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GOVERNMENT OF INDIA
MINISTRY OF AGRICULTURE
(Department of Agriculture & Cooperation)

REPORT
ON
FOREST RESOURCES OF
TULI CATCHMENT
(NAGALAND)



FOREST SURVEY OF INDIA
DEHRA DUN
1981

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MINISTRY OF AGRICULTURE
(DEPARTMENT OF AGRICULTURE & COOPERATION)

REPORT ON FOREST INVENTORY
OF
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P R E F A C E

The project area which forms principal catchment of Tuli Pulp and Paper Mill, henceforth named as 'Tuli Catchment' extends over an area of 2263.07 km². The Survey of Forest Resources of Tuli catchment was taken up during 1978-79 and was completed in about six months time. The broad objectives of the survey were -

- i) To estimate the total growing stock of commercial timber within an error limit of $\pm 10\%$ at 95% probability level of total growing stock of wood.
- ii) To furnish an estimate of bamboo and reed stock in the area.
- iii) To furnish volume table for important commercial species.

The report presents the basic facts about area surveyed, the methodology adopted and findings have been produced in the form of report. An abridged report showing in a nutshell a summary of the main report has also been prepared.

The forests primarily belong to Assam Valley tropical wet evergreen type which is multi-storied and evergreen in nature. The forests presents a most picturesque type of vegetation with a rich variety of species. Bamboos are found in almost pure patches over extensive areas. Reeds also are present. It seems the reeds and bamboos are secondary successful crop.

The project area reflects a gloomy picture for further development of timber based industries. From the available surplus of Reeds and Bamboos in the area it is observed that about 75,000 MT of pulvable material for use in pulp and paper industry is available as surplus. It is just sufficient to feed the 100 tonnes/day per mill already established at Tuli. It is cautioned at this juncture that Intensive Management Scheme must be drawn up by the State and Stress is to be laid on creating plantations for augmenting sustained yield of probable material.

A naive approach may upset the entire working of the mill and would have a devastating effect in the long run. It is presumed all those factors must have been considered while establishing the factory as the adjoining area have some bamboos and reeds it would be possible to utilise such pulvable materials to bridge any gap in supply of raw material that may be faced in future owing to less out-turn of reeds and extensive felling due to shifting cultivation. Since the reed species have come up on degraded and denuded land and neither sufficient growth data nor management experience are available, there is no immediate scope of improvement of stock. It has, therefore, become essential to lay emphasis to replace such

crop with massive plantation of maboo to regulate the flow of sustained yield.

While formulating the development activities in the factory sector, certain retarding factors that stand on the way for industrial development need a close consideration. The important among them are the special geographical configuration of the region viz. hilly and difficult terrain and lack of infrastructure facilities. Besides, the shifting cultivation has always remained a sore problem in the area that puts a halt to any forestry activities to bring about an effective change on the socio-economic uplift of the people.

It is impressed that the State Forest Department should take note of this alarming situation and must adopt proper steps to secure willing and voluntary cooperation of the people to subject their land to new Agri-Silvicultural practices.

The paper mill already established at Tuli, is indicative of the fact that feasibility study must have been carried out at sufficient depth to appreciate the limiting factors encircling the physiography and quantum of availability of raw material. The field work and drafting of report was carried out under the able guidance of Shri A.B. Chaudhuri, Zonal Coordination.

The Proinvestment Survey of Forest Resources acknowledges the hard and arduous work put in by the members of the staff of Eastern Zone headed by the Zonal Coordinator.

sl/-

Chief Coordinator.

P R E A M B L E

Luxuriant bamboo forests are the pride of the Eastern Indian States. A wide varieties of valuable bamboo species are grown extensively in these States. The gregarious occurrence of bamboos in Eastern region surpass all other States of India in respect of number and density. These huge potential of basic raw materials prompted most of the Eastern Indian States to get their bamboo wealth surveyed by the Pre-investment Survey of Forest Resources Organization. So far bamboo wealth of Tripura, Manipur, Meghalaya and a part of Arunachal has been inventoried. The vast resources of bamboo in Eastern Indian States prompted the Government to establish the factories at Tuli, Badarpur & Jagi Road for utilization of existing raw materials.

The Hindusthan Paper Corporation Ltd. (A Government of India Undertaking) was entrusted with the job of delineation of bamboo bearing areas in Tuli industrial catchment of Nagaland for Nagaland Pulp & Paper Company. The Corporation worked jointly with the Government of Nagaland. The catchment study covered an area of 1,500 km² divided into six industrial sectors. This investigation centred round delineation of bamboo and reed areas with modern technique of photointerpretation. The details were transferred on the base maps of 1:50,000 scale with the help of vertical aero sketch master and area calculation was carried out using 0.5 x 0.5 cm. dot grid.

The study has revealed some interesting features. Bamboo occurred as pure patch in about 425 km² and as an understorey in about 475 km². Thus in approximately 50% of the total area contained bamboo which could be made available for Tuli Paper Mill. A reconnaissance survey of the Tuli catchment was done by the Officers of the Chief Co-ordinator's Office and a report was submitted in May, 1976.

The National Remote Sensing Agency also carried out a Satellite Remote Sensing of Natural Resources of Nagaland at the request of North Eastern Council (Government of India). The project envisaged an intergrated survey of the entire State of Nagaland to provide basic information regarding forests, land use, soil, geomorphology and geology for the development of the region. The execution was done in six months time. It was found that inventory of the existing resources and periodic survey of the exploitation and regeneration are the primary requisites for planning and execution of developmental programme. The mountain valleys were found to be narrow and V-shaped. The Organization stressed that economic development of this region depend upon setting up of forest based industries. It also stressed on full exploitation of mineral wealth.

While making recommendations they observed that indiscriminate felling of forests have been done in the past and jhoom cultivation has extended all over state. Bamboo resources in the area was found to be plenty. They suggested immediate checking of indiscriminate destruction of forests and intensive afforestation of the blank areas.

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Introduction.

A paper mill designated as Nagaland Pulp & Paper Company has already been established under the Fourth Five Year Plan period with an investment of Rs.62.55 crores. The State Govt. subscribed Rs.425 Lakhs upto 1977-78 towards its share capital. An area of 100 Km² was acquired at Rs.4.50 crores for preserving raw materials like bamboo and reeds.

The mill was expected to produce 100 tonnes of writing and printing paper per day with annual intake of 75,000 tonnes of raw material with equal quantity of bamboo and reeds. But actually there is surplus of 19460 MT of bamboo and 56196 MT of reed, about 75,000 MT in total. In the meantime, the Hindustan Paper Corporation, Ltd., The Remote Sensing Agency and the Preinvestment Survey of Forest Resources, Dehra Dun carried out investigations and reconnaissance survey separately.

Lately, the Preinvestment Survey of Forest Resources, Eastern Zone, Calcutta carried out the resources survey of Tuli Catchment area on a sound statistical footing and the present report is the out-come of this recent survey.

The Background.

Nagaland is one of the smallest States in India with an area of 16,527 km² which was separated from Assam and was inaugurated on 1st December, 1963 with its capital at Kohima. The State is bounded in the North by Arunachal Pradesh, South by Manipur, east by Burma and west by Assam. It has a population of 5,16,449 (1971 census).

The State is located in the northern extension of the Arakan Yoma ranges representing organic upheavals in this part of the country during cretaceous and tertiary periods. The State consists of a narrow strip of hilly country running North-East to South-East and facing the Assam plains to its north and north-west. The geographical area of the State lies between 25° 20' to 95° 15' east longitude.

The population of the State is over 5 lakhs and is almost entirely tribals. There are as many as sixteen tribes and sub-tribes amongst the Nagas, with their own distinctive languages and cultural features. Most of the tribal peoples are living in the villages which are situated on the hill tops in different parts of the State. From long past people preferred hill tops as village site in spite of the fact that they were facing difficulties in transportation of water and other daily commodities.

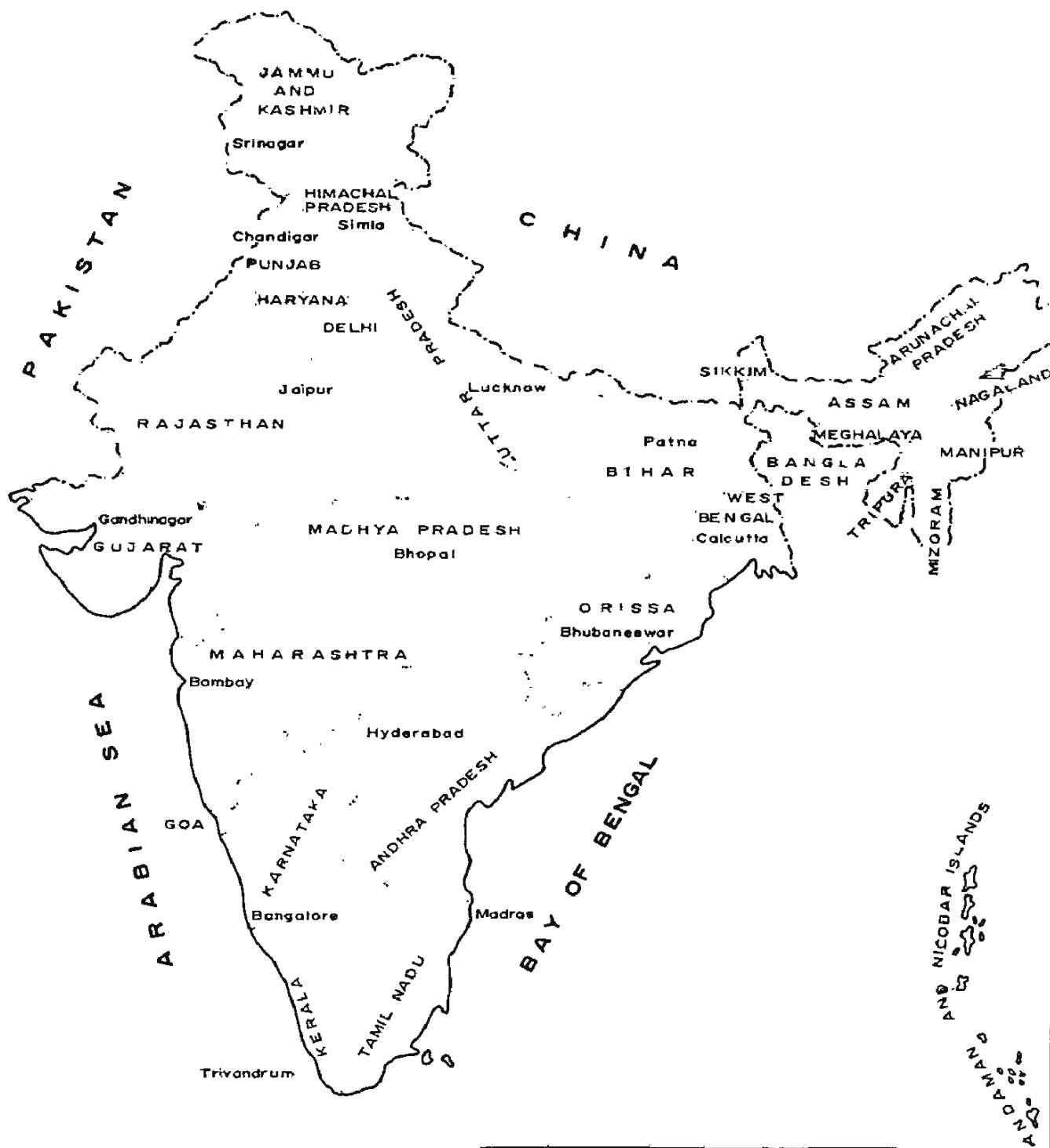
Economy of the village people of the State depends on shifting cultivation (Jhuming). But increase of population and continuous decreasing productivity of land had a retarding effect on the economy of the State. On the other hand "Jhuming" enhances soil erosion on hill slopes of denuded forest areas, which upset the ecological balance of the area. Local people adopted "Jhuming" as an ancestral agricultural practice from time immemorial.

At present Government have taken up different schemes to remove this practice and change over to permanent cultivation and terracing.

MAP OF INDIA SHOWING

PROJECT AREA IN TULI CATCHMENT (NAGALAND)

SCALE - 1cm = 158 kms.



PROJECT AREA IN THIS REPORT

C H A P T E R - I.

GENERAL.

1.1. Name of the area:

The present project area comprises of small areas of Mokokchung, Tuensung and major portion of Mon administrative districts of Nagaland. The Divisional Forest Headquarters are at Mokokchung, Tuensong and Mon. The project area which forms principal catchment of Tuli pulp & paper Mill will henceforth be named as "Tuli Catchment" and extends over an area of 2263.07 km².

1.2. Location :

The project survey area lies between 94°20'45" to 95°14'48" East longitude and 26°30' to 27°04' North latitude. The northern side of the project area is bounded by Assam, the southern side by Tuensung, Mon and Mokokchung Districts of Nagaland, the eastern side by Tirap district of Arunachal Pradesh, Burma and the western side by Assam.

Out of the total project area of 2263.07 km², Mon district covers 1615.45 km², Mokokchung 469.42 km² and Tuensung 178.20 km².

1.3. Factors of locality :

The terrain in the project area is mainly hilly and undulating. Mokokchung and Tuensung Districts are more hilly than the Mon district. Tuli, Tjit and Tiru areas are comparatively more or less flat. Southern part of the project area gradually rises in elevation towards the south and east. Average altitude of the whole project area varies from 700 m. to 800 m. and the highest altitude is about 1300 m.

The original inhabitants are Nagas, who are said to be admixture of (1) the Negritos (2) the Australoids and (3) the Mongoloids and are probably the earliest people of Nagaland. Tribal people residing in the project area are mainly Aos, Konyaks and Phoms who are basically rural in character. About 117 villages are distributed throughout the project area with a population of 1,15,917.

The main occupation of the village people is shifting cultivation (Jhuming). Jhuming is widely extended all over the hills of Nagaland. It is the most primitive and traditional method of cultivation of the Nagas.

In such practice the selected area is used continuously for two years with 8 to 12 years rotation. Jhuming is solely dependent on the seasonal rain. Besides, many of the Nagas earn their livelihood by hunting, fishing, weaving, minor forest produce collection, cane and bamboo work blacksmith for making iron implements etc.

The innerline restrictions to get entry in Nagaland is one of the most vital factors which indirectly influenced trade and transportation of forest produce and forest works. There are restrictions for general public for getting entry in the State for different works in the forest. Only the village authority arrange daily labourers for different departmental works.

1.4. Physical feature :

The terrain is in general hilly except the North-Eastern portion, which is comparatively of easier gradient.

The area is criss-crossed with seasonal streams which drain into Tiru, Jhanzi, Diku, Tigap, Sinyng, and Tijit rivers, in the project area. They are the main rivers in the area which finally drain to the river Brahmaputra.

1.5. Geology, Rock & Soil :

The project area comprises of Mokokchung, Mon and Tuensung districts of Nagaland State. The State covers an area of approximately 16,527 km² in which 2263.07 km² were surveyed.

The rock sequence is of the geosynsinal facies, represented by the Disang group (lower and middle Eocene-upper cretaceous), the Barail group (Upper Eocene and Oligocene), the Surma and the Tipam group (Miocene), the Namsang beds (Miopliocene) and the Dihing group (Pliocene pleisloceus). On the North-western flank of the Naga hills, occurs the structural unit called "The belt of Schupen" consisting of eight or more overthrusts over-ridding one above the others forming an imbricate pattern. The North-western margin is demarcated by the Naga thrust which separates the folded sediments of "The Belt of Schupen" from a little attached flat to gently dipping beds occurring north of the belt. In the South-east "The Belt of Schupen" is separated from the Disang group of rocks by the Disang thrust.

Rock types occurring in the area mainly comprise of grey splintery shale/slate, sandstone, carbonaceous, shale with coal seams etc.

The soil is loam type, rich and acidic in nature. The texture becomes finer on southwards due to additional humus content. The soil is highly susceptible to erosion and in many parts where Jhuming is in practice, has lost its fertility. In the valleys and plains the soil is deep alluvium formed by the washings of the hills and river deposits.

1.6. Climate :

The area falls under humid tropical climate. The monsoon starts in May and continues till September. The area receives on an average of 2000 m.m. rainfall annually. Mokokchung receives about 3500 m.m. and Tamu about 2500 m.m. annually. In the adjoining areas of Assam at Sonari, Nazira, Sibsagar & Amguri average annual rainfall is 2500 m.m., 3000 m.m., 2200 m.m., & 3050 m.m. respectively. At Tijit average annual rainfall is 1644 m.m. A heavy rainfall occurs between June & September.

Mean maximum and minimum temperature varies between 23.8°C. & 13.8°C. respectively. June & July are the hottest months of the year.

The percentage of humidity varies from 75% to 85% in the locality. Humidity is generally high during the rains. December and January are the coldest months of the year. Fog is noticed frequently during the period from November to February. Heavy dewfall is observed during winter.

The climatic condition of the area is generally healthy.

1.7. The people and their socio-economic condition :

The inhabitants of the State are an Indo-Mongaloid folk with a dozen of major tribes along with sub-tribes. The speaking languages and dialects are more than double the number of tribes. There is a common language among them known as Nagamese, which is the main source of correspondence among themselves and the people of adjacent plains. The official language is English. The people are as a whole agriculturist and are mostly dependent on Jhum cultivation. The Jhumming is being practiced from the time immemorial. At present terrace cultivation is being encouraged by the State Government. But still this is not adopted by the inhabitants. The main crops are paddy, maize and millets. Also pulses, grams, chilli, pumpkin, ginger, castor and tur are cultivated. These crops are sold to plains of Assam to meet the other necessary requirements, specially salt and other materials which are not produced in the area.

The people are primarily dependent on forests. About 80% of the total population of the catchment area earn their livelihood by Jhum cultivation. Besides the important cottage industries of this area are spinning and weaving, rearing of Endi and Muga, carpentry, blacksmithy, mat-making, making of bamboo and cane goods etc.

For the domestic uses the local people require firewood, constructional timber, poles, bamboos, canes, reeds and grasses including thatch from the forest produce.

1.8. Infrastructure :

The North-eastern region is potentially rich in mineral resources. Nagaland has deposits of coal and lime-stone near Nazira and in Tuensang District. Oil & Natural Gas are available in Assam not far from the project area. Coal is available in Meghalaya. Assam, Makum and Jaipur-Dilli areas have coal fields. Lime-stone and Dolomite are available in Garo, Khasi, Jaintia, North Cachar & Mikir hills. Sillimanite is found in Sonapahar. All these resources are located very near the project area.

Electricity production is a formidable constraint in the development of industry in the region. Kopili Hydro-electric project with a proposed installation of 250 MW is likely to help industrialisation in the region.

The distribution of hydro-potential of the North Eastern region is as follows :-

South bank of Barak river		Power potential at 60% L.F. in million KW
1.	Kopili Valley	0.6
2.	Umiew - Umiam - Umtru - Khri	0.4
3.	Umiam - Umkhan	0.4
4.	Kyns-hi	0.5
5.	Other small rivers in Khasi & Jaintia hills.	0.3
		<u>2.2</u>

North bank of Brahmaputra

Power potential at 60% L.F. in
million KW

H. Dihang, Dibang, Lohit, Kamrup
& Subansiri.

8.8

Barak valley & Manipur river

-

Lokiak, Barak and others

1.0

Other infrastructural requirements of the area as a whole are very unsatisfactory. Lack of communication and transportation facilities is the main cause for the backwardness of the area. There are two all weather roads namely Amguri-Mokokchung Road (104 km.) & Sonari-Mon road (55 km.) (linking this territory with the rest of India) which are also liable to interruption due to land-slides during the rains. The nearest Railway stations of Tuli catchment area are Naginimara, Amguri, Moriani, Bhajju & Simulguri.

According to available information a total of 900 km. roads exist in the project area of which metalled road is 95 km., gravelled road is 211 km. and kaccha road is 594 km. Besides 53 km. extraction path and a new road (120 km. approximately) are under construction which will lead from Dimapur (Nagaland) to Delli (Assam). Simulguri-Mon road via Naginimara is widely used for extraction of timber.

