

## PROJECT PROPOSAL

# PROPOSED THINING REGIME PLAN FOR SINNANAGAVILLU TEAK PLANTATION IN PUTTALAM SRI LANKA

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### PROJECT ABSTRACT

**Title:** Proposed Thinning Regime Plan for Puttalam Teak Plantation

#### Executive Summary:

Due to the mellow color, physical and mechanical properties as well as the high durability, Teak has got the top rank in trade demand among the other hardwood species in plantation industry of Sri Lanka. To make best production it is fruitful in practicing thinning in the plantation for acquiring high economical and environmental benefits from the plantation. This project is followed up by the Asia Tropical Plantations to prepare thinning regime plan based on the forest inventory information by analyzing and evaluating of the growth parameters and other information of teak trees in three teak plantations viz. Anamaduwa, Puttalam and Batticaloa. Among those, puttalam Plantation is consisting 8000 m<sup>2</sup> of sampling area existing with five sample plots. The studied area posses with

8.53 ha with having total number of 5093 trees. Among them 4829 were in good condition 80 in small or poor in growth and 184 were reserved trees. The estimated average DBH was 16.37 cm as well as average height was 12.4 m and average trees per hectare were 597. Total production of the Puttalama teak plantation was 595.8 m<sup>3</sup>. As the estimated volumes, 0.117m<sup>3</sup> of volume was represented per tree while 69.8 m<sup>3</sup> represented per hectare. However the mean annual increment of DBH was 1.82 cm and the mean annual increment of height was 1.38 m. According to the proposed thinning regime it is estimated that 442 trees can be removed in 2021 from 10<sup>th</sup> aged Puttalam teak plantation and as the second thinning it can be removed 740 trees in 2026. However before implementing thinning; erosion prevention methods must be applied, concrete posts at corner of sample plot need to be reestablished, number of trees to be removed should be identified, marked and numbered, fire lines must be properly maintained and trees should be closely monitored for getting the maximum benefit against to the investment.

<b>Field</b>	: Teak Plantation Management
<b>Executing Agency</b>	: Asia Teak Tropical Plantation
<b>Approving Institute</b>	:
<b>Duration</b>	:
<b>Commencing Date</b>	:
<b>Allocated Budget</b>	:
<b>Proposed Source of Finance</b>	:

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## CONTEXT

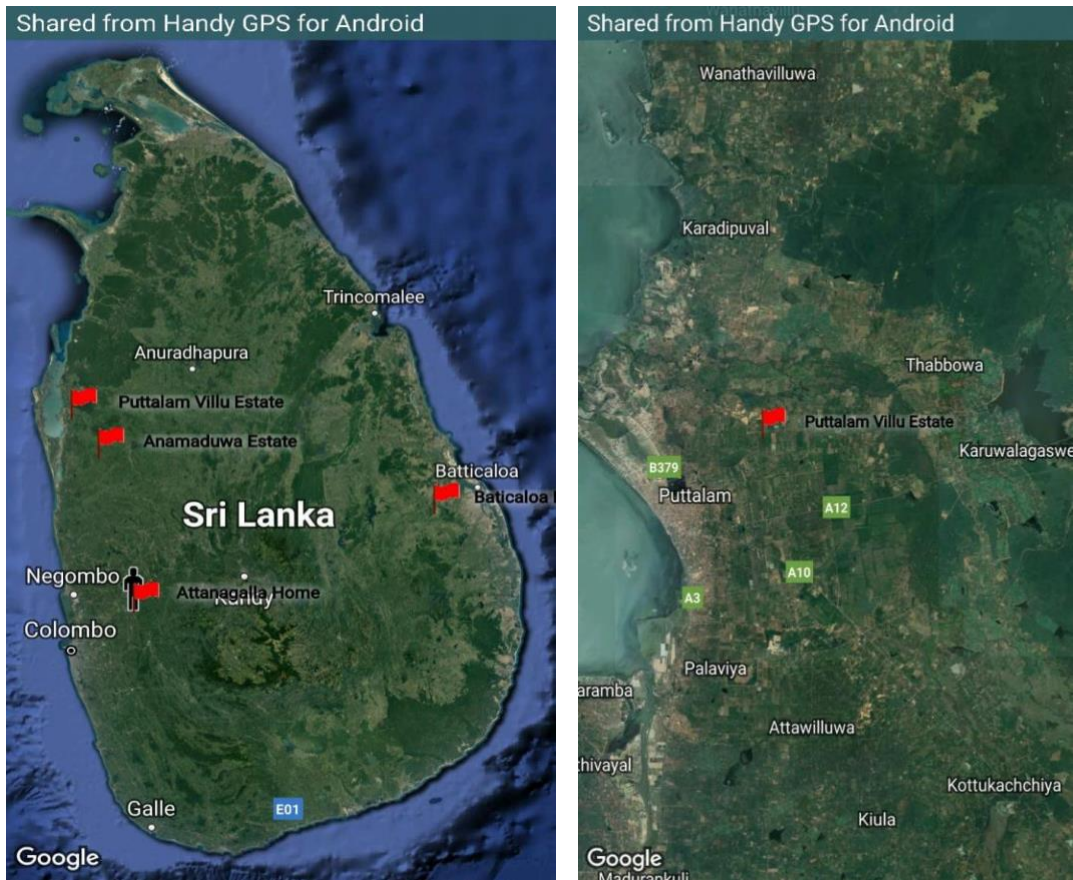
Teak grows well in the tropics in the world where having deep, flat and well-drained alluvial soils rich in calcium, a mean annual temperature of 22-27°C and annual precipitation of 1,200-2,500 mm, with a marked dry season of maximum 50 mm of rain. It was an introductory species to Sri Lanka with the aim of producing quality timber such as attractive mallow color, superior physical as well as mechanical properties and high durability. Because of that it possesses the characteristics of lightness with strength, ease of seasoning without splitting and cracking, ease of working and carving, resistance to termite, fungus, and weathering, which increased the demand for the timber in mainly construction and furniture industries.

