TEAK TREE INVENTORY AND AUDIT REPORT-2023

CONDUCTED FOR

ASIA TEAK GROUP

AT

CHON DEAN 224 ESTATES, PHETCHABUN PROVINCE

THAILAND

Dr. NIMAL RUWANPATHIRANA

2023 march

Contents

Content of Tables

Content of Figures

Content of Graphs

Executive summary

Teak plantation namely Chon Dean 224 , managed by Asia Teak Tropical Plantation was inspected by Mr.Paul Rookwood and Mr.J.M.P. Jayalath on 2023.2.20.. Inventory data collected from this plantations were computerized, analyzed by me to prepare this report..

Chon Dean 224 estate

Nineteen sample plots having with total sample area of 2736m2 have been permanently setup in different locations in Chon Dean 224 estate which consist plots area of 2016m^2 from B2 and 720m^2 from B3. It is found by this study that total estimated planted area is 2.56 ha (1.92 ha from B2 and 0.64 ha from B3) and sample plots represent 10.6 % of population. In this study, 128 trees were measured for DBH measurement.Due to unavoidable circumstance. Tree height measurement, total block tree number, good trees, tree marked for thinning and reserved tree were not taken in this year. However rough mean tree height was taken.

The inventory (tree count data of year 2020) results shows that there are 1235 trees. The average tree GBH in the estate 224in year 2023 is 70.5cm (DBH-22.4 cm) {GBH of B2-66.8 cm, GBH of B3-73.7cm}. It is found that average trees per ha is 473(B2-461, B3-486). Details of block wise information are shown in table 2.3-2.4 and page 10-11.

After analyzing the tree growth rate and other relevant factors, the age of the plantation can be estimated as approximately 17 years old, planted in 2006. Based on that and mean GBH value for year 2023 (70.25cm) the mean increment for GBH can be calculated as 4.1cm per year. However we have DBH data only for 2018 ,2020 and 2021. Therefore it is not possible to find correct periodic increment for the plantation. However periodic increment of GBH from 2018 to 2023 is 2.6cm and 2.2 for B2 and B3 sites respectively.

Analyzing inventory tree data it is found that more than 50% of trees are having GBH more than mean GBH of respective blocks (see graph 3.1 in page 9-10). These findings can be used for future planning of thinning and final mode of harvest. If we carefully and scientifically handle this valuable tree information and apply correct thinning at appropriate time, we will able to achieve highest turnover from these two blocks at end of felling rotation.

Finally it can be concluded that these two sites of teak plantation are healthy and good condition according to received information. Last year the current annual increment (GBH) of two sites is 0.7cm. This mean that last year growth rate has declined. There are much more potential to get more growth increment particularly for tree stem diameter for next coming years if the plantation is maintained and managed scientifically especially applying proper silvicultural treatments.

1. Introduction

1.1. General Introduction of Teak (*Tectonagrandis*) Plantation

Teak (*Tectonagrandis*L.f.) is a highly valuable timber in International trade sought by wood industries to produce good quality furniture and wood for house construction, carving, shipbuilding and many other purposes and Teak is an important timber species for tropical forestry. Today teak is a profitable plantation crop promoted by government agencies, the private sector and farmers.Teak plantations are widely established across Indonesia,Thailand, Sri Lanka etc. in some places, they have become an inseparable part of local cultural and socioeconomic systems.