From Mokokchung, Kohima can be approached by Nagaland State Highway through Wakha. From Tuli three roads lead to three well known villages which are Tuli-Wamaken road (8 km.), Tuli-Kungtsung to Luba (6 km.) and Tuli-Mulungy-insentroad (7 km.).

There is sufficient flat areas to store raw materials. Principal depots are situated near the Rail/Road/River head so that the materials can be transported promptly. The forestry division, Indian Photointerpretation Institute, Dehradun, suggested the location of a few depots in their as follows :-

<u>Industrial Sector</u>	<u>Distance from Tuli in km.</u>	<u>Location of Forest Depot.</u>
Namsa	120	Namsa village.
Naginimara	70	Naginimara
Singphan	68	On Dhiku Singphan near F.R.H.
Tuli	0	Near Mill site
Geleki	50	Near Geleki Chanki
Sachak	77	Sachak near Mokokchung - Mariyani road.

1.9. Area :

The study area lies within the North latitude of $26^{\circ}30'$ to $27^{\circ}4'$ North and East longitude of $94^{\circ}20'45''$ and $95^{\circ}14'48''$ East and form part of three districts viz., Mon, Mokokchung & Tuensung.

The survey was conducted over 1615.45 km^2 of Mon district, 469.42 km^2 in Mokokchung district & 178.20 km^2 in Tuensung district (Map - 1).

Stratumwise area statement is given hereunder. In absence of latest aerial photograph or any area statement from the local officials, this statement has been made from ground survey of the field staff who traversed every km² of the project area and reflected the observation on topo-sheet.

1.9.1. Stratum-wise area statement of Tuli catchment (Nagaland) (Map-2).

Map sheet Number.	Bamboo forest	Reed forest	Ever-green forest	Semi-evergreen forest.	Misc. with bamboo	Total forest area.	Jhum	Others	Total area.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
83 J/6	328 ha.	4190 ha.	-	1535 ha.	-	6053ha.	567 ha.	-	6620 ha.
83 J/9	370 ha.	-	-	41 ha.	-	411ha.	-	-	411 ha.
83 J/10	-	28919 ha.	-	3817 ha.	1608 ha.	34344ha.	3706 ha.	1500ha.	39550ha.
83 J/13	-	-	-	29582 ha.	-	29582ha.	3425 ha.	3000"	36007"
83 J/14	-	-	-	1060 ha.	-	1060ha.	44392 ha.	4000"	49452"
83 M/4	-	-	-	795 ha.	-	795ha.	132 ha.	-	927"
83 N/1	2682 ha.	11355 ha.	-	9325 ha.	-	23362ha.	24746 ha.	1500"	49608"
83 N/2	-	-	-	-	-	-	43732 ha.	-	43732"
Total:	3380 ha.	44464 ha.	-	46155 ha.	1608 ha.	95607ha.	120700"	10000"	226307"

1.9.2. Districtwise area statement of Tuli Catchment, Nagaland.

Sl. No.	Toposheet Number	Name of District			Total area
		Mon	Mokokchung	Tuensung	
1.	83 J/6	-	66.53 km ²	-	66.53 km ²
2.	83 J/9	1.83 km ²	2.42 "	-	4.25 "
3.	83 J/10	-	399.17 "	13.74 km ²	412.91 "
4.	83 J/13	335.40 "	-	24.62 "	360.02 "
5.	83 J/14	369.60 "	1.30 "	139.84 "	510.74 "
6.	83 M/4	9.27 "	-	-	9.27 "
7.	83 N/1	512.27 "	-	-	512.27 "
8.	83 N/2	387.02 "	-	-	387.08 "
Total :		1615.45 "	469.42 "	178.20 "	2263.07 "

1.10. Map & aerial photographs :

The Survey of India prepared maps of the region in 1972-1975 on a scale of 1:50,000.

The following are the details of Index number, scale, year of survey etc.

SURVEY OF INDIA MAP COVERAGE AND PROJECT AREA.

Index No.	Scale	Year of survey	Area of the project within the map sheet in km ² .	Remarks
83 J/6	1 : 50,000	1974	62.48	-
83 J/9	1 : 50,000	1974	4.12	-
83 J/10	1 : 50,000	1974-75	391.78	-
83 J/13	1 : 50,000	1974-75	358.99	-
83 J/14	1 : 50,000	1974-75	492.99	-
83 M/4	1 : 50,000	1972-73	8.76	-
83 N/1	1 : 50,000	1974-75	514.81	-
83 N/2	1 : 50,000	Trace copy	429.14	-
Total area :			2263.07 km ²	

Aerial photographs were not available during the course of our survey. The Consultancy report by the I.P.I. on the part of the project area was based on aerial photo-interpretation and transferring the area on base map.

CHAPTER - II.

THE RESOURCES BASE.

2.1. Vegetation :

The forests of the project area are contiguous to the extensive resources of Assam falling in the districts of Jorhat and Dibrugarh to the north and north-west and Tirap forests to the east. The principal valuable species of high density are - Shorea assamica and Dipterocarpus macrocarpus. A detailed list of other tree species, shrubs, bamboos and grasses occurring in Nagaland forests have been given in Appendix - I of the report.

The forests primarily belong to Assam Valley tropical wet evergreen type which are multi-storeyed and evergreen in nature. Dipterocarpus macrocarpus (Hollong) and Shorea assamica (Mekai) occur in the top canopy towering all other trees. Other comparatively minor species in the top canopy are Artocarpus chaplasha (Sam), Amoora wallichii (Amari), Cinnamomum obtusifolium (Gonsoroi). The middle storey mainly consists of Mesua ferrea (Nahor) and Vatica lanceaefolia (Morhal). Other associated species are Michelia species (Champ), Bombax ceiba (Simul), Gmelina arborea (Gamar), Adina oligocephala (Halduchopa), Syzizium species (Jam) & Dysoxylum species (Bandardima).

Unlike the forests of Tirap or Dibrugarh, Dillenia, Erythrina, Kydia, Bischofia, Terminalia myriocarpa have less incidence of occurrence. Altingia excelsa is widespread.

The ground cover has evergreen species like Pinanga gracilis, Laportia crenulata, Alpinia alluquhus, Leea sambucina, Engenia balasamina, Calamus species.

Mekai (Shorea assamica) Forests.

In higher elevation this species occurs sometimes in pure formations. In the top storey it forms 70% of the crop at places. Other associates are Amoora wallichii, Michelia champaca, Toona ciliata & Artocarpus chaplasha.

2.2. Forest types.

The forests dealt with can be subdivided into two broad categories, the Hollong forests and the Miscellaneous forests. The former, better named as the Assam Tropical Evergreen forest fits into the climatic climax vegetation of the locality and the latter is a seral type which should ultimately lead to an evergreen type if unaffected by the biotic influence.

Assam Tropical Evergreen Forests.

This type is most picturesque blessed with a rich variety of species, and comprises of the best stocked stands in the area. It starts from the western limit and becomes more pronounced in character as it proceeds eastwards, attaining its best and most typical condition in the Tigit area. These forests occur in a tract where the rainfall is heavy and the climate is damp. Even in the comparatively dry winter months, there are either occasional showers of rain or heavy dew-fall at night.

The crop is composed of several canopy layers, most of the component species are evergreen in character. The top canopy is characterised by Hollong which towers majestically over the rest, with clean straight

boles upto 35 m. or more in length sometimes. Dipterocarpus is associated in the top canopy with Hollong and Mekai. This association of Hollong and Mekai is, however, not uniform throughout these forests.

Other species that tend to reach similar heights in the top canopy are Sam, Ampil, Gonsoroi different kinds of Sopas etc. The occurrence of these species is only sporadic in an otherwise gregarious crop of Hollong and Mekai. The latter species are generally confined to the better drained areas in these forests and when drainage conditions become poor, they get replaced by other species like Ajhar, Uriam etc.

The middle storey is characterised by a preponderance of Nahor and Morhal, the former is a useful timber species while the latter (another evergreen Dipterocarpus) is used as firewood at present. Both cast a fairly heavy shade on the forest floor, the former being particularly heavy and covering a wider area on account of its spreading crown. Besides these two, there are several other species that make up the middle storey, the more common among them being Bandardima, Bhomora, Bonboguri, Dhuna, Jam, Phulgomari etc.

Regeneration of the principal species like Hollong, Mekai and Nahor, is found practically throughout the forests. Other commercially important species regeneration is generally confined to places near about the mother trees.

Miscellaneous Forests.

This type occurs in scattered patches of varying sizes. No single species is particularly dominant in this type.

In these forests the characteristic feature is that the top canopy is predominated by deciduous species whose leafless period is short. In quality, these forests contain a much poorer type of timber than the evergreen forests and are composed of a number of species that are of little commercial value. A variety of soils are encountered in these forests ranging from a sandy to clayey texture, but generally the soil is deficient in plant food.

The most common tree in the top canopy is Bhelu. It towers over the rest and grows to gigantic sizes but has a poor stem form on account of its large buttressing habit. Its occurrence is uniform throughout the forests and is found on almost all kinds of soils (though it prefers well-drained sites). Among other species in the upper canopy are Amari, different kinds of Sopas, and Sam. Occurring to a lesser extent are Bogopoma, Gonsoroi and Bonsum, among the important timber trees.

Bamboos are found in almost pure patches over extensive areas. They also occur in mixed association with miscellaneous crop. Besides, extensive areas are covered with bamboos and reeds occur as secondary forests. In Moist Deciduous and Semi-evergreen forests bamboo occurs as scattered crop. The principal species are Dalu (Teinostachyum dullooa), Jati (Bambusa tulda) & Kako (Dendrocalamus hamiltonii), D. hamiltonii occurs over extensive areas and are principal raw materials for paper and pulp industry.

Reed Forests.

Repeated Jhuming on a particular site reduces soil fertility to a state where tree crop, even herbs and shrubs fail to grow. Such soil occurs extensively in northern Nagaland and have been invaded by primarily three tall coarse grass species viz. Neyraudia renaudiana (Khagra), Thyssonolaena maxima (Phul jharu), Erianthus ravennae (Ekra, Ikra), and also Saccharum species. These reeds form basic material for pulp production in the project area which is a unique phenomenon in the North Eastern India.

2.3. Land Use.

The land, in Nagaland, belongs to the people. There is no plot without an owner. Each tribe has a well defined territory. Within the tribal territory every village has a well defined area of land. The inter-village territory is classified into :-

- (i) Primary or Agriculture Land.
- (ii) Subsidiary or building and Reserve land.

The Agricultural lands are divided into "Lineage land" & Individual land".

The individual has absolute right over his land. He has a right to share the produce of the land, to transfer holdings, to alienate and to grant right of use to others. The man who turns a piece of jungle or a plot of waste land into arable land becomes the owner of the land.

Except Reserve Forests, Protected Forests and Government holdings, two customary rights enjoyed by the people over the entire land of the State are :-

- i) The rights of rotational Jhuming by cutting and burning the vegetation.
- ii) The right of levying a charge as "Naga Commission" on any forest produce removed from the area for trade purposes.

The area dealt with constitutes 1% legally protected forest while the whole Nagaland constitutes more than 1% but less than 2% legally protected forest area.

2.4. Demarcation :

The tract dealt with has no legal position as a forest. So no demarcation was ever done. Singphan, the only reserve forest of the project area comprising an area of 2330 ha. is well demarcated with natural and artificial features. Besides the entire project area comes under the village forests. Though the areas of village forests are fixed and inter village demarcations are permanent and undisputable, yet well managed boundary line has not been observed during the time of the present survey.

2.5. Legal Status:

The land belongs to the people and the Government has no right to interfere. The provisions of the "Sadiya Frontier Tract Jhum Land Regulation, 1947" are being followed in Nagaland. The villagers have right to realise some money known as "Naga Commission" for themselves, over and above the Government royalty payable by the purchasers for removal of timber and other forest produce.

The individual has right to tender his land for a public purpose on payment of reasonable compensation with formal acquisition proceedings. One loses his customary right to Jhum land if the land is left uncultivated for a period of thirty years. This provision helps the Forest Department to convert these valuable forest into a "Reserve Forest" or "Village Forest" under the newly drafted Nagaland Forest Act, 1967.

The following areas have been purchased by the Forest department in the project area from the local people for raising bamboo plantation under the supervision of Nagaland Pulp & Paper Company, Tuli :

1. Jaboka Forest Bamboo area	-	2142.91 ha.
2. Naginimara hatadi bamboo area	-	1207.69 ha.
3. Wanching Forest bamboo area	-	674.89 ha.
4. Tirumen bamboo area	-	429.14 ha.
5. Kongtsung toluba bamboo area	-	441.66 ha.
6. Melungyimsum reed area	-	735.08 ha.
7. Kongtsung toluba reed area	-	692.30 ha.
8. Wamukam reed area	-	311.74 ha.
9. Yimchenkimong reed area	-	198.38 ha.
10. Merangkong reed area	-	772.46 ha.
Total :		<u>7606.25 ha.</u>

2.6. Natural Resources :

The State is rich in mineral resources. The coal-field area spread from Congon (near Naginimara) to Tamlu in Tuensong district. Coal was extracted from Kongon Belt till 1963. Discussion is going on at present among State and Central Governments for exploratory drilling of the same area. Promising deposit of coal located in Tiru valley area in Mon district by the Geological Survey; oil field was also found in the border of Assam & Nagaland on the bank of Dikhu river. No large scale operation has yet been undertaken.

Preliminary actions have been taken for implementation of the 1000 K.W. Dikhu Micro-Hydel project on Dikhu river with an estimated cost of Rs. 64.00 lakhs.

River beds, stones and sand are giving a good amount of revenue to the Forest Department.

2.7. Forest Resources :

The divergence of altitudinal and climatic conditions have made this area favourable for growth of many kinds of trees, shrubs climbers and herbs. The forest areas are mainly under the ownership of village headmen and the exploitation has not been on scientific line. The civil

administration must take immediate steps to settle the issue of protection, demarcation & scientific management of forests; otherwise the assessment of resources now made will prove futile in the long run.

It has been found that Dipterocarpus macrocarpus, Shorea assamica, Vatica lanceifolia, Mesua ferrea have high density. Besides these, Amoora wallichii, Artocarpus chaplasha, Canarium rosiniferum, Endospermum chinense, Stereospermum species, Altingia excelsa, Garuga pinnata, Cinnamomum glanduleferum, Terminalia citrina, Castanopsis species, Nyssa javonica, Schima wallichii, Ailanthus grandis have high incidence of occurrence.

Reeds have invaded many clearfelled areas as secondary succession species of which Saccharum arundinaceum (Ekra, Ikra), Neyraudia reynaudiana (Khagra), Thysanolaena maxima (Phul Jharu) and Erianthis revennae (Eksro) are wide spread and occur either as pure crop or in dense associations among themselves.

The most common bamboo species are Bambusa tulda (Jati) and Dendrocalamus hamiltonii (Kako). Bambusa palida (Bijuli), Melocanna bambusoides (Muli) and Pseudostachyum polymorphum (Bijal) and they occur sporadically.

2.8. Distribution of Forest Resources :

Owing to the divergence of altitude & variability of vegetative character in the area, four distinct strata namely reeds, bamboo, misc. & semi-evergreen could be recognised.

The percentage coverage of area by each stratum is as under :-

Strata	Area (ha.)	% of area covered by the stratum.
Bamboo forest	3380 ha.	1.49
Reed forest	44464 ha.	19.65
Semi-evergreen forest	46155 ha.	20.39
Misc. & bamboo forest	1608 ha.	0.71
Other + Jhum	130700 ha.	57.76
226307		

On perusal of the study on the species and diameter distribution of stems in the stratum, the following picture is revealed :-

Stratum	Stem/ha.	% of stem in (10-29) diameter class
Reeds ✓	44.145	76.8
Bamboo ✓	69.351	76.2
Misc. & bamboo ✓	85.600	73.8
Semi-evergreen ✓	205.495	72.7

The above figure pinpoints the fact that there had been an indiscriminate felling of mature & over-mature trees in the area.

2.9. Productivity of Bamboo & Reeds :

Chemical & physical status of soil under shifting cultivation for ages have been studied. Progressive decline in the productivity of hill slopes has been established. Exposed bare rocks are clear evidence of excessive soil erosion. The result is the reduction in water-retention capacity of soil.

The quantity & quality of bamboo & reed production, as such, in the jhum areas in Nagaland are not same as on virgin land. Moreover, in the second & subsequent cycles the total production is bound to be on the decline.

Keeping these in mind, it should be considered imperative to raise bamboos as plantation crop and to work them silviculturally without much depending on the natural crop in Jhum areas.

Bamboos :

Both clump forming and nonclump forming bamboos are available in the Tuli Catchment area. Among the clump forming bamboos Dalu (Teinostachyum dulooa), Jatti (Bambusa tulda) & Kako (Dendrocalamus hamiltonii) occur gregariously over an extensive areas, while the nonclump forming bamboo (Melocanna baccifera) is very insignificant and negligible.

Bamboo occur as pure crop in a limited area, bulk area of bamboo is in Miscellaneous forests where they grow as understorey. Non-clump forming bamboo is virtually absent in the study area.

Reed :

Reeds grow as pure crop on much denuded soil. Three species are conspicuous viz., Neyraudia reynaudiana, Thysanolaena maxima and Erianthus ravennae, though Saccharum occurs here and there.

2.10. Shifting Cultivation vis-a-vis Forest Resources :

Though agriculture is the only source of livelihood of majority of the people yet rational land utilisation had not been possible due to difficult terrain, climate, Taboo, Social custom and belief.

It has already been mentioned that land rights vest either in the village community or class. In some cases the rights vest on the chief or Siem or Head of the class. Non-existence of recorded individual rights poses a very serious restriction on the flow of agricultural credit to the cultivators from any institutional agency, be it a bank or a cooperative society. The Government of Nagaland have the way for the flow of agricultural credit to the farmers through the village council. A recent legislation has authorised the village council (in Nagaland) to obtain agricultural finance from the State Bank Of India and distribute it among the farmers.

Many Organizations are associated with the study of socio-economic aspects of jhuming viz., the North East Council, the State Governments, the Nehru & Gauhati Universities, the Anthropological Survey of India, the North Eastern Council for social science research, the Forest Soil Conservation, Economics and Agriculture Departments and other Organisations,

but unfortunately no authentic data on the area under jhum is available. Data put forward by different organizations differ considerably. It has not been clearly stated in such reports if (i) the areas affected by jhum have been enumerated on cumulative basis or (ii) areas on a particular year under jhum has been enumerated. No estimation of area under jhum has been based on close study of aerial photographs followed by ground survey.

While the Chief Conservator of Forests, Arunachal Pradesh puts the total area affected by shifting cultivation to 40,000 km² in his territory, available reports indicate areas under jhum to be 4269.00 km² (see page 95 of Social & Economic Problem of N.E. India, B.R. Publishing Corporation, Delhi, 1978). Similar disparity as observed in the figures of the National Commission on Agriculture (Area under Jhum is about 4530.00 km² (vide N.C.A. report Part - IX) and the areas affected by Jhum is 26940.00 km²). Further, It is observed that about 45,000 families are concerned with Jhum in Karbi Anglong & 13,000 families in North Cachar Hills (in Nagaland 80,000 families area concerned with Jhum cultivation). Further documents of N.E. Council reveal that an area of 700 km² is under shifting cultivation annually in Karbi Anglong & N.C.Hills. Dr. G.P. Gupta, Soil Conservation Director, Central Water Commission, Faridabad puts the area under jhum cultivation in North-eastern India to 34330.00 km² (4980.00 km² in Karbi Anglong and N. Cachar). All these contradictory figures indicate the necessity of proper scientific survey of jhum area.

Although some data are available on jhuming cycle, actual investigation figures differ considerably from the recorded reports. In Assam hills and Nagaland, the jhuming cycles is of 7.11 & 8.22 years respectively. On field inspection such cycles have been found to have been brought down sometimes to 3 to 4 years in Nagaland. These are moot points for any future assessment of resources.

C H A P T E R - I I I

INVESTIGATION AND METHODOLOGY.