Many factors such as site selection, seed supply and seed quality, management practices and other biological factors such as insects affect directly to the plant growth and the final harvesting volume. Site selection is the most critical issue for successful management factor of teak plantation.

This plantation located in Puttalama area in Sri Lanka which belongs to the dry zone having following climatic conditions and soil properties as shown Table 1. It consists of 8.53 hectare sampling area (8000 m<sup>2</sup>) covered 10.6% of population of the site. It was estimated that there has 5093 trees which including 4829 good trees, 80 small and poor trees and 184 reserved trees. This site produced 595.8 m<sup>3</sup> of timber as estimated in this study. Mean volume per tree of Puttalama area was 0.117m<sup>3</sup> while it produced 69.8 m<sup>3</sup> volumes per hectare. The topographical, geographical and the climatic conditions were definitely affected for the growth rate of the existing population of the plantation.

**Table 1: Puttalama site requirements of teak plantation**

<b>Puttalama site requirements for the established teak plantation</b>	
<b>Climatic/topographic</b>	
<b>Site factor</b>	<b>Optimum condition</b>
<b>Altitude</b>	<b>0-900 m</b>
<b>Temperature</b>	<b>21-32 °C</b>
<b>Precipitation</b>	<b>55-1195</b>
<b>Seasonality</b>	<b>dry season</b>
<b>Slope</b>	<b>0-5%</b>
<b>Topography</b>	<b>Flat, undulated</b>
<b>Soil properties</b>	
<b>Site factor</b>	<b>Optimum condition</b>
<b>Soil origin</b>	<b>Alluvial, Basaltic, Limestone, Sandstone, Quartzite</b>
<b>Texture</b>	<b>Loamy medium texture</b>
<b>Water holding capacity</b>	<b>Good</b>



**Figure 1: Location of Puttalama plantation shared by the GPS**

Silvicultural management applied for a plantation in correct way using appropriate techniques is very essential to gain maximum production. Site matching, pruning, spacing, thinning methods, and rotation length have been refined the productivity of the plantation. Rotation length (harvesting age) is decided by concerning the species, age, site quality, growth rate, thinning methods, thinning cost, harvesting cost and also the investment.

Teak is a light demanding species and its growth and development are reduced sharply under poor light conditions. Hence pruning, spacing and thinning are very much important in maintaining the teak plantation. Pruning refers to the cutting of the side branches off the main trunk of the trees while they are growing in order to ensure straight and high-quality logs. Meanwhile thinning refers to when some of the underperforming trees in the plantation are cut and sold prematurely, thus allowing the best trees to continue developing fully with more space and soil nutrients.

Hence, spacing as well as intensive weeding to gain better light intensity, water and nutrient are very necessary during early establishment of the plantation. Initial spacing of teak plantation depends on many factors as site quality, cost of establishment, thinning regime, small wood utilization, planting system, e.g. agro-forestry, intercropping etc.