Bole form

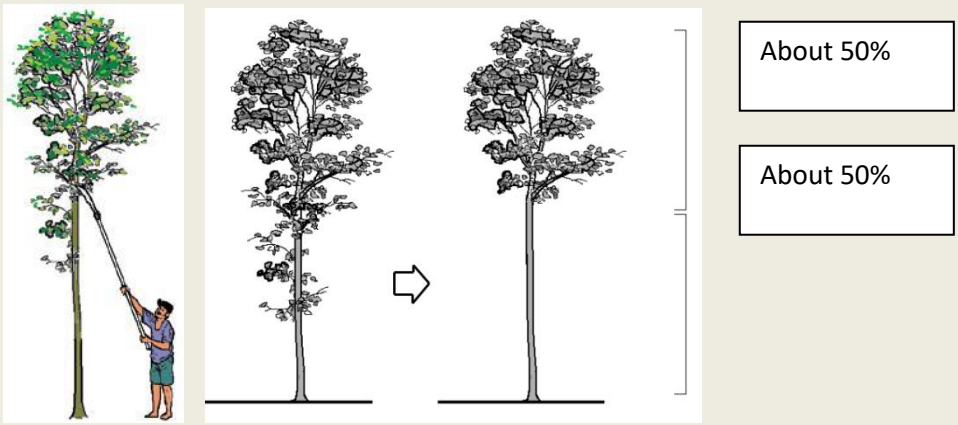
Fluting (irregular involutions and swellings) in the teak stem has been observed in a number of plantations. In some study, the mean heritability value of stem straightness was found to be 0.83, indicating that the character for stem straightness is strongly controlled by provenance and is thus genetically inherited (Kaosa-ard, 1999). Hence, fluting can be minimized if the appropriate provenance is used in breeding trials to produce plants that exhibit straight stems. The most important form characteristic determining the value of teak logs is the length of the clear bole.

1.2. Activities of teak stand maintenance

Teak grows well, grows fast, and produces high-quality timber when the land and trees are well maintained. Maintenance includes weeding, fertilizing, replanting, pruning, thinning, maintaining coppices and controlling pests and diseases.

1.2.1. Pruning

Pruning is the removal of branches which increases clear bole height and reduces knots on the main stem



Recommended height to which branches should be pruned

1.2.2. Thinning

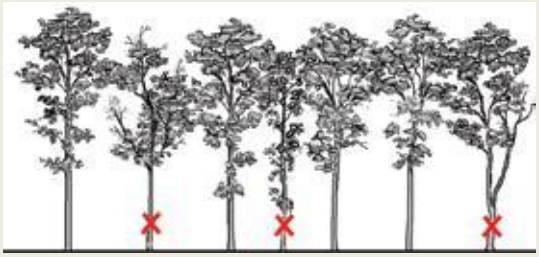
By competition for light, water and nutrients is greater in closely spaced plantations causing slower tree growth and tall, skinny stems. Thinning will encourage better growth for the good quality trees that remain.

1.3. Spacing

The spacing of trees and the number, timing and intensity of thinning strongly affect the pattern of growth and the yield of the plantation. If thinning is practiced late, growth rates decline or cease, whereas if the stand is thinned too early or too heavily, the trees have a greater tendency to produce side branches and epicormic shoots. This also reduces the potential yield of the plantation since growth is diverted from the main stem, which should be free from defects such as those caused by side branches and epicormic shoots.

Table A: Trees left after thinning based on tree height

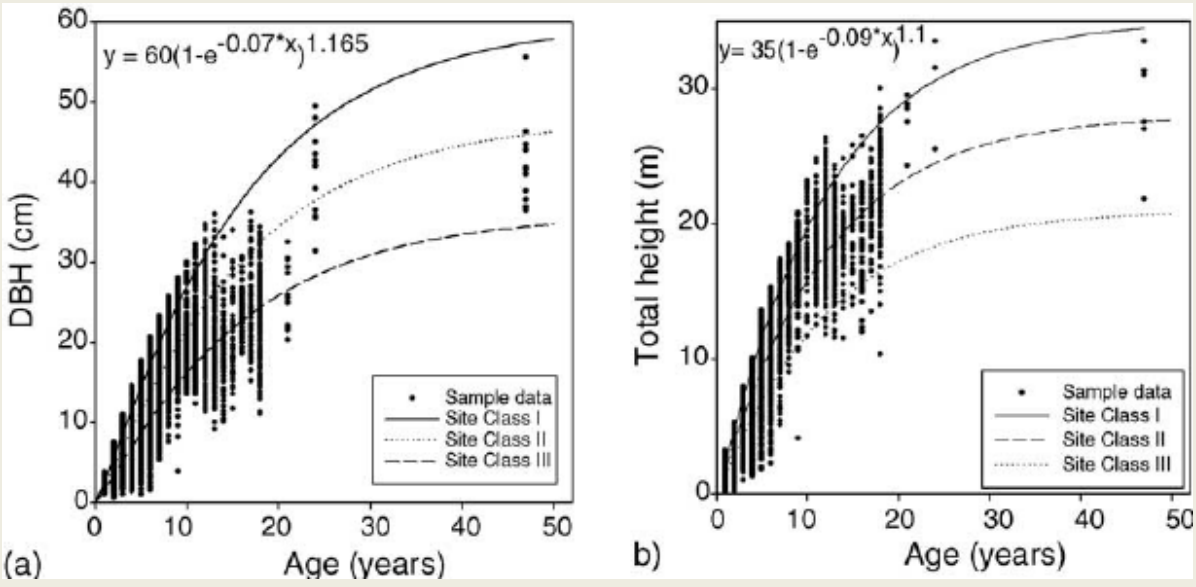
Tree height (m)	Trees remaining (trees/ha)	Age (yr) (range based on soil fertility)	Spacing (m)
11.0–13.0	1300–1500	5–11	2.5–3.0
13.5–15.5	1000–1100	7–17	3.0
15.5–17.0	800–850	10–21	3.5
17.5–21.0	500–550	15–34	4.0–4.5



