class. The effective selection diameter will be 50 cm. o.b. the annual cut will be

Dia. class	No. of trees	Vol/tree	Total volume
50-59	6392	1.866	11927.837
60-69	1701	2.730	4645.194
70-79	3401	3.850	13095.864
	11494		29,669 m ³

Checked against total volume 3278608 m³ in this stratum by Von Mantel's formula, the rotation works out at 221 years, and as the silvicultural rotation is sure to be less - may be 175 years or so, the annual cut is not excessive.

The break up of the total volume into utility classes is as below :

Plywood	..	5310.751
Timber	..	1958.154
Pole	..	474.704
Pulpwood	..	19611.209
No utility	..	2314.182
Total	..	29,669 m ³

7.3. Total Annual Cut : Timber.

7.3.1. The total utilitywise availability of broad leaved wood from the Manipur forests is therefore tabulated as below :

Utility	Stratum	in m ³				
		Wet Tempo- rate.	Pine (broad leaved trees only)	Wet hill	Semi- Ever- green	Teak Garjan
Flywood		17678	5766	74502	7211	5511
Timber		6592	2126	27396	2359	1958
Pole		1593	515	6642	645	475
Pulp & Fuel		66020	21292	274576	23029	15611
No utility		7790	2513	32377	3142	2514
Total		99378	32212	415093	40283	29669
						617138

7.3.2. The utility breakup of coniferous timber *Pinus kesiya* into timber, pulp, fuel and 'no utility' groups as below has been adopted from the studies on *Pinus armandii* of Arunachal Pradesh by the Eastern Zone. This is the only conifer studies for this data in this region. Based on this data the break up of the total available volume of coniferous timber is as below :

Fine timber	23948 m ³
Fine pulpwood/fuel	9063 m ³
No utility	2792 m ³
Total	35,803 m ³

Annual Cut of Bamboos :

As explained in the previous Chapter, the sustained annual yield of bamboos is taken as the annual recruitment, which is about 15% of the total stock. The yield worked out by the State Forest Department also is 1/6th of the growing stock.

As in this we have analysed the growing stock by age and diameter classes, we have a breakup of the diameter distribution in the harvestable age class. We consider culms under 2 cm. dia. as silviculturally not available.

The annual recruitment has not been classified into diameter classes, as the time of sampling for assessing the weight of the recruitment at maturity we have distributed them by the diameter class percentage in the harvestable class, then applied the green weight and dry weight factors of each class and computed the air dry weight in tonnes per hectare, of the annual yield, and this multiplied by the area of the bamboo stratum gives the annual availability of the bamboos. The details are given below :

7.4.1. Muli bamboo (Melocanna basifera)

The percentage distribution in dia. classes of mature culms is as below :

Under 2 cm. dia.	17.71%
2 to 5 cm. dia.	74.13%
5 to 8 cm. dia.	8.16%
Total	100%

Annual recruitment/ha. = 1532.1 culms.

	Green weight per culm.	Air dry weight factor	Total Kgs./ha. (Air dry)
Therefore culms under 2 cm. dia. = 271.33	-	-	-
Therefore culms under 2 to 5 cm. dia. = 1135.75	3.913	63.82%	2836.523
Therefore culms under 5 to 8 cm. dia. = 125.02	9.158	57.83%	662.144
			3498.667

The annual air dry (10% moisture) yield per ha. of muli bamboo is 3498.667 kg. The total area of the muli stratum is 326843 ha.

The annual total muli yield is therefore 11,43,296 tonnes air dry (i.e. 10% moisture), or 11.4 lakh tonnes.

7.4.2. Clump Forming bamboos.

In the case of clump forming bamboos, the annual recruitment is 16.5% and is just 1/6th of the total growing stock, as adopted for yield calculations in the State. We therefore take the annual recruitment as the yield. The recruitment is distributed into diameter classes, as for Muli.

Percentage distribution of mature culms.

under 2 cms. dia.	..	7.69%
2 to 5 cm. dia.	..	67.83%
5 to 8 cm. dia.	..	20.61%
over 8 cm. dia.	..	3.87%
		<hr/> 100.00 <hr/>

Annual recruitment is 152.829 culms/ha.

	Green weight in Kg. per culm.	Dry weight factor	Total Kgs./ha. (air dry)
Therefore culms under 2 cm. dia. = 11.75	-	-	-
Therefore culms under 2 to 5 cm. dia. = 103.73	5.635	62.03%	362.608
Therefore culms under 5 to 8 cm. dia. = 31.51	14.129	50.31%	224.529
over 8 cm. dia. = 5.90	34.842	40.77%	63.810
			<hr/> 670.947 <hr/>

The annual air dry (10% moisture) yield of clump forming bamboos per hectare is thus 670.947 kg./ha. These bamboos occur under tree forests and hence their density is much less. The total area under this bamboo is 459439 ha. overlapping tree forests and the annual yield is 3,08,259 tonnes or 3.08 lakh tonnes air dry (10% moisture).

7.5. Total Annual Cut of Bamboo.

The total bamboo potential therefore is 14.48 lakh tonnes per annum. air dry weight.

7.6. Overstocking in bamboo.

There is however a large surplus stock of bamboos because the forest have not been exploited. As against a theoretical stock of six times the annual cut i.e. 20.988 tonnes/ha. the muli stratum has a stocking of 29.367 tonnes. As against 4.026 tonnes for the clump forming bamboos the total stock is 3.993 tonnes/ha. However, the normal cutting cycle for bamboos is 4 years and then the surplus growing stock is 15.375 tonnes/ha. in muli and 1.309 tonnes/ha. in clump forming bamboos, which are available for liquidation in the first cutting cycle.

The annual yield in the first cycle will therefore be substantially higher. In view of the vast potential of bamboo that unfolds before us, any further higher yield in the first cycle is of little interest.

7.7. The Wood balance.

No data is available to determine the necessities of timber, fuel and bamboos of the local population. At present, there is no record of forest production or exploitation to assess these needs. The needs are nevertheless met from the forests at the will of the people.

For our assessment we assume that the average per capita requirements are as below :

Firewood	- $\frac{1}{2}$ kg. per capita per day.
Timber (including poles)	- .028 m ³ (1 cu. feet) per capita per year.
Bamboo	- 50 bamboos per capita per year.

The population of Manipur as per 1971 Census was 10,73,000. On the above scales the internal consumption works out as below (rounded off for convenience).

Firewood	: 2,90,000 m ³ per year.
Timber (including poles).	: 30,700 m ³ per year.
Bamboo	: 1,61,000 tonnes air dry.

This leaves a surplus of plywood class timber i.e. over 1,10,000 m³, about 10,000 m³ of saw timber, about 1,17,000 m³ of pulpwood from broad leaved species and 23948 m³ of Pine timber and 9063 m³ of pine pulpwood, and 12.87 lakh tonnes of bamboo.

CHAPTER - VIII

INDUSTRIAL RECOMMENDATIONS

As per the results of the inventory survey, the following different resources are available annually :

<u>Raw material</u>	<u>Quantity</u>
1. Saw timber	10,000 m ³
2. Plywood Class timber	1,10,000 m ³
3. Pine for timber use	23,948 m ³
4. Hardwoods for industrial use	1,17,000 m ³
5. Pinewood for industrial use	9,063 m ³
6. Bamboo (Total)	<u>12,87 lakh tonnes</u>

From the above figures it can be observed that there are vast and varied resources of wood and bamboo available in surplus which unfortunately have still not been put to any economic/commercial use. The state of Manipur is one of the lesser developed States of the country with a population of, according to 1971-72 Census, 10,73,000. Employment opportunities are rather poor. The forestry resources, therefore, offers a very good opportunity to provide lot of employment by creation of an integrated type of forest industry. For the time being it is recommended that the mills of the following types and capacities may preferably be s-tarted.

S.No.	Type of Mill/production	Required ⁸ wood/bamboo	Out turn expected.
1.	Saw mill/16000 cu.m. Pine & Hard wood	33948 m ³	16000 cu. m.
2.	Plywood/137500 sq.m.	110000 m ³	137500 sq.m.
3.	* Hardboard/20.6 m.sq.m. Particle"/ Chip board/	71135 m ³	17.9 m.sq.m.
4.	Integrated 400 tonnes/day Pulp & Paper/News Print Industry /or 250 tonnes/day writing & printing Paper.	400 tonnes Hardwood + 390 tonnes bamboo per day or 600 tonnes/day of Bamboo +Hardwood	-
		(60 : 40)	

The waste of Saw mill, plywood & Paper mill will be used for this.

This above set up, proposed, will probably be one of the biggest wood-based industrial complex in the country and would provide employment opportunities direct and indirect starting from tree to be market to about 2 lakhs which means that nearly 1/5th of the population of the State will be employed almost cent per cent on the basis of the various resources.

The picture is, however, still further rosy because even after catering to the requirements of the various types of productions mentioned above, there will still be a surplus of about 12 million tonnes hardwoods and bamboos which can be sent out of the state to other raw material consuming states of Bihar and West Bengal which are starving for these resources.

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Appendix I-a

MANIPUR SURVEY - FIELD MANUAL

DESIGN OUTLINE:

The manipur survey is rendered a little more difficult because of absence of maps showing area boundaries of forest and also because the total area under forest is not known with any accuracy. This means that we have to assess the total area, and each type of forest for assessing the total volume available in each stratum.

For this purpose, it will be necessary to go over the entire area of Manipur State and visit grid intervals at 1'-15" and classify the points into one of the strata as given later on. This will be a Recce with means of helicopter for the area assessment.

As far sampling, the design will be very similar to what was used in Tripura. It will be random sampling after stratification with grid distance at $1\frac{1}{4}$ minutes x $1\frac{1}{4}$ minutes. The laying out of grid points will be done by the Draftsman before the sheets are handed over to Crew Leaders.

This pattern is adopted because of the shortage of time and because photographs of the area have not yet been available to us. If the photographs are available early, the areas of various strata will be obtained by photointerpretation, if possible. As the photographs are over 8 years old, these photographs will not represent the position as existing on the ground today. The strata for photointerpretation will be as follows:

1. Areas having tree stocking below 40% (0.40) will be considered as understocked. Narrow belts of trees along water courses in large expanses or under stocked area will not be considered unless over 50 ha. in one patch.
2. Areas having more than 40% tree density considered as well stocked provided they are in patches of over 50 ha.
3. Plantation stratum having areas of planted bamboo, teak, gamar, sal etc. The area and yield may be obtained from departmental figures for up to date data.
4. Pure bamboo stratum i.e. old jhumed areas with regrowth of bamboo with isolated trees. Thin strips of forest along stream banks will be ignored.
- . Cultivation and other unproductive lands, revines, treeless areas etc.

Muli bamboo will be counted over Northern half of the plot. In the north half of the north-west quadrant as shown in the diagram, all muli bamboos will be enumerated by age classes and diameter classes. In case of clump forming bamboos the clump will be counted by clump diameter classes over the entire plot and entered in the tree enumeration form. In the entire north west quadrant the clumps will be sampled in details for total number of culms available by age classes, utility pattern, diameter classes etc. In case of current year's culms of both muli and, clump formers the diameter classification will not be made as growth will not be completed in all the areas, especially if the survey has to be carried over to the next year; Diameter classification of culms will be done for muli bamboos and clump forming bamboos, both. In the case of border clumps those which are more than half inside the plot will be totally counted and those less than half inside will be totally excluded. Sample tree studies for tree volumes will be done in southern half of north-west quadrant.

Bamboos will be divided into the following diameter classes under 2 cm., 2 cm. to under 5 cm., to under 8 cm., and 8 cm. and over. The bamboos from each diameter class for muli as well as clump forming bamboos will be felled at 0.25 metres above ground to correctly measure the total utilisable length down to 2 cm. diameter. Total length of the bamboo will not be recorded. The green weight of each culm will be recorded. Experiments for green weight to dry weight ratio are also to be taken as done in Triura. For this purpose, 3 sections of one metre length each will be cut from one of the felled bamboo of each diameter class, one from bottom, one at the top, and one at the middle section of the bamboo and this will be weighed on the spot to the nearest 5 gms. The sample will be marked with grid number, species code, date of initial weightment and diameter class in paint and tied with bark of the same species of bamboo, before weighing. These bundles will be sent to base camp for further action. The Manipur area is very hilly and also cut up, in the western part, because of which a large number of trees although existing on the ground, will not be silviculturally available for felling. In recording the enumeration data, it will be considered as to whether a tree which is existing on the ground is silviculturally available or not and will be coded accordingly. Similarly, in many of the jhum areas large trees are some-time standing isolated and at great distances from each other and although these have been included in the standing volume it may not be possible to extract them economically when it comes to exploitation, for process of pulp. Such economically unavailable trees should also be similarly coded to avoid over estimation of available volume.

SPECIAL STUDY:

Special study for tree volume equation will be carried out as done in case of Bhandara. The diameter classes will be as under :-

- 10 - 19 cm.
- 20 - 29 cm.
- 30 - 39 cm.
- 40 - 49 cm.
- 50 - 59 cm.
- 60 - 69 cm.
- 70 - 79 cm.
- 80 - 89 cm.
- 90 - 99 cm.
- 100 - 120 cm.
- 120 - cm. and above.

In each diameter class minimum of 4 trees will be needed to arrive at a proper volume equation. The species for which the data are to be collected are being given separately.

Cull study will not be done due to lack of time.

The utility classes into which the tree volume will be classified will be, plywood, timber, poles, pulpwood, fuel and no utility.

Plywood species :	1. Harish	: Albizzia stipulata
	2. Poma	: Cadrela toona
	3. Kanak	: Schima wallichii
	4. Gurjan	: Dipterocarpus turbinatus
	5. Bahera	: Terminalia belerica
	6. Ha-ruguza	: Dillenia pentagyna
	7. Udal	: Sterculia villosa
	8. Kaimala	: Odina wodier
	9. Koroi	: Albizzia procera
	10. Am	: Mangifera indica
	11. Teak	: Tectona grandis
	12. Bonsum	: Phoebe goalparencis
	13. Hollock	: Dipterocarpus tuberculata
	14. Champa	: Michelia Champaca
Timber Species :	1. Sal	: Shorea robusta
	2. Teak	: Tectona grandis
	3. Chamel	: Artocarpus chaplasha
	4. Koroi	: Albizzia procera
	5. Jam	: Eugenia species
	6. Sidha	: Lagerstroemia parviflora
	7. Champa	: Michelia champaca
	8. Gamar	: Gmelina arborea
Matchwood :	1. Semal	: Salmalia malabarica
	2. Chatwan	: Alstonia scholaris
	3. Mandar	: Erythrina superosa
	4. Kadarib	: Anthocephalus cadamba
	5. Jarul	: Lagerstroemia flosregina
	6. Nageshwar	: Mesua ferrea
	7. Sundi	: Michelia montara

Note : The local equivalents of the above names will be given in a separate list later in the manual. The local names given above are of Tribura State.

MANIPUR SURVEY

CODING INSTRUCTIONS FOR FIELD WORK

I. PLOT APPROACH FORM.

Includes lines for time also. The time is to be given in hours and minutes by the watch as given in Railway, time table e.g. start in the morning at 7.30 A.M. will be shown as 07.30 and the time of returning to camp at 4.30 p.m. will be shown as 16.30 hrs. The form will be filled up while in progress to the plot and back. If the plot has to be visited on two successive days a fresh form will be filled up for the 2nd day also.

II. PLOT DESCRIPTION FORM (Data to be collected from two ha. area)

Some changes have been made in the classification from that adopted in Tripura. The coding should therefore be done carefully.

1. Job No. (col. 1/3) - Three digit code number to be filled in by DPU which will be different for each survey area.
2. Card design (col. 4/5) - Two digit code number to be filled in by DPU to distinguish different types of forms as given below :-

<u>CODE</u>	<u>ITEM</u>
01	Plot Description Form (Field form No. 1)
02	Plot Enumeration Form (-do- 3)
03	Bamboo Enumeration Form (-do- 5)
04	Bamboo Weight Form (-do- 6)
05	Sample Tree Forms (-do- 7)
06	Special Study Form

3. State (6-7) - Two digit code number to be filled For the present survey in Central Zone the code numbers of the States in which this Survey falls, are as under :-

<u>Code</u>	<u>State</u>
01	Tripura
02	Manipur

4. Forest Division (col. 8-9) - Two digit code number to be filled in for each forest division in the State and the Forest Division will be coded as under :-

<u>Code</u>	<u>Forest Division.</u>
01	Northern
02	Northern Soil Conservation

<u>Code</u>	<u>Forest Division</u>
03	Ambassa
04	Southern Soil Conservation
05	Sadar
06	Udaour
07	Southern
08	Manipur East
09	Manipur West
10	Manipur North
11	Manipur South

5. Land use (col. 10) - The interpretation of Forest land and shifting cultivation has slightly been modified from what was used in Tripura. This may please be carefully noted.