3.1. Objectives:

The major objectives of the survey worked out in consultation with the State Forest Department are :

- i) 'To estimate the total growing stock of commercial timber within an error limit of $\pm 10\%$ at 95% probability level of total growing stock of wood.
- ii) To furnish an estimate of bamboo and reed stock in the area.
- iii) To furnish volume table for important commercial species
(Appendix - I)

3.2. Aerial reconnaissance, photointerpretation & mapping:

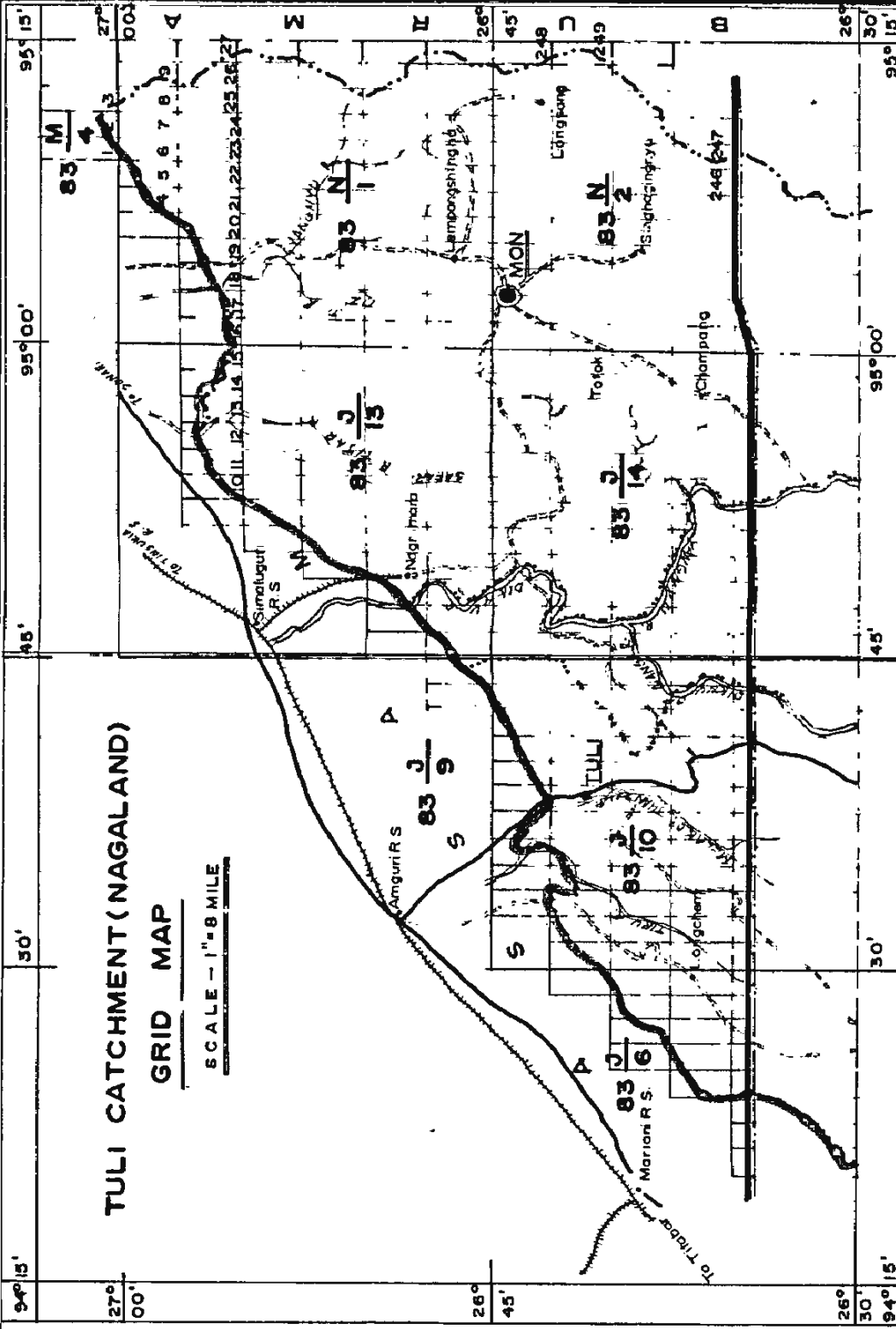
The detailed methodology may be perused in the field manual prepared for the survey. In this respect the I.P.I. made use of aerial photographs on scale 1: 40,000 which was utilised in the area determination. In spite of the scale being small, several small details were identifiable owing to (i) the excellent resolution of RMK 15/23 Camera (ii) photography having been taken in Oct. 1972 (iii) good quality printing (iv) use of 15 cm. focal length permitting optimum relief displacement to locate bamboo clumps in between the tree crowns (v) multi-storeyed crop with prominent opening in the canopy. These photographs were checked by field survey by a joint venture of Nagaland Forest Department and the Indian Photo-interpretation Institute (IPI). In the delineation of bamboo bearing areas the joint team covered an area of about 1500 km².

In ascertaining the reliability of photointerpretation a small part of the area was first photo-interpreted and transferred on the base map. This map was checked on the field and was found almost 100% correct except for the areas involved in current felling.

Taking help of 1: 50,000 Survey of India sheet a base map was prepared showing important features like roads, drainage spot heights, habitation areas, in the State boundary etc. All these features were transferred on this base map with the help of vertical aero-sketchmaster. A dot grid density 0.5 x 0.5 was used to ascertain the area proportion of each stratum. The standard error of the dot gridding was also calculated for each stratum. For area delineation in present survey the aforesaid interpretation was also considered.

3.3. Inventory Design :

A systematic cluster sampling was adopted to estimate the growing stock of the area. The grid centres were located $2\frac{1}{2}' \times 1\frac{1}{4}'$ apart intersections. It was found that a grid pattern of $2\frac{1}{2}' \times 1\frac{1}{4}'$ would generate about 235 grids in a total area of 2263.07 km² (Map-3). The Survey of India toposheets were gridded considering the terrain, vegetation and the type of the forests. The plot size was fixed at .1 ha. of 20 cm. x 50 cm. each. A cluster of four plots constituted a grid. The



TULI CATCHMENT (NAGALAND)

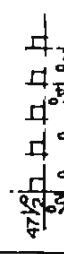
GRID MAP

SCALE - 1" = 8 MILE

REFERENCES

1. INTERNATIONAL BOUNDARY
2. STATE BOUNDARY
3. DISTRICT BOUNDARY
4. RIVER
5. RAILWAY LINE
6. STATE HIGHWAY
7. MAJOR DISTRICT ROAD
8. TOPO SHEET NO.
9. GRID NUMBER
10. CATCHMENT AREA

1 KM



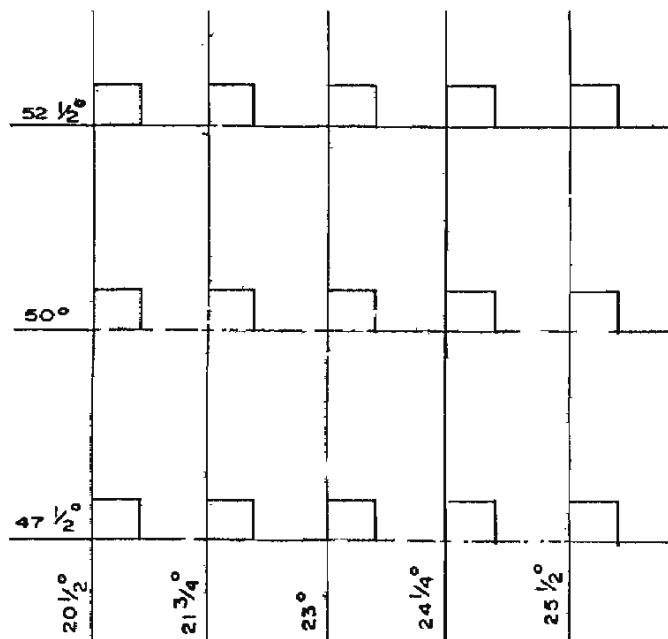
SKETCH SHOWING LAY OUT OF
GRDS (2 1/2 x 1 1/4) ON 1" MAP SHEET

83 2/6
1 TO 249

DRAWN BY. SUMAN BHATTACHARJEE

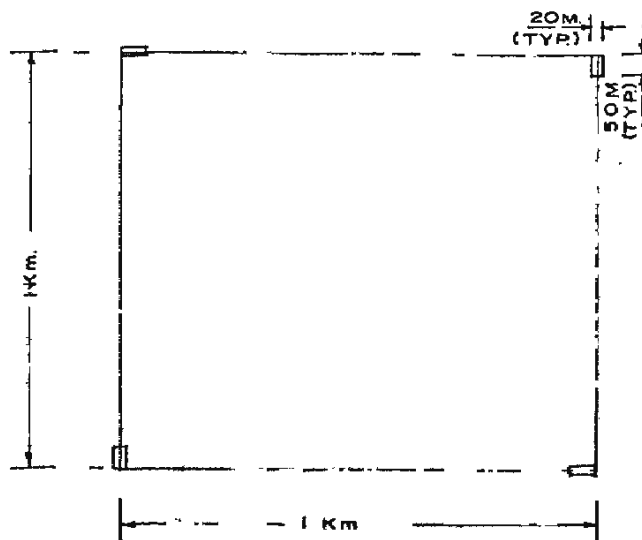
SURVEY DESIGN FOR TULI CATCHMENT (NAGALAND)

SYSTEMATIC
SAMPLING



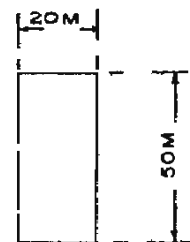
SKETCH SHOWING LAY OUT OF
GRIDS ($2\frac{1}{2}' \times 1\frac{1}{4}'$) ON 1" MAP
SHEET

FIG. I



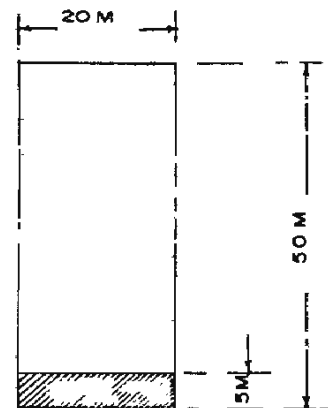
SKETCH SHOWING LAY OUT OF
SAMPLE PLOTS

FIG. II



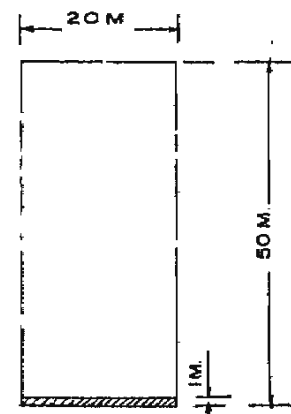
SKETCH SHOWING THE
SAMPLE PLOT

FIG. III



- 1 SKETCH SHOWING SUB SAMPLE PLOT
FOR NON CLUMP FORMING BAMBOO
ENUMERATION
- 2 SKETCH SHOWING SUB SAMPLE PLOT FOR
REED ENUMERATION

FIG. IV



SUB SAMPLE PLOT FOR DETAILED STUDY
OF NON CLUMP FORMING BAMBOO

FIG. V

four plots of area of .1 ha. each are arranged in the form of square 1 km. x 1 km. located at the four corners of the square (Figure I, II & III).

Bamboo :

For clump forming bamboo, enumeration was done on the entire plots of 20 m. x 50 m. Sample clumps were enumerated on every plot in the ratio of 1:4 i.e. for every fourth clump, one clump was enumerated. In case of Non clump forming bamboo, a sub-plot of 20 m. x 5 m. was made in all the plots of the enumerated grids. A sub sample plot of 20 m. x 1 m. was selected for detailed study (Figure IV & V).

Reed:

Reeds were measured in a sub plot of size 20 m. x 5 m. The plots were laid in all the four plots of the grid. Clump numbers and size classes were noted and data entered in bamboo enumeration form (Figure VI).

3.4. Field work in plots:

During the field work the plots were located with the help of the Survey Of India map. Plots were laid out as per design. Plot approach form (Form No. I), Plot description form (Form No. II), Sample tree form (Form No. III), Plot enumeration form (Form No. III-B), Bamboo enumeration form (Form No. IV), Bamboo weight form (Form No. V), Tree volume study form (Form No. VI) were filled in. The details of the forms may be found in (Appendix - II).

3.5. Data Processing :

A series of data processing operations are involved starting from the initial stage of planning to the presentation of the final report.

The data processing steps involved may be summarised under the following phases :

- I Design and Data collection
- II Editing of the Data
- III Estimation of tree volume
- IV Estimation of Sampling error
- V Tabulation

C H A P T E R - I V .

D A T A A N A L Y S I S .

4.1. Tree Volume Study:

Adequate number of trees could not be felled for construction of volume equation as the district council authorities did not approve of felling of any tree in the unclassified forests. A few trees that were available were measured and compared with the volume data of Tirap forests which is adjacent to the project area. It was found that the volume data compared very well. As such, the volume equations developed for Arunachal Pradesh have been applied to estimate the growing stock of the area.

4.2. The selected local volume equations for Tuli Catchment are as under:

Species name	Equations
Lagerstroemia speciosa	$V/D^2 = 0.00094 - 0.01248/D + 0.1305/D^2$
Terminalia belerica	$V/D^2 = 0.00092 - 0.01336/D + 0.1052/D^2$
Canarium resiniferum	$V = 0.0942 - 0.0643 \cdot D + 0.00129 D^2$
Gmelina arborea	$V/D^2 = 0.00094 - 0.01248/D + 0.1305/D^2$
Cinnamomum glanduliferum	$V/D^2 = 0.00092 - 0.01336/D + 0.1052/D^2$
Castanopsis indica	$V/D^2 = 0.00092 - 0.01336/D + 0.1052/D^2$
Terminalia myriocarpa	$V/D^2 = 0.00092 - 0.01336/D + 0.1052/D^2$
Dipterocarpus macrocarpus	$V = 0.096323 + 0.0011645 D^2$
Shorea assamica	$V/D^2 + 0.001469 - 0.0246/D + 0.1529/D^2$
Mesua ferrea	$V/D^2 = 0.00122 - 0.01219/D + 0.0257/D^2$
Bischofia javanica	$V/D^2 = 0.00094 - 0.01248/D + 0.1305/D^2$
Mansonia dipikae	$V = 0.0942 - 0.0643 D + 0.00129 D^2$
Rest of the species	$V/D^2 = 0.000836 + 0.00331/D^2$

4.2.1. Plot volume:

With the help of the above local volume equations the volume of all enumerated trees in a plot were calculated. The volume obtained in a plot were added up to arrive at the plot volume.

4.3. Tree Density Study:

The consolidated list of tables for distribution of stems by species and diameter class is given in table Nos. (1.1.1. to 1.1.4).

A close study of the stand tables highlights the following factors:

(A) Semi-evergreen strata:

Dipterocarpus macrocarpus is the most dominant species followed by *Shorea assamica*. The following tables illustrates the occurrence of major commercial species in the stratum.

Species name	Stem/ha.	Total Stems (000 units)	% of occurrence
<i>Dipterocarpus macrocarpus</i>	10.541	486.506	5.13
<i>Shorea assamica</i>	6.685	308.570	3.23
<i>Castanopsis indica</i>	6.588	304.067	3.21
<i>Mesua ferrea</i>	6.490	299.561	3.16
<i>Canarium resiniferum</i>	6.246	288.299	3.04
Non-commercial	134.151	6181.744	65.28

It is observed that Non-commercial species in the stratum accounts for 65.28% of the total stand stock.

(B) Bamboo stratum:

This stratum consists of bamboo forests with variable percentage of miscellaneous species.

Among the commercial tree species *Dipterocarpus macrocarpus* is the dominant species followed by *Dysoxylum procerum*. The list of important commercial species on the stratum is given below :

Species name	Stem/ha.	Total Stems (000 units)	% of occurrence
<i>Dipterocarpus macrocarpus</i>	1.935	6.542	2.79
<i>Canarium resiniferum</i>	1.935	6.542	2.79
<i>Dysoxylum procerum</i>	1.613	5.452	2.53
Non-commercial	52.906	178.824	76.29

Thus, the percentage of non-commercial species in the stratum is higher and is about 76.29% of the total trees.

(C) Reed Stratum:

Although Reeds are found in pure patches, yet in some areas thin forest is found in admixture with miscellaneous species. Among the tree species in the stratum *Schima wallichii* is observed as the dominant species in the stratum.

Species name	Stem/ha.	Total Stems (000 units)	% of occurrence
<i>Schima wallichii</i>	3.924	174.478	8.89
<i>Castanopsis indica</i>	1.701	75.608	3.85
<i>Dysoxylum procerum</i>	1.504	66.883	3.41
Non-commercial	33.354	1483.053	75.56

(D) Miscellaneous with bamboo:

Castanopsis indica is the dominant species in the stratum. The list of important commercial species in the stratum is as follows:-

Species name	Stem/ha.	Total Stems ('000 units)	% of occurrence
Castanopsis indica	4.00	6.432	4.67
Dysoxylum procerum	2.40	3.859	2.80
Canarium resiniferum	1.60	2.473	1.87
Dipterocarpus macrocarpus	1.60	2.473	1.87
Non-commercial	70.80	113.846	82.71

4.4. Bamboo study:

In the project area the most dominant species are Dendrocalamus hamiltonii and Teinostachyum dullooa.

In addition there are several other bamboo species of which B. tulda is most important. All these bamboo are clump forming. The detailed distribution of bamboo is given in table No. (1.6).

The bamboo per ha. by species and size class is summarised below:

Stratum	No. of bamboo		Mature		Total	
	Upto 2 season		Sound	Un-sound	Sound	Un-sound
	Sound	Un-sound				
1	2	3	4	5	6	7
Bamboo	914.515	164.515	1333.869	644.837	2248.384	809.352
Reeds	43.332	7.842	20.719	10.326	64.051	18.168
Semi-evergreen	300.339	33.363	336.973	154.242	637.312	187.605
Misc. with bamboo	356.000	26.800	612.000	294.000	968.000	320.800

4.5. Reeds Study:

Reeds are found almost in pure patches. The important reed species are Neyraudia reynaudiana (Khagra), Thysanolaena maxima (Phuljharu) and Erianthus ravennae.

There is a considerable variation in the distribution of reeds from stratum to stratum. In the reed stratum, the number of clumps/ha. surpasses all other strata with 2350.980 numbers followed by miscellaneous with bamboo stratum which is 416.000 numbers. The following table illustrates the per hectare distribution of reed clump by stratum and size class.

Stratum	No. of clump, of size class			Total
	I	II	III	
	(upto 1m.)	(1-2m.)	(2 + m.)	
Bamboo	9.677	3.226	-	12.903
Reed	2262.745	86.928	1.307	2350.980
Semi-evergreen	103.415	20.487	2.927	126.829
Misc. with bamboo	396.000	20.000	-	416.000

It may be noted that the occurrence of reed clump is maximum in size class I and is observed to be absent in size class III for bamboo and miscellaneous with bamboo stratum.

4.6. Volume study:

The complete list of tables for distribution of volume by diam. classes for various stratum is given in table numbers (1.31 to 1.34)

It may be noted from these tables that the stocking is very low (excepting semi-evergreen) with poor representation in the higher diameter class.

Average stocking in Tuli Catchment is only $104.876 \text{ m}^3/\text{ha.}$ and there is considerable variation in stocking from stratum to stratum as appended below :-

(A) Semi-evergreen stratum:

This stratum contributes the highest tree volume/ha. (173.611 m^3) Amongst the commercial species Shorea assamica contributes the maximum volume/ha. followed by Dipterocarpus macrocarpus although the number of stems/ha. in the former species was much below the former. The distribution of the species with respect to its contribution to volume is given as under :-

Name of the species	Volume/ha. (m^3)	%
<u>Shorea assamica</u>	40.058	23.073
<u>Dipterocarpus macrocarpus</u>	28.180	16.232
<u>Mesua ferrea</u>	6.452	3.716
<u>Canarium resiniferum</u>	6.044	3.481
Non-commercial	61.537	35.445

(B) Bamboo Stratum :

As evident, non-commercial species volume in the stratum is considerably high ($40.702 \text{ m}^3/\text{ha.}$) and accounts to 60.24% of the total volume of $65.821 \text{ m}^3/\text{ha.}$ Thus the commercial species volume in the stratum is reduced to 39.76% of the total volume. Amongst the commercial species Dipterocarpus macrocarpus contributes the maximum and is 27.77% of the total volume with $18.76 \text{ m}^3/\text{ha.}$

(C) Reed Stratum:

The non-commercial species volume contributes 63.82% of the total volume in the strata but the volume contribution per hectare is $24.107 \text{ m}^3/\text{ha.}$ and is indicative of an indiscriminate felling of mature and over mature trees in the stratum.