1.3.1. Teak growth parameters

Height (H) and diameter at breast height (dbh) are the most important measures of tree growth and their relationship is useful in determining site-index, calculating tree volume, evaluating site –quality and predicting future growth of the stand (Jayaraman and Zakrzewski,2001).

Following growth information published by researchers can be used to develop the yield prediction table for present teak plantation of Asia Teak group.



(a) Teak growth curve : DBH against age (b)Teak growth curve : Total height against age

1.4. Positions of diameter measurement at different conditions

We followed following standard governing rules when take measurement of diameter at breast height of tree stem. Ex: clean the bole surface where we measure the stem diameter, diameter tape always correctly handled and read data carefully for reporting.

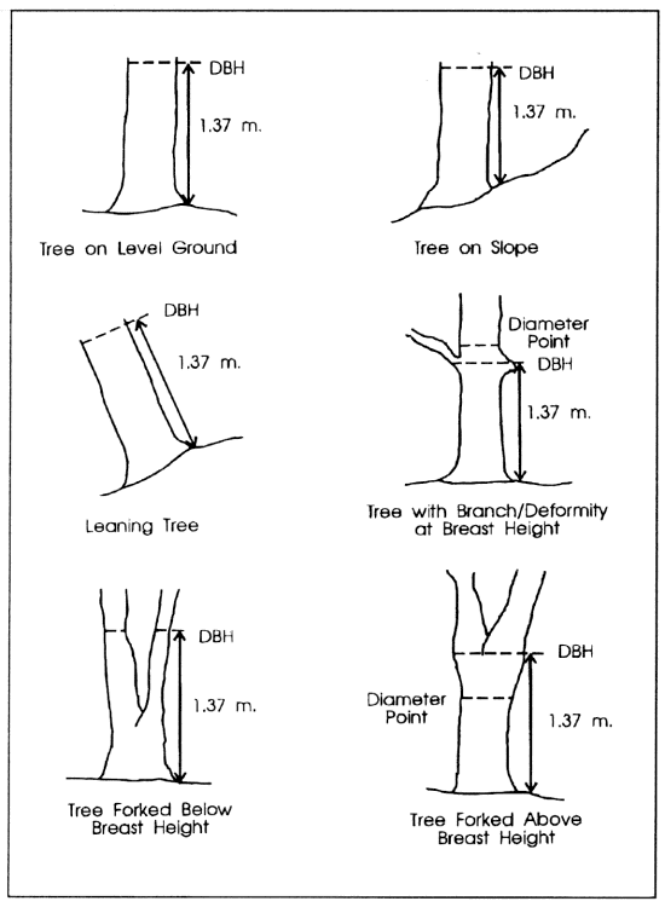


Figure 1.1 Diameter tape used for the inventory

1.5. Tree height measurement

Height is a tree variable that is used to estimate or determine the volume of a tree. The total height is the distance between the ground and top of the tree and bole height is the distance between the ground and the Crown Point.Merchantable height: the distance between the ground and the terminal position of the last useable portion of the tree stem.Tree height is defined to be the perpendicular distance between the ground level and the top of the tree. While, Tree length is the distance between the stem foot and the top along the stem