<u>Code</u>	<u>Item</u>	<u>Description.</u>
1	Forest land	<p>All lands with a Forest cover including Bamboo, Grasses, Palms and Shrub growth. When land surface is not primarily used for purposes, other than Forestry. Specific areas, which should be included or excluded are given below :-</p> <p><u>Include :</u></p> <ul style="list-style-type: none"> a) Public and Private Forests. b) All plantations including one rotation plantation, primarily used for forestry purposes. c) Areas temporarily unstocked as well as young natural stands and all plantations established for forestry purposes, which have not yet reached a crown density of more than 20%. d) Forest roads, streams and other small open areas, as well as forest nurseries that constitute an integral part of the forest. e) Bamboo bearing areas. f) Abandoned cultivation having forest cover in forest area.

Exclude :-

- a) Area occupied by orchards, parks private gardens and pastures.
- b) Area of wind break and shelter belt trees which are in small groups on narrow stripes e.g. trees along road sides, canals and streams which are too small to be managed as forests.

- 2. Agricultural Tree Land: - Consider as tree land; and lands presently under cultivation of agricultural crop with tree cover of any size and density, but Jhum areas are not to be included here.
- 3. Non-Forestry Plantation. - Consider as non forestry plantation: All lands with tree growth primarily planted for purposes other than forestry.
- 4. Agricultural Crop land. - Consider as agricultural crop land. All lands under cultivation and without any tree cover but Jhum areas are not to be included here.
- 5. Pasture Land - Consider as pasture land: all lands which are primarily managed for cultivation of grasses and grazing (i.e. used primarily for purposes other than forestry).
- 6. Urban, Village sites & Industrial Areas. - Consider here all land area included within urban locality, village sites and industrial area.
- 7. Barren lands - Consider as barren lands: all lands with exposed surface and which are lying unutilised e.g. barren land, exposed rocks, sand dunes, swamp areas without vegetation.
- 8. Current shifting cultivation (Jhum) - Current shifting cultivation within the forest i.e. this year or last.
- 9. Other Area - Consider as other areas all land classes which cannot be classified in any of the above categories.

Note : If the centre of the grid (the plot) is inaccessible fill the data upto col. 8-9 in Plot Description Form and write the word "INACCESSIBLE" in the remaining columns.

Some examples:

- | | |
|---|---|
| 1) Shifting cultivation | (Jhum) Shifting cultivation currently under crop or just harvested at the time of inventory will be classified as (8) current Jhum. |
| ii) Abandoned shifting cultivation (Old Jhum) | Site covered with tree or scrub/bamboos/ grass growth of any density will be classified as forest land. |
| iii) Farm Forests | Farm forests if less than 0.5 hectare will be classified as agricultural tree land and farm forests having an area of more than 0.5 hectare will be treated as forest land. |
| iv) Permanent cultivation. | In Forest village (within reserve forest) will be classified as agricultural crop land. |
| v) Grass banks. | Enclosed by reserved forest boundaries will be classified as forest because primary function is not pasture or grazing but forms part of forest land. |
6. Legal Status (col.11) One digit code number will be filled in as under :-

<u>Code</u>	<u>Item</u>	<u>Description</u>
1	Reserved)	As per definition in Indian Forest Act.
2	Protected)	
3	Unclassed	Unclassified as reserved forest or protected forest but Govt. land bearing forest crop-even if under other departments.
4	Nations Park	National parks and forest areas where fellings are restricted by legislation.
5	Private Forest	Forests land and Agricultural tree land owned by private individuals, community or corporation.
6	Undetermined	Any forest land which could not be classified in to any of the above categories.
7	General Topography (col.12)	General topography of the area surrounding the plot will be examined on Survey of India 1" = Mile toposheet. For this purpose terrain conditions in a minimum area of 6 to 8 square kilometers shall be viewed.
	<u>Code</u>	<u>Item</u>
	1	Flat
	2	Gently rolling
	3	Hilly
	4	Very hilly

8) Slope (col. 13)

- Slope of land around the grid centre will be determined with the help of $\frac{1}{4}$ " = 1 mile survey of India toposheets about one square km. will be classified as belonging to one of the following above classes.

<u>Code</u>	<u>Item</u>
1	Less than 10%
2	10% - 30%
3	30% - 100%
4	100% +

9) Position on slope
(col. 14)

- The position of plot will be examined on $\frac{1}{4}$ " = 1 mile toposheet and its position with reference to hill slope on which it is located will be classified as :-

<u>Code</u>	<u>Item</u>
1	Ridge top
2	Upper one third
3	Middle one third
4	Lower one third
5	No slope
6	In shallow ravines (depth of ravines (over 5 meter high)
7	Deep ravines (over 5 meter high)

10) Aspect (col. 15)

- For two hectare area of plot.

<u>Code</u>	<u>Item</u>
1	Northern
2	North Eastern
3	Eastern
4	South Eastern
5	Southern
6	South Western
7	Western
8	North Western
9	No aspect - for flat land.

11) Stoniness (col. 16)

- Stoniness refers to land surface in a two ha. area around the plot which is covered with massive stone or rock making the area unfit for growth of trees. Small pieces of broken stones and pebbles which are loose on the ground will not be included as stones. The various classes under which the stoniness will be classified are under:-

<u>Code</u>	<u>Item</u>
1	High percent of stones, more than 80% of land surface covered with stones or rock.
2	Medium percent of stones 30 to 80% of land surface covered with stones or rock.
3	Low percent of stones, less than 30% of land surface is stone.
4	Stones absent, entire land is available for tree growth.

Soil Data (col. 17/21)

- Soil data will be collected after digging a pit in a representative place in 2 hectare area. The depth of pit will be about 15 cms. Following will be recorded.

12) Humus (col. 17)

- Humus is the decomposed organic material (leaf, twigs and branches) which has become a constituent part of the upper most soil horizo. This should be clearly distinguished from undecomposed leaf litter. The latter must be removed from soil surface before making any measurements. Presence of humus will be classified in one of the following classes:

<u>Code</u>	<u>Item</u>
1	Shallow
2	Medium
3	Deep
4	No humus

13) Colour (col. 18)

- . The colour of the upper horizons of soil below humus layer will be determined and classified as :-

<u>Code</u>	<u>Item</u>
1	Black
2	Brown
3	Red
4	Other
5	No soil

14) Consistency (col. 19)

- Consistency described as the aggregation of soil particles. The various classes are :-

<u>Code</u>	<u>Item</u>	<u>Description</u>
1	Friable	A friable soil is one which is loose and which crumbles very easily while pressing with fingers in hand: Sand contents are more in this type of soil.
2	Slightly compact	A slightly compact soil is one which sticks together as a lump when taken in hand. Digging a pit in this type of soil is comparatively easier than in compact soil. Such soil can be scrapped easily with the toe of the shoe.
3	Compact	A Compact soil is one which makes digging difficult. Clay contents are more in this type and is very hard.
4	Cemented	A cemented soil is one which makes digging practically impossible due to soil particles cementing together.
5	No soil.	

15) Texture (col.20)

- Texture of soil refers to relative occurrence of clay, silt and sand particles. The various types are :-

<u>Code</u>	<u>Item</u>	<u>Description</u>
1	Clay	Soil contains mostly clay particles.
2	Clay loam	having higher percentage of clay particles but also some sand and silt.
3	Loam	Soil having mostly silt and sand with some clay.
4	Sandy loam	Soil in which sand particles are predominant but it also contains some silt.

<u>Code</u>	<u>Item</u>	<u>Description</u>
5	Sand	Soil having mostly sand particles.
6	Pebbles	The soil having very little soiled but having mostly pebbles and stores.
7	No soil	-
16) Soil Depth (col.21)		- Depth of soil will be estimated by digging a 15 cm. deep pit and guessing, the remaining depth. The guess will be based on all available in for formation e.g. exposed soil profiles in near by area of luxuriance of ground vegetation. The various classes are:-

<u>Code</u>	<u>Item</u>	<u>Description</u>
1	Very shallow	Less than 15 cms.
2	Shallow	15 to 30 cms.
3	Medium	30 to 90 cms.
4	Deep	90 cms. +
5	No soil	-

17) Vegetation (col. 22) - The vegetation classification has been changed from what was adopted in Tripura. The changes may please be noted. The vegetation will be classified as follows :-

<u>Code</u>	<u>Item</u>	<u>Description</u>
1	Tree Forest	Forest areas with tree crown density of more than 20% and not used primarily for purposes other than Forestry Specific areas which will be included or excluded from this definition are given below. :- <u>Includes</u> a) Public and private forests : b) All plantations, including rotation plantations, primarily used for forestry purposes. c) Areas temporarily unstocked as well as young natural stands and all plantations established for forestry purposes, which have not yet reached a crown density of more than 20%. d) Forest roads, streams and other small open areas as well as forest nurseries, that constitute an integral part of the forest.

Exclude

- a) Areas occupied by orchards, parks, private gardens, and pastures;
- b) Areas occupied by isolated tree groups smaller than 0.5 hectare.
- c) Areas of wind break and shelter groups on narrow strips e.g. tree along road sides canals and streams which are too small to be managed as forests.

- 2. Open Forest Open forest areas with tree cover from 20% to a lower limit of 5%. It may have undergrowth of tree species or shrubs of any density. Open forest with bamboo under growth not to be included here.
- 3. Tree in line Tree in line: along canal bank wind break and shelter belt.
- 4. Bamboo brake They will be bamboo areas secondarily caused due to jhumming in the past. Bamboos are well established and are in exploitable stage. There may be isolated trees standing, but their density will be below 20%.
- 5. Grassy blanks Open areas of forest with tree density below 5% and high grass apparently the result of old and repeated shifting cultivation.
- 6 Others Any areas which cannot be classified in any of the above categories.
- 18) Origin of stand (c l. 23) - Depending on its origin stand will be classified as belonging to one of the following classes.

<u>Code</u>	<u>Item</u>	<u>Description.</u>
1	Natural Forests	Forests naturally grown from seed.
2	Manmade forest	Where forests are out come of plantation.
3.	Natural & artificial.	Forests partly natural and partly man made e.g. natural forest supplemented with artificial regeneration.
4.	Jhum Regrowth	Old jhum restocked either with tree, bamboo or grass.

19) Forest Type (col. 24)

- Forest type of the plot will be described for the plot and a surround of 2 hectares. The types of Forest areas explained below.

<u>Code</u>	<u>Item</u>	<u>Description.</u>
1.	Wet temperate Forests.	See description after Code 5.
2	Pine Forest	This corresponds to Champion's Assam Sub-Tropical Pine Forests and the species is <i>Pinus lesiya</i> . This type will be found only in North Eastern and southern parts at high elevation between 1700 to 2000 metres. ; It is easy to recognise this type of forests.
3	Wet hill forests	This corresponds to Champion's Khasi Sub-Tropical wet hill forests and is found in upper slopes of hills including the top, where they have not been denuded. The species found are <i>Saurauja</i> , <i>Beilschmiedia</i> , <i>Schinus</i> , <i>Cinnamomum</i> , <i>Litsaea</i> , <i>Machilus</i> , <i>Quercus</i> , <i>Castanopsis</i> , <i>Lithocarpus spicatus</i> , <i>Phoebe lanceolata</i> etc. This type can be found below pine Forests between 900 to 1700 metres elevation.
4	Semi Evergreen	This corresponds to Champion's Cachar Tropical Semi Evergreen Forests and is found in western part of Manipur adjoining Silchar. The species are <i>Artocarpus chaplasha</i> , <i>Dipterocarpus turbinatus</i> , <i>Ballaquium polyanthum</i> , <i>Cynometra polyandra</i> , <i>Eugenia</i> , <i>Vitex</i> , <i>Chukrassia</i> , <i>Tetrameles</i> , <i>Gmelina</i> , <i>Adina</i> etc., under growth of Muli Bamboo may be present.
5	Teak Gurjan Forest	This corresponds to Champion's Cachar Tropical Semi Evergreen and is found in along the Burma border. Gurjan is associated with teak, species are Gurjan, Hollock, Teak, <i>Xylia Dillenia</i> , <i>Lagerstroemia Terminalia</i> , <i>Gmelina</i> , etc., Muli bamboo may be present. Many of these areas have degenerated in to bamboo brakes due to Jhuming. These forest may be found approximately between 100 to 900 metres.

<u>Code</u>	<u>Item</u>	<u>Description</u>
1	Wet Temperate Forests :	- This corresponds to Champion's East Himalayan Wet Temperate Forests. These are found in localised areas at an elevation of 1700 to 2700 metres. Species are Quercus lamellosa Q. lineata Michelia, Acer, Liana sp., Magnolia Mangilitia, Prunus, Pyrus, Bucklandia populanea, Betulalnoides, Alnus sp., Arundinria maling (Bamboo) etc.
7	Bamboo brakes	Pure bamboo area Trees under 20%.
8	Others	Areas that can not be classified in any of the above categories, will be put in here.

Bamboo brakes & Grass lands, apparently look like separate forests types but are in fact degradation stages of one or the other above said forest ty-pes, and as such, have to be classified under one of them, with reference to elevation, Rain fall and surrounding vegetation.

20.	No. of Storeys (col. 25)	The number of storeys describes the vertical distribution of height in the stand. The classes are :-
-----	-----------------------------	--

<u>Code</u>	<u>Item</u>	<u>Description.</u>
1	Forest one storeyed.	A small height variation may exist even in one storeyed forests.
2	Forest tow storeyed.	The variation in height is large and the trees can be grouped into one upper and one lower canopy.
3	Forest Three or more storeyed.	The variation in height is very large and in most cases it is not possible to group the trees in canopies.
21.	Top height (col.26-27)	Occularly estimate the average height of predominant and codominant trees surrounding the plot within an area of two hectares, round the plot within an area of two hectares, round it to the nearest 5 meter and record the height. The occular estimate must be checked by measuring few trees (say 2-3) among predominant codominant and dominant trees in the stand. If the average height of the trees is 27 metres, than round it off to 25 metres and record the same.

Example 2

If the average height of trees is 28 metres then round it off to 30 metres and record the same.

22. Size class - Size class characterises the predominant diameter class in the stand. The various classes are :-

<u>Code</u>	<u>Item</u>	<u>Description.</u>
1	Regeneration crop.	Regeneration crop (seedling and sapling only trees below 10 cms. diameter predominate.
2	Pole crop	Pole crop; Trees between 10 to 15 cms. diameter predominate.
3	Small Timber	Small timber: trees mostly between diameter 15 to 30 cms. predominate.
4	Big Timber	Big timber trees with diameter more than 30 cms. predominate.
5	Mixed size	Mixed size classes : Tree crop with no marked domination of any size class.

23. Stocking %
(col. 29)

Stocking percent describes the degree of coverage of land by trees. It is measured by the actual number of trees in the stand by size compared to number of trees required to fully utilise the growth potential of the land. A fully stocked stand in various stages of development should contain following number of trees per hectare (based on yield table).

Quality II

<u>Stage of Development</u>	<u>No. of trees per hectare.</u>
Regeneration crop (av. diameter 6 cm.)	1000
Pole crop (av. diameter 12.5 m.)	750
Small sized timber crop (Av. diameter 15 cm. to 30 cm.)	400
Big size timber crop (Av. diameter over 30 cm.)	250
Mixed crop (all age classes present)	500

Number of trees standing in 2 hectare area will be occularly estimated and compared with above tables and classified in one of the following class :-

<u>Code</u>	<u>Classes</u>
1	0 - 20%
2	20 - 40%
3	40 - 60%
4	60 - 80%
5	80% +

24. Regeneration
(col. 30)

- An occular estimate of the abundance of regeneration present on the plot and the surround to about 2 hectare will be recorded. For this purpose only tree species below 10' cm. diameter but more than 2 cm. (i.e. established regeneration) will be considered. The various classes are :-

<u>Code</u>	<u>Details</u>
1	Regeneration profuse over 3000 tree seedlings per hectare.
2	Regeneration adequate (more than 1500 seedling of tree species but less than 3000 seedling per ha.)
3	Regeneration inadequate tree seedlings less than 1500 in number per hectare)
4	Regeneration present but burnt or other wise damaged,
5	Crop not in need of regeneration viz well stocked pole or middle aged crop.)
6	Poorly stocked pole crops without adequate regeneration.
7	Regeneration absent.

25. Injuries to crop

- Borer attack, top dying of trees girdling of existing trees over a large area (About 2 hectare) and burning and scarring of tree will be recorded as follows :

<u>Code</u>	<u>Item</u>
	Borer attack, leaf defoliator or other pest attack likely to create epidemic.
	Top dying or solitary dying of timber trees caused by borer attack, pests or drought,

<u>Code</u>	<u>Item</u>
3	Girdling or felling of trees for encroachment.
4	Burning and scarring of the existing trees.
5	Grazing and lopping for fodder.
6	Wind and lightning damage.
7	No injuries
8	Past Treatment (col. 32) Treatment already given to the crop will be recorded in one of the following categories.

<u>Code</u>	<u>Item.</u>
1	Improvement felling
2	Tending
3	Thinning and selection felling.
4	Coppice with reserves/standards
5	Clear felling
6	No operations
7	Jhuming

27. Grass incidence (col. 33) - The occurrence of grass in the plot will be recorded as given below :-

<u>Code.</u>	<u>Item</u>
1	Grass growth scattered
2	Medium grass growth.
3	Dense grass growth
4	Grass absent.