Among the commercial species Dysoxylum procerum contributes 7.48% of the total volume with $2.82 \text{ m}^3/\text{ha.}$

(D) Miscellaneous with bamboo:

In the stratum non-commercial volume ($48.058 \text{ m}^3/\text{ha.}$) is 73.01% of the total volume of $68.841 \text{ m}^3/\text{ha.}$

Amongst the commercial species Dipterocarpus macrocarpus contributes 7.56% of the total volume with 4.97 m³/ha. followed by Castanopsis indica with 6.96% having 4.57 m³/ha.

Distribution of volume for important commercial species in the area is summarised as below :-

TABLE NO. 2
T U L I C A T C H M E N T

Stratum	Sl. No.	Species name	Vol./ha. (m ³)	Estimated vol. (in '000 m ³).	% of volume
BAMBOO	1	Dipterocarpus macrocarpus	18.767	63.432	27.78
	2	Endospermum chinensis	1.568	5.303	2.32
	3	Shorea assamica	1.183	3.999	1.75
	4	Artocarpus chaplasha	1.009	3.412	1.49
	5	Michelia champaca	0.837	2.828	1.24
REEDS	1	Dysoxylum procerum	2.824	125.557	7.48
	2	Castanopsis indica	2.663	118.387	7.05
	3	Schima wallichii	2.054	91.309	5.44
	4	Shorea assamica	1.799	80.006	4.76
	5	Artocarpus chaplasha	0.975	43.318	2.58
SEMI - EVERGREEN	1	Shorea assamica	40.058	1848.869	23.07
	2	Dipterocarpus macrocarpus	28.180	1300.608	16.23
	3	Mesua ferrea	6.452	297.785	3.71
	4	Canarium resiniferum	6.044	278.923	3.48
	5	Artocarpus chaplasha	4.390	202.661	2.53
MISCELLANEOUS WITH BAMBOO	1	Dipterocarpus macrocarpus	4.975	8.000	7.56
	2	Castanopsis indica	4.577	7.360	6.96
	3	Shorea assamica	3.456	5.557	5.25
	4	Endospermum chinensis	1.670	2.686	2.54
	5	Schima wallichii	0.989	1.591	1.50

4.7. Stems Estimation :

The total number of stems in the catchment by strata and diameter class is presented in table No. 3 which is estimated at 11819585. Distribution of total stems of important species on different strata is given in table No. 4. Strata-wise distribution of total stems by species and diameter class is detailed in Table No. 1.4.1 to 1.4.4.

4.8. Growing stock estimation :

Distribution of total volume in the catchment by strata and diameter class is given in table No. 5. Distribution of total volume of important species in different strata is shown in table No. 6. Strata-wise distribution of total volume by species and diameter class is presented in the Table No. 1.5.1. to 1.5.4.

4.9. Estimation of error :

As per objective, the standard error percentage for the estimated growing stock of wood in the entire forest area is 8.60%. The percentage error for bamboo is estimated 9.01%.

Table No. 3
Total Stems (in '000 units) By Strata And Diameter Classes (in cm.)

S T R A T U M	T U L I C A T C H M E N T									
	D I A M E T E R C L A S S E S (I N C M .)									
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 Total
E A M B O O	128.666	50.158	18.536	14.175	9.813	5.453	3.271	-	-	4.361 234.433
R E E D S	1137.008	351.863	191.925	116.319	52.343	37.804	23.264	14.540	17.448	20.356 1962.870
S E M I E V E R G R E E N	4892.125	2009.101	1033.825	610.381	342.350	204.959	157.661	90.091	51.802	92.342 9484.637
M I S C . W I T H B A M B O O	77.827	23.799	15.437	7.718	3.859	1.930	3.855	1.930	-	1.286 137.645
T O T A L	6235.626	2434.921	1259.723	748.593	408.365	250.146	188.055	106.561	69.250	110.345 11819.585

TABLE NO. 4

TOTAL STEMS ('000 UNIT) IN DIFFERENT STRATA.

Species name	Bamboo	Reed	Semi-ever green	Misc.with bamboo	Total
Lagerstroemia flosreginae	-	-	4.504	-	4.504
Dysoxylum procerum	5.452	66.883	204.963	3.859	281.157
Tetrameles nudiflora	-	5.816	29.278	-	35.094
Terminalia belerica	1.090	2.908	81.083	-	85.081
Pterospermum lanceaefolium	3.271	-	6.757	-	10.028
Canarium resiniferum	6.542	11.632	288.299	2.573	309.046
Gmelina arborea	2.181	11.632	24.774	0.643	39.230
Cinnamomum glanduliferum	2.181	-	42.792	-	44.973
Castanopsis indica	4.362	75.608	304.067	6.432	390.469
Terminalia myriocarpa	1.090	8.724	54.053	-	63.867
Dipterocarpus macrocarpus	6.542	8.724	486.506	2.573	504.345
Syzygium cumini	2.181	26.172	92.345	1.930	122.628
Shorea assamica	1.090	5.816	308.570	1.930	317.406
Vatica lanceaefolia	4.362	8.724	238.748	-	251.834
Mesua ferrea	1.090	2.908	299.561	-	303.559
Endospermum chienensis	2.181	-	105.857	0.643	108.681
Artocarpus chaplasha	4.362	49.436	216.220	0.643	270.661
Magnolia sp., Michelia sp.	-	11.632	105.858	-	117.490
Bischofia javanica	1.090	2.908	128.382	-	132.380
Schima wallichii	3.271	174.478	112.616	1.930	292.295
Mansonia dipika	-	2.908	36.036	-	38.944
Mangifera indica	-	2.908	33.785	0.643	37.336
Michelia champaca	3.271	-	78.828	-	82.099
Morus laevigata	-	-	2.252	-	2.252
Phoebe goalparensis	-	-	6.756	-	6.756
O t h e r s	178.824	1483.053	6191.744	113.846	7967.467
T O T A L :	234.433	1962.870	9484.637	137.645	11819.585

Table No. 5

Total Volume (in '000 M³) By Strata And Diameter Classes (in cm.)

S T R A T U M	C O D E	T U L I C A T I C H M E N T										
		D I A M E T E R C L A S S E S (I N C.M.)										
		10 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 - 99	100	T o t a l
B A M B O O	01	16.262	19.079	15.977	19.308	20.536	13.713	11.518	0.000	0.000	111.987	228.380
REEDS	02	141.526	133.675	146.759	150.898	104.132	102.694	94.462	74.935	110.402	620.078	1679.561
SEMI EVERGREEN	05	637.657	811.312	875.068	915.430	758.349	723.903	794.292	594.852	457.193	1444.975	8013.031
MISC. WITH BAMBOO	08	10.086	9.202	11.819	11.087	8.253	5.287	17.512	9.171	0.000	23.423	105.840
T O T A L :		805.531	973.268	1049.623	1096.723	891.270	845.597	917.784	678.958	567.595	2200.463	10026.812

TABLE NO. 6

TOTAL VOLUME ('000 m³) IN DIFFERENT STRATA

Species name	Bamboo	Reed	Semi-ever green	Misc. with bamboo	Total
<i>Lagerstroemia flosreginae</i>	-	-	0.701	-	0.701
<i>Dysoxylum procerum</i>	0.595	125.557	100.815	0.959	227.926
<i>Tetrameles nudiflora</i>	-	24.385	85.232	-	109.621
<i>Terminalia belerica</i>	2.447	3.678	46.877	-	53.002
<i>Pterospermum lanceaefolium</i>	0.912	-	1.056	-	1.968
<i>Canarium resiniferum</i>	0.305	16.661	278.923	1.161	295.950
<i>Gmelina arborea</i>	1.788	8.557	14.977	0.219	25.541
<i>Cinnamomum glanduliferum</i>	0.657	-	29.476	-	30.133
<i>Castanopsis indica</i>	0.826	118.387	150.921	7.360	277.494
<i>Terminalia myriocarpa</i>	0.377	35.559	163.314	-	199.250
<i>Dipterocarpus macrocarpus</i>	63.432	12.681	1300.608	8.000	1384.721
<i>Syzygium cumini</i>	0.721	8.518	22.295	0.650	32.184
<i>Shorea assamica</i>	3.999	80.006	1848.869	5.557	1938.431
<i>Vatica lanceaefolia</i>	0.903	1.052	67.462	-	69.417
<i>Mesua ferrea</i>	0.294	9.215	297.785	-	307.294
<i>Endospermum chinensis</i>	5.303	-	90.707	2.686	98.696
<i>Artocarpus chaplasha</i>	3.412	43.318	202.661	0.142	249.533
<i>Magnolia sp., Michelia sp.</i>	-	1.957	78.700	-	80.657
<i>Bischofia javanica</i>	1.105	23.076	157.427	-	181.608
<i>Schima wallichii</i>	0.902	19.309	83.404	1.591	105.206
<i>Mansonia dipika</i>	-	2.837	39.388	-	42.225
<i>Mangifera indica</i>	-	2.023	5.928	0.238	8.189
<i>Michelia champaca</i>	2.828	-	86.095	-	88.923
<i>Morus laevigata</i>	-	-	14.047	-	14.047
<i>Phoebe goalparensis</i>	-	-	5.125	-	5.125
Others	137.574	1071.881	2840.238	77.277	4126.970
T O T A L :	228.380	1679.561	8013.031	105.840	10026.812

C H A P T E R - V.

MANAGEMENT AND YIELD.

5.1. Past and Present Management:

The project area has never been under any scientific management and the crop did not receive any silvicultural treatment. Because of the peculiar legal position of the forest, the working of the forests was not done scientifically. The Singphan reserve however, is the only reserve forest of the project area to receive specific attention. Bulk area has been under the shifting cultivation and uncontrolled felling. These operations caused irreparable damage to the crop and have proved to be a serious constraint for the development of the forest. However, Namsa-Tijit area has retained much of its valuable crops as yet which needs better management for adequate protection.

Bamboos have come up over substantial portion of jhum land as secondary crops. Similarly, reeds have invaded land which have suffered severe deterioration. These facts should be studied in sufficient depth in order to ascertain if the bamboos and reeds would regenerate adequately in future to give expected yield.

Forestry development programme are being drawn up keeping in view of various socio-economic problems in the region. The State Government is making serious effort to motivate the people about the management strategy and its impact on the economic and social growth of the people. Special encouragement and inducement are being offered to attract the people to take active participation under the centrally sponsored scheme in raising plantation in villages; some jhum land are being planted with suitable species. These measures are drawing good response from the villagers. It has been possible to acquire 7601.25 ha. of denuded land by them for use in the Tuli Paper Mill.

The silvicultural system prescribed for better maintenance of Hollong-Mekai forest is the selection-cum-improvement felling with compensatory regeneration.

A Working Scheme has been prepared for Hollong-Mekai forest of Namsa - Tijit area to ascertain the feasibility of a plywood mill at Tijit. Although the scheme was prepared in 1968, the Nagaland Forest Department does not seem to achieve much in the last ten years.

It is necessary to revise the scheme in the present content of the forest in the area.

5.1.1. Enumeration Data :

Stratified random sampling of about 8% sampling intensity was done in 1968 and all trees of 90 cm. g.b.h. and above were enumerated. Hollong with 21.18%, Mekai with 24.40% had the highest percentage of occurrence followed by Nahar 16.60%, Jutuli 5.95%, Amari 4.33%, Sopa 2.45% and Phulgamari 2.29%. About 100 species were enumerated and the balance was grouped together.

Enumeration data of 1968 showed the presence of tree of all girth classes. The present survey (trees measured down to 30 cm. girth) showed that 90% of the trees was below 150 cm. girth and only 10% above 150 cm. girth. This revealed heavy exploitation of high girth trees in recent years. Hollong and Mekai together formed 45.58% of the trees. The present survey exhibited that the volume of Hollong and Mekai was 39.30% of total volume.

5.2. Rotation & exploitable girth:

Reliable statistics of growth and outturn for any of the economically important species is not available. No standard yield or volume table had been compiled so far. The evergreen Forests of Assam adjoining the project area have sufficient outturn data for Hollong, Mekai, Hollock, Chuna, Jutuli, Amari etc. Growth study of Hollong in a linear sample plot reveals that the C.A.I. for trees of sizes from 30 cm. to 240 cm. girth remained stable at about 188 cm. and then declined gradually for trees of higher girths. It was estimated that in about 112 years Hollong grew to a girth of 225 cm. From age/diameter data also, this rate of growth was found similar. The growth rate of Mekai was faster, Nahar reaches a girth of 180 cm. in 140 years.

In respect of Nagaland logs of girth 180 to 210 cm. were considered ideal for plywood production. In order to produce logs of such sizes trees at B.H. girth should be at least between 210 - 240 cms. In the adjoining Shibsagar Forests of Assam a growth rate of girth of 30 cm. has been recorded in 25 years. Hollong reaches a girth at breast height of 105 cm. in first 36 years of age; it attains another 115 cm. girth in next 98 years (from 36 years age to 134 years). This gives a growth rate of girth to 220 cm. obtained in 134 years.

The Nagaland Forest Department followed a very conservative felling schedule to safeguard over felling in the village forest. As such they prefer and to fix the minimum exploitable girth limit for Hollong to 270 cm. at breast height with rotation of 150 years.

The girth limit for other species has not been fixed on reliable data; rather it has been ascertained tentatively. Therefore, it should be judicious and safe to adopt 240 cm. as exploitable size for all other species ignoring 180 cm. and 210 cm. as proposed in the Working Scheme drawn for Namsa-Tijit forests. The volume of those species having exploitable girth of 210 cm. and 180 cm. forms only 20 to 25% of the total volume and will have least effect on the yield.

5.3. Calculation of yield :

As the volume per ha. is about 67 m^3 , 37 m^3 and 65 m^3 in bamboo, reed and miscellaneous with bamboo strata respectively (which is a poor), there is hardly any scope of felling of trees in these strata. The mature trees should be left for ensuring natural regeneration and to compensate heavy felling owing to jhum cultivation. As such yield calculation for timber will be confined only to the semi-evergreen stratum.

5.4. Yield for timber:

Annual yield in semi-evergreen stratum :-

Method (i) Applying Von Mantal's formula (modified)

$$\begin{aligned} Y &= \frac{\text{Total Volume of the strata (Rotation 150 years)}}{\text{Rotation}} \\ &= \frac{8013031 \text{ m}^3}{150} \\ &= 53420.34 \text{ m}^3 \end{aligned}$$

Method (ii) Yield of timber of semi-evergreen strata

$$\begin{aligned} &= \frac{\text{Volume of trees above exploitable girth}}{\text{Felling cycle}} \\ &= \frac{2135047}{30} \\ &= 71168.23 \text{ m}^3 \end{aligned}$$

The results of these calculation, (i) and (ii) compare with each other as may be evident from next paragraph. The test applied shows that the fixation of minimum exploitable girth limit for Hollong, Mekai at 270 cm. and others at 240 cm. is justified.

As the felling is not being done on strict silvicultural principle it is judicious to retain a few mature trees as seed bearer, to cover large gaps and to ensure against any depletion of the stock and therefore 20% of the stocking should be retained.

As such net total yield works out as :-

71168.23 m^3 minus (-) 20% or 14233.644 m^3 or 56934.58 m^3 . Yield as obtained from (i) i.e. 53420.34 m^3 has been accepted as annual availability.

5.5. Yield of bamboo :

Growing stock of air dry mature bamboo in the project area is 195780 M.T. of which sound bamboo forms 133886 M.T. and the balance unsound (Growing stock of 1 and 2 years old bamboo has not been included in the calculation).

Considering cutting cycle of bamboo to be 4 years the annual yield will be :

$$\begin{aligned}\text{Annual yield} &= \frac{\text{Weight of mature bamboo in M.T. (Air dry)}}{4} \\ &= \frac{195780}{4} \\ &= 48945 \text{ M.T.}\end{aligned}$$

The total bamboo potential therefore is 48945 M.T. air dry weight.

Yield of Reeds :

It has already been explained that no growth data of reed was available and that owing to poor status of soil yield in second and subsequent rotation may be much reduced. As such it should be judicious to work the reed on 3 years cutting cycle and by this period, the clumps are likely to be formed and wood formation would be adequate to produce pulp for use as raw material in the paper production.

$$\begin{aligned}\text{Yield} &= \frac{\text{Total weight in M.T. (air dry)}}{\text{Cutting cycle (3 years)}} \\ &= \frac{168589 \text{ M.T.}}{3} \\ &= 56196.33 \text{ M.T.}\end{aligned}$$

Thus the total annual potential of reed in the area is 56196.33 M.T.

5.6. Annual availability of Pulp wood from reed & bamboo :

From the above figures, the total availability works out as under: *

(i)	Reed	56196.33 M.T.
(ii)	Bamboo	48945.00 M.T.
	Total :	<u>105141.33 M.T.</u>

CHAPTER - VI

LOGGING AND ACCESSIBILITY STUDY.

6.1. Logging operation :

The tract dealt with has no system of departmental fellings. Felling, logging, dragging and transportation are all done by the purchaser. Purchaser himself arrange for its exploitation extraction.

Owing to hilly terrain and lack of proper development of infrastructure in the region, felling, logging and extraction pose a serious problem. At present fellings are restricted to specific girth classes for different species.

The logging operation in Nagaland is still conventional. Felling of trees are usually done by felling axes and hand saws or combined saw and axe are used. The cross cutting is generally carried out by two men with cross cut saws. The conversion of timber into pieces is divided by the hauling capacity of the elephants and, it vary generally from 2 to 2.5 m. The length of logs decreases as usual with increasing girth, resulting in more wastage in conversion. Dragging from the felling site to the road side depots and loading on the trucks are usually done by elephants and in some cases it is done manually. From road side depots timber is transported normally through road transport.

Elephants require one days rest after every 4-5 days work. Elephant dragging is costly and has been considered uneconomical, yet the use of elephants cannot be discouraged in view of high rainfall and paucity of transport and communication.

6.2. Proposed logging technique :

Modern scientific method of logging may be adopted to minimise the wastage of wood and to expedite the operation. For bringing the logs from felling site to road side depot winch, skyline crains and skidders may be used and utilization of modern tools in felling, delimbing and cross cutting can also be carried on gradually. In case of small size trees, felling and logging by power chain saw may prove to be useful.