Main purpose of thinning is to increase economic benefit. Although thinning is primarily aimed at improving the value of the residual stems, other benefits now being recognized are risk reduction for insect infestations, disease epidemics, and damage from abiotic agents.

Thinning schedule varies with site quality. The first thinning is conducted at 5-10 years after planting, depending on site quality and the size of initial spacing. Generally, under good site and close spacing (1.8×1.8 m and 2×2 m) the first and second thinning (mechanical thinning) are conducted at 5 and 10 years respectively. About 25% of the stock is left for further growth and development after the second thinning. If properly done, thinning can result in increased growth rates and improved resistance to pest attack.

Puttalam plantation was applied selective thinning. There are two main approaches to selecting the trees to be removed in any thinning, negative selection and positive selection. In negative selection, suppressed and poorly formed trees are removed without considering the growth of remaining trees. Only undesirable trees are removed, thus improving the overall quality of the stand. Undesirable trees include wolf trees, whips and badly shaped trees such as forked, bent and heavily branched individuals, damaged and diseased trees, trees of low increment or low value, and unwanted species. But in positive selection, competing trees are removed to maximize the growth of the 'best' trees. The best trees of the stand are identified and their growth and development is actively promoted by removing competitors.

Type of thinning, timing of thinning or thinning cycle and intensity of thinning are strongly influenced to the pattern of growth as well as the yield of the plantation. Usually management objectives are achieved by applying a series of thinning (*thinning regime*). It describes when thinning will start and end and the plan for each intervention in terms of type, intensity and cycle. When designing a thinning regime, it should be concerned on each species follows a characteristic growth pattern which will influence for the thinning regime. Site quality is also should be concerned which is usually expressed as Yield Class. Long-term management objectives also affect to the thinning regime. Therefore it should be concerned when proposing thinning regime.

**Table 2: Growth parameters of Teak governed by site quality of some other countries.**

Site quality 19							
Age	No. of stems (ha)	Top height (m)	DBH (cm)	Per Tree volume (m <sup>3</sup> )	Trees volume (ha)	MAI (m <sup>3</sup> /ha/yr)	CIA (m <sup>3</sup> /ha/yr)
3	1111	8	6.9	-	-	-	9.9
5	776	13.4	13.1	0.03	27.2	5.4	13.6
8	542	17.6	18.6	0.102	55.3	7.6	11.3
12	379	19.3	22.2	0.259	98.5	9.7	13.7
20	265	21.3	27.0	0.449	119.0	7.9	5.2
25	185	21.7	31.5	0.62	115.3	7.1	4.3

**Table 3: Growth parameters of Teak governed by site quality of some other countries.**

Site quality 21							
Age	No. of stems/ha	Top height (m)	DBH(cm)	Per Tree volume (m3)	Trees volume m3 (ha)	MAI (m3/ha/year)	CIA (m3/ha/year)
3	111	8.3	7.2	0	0	0	11.3
5	754	14.4	14.2	0.04	30.2	6	15.1
8	512	19.3	20.5	0.15	76.8	10.4	17.8
12	347	22.1	25.5	0.310	107.6	11	12
20	236	23.9	30.7	0.619	146.3	9.7	7.8
25	160	24.3	36.1	0.85	136	8.7	4.5