28. Fire incident (col. 34) - Based on fire scars on tree stems occurrence of fire will be indicated as :

<u>Code</u>	<u>Item.</u>
1	Fire present
2	Fire absent

29. Bamboo Data (col. 35/64) - The composition of bamboo crop (2 hectares) will be recorded in five major groups. The intention behind describing the composition is to give percentage composition of more frequent species (Maximum 5) in order of occurrence amongs the bamboos.

Switchy culm Is one which is more than 2 mt. long and 1 to 2 cms. at b.h. (1.37 ms). *Arundinaria maling bamboc* is not to be sampled.

Utilizable culms A utilisable culm is one which is two meters or more in length and more than 2 cms. in diameter at 1.37 meter height.

Definition of clump: An aggregate of more than one culm is known as a clump.

N.B. In *Melocanna bambusoides* (a non clump forming bamboo), its individual culms will be treated as clump for enumeration purposes.

GROUP - I (col.35-40)
Species (col. 35-37) -

Two digit code number will be used from the table of species appended in annexure.

Occurrence (col. 38)

One digit code number will be used. The stocking of the species finding place in col. no. 35-37 shall be filled in. The stocking, among the various species of bamboos found in the 2 ha. plot. The total of the percentage must be 100 (90-108) whether there is only one group or more than one group. Occurrence below 10% is to be ignored.

<u>Code.</u>	<u>Stocking</u>
1	10 - 19%
2	20 - 29%
3	30 - 39%
4	40 - 49%
5	50 - 59%
6	60 - 69%
7	70 - 79%
8	80 - 89%
9	90 - 99%

Flowering (col. 39)

The following details will be filled.

<u>Code</u>	<u>Details.</u>
1	Spordic
2	Gregarious
3	No flowering

Regeneration (col.40)

Bamboo bearing areas where clump formation is not very clear or area under bamboo regeneration containing bamboo seedlings in one of the following classes:

However in case of multi bamboo presentee of seedlings will indicate regeneration.

<u>Code</u>	<u>Details</u>
1	Dense regeneration
2	Medium
3	Scattered
4	Absent

Group II Cols. 41-46)	Next four groups of codes from col.41-64 are
Group III 47/52)	to be filled in the same way as prescribed for
Group IV 53/58)	col. 35-40 for bamboo species of lesser occur-
Group V 59/64)	rence than Group I in the order of occurrence.

Grid No. (col.77-80) Here the serial no. of the grids as in appendix will be filled in.

CHAPTER - III

PLOT ENUMERATION FORM

- | | |
|---|---|
| 1. Job (col. 1/3) | This will be filled in by D.P.U. |
| 2. Card design (col.4-5) | -do- |
| 3. Sample grid no.
(col. 8-9) | The grid No. will be filled in here in 3 digit code. |
| 4. Total No. of trees
(col. 10-11) | Here total No. of trees occurring in the plot will be recorded in 2 digit numbers. |
| 5. Total no. of
clumps(col.12-13) | Here the total number of bamboo clumps of all species occurring in the plot will be recorded in 2 digit code. |
| 6. Total number of
culms(col. 14-17) | Here the total number of culms of non clump forming bamboos will be recorded. |
| 7. The enumeration form is divided into 9 sections of 7 columns each. The columns are also horizontally divided into 4 rows, so that as many as 36 trees/clumps can be recorded on one sheet. If necessary a 2nd sheet may be used for more trees/clumps. Each section will contain details of one tree/clump only. In the upper part of the section, the local name/botanical name of the species should be written. The rest of the section will be filled up with the species code, in 3 digit, diameter in cms. in 3 digits and availability code in 1 digit. | |

Diameter measurement will be to the nearest cm. at 1.37 m. above ground on the up hill side of the tree. The axis of the calliper i.e. the long arm should be pointing to the centre of the plot. If there is a considerable flare at the base of the tree above the b.h. the diameter, will be measured above flare. For trees above 50 cm. diameter, a diameter tape may be used. In case of forming resulting in 2 or more stems, starting below the b.h. the diameter of each stem will be taken at b.h. or at such higher point, where they are distinctly separate. Dead trees will also be enumerated if not rotten and at least 70% utilisable.

The diameter of bamboo clumps will be recorded at the base, and only clump forming bamboos will be recorded in the sections.

All callipered trees/bamboos will be marked by blaxing. Border line trees :- Trees the stems of which touch the N.W. and S.W. lines of the plot will be treated as "IN" trees and will be enumerated. Those of which the stems of which touch the N.E. and S.E. borders of the plot will be treated as "OUT" trees and will not be enumerated.

Shrubs and small trees are not to be enumerated.

<u>Code</u>	<u>Availability</u>	<u>Description</u>
1.	Available (both silv. + Economically) (over 30 cms.)	Trees whose harvesting will not cause a permanent gap and which will be economically harvested.
2	Not available (economically)	Trees available silviculturally but far way (more than 100 mt.) from the next available tree and hence economically not available.
3	Not a-vailablc (silviculturally)	Trees not available in silvicultural grounds, though in close groups.
4	Not available (Economically non-silviculturally)	Trees which cannot be available either silviculturally or economically.
5	Dead but available	Dead trees, no longer growing but at least 75% utilizable. Such trees are always silviculturally available but may not be economically available, in which case they will be omitted from counting they will be counted only if economically available.

IV SAMPLE TREE FORM

The only plot in the grid will be sample plot. Trees, 40 cms. D.B.H. and above will be measured as sample tree from all over the plot. Trees from 10 cms. D.B.H. to 39 cms. D.B.H. will be measured as sample trees in Southern half of the N.W. quadrant with E.W. diagonal as one of the sides are shown in illustrations in Chapter IV.

The area to be sampled as sample plot will be laid out by joining the centre of the plot to the mid point of N.W. side of the plot.

On each sample tree a sample tree card will be attached facing the centre of the plot and the data will be collected as detailed below:-

- | | |
|-------------------------------|---|
| 1. Job No. (col. 1-3) | Same as given in plot description form. |
| 2. Card Design (col.4-5) | " |
| 3. Sample Grid No.(col.6-9) | " |
| 4. Grid reference (col.10-21) | Actual grid coordinates be given in six digits two for degree, two for minutes, two for seconds, for latitudes and longitude. |
| 6. Species | Local name or the botanical name of the tree will be written in the space provided. |
| 7. Serial No.(col.22-23) | Two digit code number will be written for each sample tree. |
| 8. Species code (col. 24-25) | Three digit code number will be written for each species as per Appendix I-4. |
| 9. Dominance (col.27) | The position of the tree in the canopy will be determined according to one of the following classes: |

<u>Code</u>	<u>Item</u>
1	Predominant
2	Codominant
3	Dominated
4	Suppressed
5	Tree of understorey
6	Solitary
7	Other (abnormal and damaged trees)

10. D.B.H.(col.28-30)

Diameter at breast height will be measured as per instructions already given above and the diameter will be recorded to the nearest centimetre in three digit number.

11. D.B.T.(Col.31-32)

Double bark thickness will be measured with the help of bark gauge at two point opposite to each other at D.B.H. and recorded to the nearest millimetre in two digit number.

12. Total height
(col.33-34)

Total height of the tree will be measured with blumeleiss hypsometer and recorded to the nearest metre in two digit number. Total height recorded will be that from the ground level(or one uphill side) to the tip of the crown. While measuring the height of the tree standing on the slopping ground of slope correction is given. The height of the leaning tree will also be corrected.

13. Clear bole
(Col. 35-36)

The length between the ground level and the first live branch(the branch from where the actual crown starts) will be measured with the help of Blumeleiss hypsometer and recorded to the nearest meter in two digit number. Similar corrections, if needed, will also be done as in the measurements of total height.

14. Crown Width
(37-38)

The crown width in metres, average common width will be recorded.

15. a) Form and Defects -
(col. 39-40)

Following four items for each sample tree will be described in order to indicate the quality of the stem. All these items refer to the length of clear bole only.

15. b) Form longitudinal -
(col. 39)

This item indicates whether the axis of the stem runs in a straight line or not. The information will be collected in the following classes :-

<u>Code</u>	<u>Item</u>	<u>Description</u>
1	Very straight	Complete bole in a straight line form.
2	Slightly bent	Axis of the bole deviates slightly from the Straight line form (Say less than 10 degree).
3	One pronounced bend	Axis of the bole undergoes one pronounced bend.(more than 10 degree)
4	More than one pronounced bend.	Axis of the bole undergoes many pronounced bend.

15. c) Form of sectional
(col. 40)

The item described the form of the stem in a cross sectional observation this observation will be limited to the length between stump and DBH only and classified in one of the following class.

<u>Code</u>	<u>Item</u>
1	Circular
2	Elliptical
3	Fluting
4	Buttressed

16. Defects Natural(41)

- Under this category all those abnormality will be included which are very natural and normal for the tree. Examples are :- Formation of knots, branches(including epicormic) callus formation, twist and spiral grain etc. all these observation will be limited to the clear hole only.

<u>Code</u>	<u>Item</u>
1	Complete bole length free of any natural defects.
2	One third bole length with natural defects.
3	Two third of bole length with natural defects.
4	Full bole length with natural defects.

17. Defects other
(42)

- This is a very general item and includes all kinds of defects caused by external agencies pathological, entomological, climate or other sources. The various classes to be coded are.

<u>Code</u>	<u>Item</u>
1	Complete bole length free of any defect.
2	One third of bole length with defect.
3	Two third of bole length with defect.
4	Full bole length with defect.

18. Total No. of
trees(col.78-79)

- Total number of sample trees recorded in the form will be written here in two digit number.

BAMBOO ENUMERATION FORM

Bamboo culms over 2 mts. long will be enumerated, culms under 2 cm. d.b.h. will be considered as unutilisable but will be enumerated. The utilisable culms will be enumerated in the same way as for Tripura, except that diameter classification will be done for clump forming bamboos also.

(a) Non-clump forming bamboos.

Enumeration of these will be confined to the Northern half of the plot as illustrated in Chapter IV.

Each culm present in the northern half of the N.W. quadrant will be analysed by age class i.e. current season, 1 to 2 seasons and over 2 seasons old. The current seasons bamboo will not be further classified in to diameter classes. The others will be divided into 4 dia. classes and soundness.

(b) In the case of clump forming bamboos the analysis of bamboo clumps by age and diameter classes will be done in the entire N.W. Quadrant i.e. $\frac{1}{4}$ of the total plot area. The enumeration will be carried out in the entire plot.

- | | | |
|----------------------------------|----|--|
| 1. Job No. (col. 1-3) | - | As for plot description form. |
| 2. Card design (col. 4-5) | -- | --do-- |
| 3. Sample Grid No.
(col. 6-9) | -- | --do-- |
| 4. Species (col. 10-12) | - | The species code will be given in 3 digits. The same form will be used for both Muli and clump forming Bamboos. Each clump will be recorded for a separate line on the form. |
| 5. Clump analysis | - | The form has been redesigned for Manipur Survey and is very different from that used in Tripura. All the green sound culms are first analysed, by age and dia. classes, then the green damaged, finally the dry sound and then decayed bamboos. The clump total serves as a check. The count should be made independently for the total number of bamboos and the total should not be arrived at by merely adding each separate class. |

Green sound Bamboos:

These are divided in to (i) Current years (col. 13-15) which are not to be further subdivided in to dia. classes. The next i.e. 1-2 season old are divided into 4 digit classes i.e. under 2 cms. dia. (col. 16-18) 2 cms. to under 5 cms. dia. (col. 19-21) 5 to under 8 cms. dia. (col. 22-24) 8 cms. and under above dia. (col. 25-27).

Over 2 season old.

Under 2 cms. dia. (col. 28-30).
2 cms. to under 5 cms. dia. (col. 31-33)
5 cms. to under 8 cms. dia. (col. 34-36)
8 cms. and above dia. (col. 37-39)

Green damaged

At least 50% utilisable.
Current years (col. 40-42) 1 to 2 season under 2 cms. dia. (col. 43-45)
2 cms. to under 5 cms. dia. (col. 46-48)
5 cms. to under 8 cms. dia. (col. 49-51)
8 cms. and over (col. 52-54)

Dry sound :

Dry bamboos need not be analysed by age and also bamboos under 2 cms. d.b.h. if dry, are to be ignored from count, whether sound, damaged, or decayed. They will be analysed only into 3 dia. classes.

2 cm. to under 5 cms. (col. 55-56)
5 cm. to under 8 cms. (col. 57-58)
8 cms. and over (col. 59-60)

Dry Damaged :

i.e. atleast 50% utilisable.
2 cms. to under 5 cms. (col. 61-62)
5 cms. to under 8 cms. (col. 63-64)
8 cms. and over (col. 65-66)

Decayed :

Burnt and rotten bamboos over 2 m. long with no utility col. 67-68.

Clump total : (col. 69-70)

In case of non-clump bamboos, the total number of such bamboos, in the enumerated segment will be entered in one line, and the total given in col. 69-70.

- 77 -
BAMBOO WEIGHT FORM

The weight of bamboo culm has to be determined by length and diameter classes. In Manipur survey we are classifying clump forming bamboos also by diameter classes. The weight of switchy culms i.e. below 2 cm. dia. will not be necessary.

From each diameter class of each species 2 mature culms will be cut at 25 cm. from ground level and weighed to the nearest 5 grammes on the spot. If mature culms are not available younger culms will not be weighed.

Item 1. Species code I (col. 1-3) The species of bamboo will be recorded in 3 digit code.

Item 2. Sample culm No. 1 - 1. (col. 4-13) Actual diameter in cm. col. 4-5 the actual diameter of the culm to the nearest cm. at b.h. will be entered in 2 digit code.

ii) Length in decimeter will be recorded in 3 digit code. The length of bamboo down to 2 cm. dia. at top end will be recorded. A decimeter is 1/10 of meter. Therefore a bamboo which is 6 m. and 68 cm. will be considered as 67 and in 3 digit code will be written as 067. A bamboo which is 11.33 m. will be recorded as 113 in 3 digits.

iii) Weight in grammes (col. 6-43) the weight of the culm will be recorded to nearest 5 grammes in 5 digit code. If a bamboo weighs 6.475 kg. it will be recorded as 06475 if one weighs 13.422, it will be recorded as 13420.

Col. No. 4-23 are for diameter class 2 to under 5 cm.

Col. 24-43 are for dia. class 5 to under 8 cm Col. 44 to 63 are for dia. class 8 cms. and over.

Item 3 dry weight correlation.

- This study will be done as for Tripura. From sample culm No. 1 of each diameter class cut 3 pieces of one meter length each one from the bottom, one from the top and one from the middle. Tie with bamboos strips of the same species, and record their green weight to the nearest 5 grammes in 4 digit code, col. 64-67, 68-71 and 72-75.

The weight sample will always be from the first sample culm of each dia. class. The species code, grid No. and dia. class of the sample will be written on the largest piece of each bundle and if possible on other also to facilitate the identification of pieces in case, they were to loose.