6.3. Development of communications :

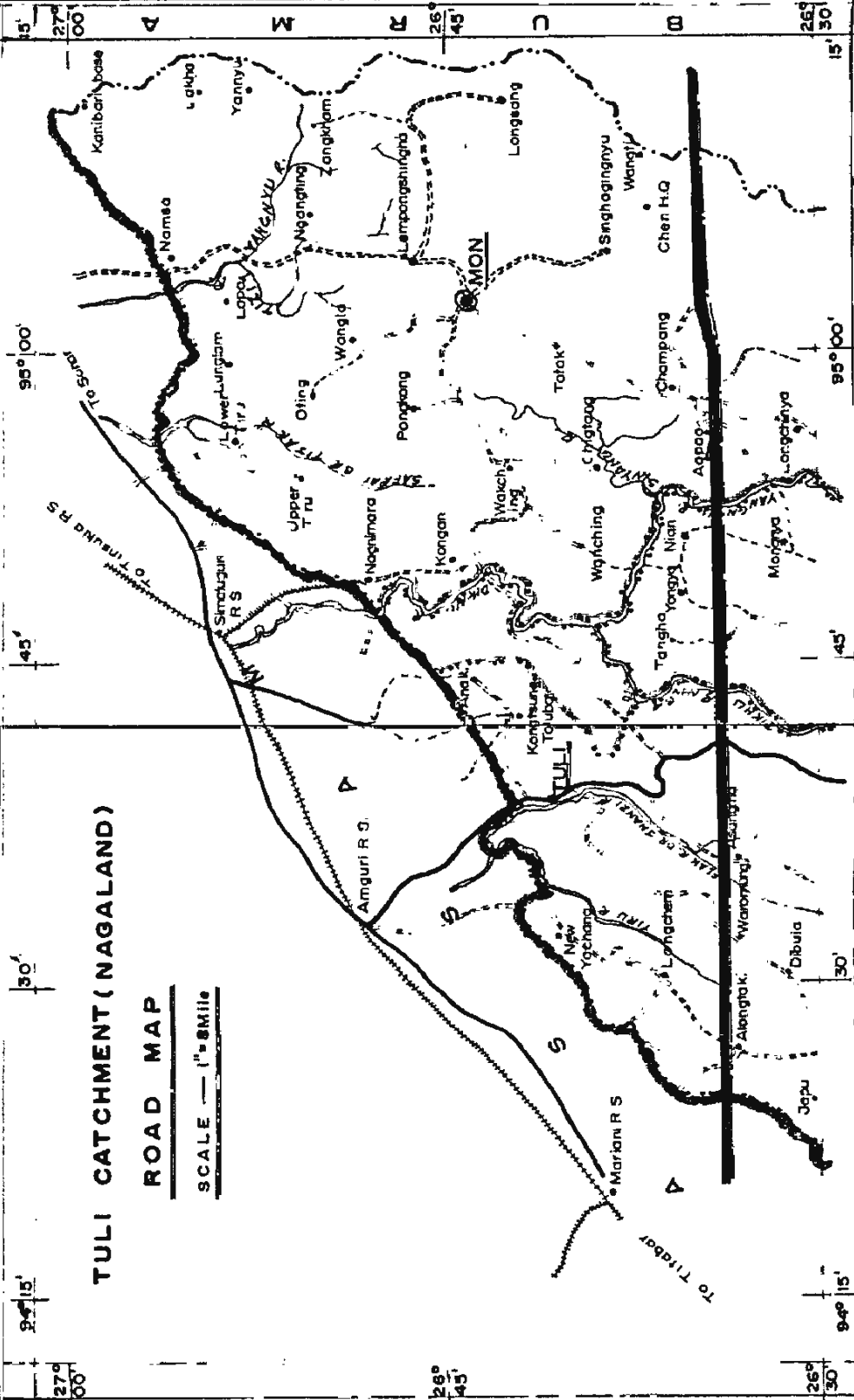
The existing infrastructure in the project area on road is not upto the mark. Ther are only two State Highways inside the project area namely Amguri-Mokokchung road and Sonari-Mon road. They touch the Assam State Highway at Amguri and Sonari respectively. The total existing unmetalled road is 805 km. and metalled road is 98 km.

In an estimate proposed by the Central Public Works Department in the year 1976 development of 1200 km. of road and 90 km. of porter track at an expenditure of Rs. 111.7 million rupees was considered essential. But the present study revealed that for an effective development of the area the development programme should be increased by 10% of Rs. 111.7 million considering the present rise of price level.

TULI CATCHMENT (NAGALAND)

ROAD MAP

SCALE — 1" = 8 Miles



R E F E R E N C E

- 1 INTERNATIONAL BOUNDARY
- 2 STATE BOUNDARY
- 3 DISTRICT BOUNDARY
- 4 RIVER
- 5 RAILWAY LINE
- 6 STATE HIGHWAY
- 7 MAJOR DISTRICT ROAD
- 8 BLOCK ROAD

9. BLOCK OFFICE
10. CATCHMENT AREA

Proper development of the area and economic utilization of the forest resources demand a well developed net work of road systems. Thus all the proposed roads are to be constructed immediately and the existing unmetalled roads are to be improved for heavy traffic throughout the year. For the maximum utilization of the resources and to minimise the wastage of timber caused by decaying agencies, all existing feeder roads should be improved for heavy all weather traffic (Map - 4).

The list of existing roads is appended as below :-

Sl. No.	From	To	Distance	Categories of road
1.	2.	3.	4.	5.
1	Amguri (Assam)	Mokokchung	104 km.	Metalled road (Partly) (88 km. in P.A.)
2	Sonari (Assam)	Mon	55 "	(43 km. in P.A.)
3	Longchem	Moriani	22 "	Metalled road
4	Simalguri (Assam)	Mon via Naginimara	72 "	Unmetalled Road (61 km. in P.A.)
5	Tuli	Dibuia-Anaki road	60 "	- do -
6	Tuli	Wamaken-Anaki	20 "	Kachha rd. (Extraction)
7	Tuli valley forest Rd.	Amguri	10 "	Kachha road "
8	Changtongia	Tuensang via (Longleng)	110 "	- do -
9	Longlang	Kamahu	13 "	Kachha road
10	Mon	Hongph road	9 "	- do -
11	Lempong Singha	Sangnya-Nyasa road	20 "	- do -
12	Singphon	Ceraidoo T.G. Road	7 "	- do -
13	Namsa	Jaboka road	14 "	- do -
14	Mon	Chongmemo road	60 "	- do -
15	Merangkong	Tamly road	16 "	- do -
16	Merangkong	Changtongia road	49 "	- do -
17	Rajabari T.G.	via Asangma, Kulingmen. Lengsamtang via Alongtaki, Longchem	90 "	Kachha road
18	Rajabari	Longchem	32 "	- do -
19	Kulingmen	Longchang road	16 "	- do -
20	Naginimara	Hathod road	10 "	- do -
21	Longleng	Tangha	25 "	- do -
22	Nimongagarh	Yatung Nallah (Lowerot Oting village)	22 "	- do -
23	Lower Tiru	Sanfrai Nallah via Upper Tiru	15 "	- do -
24	Charadeo T.G.	Naginimara	12 "	(3 km. in Project area)
25	Athkel T.G.	Kongtsung toluba	10 "	(8 km. - do -)
26	Geleki	Namsang sumniching	15 "	(3 km. - do -)
27	Nian	Kamahu	23 "	Kachha road
28	Champang	Choba	14 "	- do -
29	Champang	Longching	36 "	(30 km. in project area)
30	Champang	Yangnyn road, Aopao, Sowa	40 "	(33 km. - do -) Kachha road

1.	2.	3.	4.	5.
31	Chingkbbochingnya	Champang	21 km.	Kachha road
32	Naginimara	Upper Tiru	8 "	- do -
33	From 25 km. stone on the road of Sonari- Mon road towards Mon.	Hangkinghong	8 "	- do -
34	From 20 km. stone on the road of Sonari Mon towards Mon	Pangaiak	14 "	- do -
35	Moriani	Alongtaki	30 "	Fair weathered rodd
36	Kamahu	Yongya	13 "	- do -

6.4. Cost of construction of Roads:

In general, the construction cost of different types of roads in the project area would be approximately as follows :-

1. Tar Road - Rs. 1,70,000 per km.
2. Metal road - Rs. 1,10,000 - do-
3. Improvement of Kachha road to metal road. - Rs. 90,000 -do-
4. Construction of porter track Rs. 25,000 -do-
5. Construction of temporary extraction path - Rs. 13,000 -do-

6.5. Logging rates :

There is no fixed rate for logging operations and the prevalent rates for various operations involved in felling, delimbing, logging and transportation of the forest produce vary from place to place depending upon the physical feature of the terrain and other local circumstances particularly the remoteness of the areas.

Cost of felling & logging:

The cost for felling and logging is about Rs. 17.50 per cubic metre.

Cost of extraction from forest to depot :

The cost of extraction by elephant in dragging timber to a depot is about Rs. 90/- per cubic metre upto a distance of 3 km.

6.6. Transportation :

No logs can cross the State border directly from the forest site. They have to be brought to the Depots and registered. Transportation cost from field to such intermediate depot is about Rs. 115/- per cubic metre for a distance upto 30 km.

6.7. Method of disposal:

In the unclassified forests the State Government sanctions trees by number to each villager who applies for felling. The villagers then sell out the trees to the contractors and collect about Rs. 60/- to Rs. 100/- for a tree depending on the volume of the trees.

6.8. Rates for logs per cubic metre :- (Classification detailed in para 6.10)

Class	Rates for logs 2 m. in girth or over.
A - I	Rs. 560.00
A - II	Rs. 230.00
B Class	Rs. 120.00
C Class	Rs. 60.00
D Class	Rs. 40.00
E Class	Rs. 20.00

For the above rates the over bark girth measurement are taken into consideration. Logs having girth of 1 m. and above in classes A-I, A-II, B classes and fetches 50% less than aforesaid rates (upto 2 m.).

6.9. The rate of plots are as follows :-

Class	Rates for poles having midgirth under 0.60 metre.
A - I	0.70 paise/metre
A - II	0.60 " "
B	0.60 " "
C	0.40 " "
D	0.30 " "
E	0.10 " "

Above rates for the over bark girth measurements are taken into consideration. For debarked and dressed poles the rate increases 10% and 25% respectively.

Royalty of head load, truck load are as under :-

1. Head load	Rs. 2.00 per head load
2. Cart load	Rs. 5.00 per cart load
3. Truck load	Rs. 10.00 per tonne.

6.10. Classification of timber :

Teak has been grouped under	- A-I Class
Khoir, Sissu, Champ, Bhola, Bonsum & Sal under	- A-II Class
Haldu, Amari, Sam, Scham, Simul, Sonar, Bogipoma, Gonsorai, Hollong, Gurjan, Gamari, Sidha, Ajhar, Am, Nahor, Mekai and Hollock under	- B - Class

Mandani, Halduchopa, Borpat, Koko, Koroil, Jutuli, Kanthal, Birch, Urium, Hingori, Poma, Jia Jamuk, Badam, Behlu, Sam, Bohere, Diengan, Mekri sal under	- C - Class
Moj, Rate, Dumboli, Rata, Pichola, Ghorisopa, Pahari, etc. under	- D - Class
and the balance under	- E - Class

6.11 Royalty of Bamboo :

The royalty of bamboo per 100 pieces has been fixed as follows:-

<u>Dendrocalamus hamiltonii</u> (Kako)	- Rs. 10.00
<u>I. Dalooa</u> (Dalu)	- Rs. 5.00
<u>Melocanna bambusoides</u> (Muli)	- Rs. 10.00
<u>Bambusa pallida</u> (Bijli)	- Rs. 15.00

Other produce

Ekria	Upto 0.15 m. in girth	- Rs. 5.00 per 100 bundles
	Over 0.16 to 9.30 m. in girth	- Rs. 10.00 per 100 bundles
	Over 9.31 to 9.45 m. in girth	- Rs. 20.00 per 100 bundles

6.12. Logging and accessibility study : (Map - 5)

The study was confined to Simphan Reserve and areas adjoining the Tuli Catchment.

In absence of reliable map, the following studies were taken up on the basis of topo sheets and on local inspection :-

1. Slope in degree
2. Slope length in metres
3. Hill face area in km²
4. Estimation of growing stock in each compartment.

The area was divided into 21 compartments keeping in view that no difficulty would be experienced in constructing roads in future. Floating of bamboos by rafting was not considered feasible except by the river Dikhu.

A slope classification map along with a table are attached which would show in detail the situation in different compartments.

Average slope of the area was calculated in degrees from the topo sheets (1 : 50,000) along with the average slope length (in metres) on the hill face. The slope lengths were measured from the top of the ridge upto the valleys (minor slope variations were not considered) and the average slope was taken into account.

For a macro level planning the following are suggested:

- (i) Areas having slope below 30% should normally be operated by tractors etc. provided the ground surface is sufficiently even. The machine used should normally be medium sized Agricultural Tractors having 50 H.P. with a winch or a Frame-Steered Skidder.

- (ii) Areas having slopes above 30% and upto a limit of 50% may be operated by simple gravity ropeway (Not exceeding 1000 m. in length, capacity 0.3 m³ approximately).

The labourers who are engaged at present are mainly outsiders and are not technically trained. Training at initial stage would be helpful.

The extraction is mainly done by truck with the help of elephants for works like rolling, loading and unloading.

Rivers may provide a feasible mode of transport for bamboos in the project area excluding the Simphon Reserve. Gravity chute may also be used as an additional means.

Based on the tables it may be seen that the major portion (93.05%) of the whole terrain comes within the fold of 20% slope class. This clearly indicates that the whole area can be easily worked by developing the road system and by adopting machines or having wheels. In the interior extraction may be easily handled by tractors and the suitability of that has to be decided and considered in detail based on other important factors like ground suitability for the use of such machines.

The balance portion of the project area is either under extensive jhum or comparatively having easy slope which do not call for any special study.

The following table will show the situation (See map enclosed) :

Slope Class	No. of compartments	Area in km ²	Percentage of distribution
0 - 10%	2	10.4959	5.88%
11 - 20%	16	155.6367	87.17%
21 - 30%	3	12.3996	6.9511%
31% and above	N i l	N i l	N i l

The accessibility and logging generally becomes easier when one adopts the principle of clearfelling and this system is being followed in Simphon Reserve.

The present method of felling and logging with the help of axe and hand saw have added to the wastage. Such wastage has put its thrust for the increase in price without giving any benefit of utilization. The replacement of the present system of felling and logging including debarking has to be carried out with modern techniques by utilising upto data machines as quickly as possible. Besides, the other important aspect that demands immediate attention is the storage of raw materials in the forests for a long period without losing its quality and quantity. Construction of shed particularly in transit depots for softwood, bamboo and small wood have to be done in order to save the cost (by way of saving the wastage in quality and quantity).

It is hoped that the slope classification map and table will be of help for the State Forest Department and they will be able to utilize the slope classification map and the table in making feasibility and cost studies, if necessary, for future forestry planning.

TABLE - 'A'

N A G A L A N D

Table 'A' showing the basic data obtained from the topo sheets
Singphon Hills (Nagaland)

Sl. No.	Compartment	Slope in degree.	Slope length in meter.	Surface area in km ²
1	1	9° - 0"	506.36	1.3165
2	2	13° - 0"	769.25	2.7796
3	3	6° - 0"	1508.51	3.5903
4	4	3° - 0"	3404.30	5.5570
5	5	10° - 0"	914.11	2.3767
6	6	7° - 0"	1513.27	6.9711
7	7	0° - 0"	1001.80	4.9389
8	8	8° - 0"	2931.56	13.9589
9	9	9° - 0"	2781.89	15.3864
10	10	10° - 0"	2390.84	10.6520
11	11	10° - 0"	1627.88	4.4767
12	12	6° - 0"	2664.75	13.3238
13	13	10° - 0"	1575.09	11.3508
14	14	9° - 0"	1318.48	7.9109
15	15	10° - 0"	3705.86	12.8131
16	16	14° - 0"	1547.38	3.3423
17	17	8° - 0"	3133.94	14.2948
18	18	7° - 0"	3879.81	15.7309
19	19	13° - 0"	2051.55	6.2777
20	20	8° - 0"	3028.84	7.4913
21	21	6° - 0"	2264.97	13.9925

TABLE - 'B'

N A G A L A N D

Table 'B' shows the distribution of volume (in m³) by Compartment of Singpho Hills (Nagaland).

Compartment No.	Horizontal area in km ²	Volume of each compartment in m ³
1	1.30	22569.43
2	2.71	47048.58
3	3.57	61979.12
4	5.55	96354.10
5	2.34	40624.97
6	6.91	110965.20
7	4.93	85590.22
8	13.66	237152.63
9	15.21	264062.33
10	10.47	181770.72
11	4.40	76388.84
12	13.25	230034.58
13	11.17	193923.49
14	7.80	135416.58
15	12.62	219097.08
16	3.24	56249.96
17	14.14	255485.95
18	15.61	271006.77
19	6.12	106249.93
20	7.42	128819.36
21	13.90	241319.29

TABLE - 'C'

CONVERSION TABLE 'C' SHOWING DEGREES TO PERCENTAGE:

Degree	Percentage	Slope Class
0°	0%	
1°	1.75%	
2°	3.49%	
3°	5.24%	0-10%
4°	6.99%	
5°	8.75%	
6°	10.51%	
7°	12.28%	
8°	14.05%	11-20%
9°	15.84%	
10°	17.63%	
11°	19.44%	
12°	21.26%	
13°	23.09%	
14°	24.93%	21-30%
15°	26.79%	
16°	28.67%	

Degree	Percentage	Slope class
17°	30.57%	
18°	32.49%	
19°	34.43%	
20°	36.40%	
21°	38.39%	31 - 100%
22°	40.40%	
23°	42.45%	
24°	44.52%	
25°	46.63%	
30°	57.74%	
45°	100.00%	
46°	103.55%	101 - 173%
60°	173.21%	
61°	180.40%	174% and above.

C H A P T E R - VII.

INDUSTRIAL POTENTIAL & WOOD BALANCE.

7.1. Existing industries and markets:

The area is industrially undeveloped. Only two wood based industries namely Tuli Saw Mill and the Nagaland Forest Product Limited exist in the tract dealt with. Tuli Saw Mill has a potential capacity to consume 5 m³ round logs per day. It is a private sector enterprise with 5 employee capacity of which 2 (two) are unskilled labourer. The mill is fed by the timbers of the adjacent forest of Mokokchung. Only Dipterocarpus macrocarpus, Shorea assamica and Terminalia myriocarpa are being sawn by them at present.

The Nagaland Forest Product Limited, a Plywood Industry under joint ownership of Government Of Nagaland and Saharia group utilises 60 m³ per day. This is the only full flaged plywood industry in Nagaland with an employee strength of 250. The main source of its raw materials is the private forest of Mon district. Only Høllong is plentiful which has a great demand in the market of all over India and abroad. The quality of finished product is high. A little quantity of product is sold in Assam and rest is sold in other parts of India. Three more veneer factories are likely to be established at Tuli, Naginimara and Namsa in course of time.

Besides these two existing industries, a paper mill designated as Nagaland Pulp and Paper Company Ltd. with a production capacity of 100 tonnes per day is being established at Tuli of Mokokchung District.

Adjoining districts and Assam are the main markets of sawn and round timber of the tract dealt with.

7.2. Demand and supply:

The project area is small and does not have enough industrial establishment. The portions of the Nagaland districts falling in the project area also lags behind in this respect. The demand zones would therefore primarily constitute the industrial and Tea belt in the State of Assam. The oil field, coal field, Tea Estates, Towns have heavy demand for forest produce. The forest based industries in the Upper Assam have also a substantial requirement of timber. The demand for the plywood industry in Tijiit is high (installed capacity of the plant is 1.8 million m² per annum and is likely to consume larger quantity of timber annually. Moreover the Nagaland Sugar Mill at Dimapur, the dist-illery project at Dimapur, the Pulp and Paper Mill at Tuli will have also some demand for timber and firewood. The Borjan Colliery in Mon district, which was closed some years back and is expected to be reopened. (The Coal India Limited has submitted a preliminary report and is preparing a detailed feasibility report for opening the mining operation under the assistance of the State Government).

The Demand for the following industries are enumerated below:-

1. The Nagaland Forest Products Ltd. - 60 m³ of Hollong and Mekai a day.
2. The Nagaland Paper and Pulp Co. - 250 tonnes or about 375 m³ a day of bamboo and reeds.
3. Other wood based industries. - 50 m³ a day.
4. Other industries in the State & outside the project area. - 150 m³ per day.

It is expected that the existing and developing saw mills and Plywood industry will have demand for another 8000 m³ of timber.

As such some timber would be available for marketing outside the project area. The defective logs can be converted into railway sleepers and may be used after treatment. Amoora wallichii and Artocarpus chaplasha have heavy demand in Calcutta market.

The requirement of matchwood timber is also very high and some quantity would be available from Bombax ceiba, Tetrameles nudiflora, Trewia nudiflora and Anthocephalus cadamba. Demand for sawn timber of the species of Duabanga, Altingia, Castanopsis, Terminalia, Gmelina, Chukrasia, Toona and Michelia would also be high.

7.3. Consumption pattern:

The total consumption is small in comparison to the bulk produce available. The local people collect their domestic need of firewood, timber and bamboo from their homestead land and also from the forests.

The construction of huts are simple and bamboos and thatch are used on a large scale besides young hardwood poles. The use of timber is gradually on the increase. The requirement of bamboo, thatch and timber has been enumerated in the following paragraphs.

Simphan Reserve supplied 1,65,000 numbers of bamboo in the year 1977-78. This is a small area of about 23.30 km² and indicates rather a heavy exploitation of bamboo.