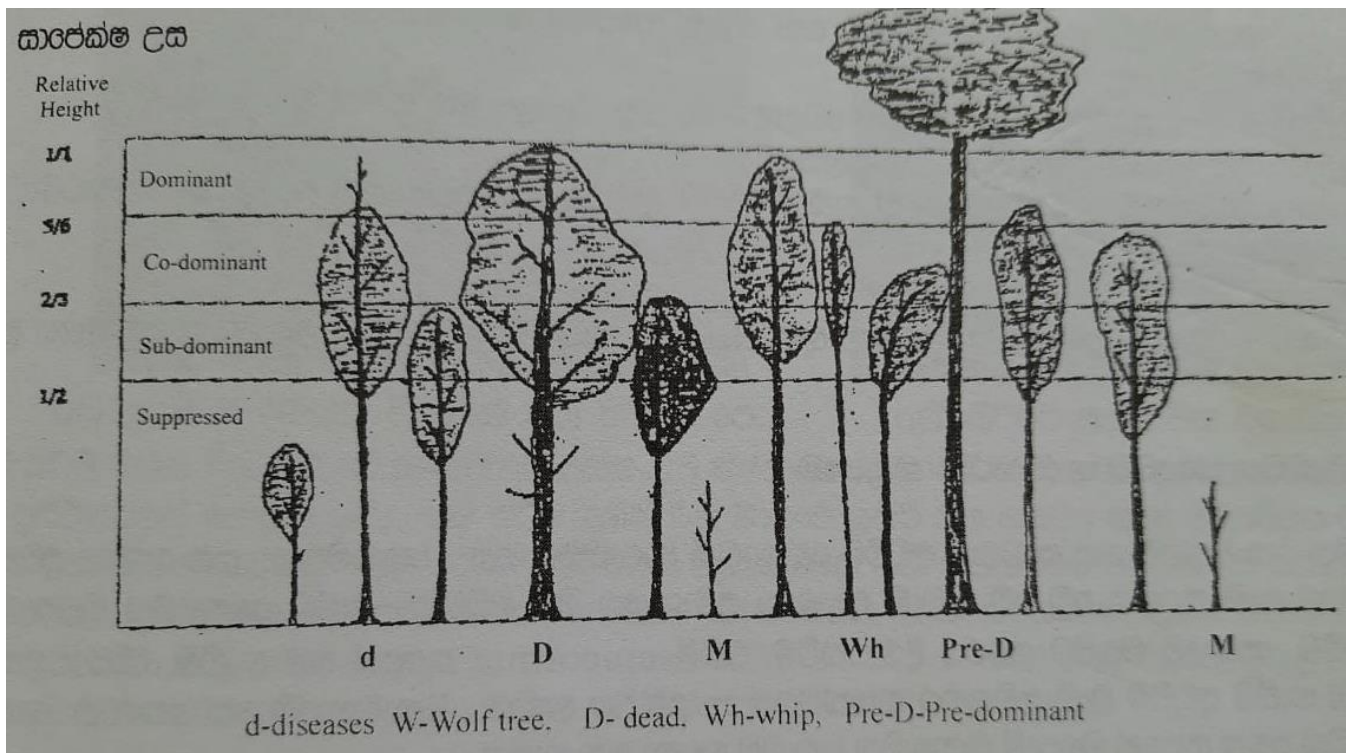


Figure showing unwanted trees to be removed from plantation



## OBJECTIVES

The specific objectives of forest audit are to assess to what extent forest management planning activities comply with forest management plan and forest management principles and also to compare the planned forest management activities with actual activities undertaken and to remedy shortcoming identified in a previous audit.

## ULTIMATE OBJECTIVE

- ✚ PREPARING THINNING REGIME FOR THE PUTTALAMA TEAK PLANTATION

## ASSOCIATE OBJECTIVES

1. To inventory the teak plantation to get Teak tree stock and tree growth parameters.
2. To decide next silvicultural treatments such as pruning, thinning and some maintenance activities of plantation.
3. To predict future tree growth, timber production and estimated timber value.
4. To remedy shortcoming identified in a previous audit and assess the forest management activities.

## METHODOLOGIES

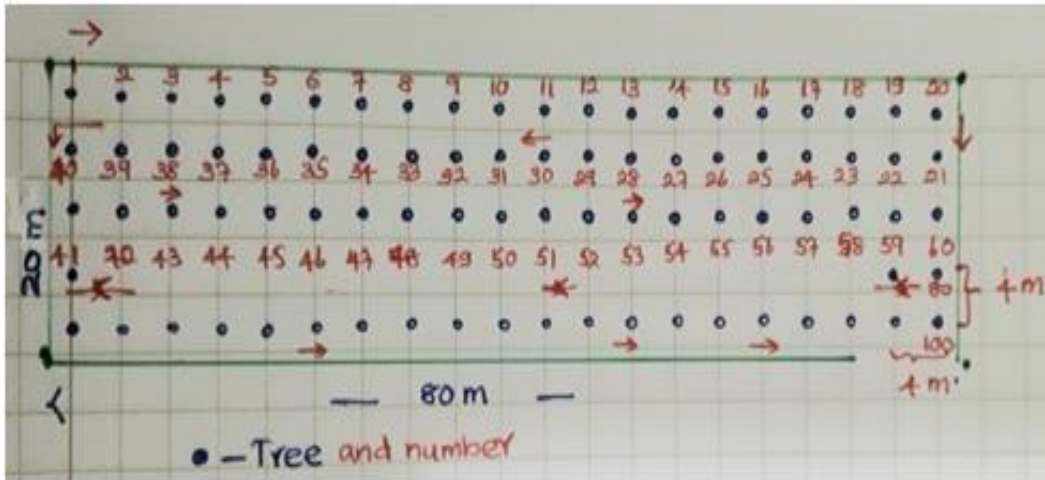
This information is obtained from forest inventories.