CODE NUMBER OF TREE SPECIES USED IN MANIPUR SURVEY

Code No.	Botanical name	Popular Hindi Name.	Vernacular Name	
			Bengali	Manipuri
1.	2.	3.	4.	5.
001	<i>Tectona grandis</i>	Teak	Segun	Chingsai
002	<i>Shorea robusta</i>	Sal	Sal	Sal
003	<i>Terminalia tomentosa</i>	Saja	-	Mayokpha
004	<i>Pterocarpus marsipium</i>	Bija	-	
005	<i>Dalbergia latifolia</i> / Shissoo	Shisham	Sissoo	
006	<i>Ougeinia dalbergioides</i>	Tinsa		
007	<i>Diospyros malanoxylon</i>	Tendu	Kendi	
008	<i>Bridelia retusa</i>	Kasai	Kanta-Kui	Kuhi
009	<i>Anogeissus latifolia</i>	Dhauda		
010	<i>Emblica officianalis</i>	Aonla	Amlaki	Keikra
011	<i>Phyllanthus emblica</i> <i>Chloroxylon sweetenia</i>	Bhirra		
012	<i>Lagerstroemia parviflora</i>	Landia	Jarul, Sidha	
013	<i>Terminalia arjuna</i>	Arjun		
014	<i>Syzigium cumini</i>	Jamun	Jam, Kala	Jam
015	<i>Hardwickia binnata</i>	Anjan	Vareppa	
016	<i>Xylia xylocarpa</i>	Tangan		
017	<i>Mangifera indica</i>	Am	Am	Heinou
018	<i>Boswellia serrata</i>	Salai		
019	<i>Schrebera swietenioides</i>	Mokha		
020	<i>Lannea grandis</i>	Mode		Akman
021	<i>Gamga pinnata</i>	Kekad	Kajikara	
022	<i>Careya arborea</i>	Kumbhi	Kum(Kumira)	Larong
023	<i>Gmelina arborea</i>	Siwa	Gamar	Wang

024	<i>Schleichera oleosa</i> /Trijuga	Kusum	Poma, markatya	Kusum
035	<i>Madhucā latifolia</i>	Mahua		
026	<i>Terminalia bellerica</i>	Bahera	Bahera	
027	<i>Adina cordifolia</i>	Haldu	Haldu	Tingkhopthing (Kuki)
028	<i>Mitragyna parviflora</i>	Mundi		
029	<i>Mallotus philippinensis</i>	Sinduri		Urei rom lata
030	<i>Terminalia chebula</i>	Harra	Haritaki	Manahie
031	<i>Acacia leucophloea</i> / <i>lonticularis</i>	Sabedbabul		
032	<i>Salmalia malabaricum</i> (<i>Bombax eliba</i>)	Semal	Simul	Tera
033	<i>Sterculia urens</i>	Kullu		Ruija (Kuki)
034	<i>Aegle marmelos</i>	Bel		Harikhagok
035	<i>Albizzia lebbek</i>	Kala Siris		Uil
036	<i>Albizzia procera</i> + <i>odoratissima</i> + <i>amara</i>	Sabed Siris	Keral	Khal
037	<i>Bauhinia malabarica</i>	Amta	}	Chingthrao
038	<i>Bauhinia purpurea</i>	Kachnar		
039	<i>Bauhinia recemosa</i>	Apta		
040	<i>Bauhinia retusa</i> + <i>Variegata</i>	Sehra		
041	<i>Bischofia javanica</i>	-	Urium	Uthumana raobi
042	<i>Buchanania lanzan</i> + <i>latifolia</i> + <i>angustifolia</i>	Achar		
043	<i>Butea monosperma</i>	Palas	Palas	Pangong
044	<i>Casaria tomentosa</i>	Gilchi		
045	<i>Casaria gravolens</i>	Gilchi		
046	<i>Cassia fistula</i>	Amaltas	Sonal	Chahai
047	<i>Cochlospermum gossypium</i> + <i>religiosum</i>	Galgai		
048	<i>Cochlospermum tomentosum</i>	-		

049	<i>Acacia catechu</i>	Khair		
050	<i>Dalbergia paniculata</i>	Dhoban		
051	<i>Dillenia indica</i>	Kamata	Chalta	Heigri
052	<i>Dillenia pentagyna</i>	Kamata	Harguza	Larong
053	<i>Diospyros embryopteris</i> + <i>montana</i> + <i>silvatica</i>	Honeymontree Makad tendu vish tendu		
054	<i>Elaeodendrone glaucum</i>	Jamrasi		
055	<i>Elengium amarchi</i> + <i>salvifolium</i>	-		
056	<i>Ficus religiosa</i>	Pipal	Ashatta	Sarakhongnang
057	<i>Ficus</i> spp.	-	Bat	
058	<i>Flacourtia romantchii</i>	Kakai		Usha
059	<i>Gardenia turgida</i> + <i>latifolia</i> + <i>gummifera</i> + <i>G. lucida</i>	Papra		Heibi
060	<i>Grewia tilliaefolia</i>	Dhaman		
061	<i>Acacia arabica</i>	Babul		
062	<i>Hymenodictyon excelsum</i>	Mach	Bankadam	Choiban- gthing (Kuki)
063	<i>Gleistanthus collinus</i>	Kerra		
064	<i>Kydia calycina</i>	Baranga		Khabu
065	<i>Moringa tinctoria</i>	Aal		
066	<i>Nyctanthes arborescens</i>	Harsingar		Shingarel
067	<i>Pongamia pinnata</i>	Karanji		
068	<i>Premna tomentosa</i>	-		
069	<i>Randia dumentorum</i>	Phetra (Kala)		Lamhubi
070	<i>Randia ulginosa</i>	Phetra (Kala)		
071	<i>Saccopetalum tomentosum</i>	Kari		
072	<i>Semicarpus anacardium</i>	Hilawa	Bhola	
073	<i>Strychnos potatorum</i>	Nirmali		
074	<i>Stereospermum suaveolens</i> + <i>Xylocarpum</i>	Pader		Ing-nge-Ching (Naga)

075	<i>Soyimida febrifuga</i>	Rohan		
076	<i>Tamarindus indica</i>	Imli	Tetul	Mange
077	<i>Vitex peduncularis</i>	-	Awal	-
078	<i>Wrightia tinctoria</i>	Dudhi		
079	<i>Zizyphus xylophyra</i>	Ghont	Kul	
080	<i>Zizyphus jujubea</i>	Ber	-	Boroi
081	<i>Azadirachta indica</i>	Neem	-	Neem
082	<i>Mimosa elegni</i>	-	-	Bokul
083	<i>Strychnos nuxvomica</i>	Kuchla		
084	<i>Glycyarpa arborea</i>	-	Banmala (gochlo-Nel)	Saiom
085	<i>Gymnosporia spp.</i>			
086	<i>Mimosops hexandra</i>	Khirmi		
087	<i>Manilkara hexandra</i>	-		
088	<i>Wendlandia exerta</i>	-		
089	<i>Spondias mangifera</i>	Anra	Amora	Heining
090	<i>Aquilaria agallocha</i>	-	Agar	Agor
091	<i>Spondias species</i>	-	-	Heing
092	<i>Anthocephalus cadamba</i>	Kadam	Kadam Kaimal	Keli
093	<i>Trema orientalis</i>	-		
094	<i>Milusa velutina</i>	-		
095	<i>Cordia mixa</i>	Senri	Aichla	Lamuk
096	<i>Erythrina indica</i>	Pangra	Mandar	Kuraoangouha
097	<i>Erythrina suberosa</i>	Pangra	Mandar	Kurao
098	<u>Miscellaneous spp.]</u>	-		
099	<i>Bursera serratum</i>	-	Neur	Kolamp
100	<i>Xanthoxylum rhetsa</i>	Rhetsa	-	Mukth rubi
101	<i>Sterospermum chelnooides</i>	-		Mixi
102	<i>Cedrella toona/Microcarpa-fabri fuga</i>	Tim	Poma (rangi)	Hanur Thiren

	- 82 -		
103	<i>Polyalthia aceraoides</i>	-	
104	<i>Zanthoxylum budrunga</i>	-	Bajna Ngang
105	<i>Cephalostachyum pergracile</i>	-	
106	<i>Cinamonium wightii</i>	-	
107			
108	<i>Mangifera sylvatica</i>	-	Lakshmi Bandam
109	<i>Jonesia asoca</i>	-	Asoka
110	<i>Plectronia dydima</i>	-	
111	<i>Macaranga denticulata</i>	-	Bhura Lakoi
112	<i>Phoebe goalparensis</i>	-	Bansum Unigthou
113	<i>Ferronia elephantum</i>	Kaweet	
114	<i>Calycarpa</i> spp.	-	- Salom spp.
115	<i>Paraktangenos kurzii</i>	Chalmugra	
116	<i>Anogeissus acuminata</i>	-	
117	<i>Holoptelia integrifolia</i>	-	
118	<i>Macaranga peltata</i>	-	
119	<i>Ailanthus excelsa</i>	Maharukh	
120	<i>Oroxylum indicum</i>	-	Samba
121	<i>Sapindus emarginatus</i>	Ritha	- Kekru
122	<i>Pterocarpus santalenus</i>	Raktachandan	-
123	<i>Santalum album</i>	Chandan	
124	<i>Acacia sundra</i>	Sundra	
125	<i>Givotia rottleriformis</i>	Punki	
126	<i>Gyrocarpus americanus</i>	-	
127	<i>Dichrostichys cinerea</i>	Yeltur	
128	<i>Dolichandrone falcata</i>	Medsing	
129	<i>Melia azadirachta</i>	Bakain	Goranem Sedzrak
130	<i>Artocarpus chaplasha</i>	-	Chamal Cham
131	<i>Acacia ferruginea</i>	Velsundra	

132	<i>Gassia siamea</i>	-		
133	<i>Eucalyptus hybrid</i>	Nilgiri tel		
134	<i>Michelia champaca</i>	-	Champa	Lei thao
135	<i>Tetrameles nudiflora</i>	-	Chandul (maina, iai rel)	Tila
136				
137	<i>Exora arborea + Parviflora</i>	-		
138	<i>Mellingtonia hortensis</i>	Akashim		
139	<i>Phoenix sylvestris</i>	Betha	-	Thangtup
140	<i>Alstonia scholaris</i>	-	Chativan	Chativan
141	<i>Prosopis spicigera</i>	Jampi		
142	<i>Polyalthia longifolia</i>	-	Debdaru	-
143	<i>Ganarium bengalense</i>	-	Dhup/Korar	Mekruk
144	<i>Cinnamomum oecidodaphne</i>	-	Gandrai	Gondroi
145	<i>Dipterocarpus turbinatus</i>	-	Garjan	Yanon
146	<i>Diospyros chloroxylon</i> (<i>Toposia</i>)	Illintha	Badam	Thingbong (Kuki)
147	<i>Steculia alata</i>	-	Gorak/Narikel	Bantai (Kuki)
148	<i>Gyrocarpus jacquini</i>	Kumarpinki	-	-
149	<i>Adria sessilifolia</i>	-	Haludehaki /Sonari	Sonari
150	<i>Albizia stipulata</i>	-	Harish	Khok
151	<i>Streclus asper</i>	Bajar santi		
152	<i>Erythroxylon monsynum</i>	Deodari	Deodhari	
153	<i>Barringtonia acutangula</i>	-	Hizal	
154	<i>Ocni wodier</i>	Gumpna or Dumpli di	Jiol	Engla, Hengla
155	<i>Stepoeogyne parviflora</i>	-	Panikadam	Tong-khop- nopong-thing (Kuki)
156	<i>Litsea polyantha</i>	-	Huoria	Thmitla

157	<i>Eugenia cymosa</i>	-	Jam, Rita Khair	Jam
158	<i>Premna bengalensis</i>	-	Jinari	Jol-chong- imalphi (Kuki)
159	<i>Cordia befragrantissima</i>	-	Kaowathuti	Iamuk
160	<i>Chukrasia tabularis</i>	-	Kheta Bogapoma	Taimreug
161	<i>Schima wallichii</i>	-	Konak	Usoi
162	<i>Holarrhena antidysenterica</i>	-	Kurchi	
163	<i>Swietenia mahogoni</i>	-	Mahogany	
164	<i>Trewia nudiflora</i>	-	Mera(Medda)	Wangphop
165	<i>Mesua ferrea</i>	-	Nageswar	
166	<i>Pterocarpus indicus, dal- bergioides</i>	-	Padauk	
167	<i>Grewia microcos</i>	-	Pichla	Langjan
168	<i>Cynometra polyandra</i>	-	Ping	Nanup
169	<i>Amora rohituka</i>	-	Pitraj (rahena)	Ungang
170	<i>Duabanga sonneratioides</i>	-	Randala (Lampate)	Randala
171	<i>Amora wallichii</i>	-	Rata lali	
172	<i>Manihot utilisans</i>	-	Sabarchuk (Simul-alu)	Kmangra
173	<i>Machilus gambelii</i>	-	Shum	Uningthong- anbi
174	<i>Michelia montana</i>	-	Sundi	
175	<i>Sterculia villasa</i>	-	Udal	Langjan
176	<i>Canarium begalense</i>	-	Dhup	Dhup (Mekruk)
177	<i>Terminalia myriocarpa</i>	-	Pani	Talhao
178	<i>Xylia dolabriformis</i>	-	Pyinkado	
179				
180				
181	<i>Actinodaphne angustifolia</i>	-	Mahi-tekra	Nabhar(Kuki)

182	<i>Acernivum</i>	--	Sundi	
183	<i>Albizia lucida</i>	--	Sundi	Luwangkhoi
184	<i>Alseodaphne owdenii</i>	--	Ti. sundi	Sundi
185	<i>Artocarpus heterophyllus</i>	--	Kathol	Thabong
186	<i>Artocarpus hirsuta</i>	--	Dewa	Hei rikokthong
187	<i>Ailanthus grandis</i>	--	Bora	Bora
188	<i>Alphonsea ventricosa</i>	--	Palma-kola	
189	<i>Aesculus pundiana</i>	--		
190	<i>Alseodaphne petiotaria</i>	--	Patrichawan	
191	<i>Bombax ensigne</i>	--	Dumboil	Knumen tera
192	<i>Baccaurea sapida</i>	--	Bhubi	Maktok
193	<i>Calophyllum inophyllum</i>	--	Tailo	
194	<i>Cinnamomum oblongifolia</i> (tanala)	--	Texia	Tezpata
195	<i>Gordia odoratissima</i>	--	Mohidai	Iamuk
196	<i>Canarium resiniferum</i>	--	Shuma	Mekruk
197	<i>Carallia integrima</i>	--	Mahitekra	--
198	<i>Cestropis hystrix/Tribuloides</i>	--	Hengari	Sahi
199	<i>Cestropis indica</i>	--		Thangji

B A M B O O

200	<i>Bambusa balcooa</i>	Bans	Barck/Baua	Bhalkea
201	<i>Tainostacknum dillooa</i> + <i>Neochouzeana dillooa</i>	"	Dolu	Dollu
202	<i>Oxytenanthera nigrociliata</i>	"	Kalyai	--
203	<i>Bambusa offinis</i>	"	Kanak-kai	--
204	<i>Bambusa pallida</i>	"	Makal/Kalasundi	Burwal
205	<i>Bambusa sulda</i>	"	Mitinga	--
206	<i>Melocanna bambusoides</i>	"	Muli	Maubi
207	<i>Bambusa teres</i>	"	Parra	--

208	<i>Dendrocalamus hamiltonii</i>	"	Pocha	Unap
209	<i>Dendrocalamus longispathus</i>	"	Rupai (orah)	
210	<i>Dendrocalamus strictus</i>	"		
211	<i>Bambusa kingiana</i>	"		
212	<i>Bambusa vulgaris</i>	"		
213	<i>Bambusa khasiana</i>	"		
214	<i>Cephatostachyum fuchsianum</i>	"		
215	-do- <i>latifolium</i>	"		
216	-do- <i>Pallidum</i>	"		
217	-do- <i>Pergracile</i>	"		
218	<i>Bambusa arundinacea</i>	"	-	Saneibi
219	Undetermined bamboo			
220				
221				
222				
223				
224				
225				
226				
227				
228				
229				
230				

1.	2.	3.	4.	5.
		<u>C A N E</u>		
231	<i>Calamus tenuis</i>	Cane	Raugi-Jali	
232	" <i>leptospathis</i>	"		
233	" <i>latifolius</i>	"		
234	" <i>floribundus</i>	"		
235	" <i>erectus</i>	"		
236	<i>Daemonorops jenkinsianus</i>	"		
237				
238				
239				
240				
241	<i>Chrysophyllum roxburghii</i>	-	Pitakora	-
242	<i>Citrus, hystrix</i>	-	Satkora	Heiribob
243	<i>Camellia thea</i>	-	Jauglichia	Cha
244	<i>Dysoxylum binectariferum</i> + <i>hamiltonii</i>	-	Rata	Ungang
245	<i>Dalmycarpus racemosus</i>	-	Kuki Jawa	-
246	<i>Diospyros toposis/Lancedo-</i> <i>folia</i>	-	Golal	Thingbong (Kuki)
247	<i>Endospermum chinense</i>	-	-	Thing- ai veng (Kuki)
248	<i>Elaeocarpus varunna</i>	-	Balto	Chonshonmanbi
249	<i>Echinocarpus assenicus</i>	-	Sita	Phai thing (Kuki)
250	<i>Eriobotrya bengalensis</i>	-	-	Ching-neitei
251	<i>Ficus elastica</i>	-	Rubber	Rubber
252	<i>Girardiniera subaequalis</i>	-	Dud Champa	-
253	<i>Gynocardia odorata</i>	-	Dal Murga (Chalmurga)	

1.	2.	3.	4.	5.
254	<i>Carcinia pedunculata</i>	-	-	-
255	<i>Heritiera macrophylla</i>	-	Mahi tekra	-
256	<i>Isonandra polyantha</i>	-	Kurta	-
257	<i>Itex gode jam species</i>	-	-	-
258	<i>Juglans regia</i>	-	Akhrot	Hei juga
259	<i>Kaya floribunda</i>	-	Korol	-
260	<i>Lagerstroemia flosreginae</i>	-	Jarul	Javall, Jarul
261	<i>Lorhopetalum weightianum</i>	-	Jatsutrong	-
262	<i>Litsaea polyantha</i>	-	-	Thmitla
263	<i>Litsaea laeta</i>	-	Patti	-
264	<i>Litsaea citrata</i>	-	-	-
265	<i>Machilus villosa</i>	-	Sundi	-
266	<i>Morus laevigata</i>	-	Champa sundi	Kabrangchak
267	<i>Myristica irya/linifolia/ amygdalina</i>	-	Fuara	-
268	<i>Nyssa sessiliflora</i>	-	Pani kadam	-
269	<i>Melia azedarach</i>	-	Gora neem	Seizrak
270	<i>Nephelium longana</i>	-	-	Nonganghei
271	<i>Phoebe hainnesiana</i>	-	Bonsum	Uningthou
272	<i>Pterospermum acerifolium</i>	-	Modu buro	Kwakla
273	<i>Quercus semiserrata</i>	-	Oak	Uyung
274	<i>Pasaria spicata/xylocarpa/ spicata</i>	-	-	-
275	<i>Sterculia alata</i>	-	Badam	Leibax hawai
276	<i>Sideroxylon grandifolium</i>	-	Mahi tekra	-
277	<i>Stephegyne parvifolia</i>	-	Pani kadam	-
278	<i>Sapium baccatum</i>	-	Blosh	-

279	<i>Sapium augeniaefolium</i>	-	Borci	
280	<i>Terminalia mydriocarpa</i>	-	Jhalna	Taihao
281	<i>Terminalia citrina</i>	-	Haritaki spp.	Manshi
282	<i>Taraktogenos kurzii</i>	-	Chalmugra	Heipok
283	<i>Ulmus species</i>	-	Manau	
284	<i>Vatica lanceaefolia</i>	-	Morhal	
285	<i>Taluma hodgaonii</i>	-	Good champa	
286	<i>Sapindus laurifolius</i>	-	Rata spp.	Kekru
287	<i>Phyllanthus emblica</i>	-	Amlaxi	Heigru
288	<i>Engelhardtia spicata</i>	-	-	Hei jugamanbi
289	<i>Betula olnoides</i>	-	-	Bhujapatra
290	<i>Alnus nepalensis</i>	-	-	Parang
291	<i>Pinus khasiana/insularis</i>	-	-	Uchal
292	<i>Salix tetrasperma</i>	-	Panijam	Uyum
293	<i>Podocarpus nerifolia</i>	-	Jinari	Nau
294	<i>Bogenalia serrata</i>	-	-	-
295	<i>Litsea citrata</i>	-	Mejankeri	Thmitla
296	<i>Parkia joyarica/roxburghii</i>	-	-	Yongchak
297	<i>Gynometra polyandra</i>	-	Ping	Nanup
298	<i>Croton joufra</i>	-	Kuki/Haitup	Iuthap-Ching (Naga)
299	<i>Celtis tetrandra (austretis)-</i>	-		Heikreng
300	<i>Crataeva religiosa</i>	-	Borun	Loiyumbalei
301	<i>Dipterocarpus tuberculatus</i>	-		

MANIPUR SURVEY

List of Herbarium specimens got identified
through F.R.I. and additional Code Nos.