7.4. Local consumption :

It has already been mentioned that the population of the project area is 1,15,917. The number of families residing in the area has been found out to be 17784. During field investigations three categories of families were stratified viz. families consisting of member 5 numbers and below (coded as 'A') members from 6 to 9 (coded as 'B' and members 10 and above (coded as 'C'). On this basis and on field investigation various requirement of forest produce have been calculated.

1) Consumption of bamboo to be used as utensils (Annually)

Type of families.	No. of families	No. of bamboo used/year/family.	Total bamboo used/year.
(a)	8307	5	41,535
(b)	6669	6	40,014
(c)	2808	7	19,656

Total requirement sums upto 1,01,205 numbers or 506 metric tonnes.

ii) Consumption of wood, bamboo and thatch:

A sample survey was conducted to ascertain the wood requirement for construction of new houses in the area. Out of 117 villages, 38 were surveyed randomly and classified under three categories. The total number of houses under each category over the entire project area is calculated as below :-

Type of houses	Particulars of houses	Total No. of houses
(a)	Number of houses made of wood or bamboo.	166
(b)	Number of houses made of wood and bamboo.	21531
(c)	No. of houses made of wood and bamboo and cemented plinth and wall (part)	554
T O T A L :		22251 houses

Consumption of timber wood:

As evident there are 22251 houses of various types in Nagaland and on an average one house needs 1.5 m^3 of wood. Therefore, each house shall be constructed at 10 years cycle. The total wood required is $2225.1 \times 1.5 = 3337.65 \text{ m}^3$. Since reconstruction of house is envisaged at 10 years cycle, wood required for repairs will be insignificant.

Firewood consumption:

Owing to easy access to the raw materials, the villagers use a large quantity of timber as fuel.

The firewood requirement per capita per years has been taken as 0.2 m^3 . The total population being 1,15,917 hence the firewood requirement per year is $0.2 \times 1,15,917 = 23,183.4 \text{ m}^3$.

Consumption for agricultural implements:

About 80% of the total cultivated area is covered by jhuming. Jhuming cultivation is a primitive form of cultivation and very few agricultural implements are required, Hence the total requirement of wood for agricultural implements may be considered to be insignificant.

Consumption of Bamboos:

The bamboos are used by the local people for house buildings, making of baskets, fencing and also used as fuel. It is estimated that on an average the bamboo requirement per capita/year is about 50 numbers. The population of the project area as per 1971 census is 1,15,917. Hence the total local consumption is $50 \times 1,15,917 = 5795850$ number or 28979 metric tonnes.

Consumption of the thatch:

Only for the construction of (a) and (b) type houses thatch are being used.

There are 166 houses in type (a) and 21531 houses in type (b) and each house needs approximately 600 kg. thatch.

Hence, the total requirement of thatch for the project area is 13018200 kg. or 13018.200 metric tonne.

Consumption by different industries:

Sl.No.	Name of the Industries	Consumption/year
1	Nagaland Forest Products	18,000 m ³ approx.
2	Other wood based industries	15,000 m ³ "

The total local demand per year is as follows :-

	Annual availability (in m ³ /MT)	Local consumption (m ³ /MT)	Surplus (m ³ /MT)
1	Constructional timber	36337.65 m ³	
2	Fire wood	23183.4 "	
3	Bamboo	29485 metric tonnes	
4	Thatch	13018.2 metric tonnes	
Total Timber	53420.34 m ³	59521.05 m ³	(-) 6100.71 m ³
Bamboo	48945.00 MT	29485 MT	(+) 19460.00 MT
Reeds	56196.33 MT	Insignificant	56196.33 M.T.

Summary and recommendation:

The inventory of the forest resources of the area (2263.07 km²) depicts the following picture:

<u>S.No.</u>	<u>Raw materials</u>	<u>Quantity (Total availability)</u>
1	Timber	53420.34 m ³
2	Bamboo	48945.00 M.T.
3	Reeds	56196.33 M.T.

But local consumption of timber surpasses the available resources of 53420.34 m³; Bamboos and Reeds resources show a surplus of 19460 M.T. and 56196.33 M.T. respectively.

As such the project area reflects a gloomy picture for further development of timber based industries.

From the available surplus of reeds and bamboos in the area it is observed that about 75,000 M.T. of pulpable material for use in pulp and paper industry is available as surplus. It is just sufficient to feed the 100 tonnes/day paper mill already established at Tuli. It is cautioned at this juncture that intensive management scheme must be drawn up and stress is to be laid on creating plantation for augmenting sustained yield of pulpable material. A naive approach may upset the entire working of the mill and would have a devastating effect in the long run. All these factors must have been considered while establishing the factory. As the adjoining areas have some bamboos and reeds it should be possible to utilise such pulpable materials to bridge any gap in supply of raw material that may be faced in future owing to less outturn of reeds and extensive felling due shifting cultivation. Since the reed species have come up on degraded and denuded land and neither sufficient growth data nor management experience are available, there is no immediate scope of improvement of stock. It, therefore, becomes essential to lay emphasis to replace such crop with massive plantation of bamboo to regulate the flow of sustained yield.

While formulating the development activities in the forestry sector, certain retarding factors that stand on the way for industrial development need a close consideration. The important among them are the special geographical configuration of the region viz. hilly and difficult terrain and lack of infrastructure facilities. Besides, the menace of shifting cultivation has always remained a sore problem in the area that puts a halt to any forestry activities to bring about an effective change on the socio-economic character of the people.

It is impressed that the State Forest Department should take note of this alarming situation and must adopt proper steps to secure willing and voluntary cooperation of the people to subject their land to new agricultural practices.

The Paper mill, already established at Tuli, is indicative of the fact that feasibility study must have been carried out at sufficient depth to appreciate the limiting factors encircling the physiography and quantum of availability of raw materials.

B I B L I O G R A P H Y.

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3. Working Plan for the Digboi Forest Division.
Part - II (1974 - 1975 to 1985 - 1986)
4. Reconnaissance report on Forest Resources of Nagaland - 1976.
5. A consultancy report - Hindustan Paper Corporation (Forestry Division, I.P.I. National Remote Sensing Agency)
6. Statistical Hand Book of Nagaland - 1976.
7. Unpublished data of Nagaland State Forest Department.

Table No. 1.1.1

Per ha. Distribution of stems by species and Diameter Classes (in cm.)

Species Name	Code No.	D I A M E T E R C L A S S E S (IN CM.)										
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	Total
Dysoxylum procerum	2	1.613	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.613
Terminalia belerica	4	0.000	0.000	0.000	0.000	0.322	0.000	0.000	0.000	0.000	0.000	0.322
Pterospermum lanceaeifolium	5	0.322	0.645	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.967
Canarium resiniferum	6	1.935	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.935
Gmelina arborea	7	0.000	0.000	0.645	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.645
Cinnamomum glanduliferum	8	0.000	0.645	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.645
Castanopsis indica	9	0.968	0.322	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.290
Terminalia myriocarpa	10	0.000	0.322	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.322
Dipterocarpus macrocarpus	11	0.646	0.000	0.322	0.645	0.000	0.000	0.000	0.000	0.000	0.322	1.935
Syzygium cumini	12	0.322	0.323	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.645
Shorea assamica	13	0.000	0.300	0.000	0.000	0.322	0.000	0.000	0.000	0.000	0.000	0.322
Vatica lanceaeifolia	14	0.968	0.322	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.290
Mesua ferrea	15	0.000	0.322	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.322
Endospermum chinensis	16	0.000	0.000	0.000	0.000	0.323	0.322	0.000	0.000	0.000	0.000	0.645
Artocarpus chaplasha	17	0.646	0.000	0.322	0.000	0.322	0.000	0.000	0.000	0.000	0.000	1.290
Blachofia javanica	19	0.000	0.000	0.322	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.322
Schima wallichii	20	0.645	0.322	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.967
Michelia champaca	23	0.322	0.000	0.323	0.322	0.000	0.000	0.000	0.000	0.000	0.000	0.967
Others	26	29.679	11.615	3.548	3.226	1.614	1.290	0.967	0.000	0.000	0.967	52.906
T O T A L		38.006	14.838	5.482	4.193	2.903	1.612	0.967	0.000	0.000	1.289	69.350

Table No. 1.1.2.

Per ha. Distribution of stems by species and Diameter Classes (in cm.)

Stratum - Reeds - Tulicatchment

Species Name	Code No.	D I A M E T E R (IN CM.)									
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+ Total
Dysoxylum procerum	2	0.916	0.131	0.196	0.131	0.000	0.000	0.065	0.000	0.000	0.065 1.504
Tetrameles nudiflora	3	0.000	0.000	0.000	0.000	0.000	0.000	0.065	0.065	0.000	0.130
Terminalia belerica	4	0.000	0.000	0.000	0.065	0.000	0.000	0.000	0.000	0.000	0.065
Canarium resiniferum	6	0.130	0.000	0.000	0.066	0.066	0.000	0.000	0.000	0.000	0.262
Gnelina arborea	7	0.065	0.131	0.000	0.000	0.066	0.000	0.000	0.000	0.000	0.262
Castanopsis indica	9	0.327	0.458	0.196	0.131	0.196	0.196	0.000	0.131	0.066	4.701
Terminalia myriocarpa	10	0.000	0.000	0.000	0.000	0.000	0.031	0.000	0.000	0.065	0.196
Dipterocarpus macrocarpus	11	0.065	0.000	0.000	0.131	0.000	0.000	0.000	0.000	0.000	0.196
Syzygium cumini	12	0.458	0.000	0.066	0.065	0.000	0.000	0.000	0.000	0.000	0.589
Shorea assanica	13	0.000	0.000	0.000	0.000	0.000	0.000	0.066	0.000	0.000	0.131
Vatica lanceaefolia	14	0.196	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.196
Mesua ferrea	15	0.000	0.000	0.000	0.000	0.065	0.000	0.000	0.000	0.000	0.065
Artocarpus chaplasha	17	0.524	0.261	0.066	0.065	0.065	0.000	0.065	0.066	0.000	1.112
Magnolia species	18	0.262	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.262
Michelia species	19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.065	0.065
Bischofia javanica	20	1.177	1.570	0.523	0.589	0.000	0.065	0.000	0.000	0.000	3.924
Schima wallichii	21	0.000	0.000	0.065	0.000	0.000	0.000	0.000	0.000	0.000	0.065
Mansonia dipikae	22	0.000	0.000	0.065	0.000	0.000	0.000	0.000	0.000	0.000	0.065
Mangifera indica	26	21.451	5.363	3.139	1.373	0.719	0.458	0.262	0.065	0.196	33.354
Others											
T O T A L		25.571	7.914	4.316	2.616	1.177	0.850	0.523	0.327	0.392	0.458 44.145

Table No. 1, 1, 3.
Per ha. Distribution of Stems By Species And Diameter Classes (in cm.)

Species Name	Sp. Code	D I A M E T E R C L A S S E S (IN CM.)										100 + Total
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 +	
Lagerstroemia speciosa	1	0.098	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.098
Dysoxylum procerum	2	2.147	1.220	0.635	0.293	0.000	0.098	0.000	0.000	0.000	0.048	4.441
Tetrameles nudiflora	3	0.000	0.195	0.049	0.049	0.049	0.049	0.146	0.000	0.000	0.097	0.634
Terminalia belerica	4	0.586	0.439	0.390	0.196	0.146	0.000	0.000	0.000	0.000	0.000	1.757
Pterospermum lanceaeifolium	5	0.146	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.146
Canarium resiniferum	6	2.879	1.513	1.074	0.390	0.049	0.146	0.049	0.097	0.049	0.000	6.246
Gmelina arborea	7	0.196	0.147	0.097	0.097	0.000	0.000	0.000	0.000	0.000	0.000	0.537
Cinnamomum glanduliferum	8	0.440	0.147	0.097	0.097	0.097	0.049	0.000	0.000	0.000	0.000	0.927
Castanopsis indica	9	2.977	1.953	0.829	0.536	0.146	0.049	0.098	0.000	0.000	0.000	6.588
Terminalia myriocarpa	10	0.098	0.146	0.146	0.146	0.244	0.097	0.049	0.000	0.147	0.098	1.171
Dipterocarpus macrocarpus	11	2.635	2.049	1.416	1.122	0.732	0.732	1.024	0.440	0.146	0.245	10.541
Syzygium cumini	12	1.416	0.439	0.097	0.049	0.000	0.000	0.000	0.000	0.000	0.000	2.001
Shorea assamica	13	0.341	0.341	0.830	1.220	0.634	0.829	0.683	0.489	0.439	0.879	6.685
Vatica lanceaeifolia	14	3.709	1.122	0.196	0.049	0.049	0.000	0.000	0.048	0.000	0.000	5.173
Mesua ferrea	15	2.049	2.049	1.268	0.732	0.245	0.049	0.049	0.000	0.000	0.049	6.490
Endospermum chinensis	16	0.635	0.390	0.585	0.390	0.195	0.049	0.000	0.000	0.000	0.049	2.293
Artocarpus chaplasha	17	1.512	1.073	0.830	0.390	0.341	0.196	0.098	0.196	0.049	0.000	4.685
Magnolia sp., Michelia sp.,	18	0.585	0.781	0.391	0.293	0.049	0.146	0.049	0.000	0.000	0.000	2.294
Bischofia javanica	19	1.610	0.537	0.097	0.196	0.097	0.049	0.049	0.000	0.000	0.147	2.782
Schima wallichii	20	0.829	0.488	0.733	0.146	0.049	0.146	0.000	0.000	0.049	0.000	2.440
Mansonia dipikae	21	0.292	0.146	0.196	0.049	0.049	0.049	0.000	0.000	0.000	0.000	0.781
Mangifera indica	22	0.585	0.147	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.732
Michelia champaca	23	0.196	0.634	0.292	0.245	0.098	0.098	0.049	0.048	0.000	0.048	1.708
Morus laevigata	24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.048	0.000	0.048
Phoebe goalpatensis	25	0.049	0.000	0.048	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.146
Others	26	79.983	27.573	12.103	6.491	4.188	1.610	1.073	0.634	0.195	0.341	134.151
T O T A L		105.993	43.529	22.399	13.225	7.417	4.441	3.416	1.952	1.122	2.001	205.495

Table No. 1. 1. 4.
Per hectare Distribution Of Stems By Species And Diameter Classes (in cm.)
Stratum - Miscellaneous with Bamboo - Juli Catchment

Species Name	Sp. Code	D I A M E T E R C L A S S E S (IN CM.)										Total
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+	
Dysoxylum procerum	2	1,200	1,200	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	2,400
Canarium resiniferum	6	0,000	0,400	0,400	0,000	0,000	0,000	0,000	0,000	0,000	0,000	1,600
Gmelina arborea	7	0,000	0,400	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,400
Castanopsis indica	9	2,000	0,400	0,400	0,000	0,800	0,000	0,000	0,400	0,000	0,000	4,000
Dipterocarpus macrocarpus	11	0,000	0,400	0,000	0,800	0,000	0,000	0,400	0,000	0,000	0,000	1,600
Syzygium cumini	12	0,400	0,800	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	1,200
Shorea assamica	13	0,400	0,000	0,000	0,400	0,000	0,000	0,400	0,000	0,000	0,000	1,200
Endospermum chinensis	16	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,400	0,000	0,000	0,400
Artocarpus chaplasha	17	0,400	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,400
Schinus molle	20	0,800	0,000	0,000	0,000	0,400	0,000	0,000	0,000	0,000	0,000	1,200
Mangifera indica	22	0,000	0,400	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,400
Others	26	42,400	10,800	8,800	3,600	1,200	1,200	1,600	0,400	0,000	0,800	70,800
T O T A L		48,400	14,800	9,600	4,800	2,400	1,200	2,400	1,200	0,000	0,800	85,600

Table No. 1. 1. 5.

Per Hectare Distribution of Stems By Stratum And Diameter Class (in cm.)

S T R A T U M	C a t c h m e n t									
	D I A M E T E R C L A S S E S (I N C M.)									
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+ Total
BAMBOO	38.066	10.838	5.482	4.193	2.903	1.612	0.967	0.000	0.000	1.289 69.350
REEDS	25.571	7.914	4.316	2.616	1.177	0.850	0.523	0.327	0.392	0.458 44.145
SEMI EVERGREEN	105.993	43.529	22.399	13.225	7.417	4.441	3.416	1.952	1.122	2.001 205.495
MISC. WITH BAMBOO	48.400	14.800	9.600	4.800	2.400	1.200	2.400	1.200	0.000	0.800 85.600
T O T A L	65.221	25.468	13.176	7.830	4.271	2.616	1.967	1.115	0.724	1.238 123.626

Table No. 1. 2. 1
 PERCENTAGE OF STEMS BY SPECIES
 Stratum - Bamboo - Tulicatchment

Code No.	Species Name	Stems/ha.	% of Stems' occurrence
2	Dysoxylum procerum	1.613	2.33
4	Terminalia belerica	0.322	0.46
5	pterosperrum lanceaeifolium	0.967	1.40
6	Cannarium resiniferum	1.935	2.79
7	Gnelina arborea	0.645	0.93
8	Cinnamomum glanduliferum	0.645	0.93
9	Castanopsis indica	1.290	1.86
10	Terminalia myriocarpa	0.322	0.46
11	Dipterocarpus macrocarpus	1.935	2.79
12	Syzygium cumini	0.645	0.93
13	Shorea assamica	0.322	0.46
14	Vatica lanceaeifolia	1.290	1.86
15	Mesua ferrea	0.322	0.46
16	Endospermum chinensis	0.645	0.93
17	Artocarpus chaplasha	1.290	1.86
19	Bischofia javanica	0.322	0.46
20	Schima wallichii	0.967	1.40
23	Michelia champaca	0.967	1.40
26	Others	52.906	76.29
T O T A L		69.350	100.00

Table No. 1.2.2

PERCENTAGE OF STEMS BY SPECIES

Stratum - Reeds -- Tuli catchment

Sp. Code	Species Name	Stems/ha.	% of stems occurrence
2	Dysoxylum procerum	1.504	3.41
3	Tetrameles nudiflora	0.131	0.30
4	Terminalia belerica	0.065	0.15
6	Canarium resiniferum	0.262	0.59
7	Gmelina arborea	0.262	0.59
9	Castanopsis indica	1.701	3.85
10	Terminalia myriocarpa	0.196	0.44
11	Dipterocarpus macrocarpus	0.196	0.44
12	Syzygium cumini	0.589	1.33
13	Shorea assamica	0.131	0.30
14	Vatica lanceaeifolia	0.196	0.44
15	Mesua ferrea	0.065	0.15
17	Artocarpus chaplasha	1.112	2.52
18	Magnolia species, Michelia species	0.262	0.59
19	Bischofia javanica	0.065	0.15
20	Schima wallichii	3.924	8.89
21	Mansonia dipikae	0.065	0.15
22	Mangifera indica	0.065	0.15
26	Others	33.354	75.56
T O T A L		44.145	100.00

Table No. 1.2.3
Percentage of stems by species
Stratum - Semi-evergreen - Tulicatchment

Spp. Code	Species Name	Stems/ha.	% of stems' occurrence
1	Lagerstroemia speciosa	0.098	0.05
2	Dysoxylum procerum	4.441	2.16
3	Tetrameles nudiflora	0.634	0.31
4	Terminalia belerica	1.757	0.85
5	pterosperrum lanceaeafolium	0.146	0.07
6	Canarium resiniferum	6.246	3.04
7	Gmelina arborea	0.537	0.26
8	Cinnamomum glanduliferum	0.927	0.45
9	Castanopsis indica	6.588	3.21
10	Terminalia myriocarpa	1.171	0.57
11	Dipterocarpus macrocarpus	10.541	5.13
12	Syzygium cumini	2.001	0.97
13	Shorea assamica	6.685	3.25
14	Vatica lanceaeafolia	5.173	2.52
15	Mesua ferrea	6.490	3.16
16	Endospermum chinensis	2.293	1.12
17	Artocarpus chaplasha	4.685	2.28
18	Magnolia species, Michelia species	2.294	1.12
19	Bischofia javanica	2.782	1.35
20	Schima wallichii	2.440	1.19
21	Mansonia dipikae	0.781	0.38
22	Mangifera indica	0.732	0.36
23	Michelia champaca	1.708	0.83
24	Morus laevigata	0.048	0.02
25	Phoebe goalparensis	0.146	0.07
26	Others	134.151	65.28
	T O T A L	205.495	100.00

Table No. 1. 2. 4
Percentage of stems by species
Stratum - Misc. with Bamboo - Tulicatchment

Spp. Code	Species Name	Stems/ha.	% of stems' occurrence
2	Dysoxylum procerum	2.400	2.80
6	Canarium resiniferum	1.600	1.87
7	Gmelina arborea	0.400	0.47
9	Castanopsis indica	4.000	4.67
11	Dipterocarpus macrocarpus	1.600	1.87
12	Syzygium cumini	1.200	1.40
13	Shorea assamica	1.200	1.40
16	Endospermum chinensis	0.400	0.47
17	Artocarpus chaplasha	0.400	0.47
20	Schima wallichii	1.200	1.40
22	Mangifera indica	0.400	0.47
26	Others	70.800	82.71
T O T A L		85.600	100.00

Table No. 1.2.5

Percentage of stems by Diameter Class and Stratum

(All May 1964)

TULI

CATCHMENT

Diameter Class (cm.)	Bamboo		Reeds		Semi Ever-green		Misc. with Bamboo		Total (Full Catchment)	
	Stems/Hec.	% of Occurrence with respect to total.	Stems/Hec.	% of occurrence with respect to total.	Stems/Hec.	% of occurrence with respect to total.	Stems/Hec.	% of occurrence with respect to total.	Stems/Hec.	% of occurrence with respect to total.
10-19	38.066	54.89	25.571	57.93	105.993	51.58	48.400	56.54	65.221	52.76
20-29	14.838	21.40	7.914	17.95	43.529	21.18	14.800	17.29	25.468	20.60
30-39	5.482	7.90	4.316	9.78	22.399	10.90	9.600	11.22	13.176	10.66
40-49	4.193	6.05	2.616	5.92	13.225	6.44	4.800	5.61	7.830	6.33
50-59	2.903	4.19	1.177	2.67	7.417	3.61	2.400	2.89	4.271	3.45
60-69	1.612	2.32	0.850	1.92	4.441	2.16	1.200	1.40	2.616	2.12
70-79	0.967	1.39	0.523	1.18	3.416	1.66	2.400	2.89	1.967	1.59
80-89	0.000	-	0.327	0.72	1.952	0.95	1.200	1.40	1.115	0.90
90-99	0.000	-	0.392	0.89	1.122	0.55	0.000	-	0.724	0.59
100+	1.289	1.86	0.458	1.04	2.001	0.97	0.800	0.94	1.238	1.00
T O T A L	69.350	100.00	44.135	100.00	205.495	100.00	85.600	100.00	123.626	100.00

Percentage of stems by Diameter Class and Stratum

Table No. 1. 3. 2.