## MATERIALS

- Field assessment datasheets (current and previous)
- Plastic flagging (at least three different colors)
- Sharpie permanent ink pen
- Calculator
- 75' or 100' Spencer tape w/dbh tape
- Clipboard or datum
- Plots mapped
- Digital camera
- Unmarked bearing tree tags for scribing
- Tree paint (spray can): orange or other bright color
- Water
- Field vests
- Mechanical pencils
- Compass
- Small Ruler (metric & English)
- Clinometers
- Stand map
- Small pocket sized notebook
- Numbered tree tags (check for numbers that have not been used)
- Rebar & plastic pipes (for replacement if missing)
- First-aid kit
- Cell phone

**METHODOLOGY USED TO COLLECT TREE PARAMETERS IN THE PROCESS OF FOREST INVENTORY**

All the plots of Puttalama area is 80m x 20m (1600 m<sup>2</sup>). 20 trees from vertical lines and 4 trees from horizontal rows were included to plot area. Tree spacing was 4m x 4m.



Sample plot of forest inventory

Diameter of breast height (DBH) measurement was taken using diameter tapes. In most countries breast height level is defined as 1.30 meter above from ground level.



Sunto hypsometer was used to measure the height of the tree. It was estimated the tree according to the trigonometric principles.

When determining site-index, calculating tree volume, evaluating site-quality and predicting future growth of the stand, DBH, Height and the growth is highly useful. Following yieldtables (table 1 and 2) were used for the growth information

Proposed thinning regime (table 6) was applied for the thinning process in the plantation as described below. According to the priorities stated by the management group, thinned trees were decided.





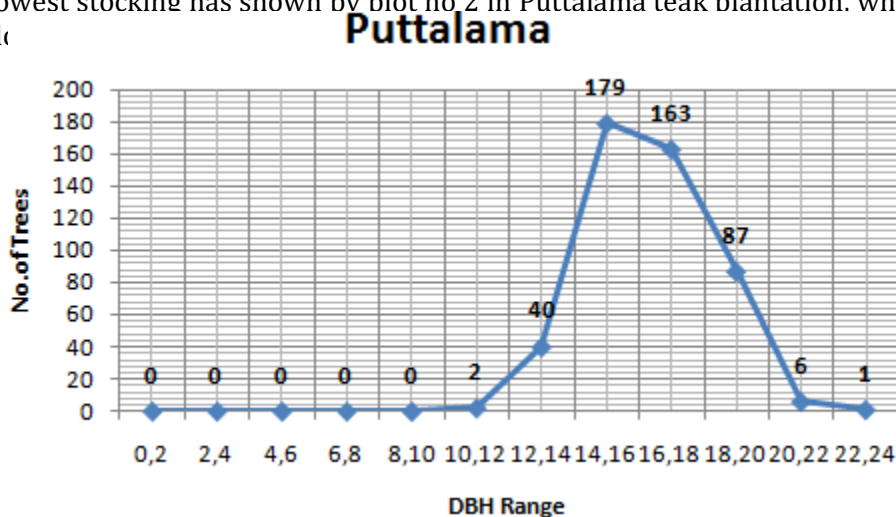
## OUTCOMES OF FOREST INVENTORY IN 2020

As the results of inventory of teak plantation, There were five plots in the Puttalam plantation. As shown in table 3, it was shown that each and every plots Mean DBH values, Mean height and the stocking amounts.

**Table 4: Number of trees and tree mean DBH values in plots in Puttalam**

Plot number (P)	Block 01		
	No. of trees	Mean DBH (cm)	Mean height (m)
1	93	16.24	12.4
2	84	16.08	11.7
3	103	15.57	12.4
4	91	17.11	12.5
5	107	16.85	13.1
mean	95.6	16.37	12.4

Lowest stocking has shown by plot no.2 in Puttalam teak plantation. while it shown the lowest mean Height. Plot



Out of 478 of trees, 257 trees are having more than 16 cm dbh. Mean dbh is 16.37 cm.

It can be assumed that out of 5093 trees, 2738 trees are belonged to more than 16 cm DBH category in block no.1.