S.No	Botanical name	Local name	Code No.
1.	<i>Acer</i> spp.	Kuhi, Thinghi	399
2.	<i>Aceroblongum</i>	Tapaik	350
3.	<i>Albizzia stipulata</i>	Longchoum	
4.	<i>Alnus nepalensis</i>	Vchan, Pareng, Nagwalthing Hengpi	
5.	<i>Ardisia floribunda</i>	Ingthanaba	386
6.	<i>Artocarpus chaplasi</i>	Paran	
7.	<i>Atalantia spinosa</i>	Nalaking	327
8.	<i>Betula alonoides</i>	Hengmelki	
9.	<i>Bischofia javanica</i>	Inbou	
10.	<i>Betiaspermum nierenantha</i>		341
11.	<i>Callophyllum polyanthum</i>	Foi	330
12.	<i>Castanopsis turbuloides</i> <i>hystrix</i>	Sithing(k), Uthangen(M)	
13.	<i>Castanopsis aronata</i>	Achathing	361
14.	<i>Castanopsis</i> spp.	Rokhui	
15.	<i>Gongea tomentosa</i>	Mumsing, Thathaitthing	378
16.	<i>Croton oblongifolius</i>	Hautam	388
17.	<i>Cordia</i> spp.	Tamuk	397
18.	<i>Cordia dichotoma</i>	Tamband	349
19.	<i>Dalbergia</i> spp.	Dalha, Laiithitha, Laihicha	376
20.	<i>Dephniophyllum himalayense</i>	Nobabung, Gobung	381
21.	<i>Debregeasia wallichii</i>	Maamp	336
22.	<i>Dremycarpus racemosus</i>	Engai	337
23.	<i>Eleocarpus rugosus</i>	nil	354

24. <i>Eleocarpus aristatus</i>	Naiscol	357
25. <i>Euonymus frigidus</i>	Sukhathing, Timra- thing	370
26. <i>Eleodendron roxburghii</i>	Khonijrian	374
27. <i>Eriolaena spectabilis</i>	Singapai, Kalasingh	379
28. <i>Ficus hispida</i>	Hairith, Limti	396
29. <i>Ficus semicordata</i>	Heighong	363
30. <i>Ficus</i> spp.	Tada	
31. <i>Garcinia cowa</i>	Wangthing	353
32. <i>Grewia abutifolia</i>	Kalpa	345
33. <i>Grewia elatostenioides</i>	Suthing	375
34. <i>Grewia</i> spp.	Kolpe	355
35. <i>Gymnosporia rufa</i>	Ship, stikcing	359
36. <i>Glochidion</i> spp.	Knothi, Jongding	380
37. <i>Gmelina arborea</i>	Gain	
38. <i>Heritiera acuminata</i>	Gymen	326
39. <i>Hydnocarpus</i> spp.	Khonthing, Thapapa	331
40. <i>Hymenodictyon flacidum</i>	Tapai	329
41. <i>Hydnocarpus kurzii</i>	Thusak	343
42. <i>Ilex fragilis</i>	Nungbung	377
43. <i>Ilex</i> spp.	Thingpi	400
44. <i>Ixora</i> spp.	Mongoibung	382
45. <i>Knema glauca</i>	Thingchow, Kurtai	328
46. <i>Litsea oblonga</i>	Gaithing(k)Schi(M) Lessathing, Phunthing	352
47. <i>Litsea salicifolia</i>	Shohnil, upan	360
48. <i>Litsea</i> spp.	Thangcing	394
49. <i>Litsea khasyana</i>	Pontha	346
50. <i>Lonicera quinquelocularis</i>	Misajai	372
51. <i>Macranga denticulata</i>	Nafalt (K)	

52.	<i>Macranga indica</i>	Talam	383
53.	<i>Michalia baillonii</i>	Khayangcing	395
54.	<i>Michalia daltsoa</i>	Bagatani, Wangthing	325
55.	<i>Malotus</i> spp.	Bongo	384
56.	<i>Meliosma simplicifolia</i>	Mangsea	385
57.	<i>Malropanax oreophyllum</i>		342
58.	<i>Mesua ferrea</i>	Angai, Khorang	
59.	<i>Machilis parviflora</i>	Goshing, Deon	339
60.	<i>Nandlea griffithi</i>	Tumok	332
61.	<i>Pieris ovalifolia</i>	Sip	392
62.	<i>Phoebe peniculata</i>	Khen thing	358
63.	<i>Pterospermum acerifolium</i>	Thubuai	
64.	<i>Protium serratum</i>	Bill sing	373
65.	<i>Prunus domestica</i>	Khaheng	393
66.	<i>Quercus incana</i>	Paithing, Lithing	389
67.	<i>Quercus griffithi</i>	Chakomagung	367
68.	<i>Quercus lanugiosa</i>	Lainidak, Hopnthing	366
69.	<i>Quercus serrata</i>	Gongpi, Lainidak Foi	368
70.	<i>Quercus</i> spp.	Lithing	351
71.	<i>Rhus javanica</i>	Hemang	347
72.	<i>Rhus succedenia</i>	Thine	348
73.	<i>Sapium baccatum</i>	Bon	
74.	<i>Saurinia punctana</i>	Karap, Kharapy	398
75.	<i>Sapindus</i> spp.		369
76.	<i>Sapindus attenuatus</i>	Chaothing, Nageapel	387
77.	<i>Syzygium ramphiphyla</i>	Moithing thingchithing	338
78.	<i>Syzygium</i> spp.	Musthing	391
79.	<i>Sterculla villosa</i>	Ambai	335
80.	<i>Thpidanthus calyptratus</i>	Khon thing	390

81. <i>Trignostemon semiperflorens</i>	Goigthing	334
82. <i>Vvaria kamiltonii</i>	Tindur	344
83. <i>Vitex</i> spp.	Tasa	364
84. <i>Wendlendia wallichii</i>	Spatithing	362
85. <i>Xerospermum glabratum</i>	Thingsaki (K)	

-94-
APPENDIX II-a

Field Form No.1

Pre-Investment Survey of Forest Resources
CENTRAL ZONE - MANIPUR SURVEY
PLOT APPROACH FORM

1. Name of Division and its Code No.
2. Name of Range and its Code No.
3. Name of Block and its Code No.
4. Stratum Code ..
5. Compartment No. ..
6. Date ..
7. Name and Code No. of the Crew Leader: (1) Name
(2) Code No.
8. Name of the camp site ..
9. Time of starting from camp ..
10. Distance covered by vehicle (km)
Time taken by vehicle.
11. Name, if any, of the place up to which
journey was performed by vehicle.
12. Conspicuous features observed during
the journey by vehicle (Describe
in details)
13. Direction and distance covered on foot
up to the reference point (km).
14. Time of starting on foot.
15. Conspicuous features observed during
the journey on foot (Describe in details)
16. Description of the reference point
(Describe in details).
17. Time of arrival at reference point.
18. Bearing from the reference point
to the plot No.
19. Distance of the plot from reference
point (km)
20. Time of arrival in plot
21. Time of leaving plot
22. Time of return to camp
23. Remarks, record the presence of
Permanent Roads, Temporary Roads,
Lake, Nallas, Railway Line, Fire
line and Demarcation Lines, any other
item of note, etc.

Signature of Crew Leader.

Job No.	C.D.
1-3	4-5

PRE-INVESTMENT SURVEY OF FOREST RESOURCES
CENTRAL ZONE - MANIPUR SURVEY.
PLOT DESCRIPTION FORM

Appendix II-b
(Field Form No. II)
Grid No. and its Co-ordinates (Not to be coded)
(Actual Co-ordinates)

Serial	77-80
Grid No.	

6-7	State	To be filled in only for forest and agricultural/ tree land	For Forest only	Stand treatment
8-9	Forest Division			
10	Land use			
11	Legal status			
12	Topography			
13	Slope			
14	Position on slope			
15	Aspect			
16	Stoniness			
17	Humus			
18	Colour	Soil-data		
19	Consistency			
20	Texture			
21	Depth			
22	Vegetation			
23	Origin of stand			
24	Forest type			
25	No. of storeys			
26-27	Top Height			
28	Size class			
29	Stocking %			
30	Regeneration			
31	Injuries to crop			
32	Past treatment			

B a m b o o D a t a									
Grass incidence		Group - I		Group - II		Group - III		Group - IV	
33	Fire incidence	Group - I		Group - II		Group - III		Group - IV	
34	Species	Group - I		Group - II		Group - III		Group - IV	
35-37	Occurrence	Group - I		Group - II		Group - III		Group - IV	
38	Flowering	Group - I		Group - II		Group - III		Group - IV	
39	Regeneration	Group - I		Group - II		Group - III		Group - IV	
40	Species	Group - I		Group - II		Group - III		Group - IV	
41-43	Occurrence	Group - I		Group - II		Group - III		Group - IV	
44	Flowering	Group - I		Group - II		Group - III		Group - IV	
45	Regeneration	Group - I		Group - II		Group - III		Group - IV	
46	Species	Group - I		Group - II		Group - III		Group - IV	
47-49	Occurrence	Group - I		Group - II		Group - III		Group - IV	
50	Flowering	Group - I		Group - II		Group - III		Group - IV	
51	Regeneration	Group - I		Group - II		Group - III		Group - IV	
52	Species	Group - I		Group - II		Group - III		Group - IV	
53-55	Occurrence	Group - I		Group - II		Group - III		Group - IV	
56	Flowering	Group - I		Group - II		Group - III		Group - IV	
57	Regeneration	Group - I		Group - II		Group - III		Group - IV	
58	Species	Group - I		Group - II		Group - III		Group - IV	
59-61	Occurrence	Group - I		Group - II		Group - III		Group - IV	
62	Flowering	Group - I		Group - II		Group - III		Group - IV	
63	Regeneration	Group - I		Group - II		Group - III		Group - IV	
64		Group - I		Group - II		Group - III		Group - IV	

Date.....

Name of Crew Leader.....

(Field Form No. III)

Appendix II-c

-96-

PILOT ENUMERATION FORM

PRE-INVESTMENT SURVEY OF FOREST RESOURCES
CENTRAL ZONE
MANIPUR SURVEY

Job No.	Card Design	Sample Grid No.	Total No. of trees	Total No. of bamboo clumps	Total No. of non-bamboo clumps
1-3	4-5	6-9	10-11	12-13	14-17

Species	Diam.	Availabl- lity	Species	Diam.	Availabl- lity	Species	Diam.	Availabl- lity	Species	Diam.	Availabl- lity	Species	Diam.	Availabl- lity
18-20	21-23	24	25-27	28-30	31	32-34	35-37	38	39-41	42-44	45	46-48	49-51	52

Species	Diam.	Availabl- lity	Species	Diam.	Availabl- lity	Species	Diam.	Availabl- lity	Species	Diam.	Availabl- lity	Species	Diam.	Availabl- lity
60-62	63-65	66	67-69	70-72	73	74-76	77-79	80	81-83	84-86	87-89	90-92	93-95	96-98

Notes

Name of the Locality

SAMPLE TREE FORM

-9/-

Appendix II-d

(Field Form No. IV)

PRE-INVESTMENT SURVEY OF FOREST RESOURCES

CENTRAL ZONE

MANIPUR SURVEY

Sample Grid No.	Grid Co-ordinates	
	Lat.	Long.
6-9	10-15	16-21

No. of Trees
78-79

Job CD
1-3 4-5

Name of Species	Sl. No.	Spp. Code	Dominance	D.B.H. Cm.	D.B.T. Cm.	Total Height Metres	Clear Bolo Metres	Crown Width Metres	FORM		DEFECTS	
									Longi- tudinal	Sectional	Natural	Others
	23-25	24-25	27	28-30	31-33	34-34	35-36	37-38	39	40	41	42

Area Leader.....

Date

Pre-Investment Survey of Forest Resources,
Central Zone, Nagpur.

SAMPLE TREE CARD

1. S.No. of Tree
2. Species
3. Dominance
4. D.B.H.
5. Double Bark Thickness
6. Total Height
7. Clear Bole
8. Form:
 - Longitudinal
 - Sectional
9. Defect:
 - Natural
 - and
 - Other

(FIELD FORM NO. V)

Job No.	Gard Design	Sample Grid No.
1-3	4-5	6-9

[illegible]

NAME OF CELL LEADER.....

PRE-INVESTMENT SURVEY OF FOREST RESOURCES
CENTRAL ZONE - MANIPUR SURVEY

Appendix II-g

Sample Grid No.
76-78

BAMBOO WEIGHT FORM

D i a m e t e r C l a s s											
2 to under 5 cm.				5 to under 8 cm.				8 cm. and over			
Sample culm 1		No. Sample Culm 1		No. Sample Culm 2		No. Sample Culm 1		No. Sample Culm 1		No. Sample Culm 2	
Actual Diam.	Length in dmt.	Weight in grams.	In cm.	Actual Diam.	Length in dmt.	Weight in grams.	In cm.	Actual Diam.	Length in dmt.	Weight in grams.	In cm.
4-5	6-8	9-13	14-15	16-18	19-23	24-25	26-28	29-30	31-35	36-44	45-54
1-3											
Species Code											
Weight of Sample Culm No. 1											
2 to > 5 cm. Diam.											
Weight of Sample Culm No. 1											
5 to > 8 cm. Diam.											
Weight of Sample Culm No. 1											
8 cm. and over.											

Name of Crew Leader.....
Map Sheet No.....

Date.....

Form for recording of Aerial observations: .

Name of Crew Leader.....