Per Hectare Distribution of Volume by species and Diameter Classes (in cm.)

Species Name	Sp. Code	D I A M E T E R C L A S S E S (IN CM.)										Total
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 +	
Dysoxylum procerum	2	0.115	0.053	0.137	0.154	0.000	0.000	0.259	0.000	0.000	2.106	2.824
Tetramales nudiflora	3	0.000	0.000	0.000	0.000	0.000	0.000	0.219	0.329	0.000	0.000	0.548
Terminalia belerica	4	0.000	0.000	0.000	0.082	0.000	0.000	0.000	0.000	0.000	0.000	0.082
Cenarium resiniferum	6	0.019	0.000	0.000	0.117	0.214	0.000	0.000	0.000	0.000	0.000	0.350
Gmelina arborea	7	0.008	0.063	0.000	0.000	0.121	0.000	0.000	0.000	0.000	0.000	0.192
Castanopsis indica	9	0.045	0.198	0.134	0.166	0.372	0.593	0.000	0.740	0.415	0.000	2.663
Terminalia myriocarpa	10	0.000	0.000	0.000	0.000	0.000	0.348	0.000	0.000	0.452	0.000	0.800
Dipterocarpus macrocarpus	11	0.008	0.000	0.000	0.277	0.000	0.000	0.000	0.000	0.000	0.000	0.285
Syzygium cumini	12	0.073	0.000	0.041	0.078	0.000	0.000	0.000	0.000	0.000	0.000	0.192
Shorea assamica	13	0.000	0.000	0.000	0.000	0.000	0.000	0.489	0.000	0.000	1.310	1.799
Vatica lanceaefolia	14	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.023
Mesua ferrea	15	0.000	0.000	0.000	0.000	0.207	0.000	0.000	0.000	0.000	0.000	0.207
Artocarpus chaplasha	17	0.061	0.095	0.041	0.093	0.145	0.000	0.250	0.290	0.000	0.000	0.975
Magnolia sp., Michelia sp.	18	0.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.044
Bischofia javanica	19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.519	0.000	0.519
Schima wallichii	20	0.181	0.607	0.391	0.704	0.000	0.171	0.000	0.000	0.000	0.000	2.054
Mansonia dipikae	21	0.000	0.000	0.064	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.064
Mangifera indica	22	0.000	0.000	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.045
Others	26	2.606	1.891	2.448	1.723	1.283	1.197	0.807	0.326	1.097	10.529	24.107
T O T A L		3.183	3.007	3.301	3.394	2.342	2.339	2.124	1.685	2.483	13.945	37.773

Table No. 1.3.3.

Per ha. Distribution of volume (m³) by species and diameter classes (in cm.)

Stratum - Semi Evergreen

Tulicatchment

Species Name	Code No.	D I A M E T E R C L A S S E S (IN CM.)											Total
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 +		
Lagerstroemia speciosa	1	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.015	
Dysoxylum procerum	2	0.286	0.445	0.472	0.338	0.000	0.239	0.000	0.000	0.000	0.404	2.184	
Tetrameles nudiflora	3	0.000	0.086	0.040	0.055	0.085	0.139	0.491	0.000	0.000	0.951	1.047	
Terminalia belerica	4	0.069	0.129	0.291	0.258	0.269	0.000	0.000	0.000	0.000	0.000	1.016	
Pterospermum lanceaefolium	5	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.022	
Canarium resiniferum	6	0.352	0.832	1.456	0.876	0.142	0.677	0.291	0.869	0.549	0.000	6.044	
Orelina arborea	7	0.033	0.071	0.077	0.144	0.000	0.000	0.000	0.000	0.000	0.000	0.325	
Cinnamomum glanduliferum	8	0.041	0.043	0.067	0.131	0.213	0.143	0.000	0.000	0.000	0.000	0.638	
Cestonopsis indica	9	0.328	0.679	0.619	0.753	0.343	0.162	0.385	0.000	0.000	0.000	3.269	
Terminalia myriocarpa	10	0.015	0.059	0.107	0.209	0.507	0.260	0.208	0.000	1.007	1.165	3.538	
Dipterocarpus macrocarpus	11	0.351	1.261	1.824	2.514	2.436	3.473	6.584	3.571	1.498	4.668	28.180	
Syzygium cumini	12	0.172	0.158	0.093	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.483	
Shorea assamica	13	0.037	0.156	0.895	2.500	2.083	4.001	4.260	4.273	4.922	16.931	40.058	
Vatica lanceaefolia	14	0.544	0.430	0.136	0.070	0.083	0.000	0.000	0.198	0.000	0.000	1.461	
Mesua ferrea	15	0.222	1.053	1.276	1.381	0.645	0.204	0.260	0.000	0.000	1.411	6.452	
Endospermum chinensis	16	0.090	0.154	0.475	0.468	0.342	0.119	0.000	0.000	0.000	0.310	1.965	
Artocarpus chaplasha	17	0.262	0.380	0.574	0.491	0.675	0.479	0.360	0.883	0.286	0.000	4.390	
Magnolia sp., Michelia sp.	18	0.081	0.305	0.288	0.378	0.105	0.393	0.156	0.000	0.000	0.000	1.706	
Bischofia javanica	19	0.230	0.196	0.104	0.295	0.242	0.179	0.232	0.000	0.000	1.933	3.411	
Schima wallichii	20	0.110	0.193	0.537	0.180	0.108	0.417	0.000	0.000	0.263	0.000	1.808	
Mansonia dipikae	21	0.027	0.081	0.221	0.120	0.143	0.261	0.000	0.000	0.000	0.000	0.853	
Mangifera indica	22	0.068	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.128	
Michelia champaca	23	0.025	0.240	0.200	0.302	0.179	0.245	0.156	0.208	0.000	0.310	1.865	
Morus laevigata	24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.304	0.000	0.304	
Phoebe goalparensis	25	0.012	0.000	0.049	0.051	0.000	0.000	0.000	0.000	0.000	0.000	0.112	
Others	26	10.424	10.567	9.158	8.260	7.823	4.293	3.826	2.886	1.077	3.223	61.537	
T O T A L		13.816	17.578	18.959	19.834	16.430	15.684	17.209	12.888	9.906	31.307	173.611	

Table No. 1.3.4

Per ha. Distribution of Volume (m³) By Species and Diameter Classes (in cm.)
Stratum - Misc. with Bamboo - Tulicatchment

Species Name	Code No.	D I A M E T E R C L A S S E S (I N C M .)										
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 +	Total
Dysoxylum procerum	2	0.155	0.442	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.597
Canarium resiniferum	6	0.119	0.197	0.405	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.721
Gmelina arborea	7	0.000	0.137	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.137
Castanopsis indica	9	0.185	0.083	0.221	0.000	1.726	0.000	0.000	2.362	0.000	0.000	4.577
Dipterocarpus macrocarpus	11	0.000	0.176	0.000	2.003	0.000	0.000	2.796	0.000	0.000	0.000	4.975
Syzygium cumini	12	0.038	0.367	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.405
Shorea assamica	13	0.063	0.000	0.000	0.646	0.000	0.000	2.747	0.000	0.000	0.000	3.456
Endospermum chinensis	16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.670	0.000	0.000	1.670
Artocarpus chaplasha	17	0.088	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.088
Schima wallichii	20	0.087	0.000	0.000	0.000	0.902	0.000	0.000	0.000	0.000	0.000	0.989
Mengifera indica	22	0.000	0.148	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.148
Others	26	5.537	4.173	6.724	4.246	2.505	3.288	5.348	1.671	0.000	14.566	48.058
TOTAL		6.272	5.723	7.350	6.895	5.133	3.288	10.891	5.703	0.000	14.566	65.821

Table No. 1. 3. 5

Per Ha. Distribution Of Volume (m³) By Stratus And Diameter Classes (in cm.)

TULI CATCHMENT

S T R A T U M	C O D E N o.	D I A M E T E R C L A S S E S (I N C M.)									
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	Total
B A M B O O	01	4.811	5.546	4.727	5.712	6.076	4.057	3.407	0.000	0.000	33.132 67.568
R E E D S	02	3.183	3.007	3.301	3.394	2.342	2.309	2.124	1.685	2.483	13.945 37.773
S E M I E V E R G R E E N	05	13.816	17.578	18.959	19.834	16.430	15.684	17.209	12.888	9.906	31.307 173.611
M I S C. W I T H B A M B O O	08	6.272	5.723	7.350	6.895	5.133	3.288	10.891	5.703	0.000	14.566 65.821
T O T A L		8.425	10.180	10.978	11.471	9.322	8.845	9.599	7.102	5.937	23.016 104.875

Table No. i. 4. 1.
Total stems (in '000 units) by species and diameter classes (in cm.)
Stratum - Bamboo - Tulicatchment

Species Name	Code No.	D I A M E T E R C L A S S E S (IN CM.)										100 + Total
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 +	
Dysoxylum procerum	2	5.452	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.452
Terminalia belerica	4	0.000	0.000	0.000	0.000	1.090	0.000	0.000	0.000	0.000	0.000	1.090
Pterospermum lanceaefolium	5	1.090	2.181	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.271
Cannarium resiniferum	6	6.542	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.542
Gmelina arborea	7	0.000	0.000	2.181	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.181
Cinnamomum glanduliferum	8	0.000	2.181	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.181
Castanopsis indica	9	3.271	1.091	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.362
Terminalia myriocarpa	10	0.000	1.090	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.090
Dipterocarpus macrocarpus	11	2.181	0.000	1.090	2.181	0.000	0.000	0.000	0.000	0.000	1.090	6.542
Syzygium cumini	12	1.090	1.091	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.181
Shorea assamica	13	0.000	0.000	0.000	0.000	1.090	0.000	0.000	0.000	0.000	0.000	1.090
Vatica lanceaefolia	14	3.272	1.090	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.362
Mesua ferrea	15	0.000	1.090	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.090
Endospermum chinensis	16	0.000	0.000	0.000	0.000	1.090	1.090	0.000	0.000	0.000	0.000	2.181
Artocarpus chaplasha	17	2.181	0.000	1.090	0.000	1.091	0.000	0.000	0.000	0.000	0.000	4.362
Bischofia javanica	19	0.000	0.000	1.090	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.090
Schima wallichii	20	2.181	1.090	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.271
Michelia champaca	23	1.090	0.000	1.091	0.090	0.000	0.000	0.000	0.000	0.000	0.000	3.271
Others	26	100.316	39.254	11.994	10.904	5.452	4.362	3.271	0.000	0.000	3.271	178.824
T O T A L		128.666	50.158	18.536	14.175	9.813	5.453	3.271	0.000	0.000	4.361	234.433

Table No. 1. 4. 2
Total Stems (in '000 units) by species and diameter classes (in cm.)
Stratum - Reeds - Tulicatchment

Species Name	Code No.	D i a m e t e r c l a s s e s i n c m.)											100 +	Total
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99				
Lagerstroemia speciosa	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dysoxylum procerum	2	40.711	5.816	8.724	5.816	0.000	0.000	2.908	0.000	0.000	0.000	2.908	66.883	
Tetrameles nudiflora	3	0.000	0.000	0.000	0.000	0.000	0.000	2.908	0.000	0.000	0.000	0.000	5.816	
Terminalia belerica	4	0.000	0.000	0.000	2.908	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.908	
Pterospermum lanceaeifolium	5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Cenarium resiniferum	6	5.816	0.000	0.000	2.908	2.908	0.000	0.000	0.000	0.000	0.000	0.000	11.632	
Gmelina arborea	7	2.908	5.816	0.000	0.000	2.908	0.000	0.000	0.000	0.000	0.000	0.000	11.632	
Cestanopsis indica	9	14.540	20.356	8.724	5.816	8.724	8.724	0.000	5.816	2.908	0.000	0.000	75.608	
Terminalia myriocarpa	10	0.000	0.000	0.000	0.000	0.000	5.816	0.000	0.000	2.908	0.000	0.000	8.724	
Dipterocarpus macrocarpus	11	2.908	0.000	0.000	5.816	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.724	
Syzygium cumini	12	20.356	0.000	2.908	2.908	0.000	0.000	0.000	0.000	0.000	0.000	0.000	26.172	
Shorea assamica	13	0.000	0.000	0.000	0.000	0.000	0.000	2.908	0.000	0.000	0.000	2.908	5.816	
Vatica lanceaeifolia	14	8.724	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.724	
Mesua ferrea	15	0.000	0.000	0.000	0.000	2.908	0.000	0.000	0.000	0.000	0.000	0.000	2.908	
Endospermum chinensis	16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Artocarpus chaplasha	17	23.264	11.632	2.908	2.908	2.908	0.000	2.908	0.000	0.000	0.000	0.000	49.436	
Magnolia sp., Michelia sp.	18	11.632	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.632	
Bischofia javanica	19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.908	
Schinus molle	20	52.343	69.791	23.264	26.172	0.000	2.908	0.000	0.000	0.000	0.000	0.000	174.478	
Mansonia dipikae	21	0.000	0.000	2.908	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.908	
Mangifera indica	22	0.000	0.000	2.908	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.908	
Michelia champaca	23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Others	26	953.806	230.452	139.581	61.067	31.987	20.356	11.632	2.908	8.724	14.540	1483.053		
T O T A L		1137.008	351.863	191.925	116.319	52.343	37.804	23.264	14.540	17.448	20.356	1962.870		

Table No. 1. 4. 3

Total stems (in '000 units) By Species and Diameter Classes (in cm.)

Stratum - Semi-evergreen - Tulicatchment

Species Name	Sp. Code	D i a m e t e r C l a s s e s (i n c m.)											Total
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	80-99	1.0+		
Lagerstroemia speciosa	1	4,504	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	4,504	
Dysoxylum procerum	2	99,104	56,309	29,280	13,514	0,000	4,504	0,000	0,000	0,000	2,252	204,963	
Tetrameles nudiflora	3	0,000	9,009	2,252	2,252	2,252	2,252	6,757	0,000	0,000	4,504	29,278	
Terminalia belerica	4	27,028	20,271	18,018	9,009	6,757	0,000	0,000	0,000	0,000	0,000	81,083	
Pterospermum lanceaeifolium	5	6,757	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	6,757	
Canarium resiniferum	6	132,889	69,823	49,552	18,018	2,252	6,757	2,252	4,504	2,252	0,000	288,299	
Grelina arborea	7	9,009	6,757	4,504	4,504	0,000	0,000	0,000	0,000	0,000	0,000	24,774	
Cinnamomum glanduliferum	8	20,271	6,757	4,504	4,504	4,504	2,252	3,003	0,000	0,000	0,000	42,792	
Cestanopsis indica	9	137,394	90,094	38,290	24,776	6,757	2,252	4,504	0,000	0,000	0,000	304,067	
Terminalia myriocarpa	10	4,504	6,757	6,757	6,757	11,261	4,504	2,252	0,000	6,757	4,504	54,053	
Dipterocarpus macrocarpus	11	121,527	94,599	65,318	51,804	33,785	33,785	47,299	20,271	6,757	11,261	486,506	
Syzygium cumini	12	65,318	20,271	4,504	2,252	0,000	0,000	0,000	0,000	0,000	0,000	92,345	
Shorea assamica	13	15,766	15,766	38,290	56,309	29,280	38,290	31,533	22,523	20,271	40,542	308,570	
Vatica lanceaeifolia	14	171,179	51,804	9,009	2,252	2,252	0,000	0,000	2,252	0,000	0,000	238,748	
Mesua ferrea	15	94,599	94,599	58,561	33,785	11,261	2,252	2,252	0,000	0,000	2,252	299,561	
Endospermum chinensis	16	29,280	18,018	27,028	18,018	9,009	2,252	0,000	0,000	0,000	2,252	105,857	
Artocarpus chaplasha	17	69,823	49,552	38,290	18,018	15,766	9,009	4,504	9,009	2,252	0,000	216,223	
Magnolia sp., Michelia sp.	18	27,028	36,037	18,018	13,514	2,252	6,757	2,252	0,000	0,000	0,000	105,858	
Bischofia javanica	19	74,328	24,776	4,504	9,009	4,504	2,252	2,252	0,000	0,000	6,757	128,382	
Schima wallichii	20	38,290	22,523	33,785	6,757	2,252	6,757	0,000	0,000	2,252	0,000	112,618	
Mansonia dipikae	21	13,514	6,757	9,009	2,252	2,252	2,252	0,000	0,000	0,000	0,000	36,036	
Mangifera indica	22	27,028	6,757	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	33,785	
Michelia champaca	23	9,009	29,280	13,514	11,261	4,504	4,504	2,252	2,252	0,000	2,252	78,828	
Morus laevigata	24	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	2,252	0,000	2,252	
Phoebe goalparensis	25	2,252	0,000	2,252	2,252	0,000	0,000	0,000	0,000	0,000	0,000	6,756	
Others	26	3691,624	1272,585	558,586	299,564	191,450	74,328	49,552	29,280	9,009	15,766	6191,744	
T O T A L		4892,125	2009,101	1033,825	610,381	342,350	204,959	157,661	90,091	51,802	92,342	9484,637	

Table, No. 1. 4. 4
Total Stems (in '000 Unit) By Species and Diameter Classes (in cm.)
 Stratum - Miscellaneous with Bamboo - Tulicatchment