**Fig.1: Number of trees against to average DBH range values in Blocks in Puttalam plantation**

**Table 5: Growth parameters and growth rate of Puttalam plantation**

Puttalam (planted area app. 8.53 ha from 10ha) Planted year. 2011					
Age (year)	Measurement taken year	Total no. of tree	No. of trees per ha	DBH (cm)	Height (m)
3	2014	5630	660	4.4	5.1
4	2015	5587	655	8.1	6.1
5	2016	5587	654	10.5	8.0
6	2017	5552	651	12.3	9.0
7	2018	5488	643	12.9	10.4
8	2019	5447	638	15.4	11
9	2020	5093	597	16.37	12.4

**Table 6: Puttalam block growth parameter with age**

Puttalam Planted year 2011				MAI and (CAI)	MAI and (CAI)
Age (year)	Measurement taken year	DBH (cm)	Height (m)	For DBH (cm)	For height (m)
3	2014	4.4	5.1	1.46	1.7
4	2015	8.1	6.1	2.03(3.7)	1.52(1)
5	2016	10.5	8.0	2.1(2.4)	1.6(1.9)
6	2017	12.3	9.0	2.05 (1.8)	1.5(1)
7	2018	12.9	10.4	1.84(0.6)	1.48(1.4)
8	2019	15.4	11	2.5 (2.5)	1.37(1.6)
9	2020	16.37	12.4	1.82 (0.97)	1.38(1.4)

### PLANNING OF THINNING REGIME

Harvesting age (20 years) and number of trees remained for harvesting was predetermined by company. Additional 10% of trees as reserved tree will be maintained up to final harvesting.

This thinning plan was developed based on company management objectives. Puttalam plantation is consisting with 8.53 ha and harvesting age of Puttalam plantation is 20 years. Number of trees at rotation age to be harvested is 3911 (3556+10%).

It is very important to mention here that after first thinning close supervision of tree growth parameter should be monitored. Subsequently intermediate thinning (in between first and second thinning) may be applied if necessary.

**Table 7: Thinning regime developed for Puttalama plantation**

Age/ Year	Main crop before thinning					Crop removed				
	Tree No.	Trees / ha	Mean DBH (cm)	Mean Height (m)	Tree Vol. (m <sup>3</sup> ) or Tree Vol. / ha	Tree No.	Trees / ha	Mean DBH (cm)	Mean Height (m)	Tree Vol. (m <sup>3</sup> ) or Tree Vol. / (ha)
9/2020	5093	597	16.37	12.4	0.117/69.8					
10/2021	5093	597				442	52			First thinning
11/2022	4651	545								
12/2023	4651	545								
13/2024	4651	545								
14/2025	4651	545								
15/2026	4651	545				740	87			Second thinning
16/2027	3911	458								
17/2028	3911	458								
18/2029	3911	458								
19/2030	3911	458								
20/2031	3911	458	Final harvesting							

### APPLIED PROCEDURE FOR SELECT THE TREES FOR THINING

According to the proposed thinning regime it is estimated that 442 trees can be removed in 2021 from 10<sup>th</sup> aged Puttalam teak plantation and as the second thinning it can be removed 740 trees in 2026.

Following steps were applied in the thinning regime methodology.

1. 8.53 ha of plantation were divided into blocks.
2. Around 52 trees which was supposed to be thinned out for 1 ha block was distributed with equally spacing.
3. First priority was given for trees which are dead, diseased, dying, poor, bad form stem, slow growing in remaining trees.
4. Suppressed, thin, whip, under canopy competition, more crowded trees were considered as second priority in removing trees.
5. Few good trees may be marked for thinning in order to give space for the rest of surrounding good trees.
6. Trees which were supposed to be removed were marked in tree map and double checking was done whether removing trees were equally distributed within the block.
7. Yellow color paint was used for marking of removal trees

## SOME OTHER RECOMMENDATIONS FOR THINNING & MANAGEMENT OF TEAK PLANTATION

In this study following recommendations were given for proposed thinning regime as shown in table 7. Marked tree list for thinning (to remove the trees) are annexed herewith (Annex 1).

- ✚ When excess trees build up canopy and root completion among the trees in plantation, those inferior trees must be thinned out (removing whole tree) in order to give space for good trees to grow freely and produce larger cylindrical bole. *This can be done as intermediate thinning.*
- ✚ Selective thinning must be applied after careful study of tree growth parameters and one to one tree inspection. *The tree map for removing trees were prepared and annexed herewith. In addition to that the tree parameters of removing trees were also attached herewith.*
- ✚ Pruning of the adventitious shoots should be carried out only after required training given under close supervision.
- ✚ Concrete posts at corner of sample plot need to be re-established otherwise unnecessary time is wasted to find the boundary of the plots

## ANNEXES

- i. Thinned tree list of the plantation
- ii. Tree Map of the plantation