[illegible]

MANIPUR SURVEY

App. III-a

Table - 1.1

Distribution of area by land use

<u>Land use</u>	<u>Area in sq.km.</u>	<u>Percentage of total area.</u>	<u>S.E. %</u>
Forest	15154.94	67.76	1.0
Agricultural Tree Land	537.10	1.51	11.9
Crop land	3170.72	14.18	3.6
Pasture + Barren land	1578.03	7.05	5.4
Urban sites	293.13	1.31	12.8
Current Jhum	1832.08	8.19	4.9
Total	22366.00	100	

MANIPUR SURVEY

App. III-b

Table - 1.2

Distribution of Forest Area by Vegetation

Vegetation	Area in Sq. km.	Percent of Forest Area.	S.E. %	Percent of Total area.
Tree Forest	7621.44	50.29	2.1	34.08
Open Forest	4118.51	27.18	3.1	18.41
Bamboo brake	3268.43	21.56	3.6	14.61
Grass bank	146.57	0.97	18.2	0.66
Total	15154.95	100		67.76

MANIPUR SURVEY

Ann. III-c

Table - 1.3

Distribution of Tree Forest and Open Forest area by Forest Type

Forest Type	Tree Forest (Area in Sq.Km.)	Percent of total tree Forest.	S.E.%	Open Forest (Area in Sq.km.)	Percent of Total Open Forest.	S.E. %
Wet temperate	1284.90	16.86	6.0	166.11	4.03	17.1
Pine	1519.40	19.94	5.5	923.37	22.42	7.1
Wet Hills	3918.20	51.41	3.2	2672.39	64.89	4.0
Semi Evergreen	439.70	5.77	10.4	205.19	4.98	15.4
Teak Gurjan	459.24	6.02	10.2	151.45	3.68	17.9
Total	7621.44	100	-	4118.51	100	-

MANIPUR SURVEYVEGETATION - TREE FOREST

App. IV-a

Table - 2.1

DISTRIBUTION OF VOLUME BY FOREST TYPE

Forest Type	Vol/ha. M ³	S.E.%	Area KM ²	S.E.%	Total volume (1000 cu.m.)	S.E.%
Wet Temperate	123.150	19.7	1284.90	6.0	15823.5	20.6
Pine	60.001	17.3	1519.40	5.5	9116.6	18.2
Wet Hills	90.720	16.2	3918.20	3.2	35545.9	16.5
Semi Evergreen	98.095	26.4	439.70	10.4	4313.2	28.4
Teak Gurjan	71.392	28.2	459.24	10.2	3278.6	30.0
Total	89.324	10.2	7621.44	2.1	68077.8	10.4

-106-
MANIPUR SURVEY

VEGETATION - OPEN FOREST

App. IV-b

Table 2.2

DISTRIBUTION OF VOLUME BY FOREST TYPE

Forest type	Vol/ha. M ³	S.E. %	Area KM ²	S.E. %	Total volume (1000 cu.m.)	S.E. %
Wet Temperate	5.663	70.4	166.11	17.1	94.1	72.4
Pine	5.342	90.2	923.37	7.1	493.3	90.4
Wethills	14.018	51.0	2672.39	4.0	3746.2	51.2
Semi Ever-green & Teak-Gurjan	0	0	356.64	-	-	-
Total	10.522	43.2	4118.51	3.1	4333.6	43.3

68077.8
4333.6
72411.4

MANTPUR SURVEY

APP. V-a

Table 3.1.1

Vegetation-free Forest, Forest Type - Wet Temperate

Distribution of Stem per hectare by Diameter Classes and Species

Species	DIAMETER CLASSES (Cm)											Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-109			
Gmelina arborea	2.222	0	0	0	0	0	0	0	0	0	2.222	0.7	
Calycarpa arborea	.555	0	0	0	0	0	0	0	0	0	.555	.2	
Miscellaneous species	87.778	42.778	28.889	5.555	1.667	5.000	1.111	1.111	1.111	.555	175.555	53.0	
Macaranga denticulata	.555	0	0	0	0	0	0	0	0	0	.555	.2	
Scheemia wallii	9.444	2.222	0	0	0	0	.555	.555	0	0	12.776	3.9	
Kydia calycina	0	0	.555	0	0	0	0	0	0	0	.555	.2	
Castanopsis hystrix	1.111	8.333	4.444	0	0	0	0	0	0	0	23.888	7.2	
Castanopsis indica	0	0	0	0	0	0	0	0	.555	0	.555	.2	
Quercus semi serrata	1.111	0	0	0	0	0	0	0	0	0	1.111	.3	
Quercus species	8.889	2.778	0	0	0	0	0	0	0	0	11.667	3.5	
Quercus species	14.444	4.444	1.111	0	0	0	0	0	0	0	19.999	6.0	
Alnus nepalensis	1.111	1.667	.555	1.667	0	0	0	0	0	0	5.000	1.5	
Bridelia retusa	7.778	1.667	0	0	0	0	0	0	0	0	9.445	2.8	
Salix tetrasperma	0	4.444	6.667	0	0	.555	.555	.555	.555	0	13.331	4.1	
Rest of species	34.444	8.889	7.222	1.667	0	1.111	.555	0	0	0	53.888	16.2	
Total	179.442	77.222	49.443	8.889	1.667	6.666	2.776	2.221	2.221	.555	331.102	-	
Percentage	54.2	23.3	14.9	2.7	.5	2.0	.8	.7	.7	.2	-	100.0	

MANIPUR SURVEY

App. V-b

TABLE:- 3.1.2

VEGETATION-TREE FOREST - FOREST TYPE-PINE

Distribution of Stems per hectare by Diameter Classes and Species

SPECIES	DIAMETER CLASSES (Cm)										Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99			
<i>Pinus kesiya</i>	13,809	25,714	13,333	4,762	3,333	-	-	.476	-	01,427	23.6	
<i>Albizia procera</i>	1,429	-	-	-	-	-	-	-	-	1,429	.6	
<i>Grewia tilliaefolia</i>	1,905	-	-	-	-	-	-	-	-	1,905	.7	
<i>Calycarpa arborea</i>	2,857	-	-	-	-	-	-	-	-	2,857	1.1	
Miscellaneous species	54,762	9,048	3,009	-	-	-	-	-	-	67,619	28.0	
<i>Macaranga denticulata</i>	.952	-	-	-	-	-	-	-	-	.952	.4	
<i>Schinus wallichii</i>	3,809	-	.952	.476	-	-	-	-	-	5,237	2.0	
<i>Castanopsis hystrix</i>	42,857	5,714	3,333	.952	-	-	-	-	-	52,856	20.3	
<i>Castanopsis indica</i>	11,905	-	.952	-	-	-	-	-	-	12,857	5.0	
<i>Quercus semiserrata</i>	7,143	6,190	2,381	.476	-	-	.476	-	-	16,666	6.4	
<i>Alnus nepalensis</i>	-	-	-	-	-	-	.476	-	.476	.952	.4	
<i>Bridelia retusa</i>	2,381	2,381	-	-	-	-	-	-	-	4,762	1.8	
<i>Salix tetrasperma</i>	8,571	3,333	.952	-	-	-	-	-	-	12,856	4.9	
Rest of species	13,333	1,905	1,428	.476	.476	-	-	-	-	17,618	6.8	
TOTAL	165,713	54,285	27,140	7,142	3,809	-	.952	.476	.476	259,993	-	
PERCENTAGE	63.7	20.9	10.4	2.7	1.5	-	.4	.2	.2	-	100.0	

MANTPUR SURVEY

Table - 3.1.3.

App. V-c

VEGETATION - TREE FOREST, FOREST TYPE - WET HILLS

Distribution of Stems per hectare by Diameter Classes and Species.

Species	DIAMETER CLASSES (cm)											Total
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-109		
Pinus kesiya	0	.580	.530									1.110
Amelina arborea	2.029	1.304	.580	.580	.145							4.638
Albizia lebbek	3.736	.725	.720	.145								4.928
Albizia procera	2.609	.715	.115									3.479
Acacia species	2.464	1.304	3	0	0	.145	0	0	0			5.915
Acacia baobabifolia	2.464	1.304	0									3.768
Pyrus carolina	2.464	2.354	.550									5.368
Ostrya arborea	4.493	1.304	.685	.145								6.627
Masellanus species	85.072	29.420	14.205	3.915	1.504	1.014	1.304	.725	.435	.290	137.680	42.6
Macaranga dentata	2.319	1.294	.725	.435								4.783
Micheia champaca	1.304	1.159	1.014	.290	0	.290						4.057
Hypericarpus viridatus	3	.145										.145
Schima villosa	2.464	2.609	1.739	.435								7.247
Gastanopsis hystrix	20.725	8.551	2.754	.470	0		.145					33.045
Gastanopsis indica	9.565	6.232	2.319	.435	.145							18.696
Lagerstroemia floribunda	.884											1.884
Quercus semiserrata	1.594	1.014	.530									3.138
Quercus species	.580	0	.530									.870
Alnus nepalensis	2.609	.290	.435									3.334
Bridelia retusa	4.203	1.014	.145									5.362
Rest of species	42.609	14.927	5.797	2.029	.145	.290	0	.435	.580	.580	67.292	20.5
Total	138.282	75.351	32.611	9.277	1.719	2.624	1.534	1.130	1.015	.870	325.485	
Percentage	61.3	23.3	10.1	2.9	0.5	0.5	0.5	0.3	0.3	0.3	100.0	

MANIPUR SURVEY

Ann. V-d

Table - 3.1.4.

Vegetation - Tree Forest, Forest Type - Semi Evergreen

Distribution stems per hectare by diameter classes and species

Species	DIAMETER CLASSES (Cm)										Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+		
Pinus kesiya	2,308	-	-	-	-	-	-	-	-	-	2,308	0.9
Gmelina arborea	-	1,538	-	-	-	.769	-	-	-	-	2,307	0.9
Albizia procera	1,538	-	-	-	-	-	-	-	-	-	1,538	0.6
Ficus species	.769	-	-	-	-	-	-	-	-	-	.769	0.3
Kydia calycina	10,769	1,538	1,538	-	-	-	-	-	-	-	13,845	5.2
Calycarpa arborea	3,077	1,538	-	-	-	-	-	-	-	-	4,615	1.7
Miscellaneous species	67,692	25,077	19,231	3,846	.769	3,846	.769	-	-	-	119,230	44.8
Macaranga denticulata	16,154	-	-	-	-	-	-	-	-	-	16,154	6.0
Schemia wallichii	-	.769	-	-	-	-	-	-	-	-	.769	0.3
Castanopsis hystrix	.769	-	-	-	-	-	-	-	-	-	.769	0.3
Castanopsis indica	-	-	.769	-	-	-	-	-	-	-	.769	0.3
Salix tetrasperma	-	.769	-	-	-	-	-	-	-	-	.769	0.3
Rest of species	53,842	22,306	14,615	3,846	2,308	.769	1,538	.769	-	2,308	102,307	38.4
Total	156,922	51,537	35,153	7,692	3,077	5,334	2,307	.769	-	2,308	286,149	
Percentage	59.0	19.3	13.6	2.9	1.1	2.0	0.9	0.3	-	0.9		100.0

MANIPUR SURVEY

APP. V-e

TABLE 3.1.5.

Vegetation-Tree Forest, Forest Type - Teak Gurian

Distribution of stems per hectare by Diameter Class and Species

Species	DIAMETER CLASSES (Cm)										Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+		
Amelina arborea	-	1.111	-	-	-	-	-	-	-	-	1.111	.4
Calycarpa arborea	-	1.111	-	-	-	-	-	-	-	-	1.111	.4
Miscellaneous species	83.333	25.555	2.222	7.778	1.111	-	-	-	-	-	119.999	37.8
Michelia champaca	-	-	1.111	-	-	-	-	-	-	-	1.111	.5
Dipterocarpus turbinatus	12.222	8.889	11.111	3.333	1.111	1.111	-	-	-	-	37.777	11.9
Schemia wallichii	1.111	-	-	-	-	-	-	-	-	-	1.111	.4
Gastropsis hystrix	32.222	4.444	-	-	-	-	-	-	-	-	36.666	11.5
Gastanopsis indica	1.111	-	-	-	-	-	-	-	-	-	1.111	.4
Lagerstroemia flosreginae	18.889	6.667	-	-	-	-	-	-	-	-	25.555	8.0
Quercus species	7.778	-	-	2.222	-	-	-	-	-	-	10.000	3.1
Bridelia retusa	16.667	-	-	-	-	-	-	-	-	-	16.667	5.2
Rest of species	40.000	15.555	3.333	1.111	3.333	-	2.222	-	-	-	65.555	20.6
Total	215.333	63.333	17.777	14.444	5.555	1.111	2.222	-	-	-	317.775	
Percentage	67.1	19.9	5.6	4.5	1.8	0.4	.7	-	-	-	100.0	

Table - 3.2.1.

VEGETATION-OPEN FOREST, FOREST TYPE-WET TEMPERATE
DISTRIBUTION OF STEMS PER HECTARE BY DIAMETER CLASSES AND SPECIES

Species	DIAMETER CLASSES (Cm)					%
	10-19	20-29	30-39	40-49	Total	
Ficus species	2.000	-	-	-	2.000	3.4
Miscellaneous species	12.000	4.000	-	-	16.000	27.6
Castanopsis hystrix	2.000	6.000	-	-	8.000	13.8
Quercus semiserrata	14.000	2.000	-	-	16.000	27.6
Rest of species	14.000	-	-	2.000	16.000	27.6
Total	44.000	12.000	-	2.000	58.000	
Percentage	75.9	20.7	-	3.4		100.0

MANIPUR SURVEY

Table - 3.2.2a

App. VI-b

VEGETATION-OPEN FOREST-FOREST TYPE-PINE

DISTRIBUTION OF STEMS PER HECTARE BY DIAMETER CLASSES AND SPECIES

Species	DIAMETER CLASSES (Cm)				
	10-19	20-29	30-39	Total	%
Pinus kesiya	3.333	-	-	3.333	8.3
Albizzia lebbek	6.667	-	-	6.667	16.7
Grewia tilliaefolia	3.333	-	-	3.333	8.3
Calycarpa arborea	3.333	-	-	3.333	8.3
Rest of species	16.667	3.333	3.333	23.333	58.4
Total	33.333	3.333	3.333	39.999	
Percentage	83.4	8.3	8.3		100.0

MANIPUR SURVEY

App. VI-c

TABLE: 3, 2, 3

VEGETATION-OPEN FOREST, FOREST TYPE -WET HILLS

DISTRIBUTION OF STEMS PER HECTARE BY DIAMETER CLASSES AND SPECIES.

SPECIES	D I A M E T E R C L A S S E S (Cm)										
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-109	Total %
Pinus kesiya	-	2.727	1.818	.909	-	-	-	-	-	-	5.454 14.3
Ficus species	2.727	-	-	-	-	-	-	-	-	-	2.727 7.1
Grewia tilliaefolia	.909	.909	-	-	-	-	-	-	-	-	1.818 4.8
Calycarpa arborea	2.727	-	-	-	-	-	-	-	-	-	2.727 7.1
Miscellaneous species	10.000	3.636	-	-	-	-	-	-	.909	0	14.545 38.1
Schenia wallichii	1.818	1.818	-	-	-	-	-	-	-	-	3.636 9.6
Castanopsis hystrix	1.818	0	.909	-	-	-	-	-	-	-	2.727 7.1
Rest of species	.909	0	0	.909	-	-	-	-	-	-	1.818 4.8
Quercus species	0	0	1.818	0	.909	-	-	-	-	-	2.727 7.1
TOTAL	20.908	9.090	4.545	1.818	.909	-	-	-	.909	0	38.179
PERCENTAGE	54.7	23.8	11.9	4.8	2.4	-	-	-	2.4	-	100.0

MANIPUR SURVEY

Ann. VII-a

TABLE : 3.3

Vegetation- Bamboo Brake

Distribution/Stems per hectare by Diameter Classes and Species

Species	DIAMETER CLASSES (Cm)										Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	Total	%		
Ficus species	4.211	-	-	-	-	-	-	-	4.211	6.3		
Grewia tilliaefolia	3.158	-	-	-	-	-	-	-	3.158	4.8		
Calycarpa arborea	4.211	.526	-	-	-	-	-	-	4.737	7.1		
Miscellaneous species	8.947	3.158	.526	.526	-	-	-	-	13.157	19.8		
Macaranga denticulata	9.474	1.053	-	-	-	-	-	-	10.527	15.9		
Schomia wallichii	1.579	.526	-	-	-	-	-	-	2.105	3.2		
Castanopsis kystrix	.526	.526	-	.526	-	-	-	-	1.578	2.4		
Castanopsis indica	.526	-	-	-	-	-	-	-	.526	.8		
Alnus nepalensis	4.211	-	-	-	-	-	-	-	4.211	6.3		
Rest of Species	14.211	5.263	1.579	.526	-	-	-	.526	22.105	33.3		
TOTAL	51.054	11.052	2.105	1.578	-	-	-	.526	66.315			
PERCENTAGE	77.0	16.6	3.2	2.4	-	-	-	0.8	-	100.0		

Vegetation-Other than Tree Forest, Open Forest and Bamboo Brake
Distribution of Volume (M^3) per hectare by Diameter Classes and Species.

Species	DIAMETER CLASSES (Cm)										Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+		
Albizia procera	.013	-	-	-	-	-	-	-	-	-	.013	0.3
Miscellaneous species	.034	.039	-	-	-	-	.984	-	-	3.607	4.633	95.1
Castanopsis hystrix	.077	-	-	-	-	-	-	-	-	-	.077	1.6
Rest. of species	.061	.085	-	-	-	-	-	-	-	-	.146	3.0
TOTAL	.155	.123	-	-	-	-	.984	-	-	3.607	4.869	
PERCENTAGE	3.2	2.5					20.2			74.1		100.0

MANIPUR SURVEY

App. VIII-b

TABLE : 4.1.1.

Vegetation-Tree Forest, - Forest Type - Wet Temperate
 Distribution of Volume (M³) per hectare by Diameter Classes and species.