Species Name	Sp. Code	D I A M E T E R C L A S S E S (in cm.)										Total
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 +	
Dysoxylum procerum	2	1.930	1.929	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.859
Canarium resiniferum	6	1.286	0.643	0.644	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.573
Gmelina arborea	7	0.000	0.643	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.643
Castanopsis indica	9	3.216	0.643	0.643	0.000	1.286	0.000	0.000	0.644	0.000	0.000	6.432
Dipterocarpus macrocarpus	11	0.000	0.643	0.000	1.287	0.000	0.000	0.643	0.000	0.000	0.000	2.573
Syzygium cumini	12	0.643	1.287	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.930
Shorea assamica	13	0.643	0.000	0.000	0.643	0.000	0.000	0.644	0.000	0.000	0.000	1.930
Endospermum chinensis	16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.643	0.000	0.000	0.643
Artocarpus chaplasha	17	0.643	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.643
Schima wallichii	20	1.287	0.000	0.000	0.000	0.644	0.000	0.000	0.000	0.000	0.000	1.930
Mangifera indica	22	0.000	0.643	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.643
Others	26	68.179	47.368	14.150	5.788	1.929	1.930	2.572	0.643	0.000	1.286	113.846
T O T A L		77.827	23.799	15.437	7.718	3.859	1.930	3.859	1.930	0.000	1.286	137.645

Table No. 1. 5. 1.
Estimation of Volume (in '000 m³) By Species and Diameter Classes (in cm.)
Stratum - Bamboo - Tulicatchment

Species Name	Sp. Code	D I A M E T E R C L A S S E S (IN CM.)										Total
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 +	
Dysoxylum procerum	2	0.595	-	-	-	-	-	-	-	-	-	0.595
Terminalia telericia	4	-	-	-	-	2.447	-	-	-	-	-	2.447
Pterospermum lanceaeifolium	5	0.103	0.809	-	-	-	-	-	-	-	-	0.912
Canarium resiniferum	6	0.305	-	-	-	-	-	-	-	-	-	0.305
Gmelina arborea	7	-	-	1.788	-	-	-	-	-	-	-	1.788
Cinnamomum glanduliferum	8	-	0.657	-	-	-	-	-	-	-	-	0.657
Castanopsis indica	9	0.312	0.514	-	-	-	-	-	-	-	-	0.826
Terminalia myriocarpa	10	-	0.377	-	-	-	-	-	-	-	-	0.377
Dipterocarpus macrocarpus	11	0.240	-	1.602	4.007	-	-	-	-	57.503	-	63.432
Syzygium cumini	12	0.267	0.454	-	-	-	-	-	-	-	-	0.721
Shorea assamica	13	-	-	-	-	3.999	-	-	-	-	-	3.999
Vatica lanceaeifolia	14	0.533	0.370	-	-	-	-	-	-	-	-	0.903
Mesua ferrea	15	-	0.294	-	-	-	-	-	-	-	-	0.294
Endospermum chinensis	16	-	-	-	-	2.139	3.164	-	-	-	-	5.303
Artocarpus chaplasha	17	0.344	-	1.005	-	2.063	-	-	-	-	-	3.412
Bischofia javanica	19	-	-	1.105	-	-	-	-	-	-	-	1.105
Schima wallichii	20	0.374	0.528	-	-	-	-	-	-	-	-	0.902
Michelia champaca	23	0.267	-	1.058	1.503	-	-	-	-	-	-	2.828
Others	26	12.922	15.076	9.339	13.790	9.888	10.549	11.518	-	54.484	-	137.574
TOTAL		16.262	19.079	15.977	19.308	20.536	13.713	11.518	-	111.987	-	228.380

Estimation Of Volume (in '000 m³) By Species and Diameter Classes (in cm.)

Species Name	Sp. Code	D I A M E T E R C L A S S E S (I N C M.)										Total
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 +	
Dysoxylum procerum	2	5,112	2,368	6,079	6,807	-	-	11,552	0,000	93,639	125,557	
Tetramelas nudiflora	3	-	-	-	-	-	-	9,730	14,659	-	24,389	
Terminalia belerioa	4	-	-	-	3,678	-	-	-	-	-	3,678	
Cenarium resiniferum	6	0,875	-	-	5,237	9,449	-	-	-	-	15,561	
Gnelina arborea	7	0,389	2,770	-	-	5,399	-	-	-	-	8,557	
Cestanopsis indica	9	1,991	8,788	5,938	7,377	16,569	26,369	-	32,876	18,479	118,387	
Terminalla myriocarpa	10	-	-	-	-	-	15,497	-	-	-	35,559	
Dipterocarpus macrocarpus	11	0,383	-	-	12,298	-	-	-	20,062	-	12,681	
Syzygium cumini	12	3,164	-	1,845	3,509	-	-	-	-	-	8,516	
Shorea assamica	13	-	-	-	-	-	-	21,757	-	58,249	80,006	
Vatica lanceaeifolia	14	1,052	-	-	-	-	-	-	-	-	1,052	
Mesua ferrea	15	-	-	-	-	9,215	-	-	-	-	9,215	
Artocarpus chaplasha	17	2,684	4,225	1,845	4,095	6,447	-	11,117	12,905	-	43,318	
Magnolia sp., Michelia sp.	18	1,957	-	-	-	-	-	-	-	-	1,957	
Bischofia javanica	19	-	-	-	-	-	-	-	23,076	-	23,076	
Schinus wallichii	20	8,076	26,991	17,348	31,309	-	7,585	-	-	-	91,309	
Mansonia dipika	21	-	-	2,837	-	-	-	-	-	-	2,837	
Mangifera indica	22	-	-	2,023	-	-	-	-	-	-	2,023	
Others	26	115,844	88,533	108,844	76,588	57,053	53,243	40,306	14,495	48,785	468,190	
TOTAL		141,526	133,675	146,759	150,898	104,132	102,694	94,462	74,935	110,402	620,078	

Table No. 1. 5. 3.

Estimation of Volume (in '000 m³) By Species and Diameter Classes (in cm.)

Stratum - Semievergreen - Pulicatchment

Species Name	Sp. Code	Diameter Classes (in cm.)										Total
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 +	
Lagerstroemia speciosa	1	0.701	-	-	-	-	-	-	-	-	-	0.701
Dysoxylum procerum	2	13.240	20.517	21.793	15.613	-	11.028	-	-	-	18.624	100.815
Tetrameles nudiflora	3	-	3.935	1.864	2.534	3.956	6.437	22.621	-	-	43.885	85.232
Terminalia belerica	4	3.165	5.974	13.416	11.944	12.377	0.000	0.000	-	-	-	46.877
Pterospermum lanceaefolium	5	1.055	-	-	-	-	-	-	-	-	-	1.056
Canarium resimiferum	6	16.242	38.398	67.158	40.423	6.593	31.287	13.438	40.088	25.296	-	278.923
Gmelina arborea	7	1.523	3.024	3.526	6.642	-	-	-	-	-	-	14.977
Cinnamomum glanduliferum	8	1.072	2.010	3.110	6.053	9.857	6.566	-	-	-	-	29.476
Castanopsis indica	9	15.113	31.349	28.535	34.750	15.876	7.523	17.761	-	-	-	150.921
Terminalia myriocarpa	10	0.652	2.730	4.941	9.692	23.433	12.003	9.637	-	46.453	53.773	163.314
Dipterocarpus macrocarpus	11	16.237	58.162	84.222	112.059	12.307	160.252	303.095	164.776	69.167	215.447	1300.608
Syzygium cumini.	12	7.923	7.274	4.318	2.700	-	-	-	-	-	-	22.295
Shorea assamica	13	1.743	7.208	41.289	115.403	96.110	184.609	196.645	197.197	227.164	781.421	1848.869
Vatica lanceaefolia	14	25.071	19.879	6.289	3.240	3.007	-	-	9.176	-	-	67.462
Mesua ferrea	15	10.260	46.598	58.067	63.735	29.800	9.394	11.961	-	-	65.162	297.785
Endospermum chinensis	16	4.180	7.106	21.687	21.605	16.002	5.514	-	-	-	14.333	90.707
Artocarpus chaplasha	17	12.120	17.571	26.521	22.620	31.157	22.081	16.598	40.776	13.209	-	202.661
Mangolia sp., Michelia sp.	18	3.700	14.040	13.320	17.458	4.027	18.119	7.228	-	-	-	78.700
Bischofia javanica	19	10.606	9.089	4.770	13.571	11.159	0.303	10.682	-	-	89.247	157.427
Schima wallichii	20	5.032	8.901	24.818	8.294	4.994	19.233	-	-	12.132	-	83.404
Mansonia dipikae	21	1.284	3.737	10.197	5.507	6.593	12.070	-	-	-	-	39.388
Mangifera indica	22	3.130	2.790	-	-	-	-	-	-	-	-	5.928
Michelia champaca	23	1.146	11.033	9.267	13.919	8.234	11.297	7.228	9.659	-	14.332	86.095
Morus laevigata	24	-	-	-	-	-	-	-	-	14.047	-	14.047
Phoebe goalparensis	25	0.525	-	2.242	2.350	-	-	-	-	-	-	5.125
Others	26	481.111	487.711	422.705	31.222	361.107	198.107	176.598	133.200	49.725	148.751	2840.238

T O T A L 637.657 811.312 875.068 915.430 750.349 723.903 794.292 594.052 457.193 1444.975 8013.031

Table No. 1. 5. 4.
ESTIMATION OF VOLUME (in '000 m³) BY SPECIES AND DIAMETER CLASSES (IN CM.)

STRATUM - MISC. WITH BAMBOO		DIVISION - TILICATCHMENT									
		D I A M E T E R C L A S S E S (IN CM.)									
Code No.		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 + Total
Dysoxylum procerum	2	0.250	0.709	-	-	-	-	-	-	-	0.959
Canarium resiniferum	6	0.190	0.319	0.652	-	-	-	-	-	-	1.161
Gmelina arborea	7	-	0.219	-	-	-	-	-	-	-	0.219
Castanopsis indica	9	0.298	0.133	0.356	-	2.775	-	-	3.798	-	7.360
Dipterocarpus macrocarpus	11	-	0.284	-	3.221	-	-	4.495	-	-	8.000
Syzygium cumini	12	0.061	0.509	-	-	-	-	-	-	-	0.650
Shorea assamica	13	0.102	-	-	1.038	-	-	4.417	-	-	5.557
Endospermum chinensis	16	-	-	-	-	-	-	-	2.686	-	2.686
Artocarpus chaplasha	17	0.142	-	-	-	-	-	-	-	-	0.142
Schinus molle	20	0.140	-	-	-	1.451	-	-	-	-	1.591
Mangifera indica	22	-	0.238	-	-	-	-	-	-	-	0.238
Others	26	8.903	6.711	10.811	6.828	4.027	5.287	8.600	2.687	23.423	77.277
T O T A L		10.086	9.207	11.819	11.087	6.253	5.287	17.512	9.171	23.423	105.840

Table No. 1. 6.
Per Hectare Distribution of Bamboo By Species and Stratum

T U L I C A T C H M E N T

S T R A T U M	Species Name	Sp. Code	Name of Bamboo				Total	
			Upto two seasons		Mature		Sound	Unsound
			Sound	Unsound	Sound	Unsound		
Bamboo	Dendrocalamus hamiltonii	1	741.290	131.290	1096.451	518.387	1837.741	649.677
	Teinostachyum dullo	4	40.645	8.709	60.645	30.322	101.290	39.031
	Bambusa tulda	7	62.258	9.355	69.677	39.677	131.935	49.032
	Other bamboo	9	70.322	15.161	107.096	56.451	177.418	71.612
	T O T A L		914.515	164.515	1333.869	644.837	2248.384	809.352
R e e d	Dendrocalamus hamiltonii	1	36.993	6.862	17.124	9.019	54.117	15.881
	Bambusa tulda	7	6.339	0.980	3.595	1.307	9.934	2.287
	T O T A L		43.332	7.842	20.719	10.326	64.051	18.168
Semi- Evergreen	Dendrocalamus hamiltonii	1	231.512	24.780	269.122	121.707	500.634	146.487
	Bambusa palida	2	4.243	0.585	3.561	1.561	7.804	2.146
	Melocanna bambusoides	3	1.073	0.048	1.463	0.585	2.536	0.633
	Teinostachyum dullo	4	31.561	3.853	29.414	12.926	60.975	16.779
	Pseudostachyum polymorphum	5	9.853	1.073	11.853	5.317	21.706	6.390
	Bambusa tulda	7	13.024	1.853	14.097	6.683	27.121	8.536
	Other bamboo	9	9.073	1.171	7.463	5.463	16.536	6.634
	T O T A L		300.339	33.363	336.973	154.242	637.312	187.605
Misc. with Bamboo	Dendrocalamus hamiltonii	1	328.000	25.200	558.400	270.800	886.400	296.000
	Teinostachyum dullo	4	4.000	0.800	6.400	3.600	10.400	4.400
	Pseudostachyum polymorphum	5	24.000	0.800	47.200	19.600	71.200	20.400
	T O T A L		356.000	26.800	612.000	294.000	968.000	320.800

Table No. 1. 7.

Stratum/Project area	S p e c i e s	N a m e	T U L I C A T C H M E N T
		Bamboo weight/hectare (in tonne)	
		Sound	Unsound
B a m b o o	Dendrocalamus hamiltonii	7.716	3.648
	Teinostachyum dulla	0.096	0.048
	Bambusa tulda	0.298	0.170
	Other bamboo	0.172	0.091
	T O T A L	8.282	3.957
R e e d s	Dendrocalamus hamiltonii	0.120	0.063
	Bambusa tulda	0.015	0.005
	T O T A L	0.135	0.068
Semi Evergreen	Dendrocalamus hamiltonii	1.894	0.056
	Bambusa palida	0.005	0.002
	Molocanna bambusoides	0.002	0.001
	Teinostachyum dullo	0.046	0.026
	Pseudostachyum polymorphum	0.007	0.003
	Bambusa tulda	0.060	0.028
	Other bamboo	0.012	0.009
	T O T A L	2.026	0.919
Misc. with Bamboo	Dendrocalamus hamiltonii	3.930	1.900
	Teinostachyum dulla	0.010	0.005
	Pseudostachyum polymorphum	0.028	0.012
	T O T A L	3.968	1.917
Tuli Catchment		1.400	0.647

Table No. 1. 8.

Per Ha. Distribution of Reeds Clump and Estimation of total weight (in 000 tonnes) By Stratum and Size Class

T U L I C A T C H M E N T							
S T R A T U M	No. of clump by size class			Total	Weight	Estimation	
	I	II	III				
					in ton- ne/hect.	of Reeds by weight (in '000 tonnes)	
Bamboo (01)	9.677	3.226	-	12.903	0.019	0.066	
Reed (02)	2262.745	86.928	1.307	2350.980	3.568	158.647	
Semi Evergreen (05)	103.415	20.487	2.927	126.829	0.192	8.861	
Misc. with Bamboo (08)	396.000	20.000	-	416.000	0.631	1.015	
T O T A L					1.763	168.589	

Table No. 1. 8. 1.
Estimation of Bamboo Weight (in 000 tonne) By Species & Stratum

Stratum/Project area	Species Name	Bamboo weight/in 000 tonne	
		Sound	Unsound
B a m b o o	Dendrocalamus hamiltonii	26.080	12.330
	Teinostachyum dulloa	0.325	0.162
	Bambusa tulda	1.007	0.575
	Other bamboo	0.581	0.308
	T O T A L	27.993	13.375
R e e d s	Dendrocalamus hamiltonii	5.336	0.801
	Bambusa tulda	0.667	0.222
	T O T A L	6.003	3.023
Semi Evergreen	Dendrocalamus hamiltonii	87.418	39.509
	Bambusa palida	0.231	0.092
	Melocanna bambusoides	0.092	0.046
	Teinostachyum dulloa	2.123	0.923
	Pseudostachyum polymorphum	0.323	0.138
	Bambusa tulda	2.769	1.293
	Other Bamboo	0.554	0.415
	T O T A L	93.510	42.416
Misc. with Bamboo	Dendrocalamus hamiltonii	6.319	3.055
	Teinostachyum dulloa	0.016	0.008
	Pseudostachyum polymorphum	0.045	0.019
	T O T A L	6.380	3.082
Tuli Catchment		133.886	61.896

VOLUME TABLE (M³)

Table - 1.9

Diameter Class (in c.m.)	Lagerstroemia species.	Terminalia Beleric.	Canarium resiniferum.	Gmelina arborea	Cinnamomum glanduliferum	Castanopsis Indica.	Terminalia myrtocarpa.	Dipterocarpus macrocarpus	Shorea assamica	Mesua Ferra	Bischofia javanica	Mansonia diptikae	O t h e r s .
10-19	0.1472	0.1049	0.1205	0.1471	0.1049	0.1049	0.1049	0.3411	0.1050	0.1054	0.1471	0.1205	0.1790
20-29	0.3889	0.3301	0.5502	0.3889	0.3301	0.3301	0.3301	0.7953	0.4319	0.4593	0.3889	0.5502	0.5051
30-39	0.8187	0.7393	1.2519	0.8187	0.7393	0.7393	0.7393	1.4823	1.0526	1.0572	0.8187	1.2519	0.9983
40-49	1.4365	1.3325	2.2197	1.4365	1.3325	1.3325	1.3325	2.4023	1.9671	1.8991	1.4365	2.2197	1.6587
50-59	2.2423	2.1097	3.4511	2.2423	2.1097	2.1097	2.1097	3.5551	3.1754	2.9850	2.2423	3.4511	2.4864
60-69	3.2361	3.0709	4.9445	3.2361	3.0709	3.0709	3.0709	4.9409	4.5776	4.3149	3.2361	4.9445	3.4812
70-79	4.4179	4.2161	6.6990	4.4179	4.2161	4.2161	4.2161	6.5595	6.4735	5.8888	4.4179	6.6990	4.6433
80-89	5.7877	5.5453	8.7140	5.7877	5.5453	5.5453	5.5453	8.4111	8.5632	7.7067	5.7877	8.7140	5.9725
90-99	7.3455	7.0585	10.9891	7.3455	7.0585	7.0585	7.0585	10.4955	10.9467	9.7686	7.3455	10.9891	7.4689
100 +	9.0913	8.7557	13.5240	9.0913	8.7557	8.7557	8.7557	12.8129	13.6240	12.0745	9.0913	13.5240	9.1326

APPENDIX NO. I.

List of species enumerated

Sl.No.	Local Name	Botanical Name	Species Code
1	Ajhar	Lagerstroemia speciosa	001
2	Bandardima	Dysoxylum procerum	002
3	Bhela	Tetrameles nudiflora	003
4	Bhomera	Terminalia belerica	004
5	Bhonboguri	Pterospermum lanceaefolium	005
6	Dhuna	Canarium resiniferum	006
7	Gamari	Gmelina arborea	007
8	Ganseri	Cinnamomum glanduliferum	008
9	Hingori	Castanopsis indica	009
10	Hollock	Terminalia myriocarpa	010
11	Hollong	Dipterocarpus macrocarpus	011
12	Jam	Syzygium cumini	012
13	Makai	Shorea assamica	013
14	Morhal	Vatica lanceaefolia	014
15	Nahar	Mesua ferrea	015
16	Phulgomari	Endospermum chinensis	016
17	Sam	Artocarpus chaplasha	017
18	Sopa	Magnolia sp., Michelia sp.	018
19	Variam	Bischofia javanica	019
20	Gogra	Schima wallichii	020
21	Badam	Mansonia dipikae	021
22	Am	Mangifera indica	022
23	Champ, Titasopa	Michelia champaca	023
24	Bhola	Morus laevigata	024
25	Bonsum	Phoebe goalparensis	025
26	Others	Others	026

B A M B O O

Sl.No.	Local Name	Botanical Name	Species Code
1	Kako	Dendrocalamus hamiltonii	1
2	Bijli, Makal	Bambusa palida	2
3	Muli	Melocanna bambusoides	3
4	Dalu	Teinostachyum dulloa	4
5	Bajal	Pseudostachyum polymorphum	5
6	Kata bas	Dendrocalamus strictus	6
7	Jati, Mirtenga	Bambusa tulda	7
8	Bhaluka	Bambusa balcooa	8
9	Other bamboo	Other bamboo	9

R E E D S

Sl.No.	Local Name	Botanical Name	Species Code
1	Bhutang	Saccharum arundinacium	1
2	Khagra	Neyraudia reynaudiana	2
3	Phuljharu	Thysanolaena maxima	3
4	Egra	Eulalia species	4
5	Others	Others	5