SPECIES	DIAMETER CLASSES (Cm)										Total %
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-109	
Gmelina arborea .101	-	-	-	-	-	-	-	-	-	-	.101 0.1
Galycarpa arborea .002	-	-	-	-	-	-	-	-	-	-	.002 0.0
Kydia calycina -	-	-	.331	-	-	-	-	-	-	-	.331 0.3
Miscellaneous species: 33.466	9.784	17.378	6.021	3.351	12.984	4.026	3.363	7.060	4.167	73.600	59.8
Macaranga denticulata .051	-	-	-	-	-	-	-	-	-	-	.051 0.0
Schemia wallichii .479	.486	-	-	-	-	1.858	2.502	-	-	-	5.328 4.3
Castanopsis hystrix .454	1.846	2.612	-	-	-	-	-	-	-	-	4.912 4.0
Castanopsis indica -	-	-	-	-	-	-	-	3.648	-	-	3.648 3.0
Quercus semiserrata .028	-	-	-	-	-	-	-	-	-	-	.028 0.0
Quercus species .308	.411	-	-	-	-	-	-	-	-	-	.719 0.6
Quercus species .572	.962	.566	-	-	-	-	-	-	-	-	2.100 1.7
Alnus nepalensis .058	.356	.411	1.789	-	-	-	-	-	-	-	2.614 2.1
Bridelia retusa .417	.297	-	-	-	-	-	-	-	-	-	.714 0.6
Salix tetrasperma 0	1.005	4.249	0	0	1.572	1.858	3.087	3.483	0	15.254	12.4
Rest of species 1.394	1.621	4.003	1.829	0	3.043	1.858	-	-	-	13.748	11.1
TOTAL	7.330	16.771	29.550	9.639	3.351	17.599	9.600	10.952	14.191	4.167	123.150 -
PERCENTAGE	6.0	13.6	24.0	7.8	2.7	14.3	7.8	8.9	11.5	3.4	- 100.0

MANIPUR SURVEY

App. VIII c

TABLE : 4.1.2.

VEGETATION-TREE FOREST.-FOREST TYPE - PINE

Distribution of Volume (M³) per hectare by Diameter Classes and species.

SPECIES	DIAMETER CLASSES (Cm)										Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99			
<i>Pinus kesiya</i>	.884	6.940	8.322	5.740	6.542	-	-	2.622	-	31.050	51.8	
<i>Albizia procera</i>	.100	-	-	-	-	-	-	-	-	.100	.2	
<i>Grewia tilliaefolia</i>	.113	-	-	-	-	-	-	-	-	.113	.2	
<i>Calycarpa arborea</i>	.029	-	-	-	-	-	-	-	-	.029	0	
Miscellaneous species	1.628	2.106	2.255	-	-	-	-	-	-	5.999	10.0	
<i>Macaranga denticulata</i>	.009	-	-	-	-	-	-	-	-	.009	.0	
<i>Schima wallichii</i>	.079	-	.416	.700	-	-	-	-	-	1.225	2.0	
<i>Castanopsis hystrix</i>	1.318	1.185	1.893	.994	-	-	-	-	-	5.390	9.0	
<i>Castanopsis indica</i>	.405	-	.568	-	-	-	-	-	-	.973	1.6	
<i>Quercus semiserrata</i>	.395	1.594	1.197	.455	-	-	1.914	-	-	5.555	9.3	
<i>Alnus nepalensis</i>	-	-	-	-	-	-	1.750	-	2.916	4.666	7.8	
<i>Bridella retusa</i>	.030	.472	-	-	-	-	-	-	-	.510	.8	
<i>Salix tetrasperma</i>	.234	.694	.403	-	-	-	-	-	-	1.386	2.3	
Rest of species	.444	.327	.750	.633	.842	-	-	-	-	2.996	5.0	
TOTAL	5.786	13.318	15.849	15.522	7.384	-	3.664	2.622	2.916	60.001	-	
PERCENTAGE	9.5	22.2	26.4	14.2	12.3	-	6.1	4.4	4.9	-	100.00	

MANIPUR SURVEY

App. VIII-d

Table - 4.1.3.

VEGETATION-TREE FOREST, FOREST TYPE-WET HILLS

DISTRIBUTION OF VOLUME (M³) PER HECTARE BY DIAMETER CLASSES AND SPECIES

Species	DIAMETER CLASSES (Cm)											Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-109	Total		
<i>Pinus kesiya</i>	0.101	.188	.370	-	-	-	-	-	-	-	.558	0.6	
<i>Gmelina arborea</i>	.108	.221	.318	.633	.279	-	-	-	-	-	1.552	1.7	
<i>Albizia lebbek</i>	.159	.172	.136	.138	-	-	-	-	-	-	.605	0.7	
<i>Albizia procera</i>	.111	.151	.100	-	-	-	-	-	-	n	.362	0.4	
<i>Ficus species</i>	.089	.233	0	0	0	.485	-	-	-	-	.807	0.9	
<i>Grewia tilliaefolia</i>	.053	.019	-	-	-	-	-	-	-	-	.072	0.1	
<i>Kydia calcina</i>	.190	.539	.303	-	-	-	-	-	-	-	1.032	1.1	
<i>Calycarpha arborea</i>	.160	.350	.231	.147	-	-	-	-	-	-	.888	1.0	
<i>Miscellaneuous species</i>	3.222	6.684	8.468	4.276	2.304	2.596	4.701	3.431	2.685	3.075	41.442	45.7	
<i>Macaranga denticulata</i>	.083	.315	.404	.496	-	-	-	-	-	-	1.298	1.4	
<i>Michelia champaca</i>	.059	.231	.654	.285	0	.796	-	-	-	-	2.025	2.2	
<i>Dipterocarpus turbinatus</i>	0	.033	-	-	-	-	-	-	-	-	.033	0.0	
<i>Scheemia wallichii</i>	.113	.564	1.079	.496	-	-	-	-	-	-	2.252	2.5	
<i>Castanopsis hystrix</i>	.633	1.968	1.602	.874	-	-	.549	-	-	-	5.926	6.2	
<i>Castanopsis indica</i>	.392	1.356	1.389	.450	.268	-	-	-	-	-	3.855	4.3	
<i>Lagerstroemia floribunda</i>	.047	-	-	-	-	-	-	-	-	-	.047	0.1	
<i>Quercus semiserrata</i>	.042	.176	.319	-	-	-	-	-	-	-	.537	0.6	
<i>Quercus species</i>	.021	0	.177	-	-	-	-	-	-	-	.198	0.2	
<i>Quercus species</i>	0	.033	-	-	-	-	-	-	-	-	.033	0.0	
<i>Alnus nepalensis</i>	.080	.094	.239	-	-	-	-	-	-	-	.473	0.5	
<i>Bridellia retusa</i>	.161	.207	.115	-	-	-	-	-	-	-	.483	0.5	
<i>Rest of species</i>	1.435	3.528	3.435	2.415	.291	.778	0	2.166	3.550	8.964	26.542	29.3	
Total	7.151	17.062	19.399	10.210	5.142	4.170	5.735	5.597	6.215	12.039	90.720		
Percentage	7.9	18.8	21.4	11.2	5.5	4.6	6.3	6.2	6.8	13.3	100.0		

MANIPUR SURVEY

Add. VIII-8

Table - 4.1.4.

Vegetation-Tree Forest, Forest Type-Semi Evergreen

Distribution of Volume per hectare by Diameter Classes and species

Species	DIAMETER CLASSES (cm)										Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+		
<i>Pinus kesiya</i>	.073	-	-	-	-	-	-	-	-	-	.073	0.1
<i>Gmelina arborea</i>	-	.423	-	-	-	2.331	-	-	-	-	2.754	2.8
<i>Albizia procera</i>	.116	-	-	-	-	-	-	-	-	-	.116	0.1
<i>Ficus species</i>	.012	-	-	-	-	-	-	-	-	-	.012	0
<i>Kydia calycina</i>	.287	.276	.689	-	-	-	-	-	-	-	1.252	1.3
<i>Calycarpa arborea</i>	.058	.322	-	-	-	-	-	-	-	-	.380	0.4
Miscellaneous species	2.611	6.129	12.047	4.254	1.611	10.667	2.572	-	-	39.931	40.7	40.7
<i>Macaranga denticulata</i>	.280	-	-	-	-	-	-	-	-	-	.280	0.3
<i>Scheedia wallichii</i>	-	.300	-	-	-	-	-	-	-	-	.300	0.3
<i>Castanopsis hystrix</i>	0.007	-	-	-	-	-	-	-	-	-	0.007	0
<i>Castanopsis indica</i>	-	-	.329	-	-	-	-	-	-	-	.329	0.3
<i>Salix tetrasperma</i>	-	.176	-	-	-	-	-	-	-	-	.176	0.2
Rest of species	2.005	5.455	9.121	4.777	4.457	2.176	5.747	4.168	-	14.669	52.485	53.5
Total	5.449	13.131	22.186	9.031	6.068	15.174	8.319	4.168	-	14.509	98.095	
Percentage	5.5	13.4	22.6	9.2	6.2	15.5	8.5	4.2	-	14.9	100.0	

MANIPUR SURVEY

App. VIII-F

Table -4.1.5.

Vegetation-Tree Forest, Forest Type-Teak Gurian

Distribution of Volume (M³) Per hectare by Diameter Class and Species

Species	D I A M E T E R C L A S S E S (Cm)							Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79		
Gmelina arborea	-	.224	-	-	-	-	-	.224	.3
Calycarpa arborea	-	.394	-	-	-	-	-	.394	.6
Miscellaneous species	3.142	5.858	1.274	8.807	1.878	-	-	20.959	29.4
Michelia champaca	-	-	.662	-	-	-	-	.662	.9
Dipterocarpus turbinatus	.471	2.330	6.746	4.090	2.326	3.034	-	18.997	26.6
Scleria wallichii	.122	-	-	-	-	-	-	.122	.2
Castanopsis hystrix	1.050	1.298	-	-	-	-	-	2.348	3.3
Castanopsis indica	.010	-	-	-	-	-	-	.010	.0
Lagerstroemia floreginae	.807	1.709	-	-	-	-	-	2.516	3.5
Quercus species	.259	-	-	2.322	-	-	-	2.581	3.6
Bridella rebusa	.253	-	-	-	-	-	-	.253	.4
Rest of species	1.042	3.408	1.754	1.404	6.162	-	8.556	22.326	31.2
Total	7.156	15.221	10.433	16.623	10.366	3.034	8.556	71.392	
Percentage	10.0	21.3	16.6	23.3	14.5	4.3	12.0		100

-122-
MANIPUR SURVEY

App. IX-a

Table - 4.2.1.

VEGETATION-OPEN FOREST, FOREST TYPE-WET TEMPERATE

DISTRIBUTION OF VOLUME (M³) PER HECTARE BY DIAMETER CLASSES AND SPECIES

Species	DIAMETER CLASSES (Cm)				Total	%
	10-19	20-29	30-39	40-49		
Ficus species	.019	-	-	-	.019	0.3
Miscellaneous species	.378	.970	-	-	1.348	23.8
Castanopsis hystrix	.048	1.298	-	-	1.346	23.8
Quercus semiseerata	.331	.352	-	-	.683	12.1
Rest of species	.240	0	0	2.027	2.267	40.0
Total	1.016	2.620	0	2.027	5.663	
Percentage	17.9	46.3		35.8		100.0

-123-
MANIPUR SURVEY

Table - 4.2.2.

Ann. IX-b

VEGETATION-OPEN FOREST, FOREST TYPE-PINE

DISTRIBUTION OF VOLUME (M³) PER HECTARE BY DIAMETER CLASSES AND SPECIES

Species	DIAMETER CLASSES (Cm)				%
	10-19	20-29	30-39	Total	
Pinus kesiya	.190	-	-	.190	3.6
Gmelina arborea	.145	-	-	.145	2.7
Grewia tilliaefolia	.152	-	-	.152	2.8
Calycarpa arborea	.031	-	-	.031	0.6
Rest of species	.709	1.302	2.813	4.824	90.3
Total	1.227	1.302	2.813	5.342	
Percentage	23.0	24.4	52.6		100.0

MANIPUR SURVEY

Table -4.2.3.

VEGETATION - OPEN FOREST, FOREST TYPE - WET HILLS

DISTRIBUTION OF VOLUME (M³) PER HECTARE BY DIAMETER CLASSES AND SPECIES

Species	DIAMETER CLASSES (Cm)										Total %
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-109	
Pinus kesiya	0	.702	1.067	.909	-	-	-	-	-	-	2.678 19.1
Ficus species	.034	-	-	-	-	-	-	-	-	-	.034 0.2
Grewia talliaefolia	.031	.160	-	-	-	-	-	-	-	-	.191 1.4
Calycarina arborea	.104	-	-	-	-	-	-	-	-	-	.104 0.7
Miscellaneous species	.293	.690	-	-	-	-	-	-	5.436	0	6.428 45.9
Schima walllichii	.029	.430	-	-	-	-	-	-	-	-	.459 3.3
Castanopsis hystrix	.068	0	.339	-	-	-	-	-	-	-	.457 3.3
Quercus species	0	0	1.229	0	1.607	-	-	-	-	-	2.836 20.2
Rest of species	.014	0	0	.817	-	-	-	-	-	-	.831 5.9
Total	.573	1.991	2.685	1.726	1.607	-	-	-	5.436	0	14.018
Percentage	4.1	14.2	19.1	12.3	11.5	-	-	-	38.8	-	100.0

MANIPUR SURVEY

App. X-a

Table - 4.3.

Vegetation - Bamboo brake

Distribution of Volume (M³) per hectare by Diameter Classes and species.

Species	DIAMETER CLASSES (Cm)							Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79		
Ficus species	.053	-	-	-	-	-	-	.053	0.6
Grewia tilliaefolia	.086	-	-	-	-	-	-	.086	0.9
Calycarpa arborea	.117	.068	-	-	-	-	-	.185	2.1
Miscellaneous species	.263	.599	.225	.736	-	-	-	1.816	20.0
Macaranga denticulata	.395	.186	-	-	-	-	-	.581	6.4
Scheemia wallichii	.044	.093	-	-	-	-	-	.137	1.5
Castanopsis hystrix	.043	.120	0	.503	-	-	-	.671	7.4
Castanopsis indica	.024	0	0	0	0	0	0	.024	0.3
Alnus nepalensis	.086	-	-	-	-	-	-	.086	0.9
Rest of species	.331	1.256	.878	.597	-	-	-	2.371	5.433
Total	1.450	2.312	1.103	1.836	-	-	-	2.371	9.072
Percentage	16.0	25.5	12.2	20.2	-	-	-	26.1	100.0

MANIPUR SURVEY

App. XL-a

Stratum Area: 128490 ha.

Vegetation- Tree Forest, Forest Type - Wet Temperate

Table - 5.1.1.

Distribution of Total stems by Diameter Classes and Species.

Species	DIAMETER CLASSES (Cm)										Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-109		
<i>Gmelina arborea</i>	285504	-	-	-	-	-	-	-	-	-	285504	0.7
<i>Galycarpa arborea</i>	71312	-	-	-	-	-	-	-	-	-	71312	0.2
Miscellaneous species	11278569	5496532	3711939	713760	214192	642449	142752	142752	142752	71312	22557009	53.0
<i>Macaranga denticulata</i>	71312	-	-	-	-	-	-	-	-	-	71312	0.2
<i>Schemia wallichii</i>	1213457	285504	-	-	-	-	71312	71312	-	-	1641585	3.9
<i>Kydia calycina</i>	-	-	71312	-	-	-	-	-	-	-	71312	0.2
<i>Castanopsis hystrix</i>	1427649	1070705	571008	-	-	-	-	-	-	-	3069362	7.2
<i>Castanopsis indica</i>	-	-	-	-	-	-	-	-	71312	-	71312	0.2
<i>Quercus semiserrata</i>	142752	-	-	-	-	-	-	-	-	-	142752	0.3
<i>Quercus species</i>	1142145	358944	-	-	-	-	-	-	-	-	1499089	3.5
<i>Quercus species</i>	1855905	571008	142752	-	-	-	-	-	-	-	2569665	6.0
<i>Alnus nepalensis</i>	142752	214192	71312	214192	-	-	-	-	-	-	642448	1.5
<i>Bridellia retusa</i>	999292	214192	-	-	-	-	-	-	-	-	1213585	2.9
<i>Salix tetrasperma</i>	-	571008	858441	-	-	71312	71312	71312	71312	-	1712897	4.0
Rest of species	4425699	1142145	927953	214192	-	142752	71312	-	-	-	6924053	16.2
Total	23056449	9922230	6352317	1142144	214192	856513	356688	385376	385376	71312	4254197	-
Percentage	54.2	23.3	14.9	2.7	0.5	2.0	0.8	0.7	0.7	0.2	4254197	100.0

MANIPUR SURVEY

App. XL-b

Stratum Area: 151940 ha.

Table -5.1.2.

VEGETATION-TREE FOREST-FOREST TYPE -PINE

Distribution of Total Stems by Diameter Classes and Species.

Species	D I A M E T E R C L A S S E S (Cm)										Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	Total		
Pinus kesiya	2083143	3906993	2025820	723540	508417	-	-	72324	-	9333237	23.6	
Albizia procera	217123	-	-	-	-	-	-	-	-	217123	0.6	
Grewia tilliaefolia	289446	-	-	-	-	-	-	-	-	289446	0.7	
Calycarpha arborea	434093	-	-	-	-	-	-	-	-	434093	1.1	
Miscellaneous species	8320554	1374756	578741	-	-	-	-	-	-	10274051	26.0	
Macaranga denticulata	144647	-	-	-	-	-	-	-	-	144647	0.4	
Schima wallichii	573741	-	144647	72324	-	-	-	-	-	795712	2.0	
Castanopsis hystrix	6511705	868187	596417	144647	-	-	-	-	-	8030956	20.3	
Castanopsis indica	1803849	-	144647	-	-	-	-	-	-	1953496	5.0	
Quercus semiserrata	1085309	940510	361770	72324	-	-	72324	-	-	2532237	6.4	
Alnus nepalensis	-	-	-	-	-	-	72324	-	72324	144648	.4	
Bridelia retusa	361770	361770	-	-	-	-	-	-	-	723540	1.8	
Salix tetrasperma	1302380	506417	144647	-	-	-	-	-	-	1953344	4.9	
Rest of species	2025820	289446	216971	72324	72324	-	-	-	-	2676885	6.8	
Total	25178480	8248079	4123660	1085159	578741	-	144648	72324	72324	39503415		
Percentage	63.7	20.9	10.4	2.7	1.5	-	.4	.2	.2	-	100.0	

MANIPUR SURVEY

Stratum Area : 391820 ha.
Vegetation : Tree Forest
Forest Type: Wet Hills

Table 5.1.3.

Distribution of Total Stems by Diameter classes and Species

p.128

Species	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	Total	%
<i>Pinus kesiya</i>	0	227256	227256	-	-	-	-	-	-	-	454512	0.4
<i>Ocotea arborea</i>	795703	510934	227256	277256	56814	-	-	-	-	-	1817263	1.4
<i>Albizia lebbek</i>	1476379	284070	113628	56814	-	-	-	-	-	-	1930891	1.5
<i>Albizia procera</i>	1022259	284070	56814	-	-	-	-	-	-	-	1363143	1.1
<i>Ficus species</i>	965445	510954	0	0	0	0	56814	-	-	-	1533193	1.2
<i>Grewia tiliacolia</i>	1362751	56814	-	-	-	-	-	-	-	-	1419565	1.1
<i>Kydia calycina</i>	1760419	965445	227256	-	-	-	-	-	-	-	2953150	2.3
<i>Calycotroa arborea</i>	1760449	510934	170442	56814	-	-	-	-	-	-	2498639	2.0
Miscellaneous species	33332937	1152753	5685024	1533193	510934	397306	510934	284070	170442	113628	33945821	42.6
<i>Moranga denticulata</i>	908631	510934	284070	170442	-	-	-	-	-	-	1874077	1.5
<i>Michelia champaca</i>	510934	454120	397306	113628	0	113628	-	-	-	-	1589616	1.3
<i>Dipterocarpus turbinatus</i>	0	56814	-	-	-	-	-	-	-	-	56814	0.0
<i>Schinus wallichii</i>	965445	1022259	681375	170442	-	-	-	-	-	-	2839521	2.2
<i>Castanopsis hystrix</i>	8120476	3350455	1079073	340884	0	0	56814	-	-	-	12947702	10.2
<i>Castanopsis indica</i>	3747791	2441824	908631	170442	56814	-	-	-	-	-	7325472	5.8
<i>Lagerstroemia flosreginae</i>	738189	-	-	-	-	-	-	-	-	-	738189	0.6
<i>Quercus semiserrata</i>	624561	397306	227256	-	-	-	-	-	-	-	1249123	1.0
<i>Quercus species</i>	227256	0	113628	-	-	-	-	-	-	-	340884	0.3
<i>Alnus nepalensis</i>	1022259	113628	170442	-	-	-	-	-	-	-	1306329	1.0
Rest of species	16695072	5848702	2271392	795006	56814	113628	0	170442	227256	227256	26405555	20.8
<i>Bridellia repusa</i>	1646821	397306	56814	-	-	-	-	-	-	-	2100941	1.7
<i>Quercus species</i>	-	-	-	-	-	-	-	-	-	-	56814	0.0
Total	77683077	29527972	12777653	3634918	681376	624562	624562	454512	397698	340884	126747214	

MANIPUR SURVEY

Stratum Area : 43970 ha.

Table 5.1.4.

Vegetation - Tree Forest-Forest Type-Semi Evergreen

Distribution of Total Stems by Diameter Classes and Species.

Species	DIAMETER CLASSES (cm)										Total %
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-109	
Pinus kesiya	101432	-	-	-	-	-	-	-	-	-	101432 0.9
Gmelina arborea	-	67626	-	-	-	33313	-	-	-	-	101439 0.9
Albizia procera	67626	-	-	-	-	-	-	-	-	-	67626 0.6
Ficus species	33315	-	-	-	-	-	-	-	-	-	33313 0.3
Kydia calycina	473311	67626	67626	-	-	-	-	-	-	-	608763 5.2
Ostrya arborca	135235	67626	-	-	-	-	-	-	-	-	202921 1.7
Miscellaneous species	2570408	1014592	845584	169108	33313	169108	33313	-	-	-	5242526 44.8
Macaranga denticulata	710289	-	-	-	-	-	-	-	-	-	710289 6.0
Scheffia wallichii	-	33313	-	-	-	-	-	-	-	-	33313 0.3
Castanopsis hystrix	33313	-	-	-	-	-	-	-	-	-	33313 0.3
Castanopsis indica	-	-	33313	-	-	-	-	-	-	-	33313 0.3
Salix tetrasperma	-	33313	-	-	-	-	-	-	-	-	33313 0.3
Rest of species	2327601	980880	642520	169108	101432	33313	67626	33313	-	101432	4498425 38.4
Total	669832	2328076	1589645	333216	135235	232734	101439	33313	-	101432	11702536 -
Percentage	59.0	19.3	15.6	2.9	1.1	2.0	0.9	0.3	-	0.8	100.0

MANIPUR SURVEY

Stratum Area : 45924 ha.

TABLE : 5,1,5.

Vegetation-Tree Forest, Forest Type-Teak Gurial.Distribution of Total Stem by Diameter Classes and Species.

SPECIES	D I A M E T E R C L A S S E S (Cm.)							Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79		
Gmelina arborea	-	51022	-	-	-	-	-	51022	.3
Calycarpa arborea	-	51022	-	-	-	-	-	51022	.3
Miscellaneous species	3826991	1173590	102043	357197	51022	-	-	5510843	38.0
Michelia champaca	-	-	51022	-	-	-	-	51022	.3
Dipterocarpus turbinatus	561284	408219	51022	153065	51022	51022	-	1734874	12.0
Schemia wallichii	51022	-	-	-	-	-	-	51022	.3
Castanopsis hystrix	1479766	204087	-	-	-	-	-	1683853	11.6
Castanopsis indica	51022	-	-	-	-	-	-	51022	.3
Lagerstroemia floreginae	867460	206178	-	-	-	-	-	1173838	8.0
Quercus species	357197	-	-	102043	-	-	-	459240	3.1
Bridella retusa	765417	-	-	-	-	-	-	765417	5.2
Rest of species	1836963	714395	153065	51022	153065	-	102043	3010553	20.6
Total	9797122	2008511	816392	663327	255109	51022	102043	14593528	-
Percentage	67.1	20.0	5.6	4.6	1.7	.3	.7	-	100.0

MANIPUR SURVEY

App. XI-a

Table -5.2.1.

Stratum Area 16611 ha.

Vegetation -Open Forest, Forest Type -Wet Temperate

Distribution of Total Stem by Diameter Classes and Species

Species	DIAMETER CLASSES (Cm)					%
	10-19	20-29	30-39	40-49	Total	
Ficus species	33222	-	-	-	33222	3.4
Miscellaneous species	199330	66443	-	-	265773	27.6
Castanopsis hystrix	33222	99665	-	-	132887	13.8
Quercus semiserrata	232552	33222	-	-	265774	27.6
Rest of species	232552	-	-	33222	265774	27.6
Total	730878	199330	-	33222	963430	
Percentage	75.9	20.7	-	3.4		100.0

MANIPUR SURVEY

Ann. XII-b

Table - 5.2.2.

Stratum Area 92337 ha.

Vegetation - Open Forest, Forest Type - Pine

Distribution of Total Stems by Diameter Classes and Species.

Species	DIAMETER CLASSES (Cm)				Total	%
	10-19	20-29	30-39	100-109		
Pinus kesiya	307758				307758	8.3
Albizia lebbek	615609				615609	16.7
Grewia tillaefolia	307758				307758	8.3
Calycarpa arborea	307758				307758	8.3
Rest of species	1538976	307758	307758		2154492	58.4
Total	3077859	307758	307758		3693375	
Percentage	83.4	8.3	8.3			100.0

MANIFUR SURVEY

Stratum Area : 287239 ha.

App. XII-c

TABLE : 5.2.3.

Vegetation -Open ForestForest Type-Met Hills.Distribution of Total Stems by Diameter Classes and Species.

Species	D I A M E T E R C L A S S E S (Cm)									
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	Total %
<i>Pinus keslya</i>		7 28761	485840	242920	-	-	-	-	-	1457521 14.3
<i>Ficus species</i>	7 28761	-	-	-	-	-	-	-	-	7 28761 7.1
<i>Grewia tilliaefolia</i>	242920	242920	-	-	-	-	-	-	-	485840 4.8
<i>Calycarpa arborea</i>	7 28761	-	-	-	-	-	-	-	-	7 28761 7.1
Miscellaneous species	2872390	971661	-	-	-	-	-	-	242920	3886991 38.1
<i>Schemia walllichii</i>	485840	485840	-	-	-	-	-	-	-	971680 9.6
<i>Gastanopsis hystrix</i>	485840	-	242920	-	-	-	-	-	-	7 28760 7.1
Rest of species	242920	-	242920	242920	-	-	-	-	-	485840 4.8
<i>Quercus species</i>	-	-	485840	-	242920	-	-	-	-	7 28760 7.1
Total	5587432	2429202	1214600	48540	242920				242920	10202914
Percentage	54.7	23.8	11.9	4.8	2.4				2.4	100.0

MANIPUR SURVEY

ADD. XILL-8

Stratum Area : 128480 ha.

Table -6.4.1.

VEGETATION-TREE FOREST: FOREST TYPE-WET TEMPERATE.

DISTRIBUTION OF TOTAL VOLUME BY DIAMETER CLASSES AND SPECIES.

Species	DIAMETER CLASSES (Cm)										Total %
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-109	
Gmelina arborea	12977	-	-	-	-	-	-	-	-	-	12977 0.1
Calycarpa arborea	-	-	42530	-	-	-	-	-	-	-	42530 0.3
Kydia calycina	445345	1257143	2232394	773636	430569	1668310	517300	689090	907137	535417	9456841 59.8
Miscellaneous Species	6553	-	-	-	-	-	-	-	-	-	6553 0
Macaranga dent-iculata	61547	64831	-	-	-	-	233734	321481	-	-	584593 4.3
Schenia Walliichii	58334	237192	335615	-	-	-	-	-	-	-	631141 4.0
Castanopsis hystrix	-	-	-	-	-	-	-	-	468730	-	468730 3.0
Castanopsis indica	3598	-	-	-	-	-	-	-	-	-	3598 0
Quercus semiserrata	39575	52809	-	-	-	-	-	-	-	-	92384 0.6
Quercus species	73496	123307	72725	-	-	-	-	-	-	-	269828 1.7
Quercus species	7452	45742	52809	223868	-	-	-	-	-	-	335871 2.1
Alnus nepalensis	33580	33161	-	-	-	-	-	-	-	-	91741 0.6
Bridelia retusa	-	129132	545953	-	-	201986	233734	396648	447530	-	1959983 12.4
Salix tetrasperma	179115	208282	514344	255008	-	390994	233434	-	-	-	1766477 11.1
Rest of species	257	-	-	-	-	-	-	-	-	-	257 0
Total	941829	2154899	3796370	1238512	430569	2261230	1233502	1407219	1823397	535417	15823504 -
Percentage	5.0	13.6	24.0	7.8	2.7	14.3	7.8	8.9	11.5	3.4	100.0

Total
Percentage

Stratum Area : 151940 ha.

Table -6.1.2

VEGETATION - TREE FOREST, FOREST TYPE - PINE

Distribution of Total Volume M³ by Diameter Classes and Species.

Species	DIAMETER CLASSES (cm)										Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99			
<i>Pinus kesiya</i>	134315	1054466	1284447	872137	993993	-	-	398337	-	4717745	51.8	
<i>Albizia procera</i>	15194	-	-	-	-	-	-	-	-	15194	.2	
<i>Grewia tilliaefolia</i>	17169	-	-	-	-	-	-	-	-	17169	.2	
<i>Calycarpa arborea</i>	4406	-	-	-	-	-	-	-	-	4406	0	
<i>Miscellanacus species</i>	247359	319986	344155	-	-	-	-	-	-	911490	10.0	
<i>Macaranga denticulata</i>	1367	-	-	-	-	-	-	-	-	1367	0	
<i>Schinus wallichii</i>	12003	-	97765	106358	-	-	-	-	-	186128	2.0	
<i>Castanopsis hystrix</i>	200237	180049	237623	151029	-	-	-	-	-	818958	9.0	
<i>Castanopsis indica</i>	61536	-	86302	-	-	-	-	-	-	147838	1.6	
<i>Quercus semiserrata</i>	60016	242193	181873	69133	-	-	290814	-	-	844029	9.3	
<i>Alnus nepalensis</i>	-	-	-	-	-	-	285896	-	443058	708954	7.8	
<i>Bridellia retusa</i>	5774	71716	-	-	-	-	-	-	-	77490	.8	
<i>Salix tetrasperma</i>	43151	105447	61992	-	-	-	-	-	-	210590	2.3	
Rest of species	67461	49684	113955	96178	127934	-	-	-	-	455212	5.0	
Total	870008	2023541	2408102	1294635	1121927	-	556710	398337	443058	9143568	-	
Percentage							6.1	4.4				

MANIPUR SURVEY

Add. XIII-C

Stratum Area : 45924 ha.

Table : 6.1.5.

Vegetation-Tree Forest, Forest Type - Teak Gurian

Distribution of Total Volume by Diameter Classes and species.

Species	DIAMETER CLASSES (Cm)							Total	%
	10-19	20-29	30-39	40-49	50-59	60-69	70-79		
<i>Gmelina arborea</i>	-	10287	-	-	-	-	-	10287	0.3
<i>Calycarpa arborea</i>	-	18094	-	-	-	-	-	18094	0.6
Miscellaneous species	144293	289023	58507	404453	86245	-	-	962521	29.4
<i>Michellia champaca</i>	-	-	30302	-	-	-	-	30402	0.9
<i>Dipterocarpus turbinatus</i>	21630	107003	309804	187829	106819	139334	-	872419	26.6
<i>Schemdia wallidhii</i>	5603	-	-	-	-	-	-	5603	0.2
<i>Castanopsis hystrix</i>	48220	58609	-	-	-	-	-	107829	3.3
<i>Castanopsis indica</i>	459	-	-	-	-	-	-	459	0
<i>Lagerstroemia floreginna</i>	37061	78484	-	-	-	-	-	115545	3.5
<i>Quercus species</i>	11894	-	-	106636	-	-	-	118530	3.6
<i>Bridelia retusa</i>	11619	-	-	-	-	-	-	11619	0.4
Rest of species	47853	156509	80551	64477	282984	-	292926	1025300	31.2
Total	328632	699809	479264	763395	476048	139334	392926	3278608	-
Percentage	10.0	21.5	14.6	23.3	14.5	4.3	12.0	-	100.0

VEGETATION-OPEN FOREST, FOREST TYPE-WET TEMPERATE

DISTRIBUTION OF TOTAL VOLUME BY DIAMETER CLASSES AND SPECIES

Species	DIAMETER CLASSES (Cm)					Total	%
	10-19	20-29	30-39	40-49			
Ficus species	316	--	--	--		316	0.3
Miscellaneous species	6279	16115	--	--		22392	23.8
Castanopsis hystrix	797	21561	--	--		22358	23.8
Quercus semiserrata	5498	5847	--	--		11345	12.1
Rest of species	3987	--	--	33670		37657	40.0
Total	16877	43521	--	33670		94068	
Percentage	17.9	46.3	--	35.8			100.0

MANIPUR SURVEY

Ann. XIV-b

Table - 6.2.2.

Stratum Area 92337 ha.

Vegetation - Open Forest. Forest Type-Pine

Distribution of Total Volume by Diameter Classes and Species.

Species	DIAMETER CLASSES (CM)					%
	10-19	20-29	30-39	100-109	Total	
Pinus kesiya	17544				17544	3.6
Albizia lebbek	13389				13389	2.7
Grewia tilliaefolia	14035				14035	2.8
Calycarpa arborea	2862				2862	0.6
Rest of species	65467	120222	259743		445432	90.3
Total	113297	120222	259743		493262	100.0
Percentage	23.0	24.4	62.6			100.0