1.5.1. Method of tree height measurement

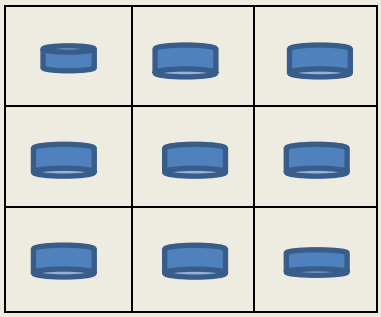
There are two methods; one is direct method which involves using height measuring rods only for small trees. Other method we used is trigonometric principles.Sunnto hypsometer used as instrument for this purpose

Figure 1.2. Total Tree height was measured by hypsometer, used instrument is shown in left side

Figure 1.3 .Mr.J.M.P.Jayalath is correctly identifying the sample plots in the plantation.

1.5.2. Plot size:

(i) 12m x12m=144m2 plots in Chon Dean 224



Sample plot with 9 trees.

A part of plantation

Figure 1.4 Mr.Paul is inspecting the inventory and auditing process.

A part of plantation

2. Results of inventory of teak plantation

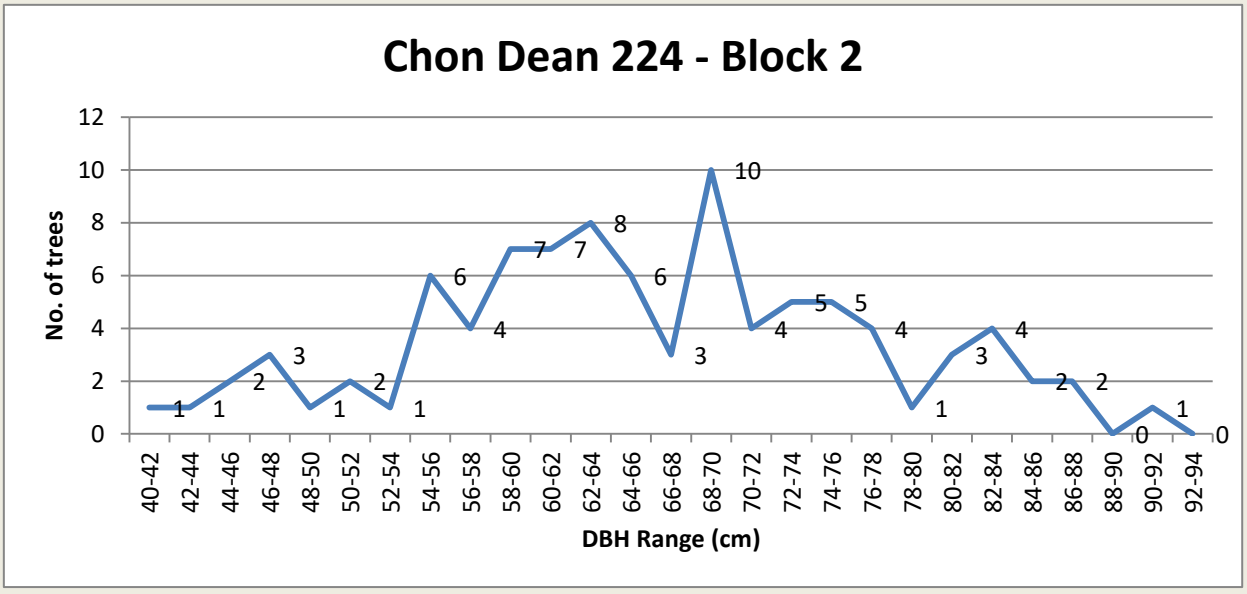
2.1. Chon Dean 224

Plantation name: Chon Dean 224- Block No.B2 and Block No.B3

Table 2.1 Number of trees and its mean GBH values in Chon Dean 224

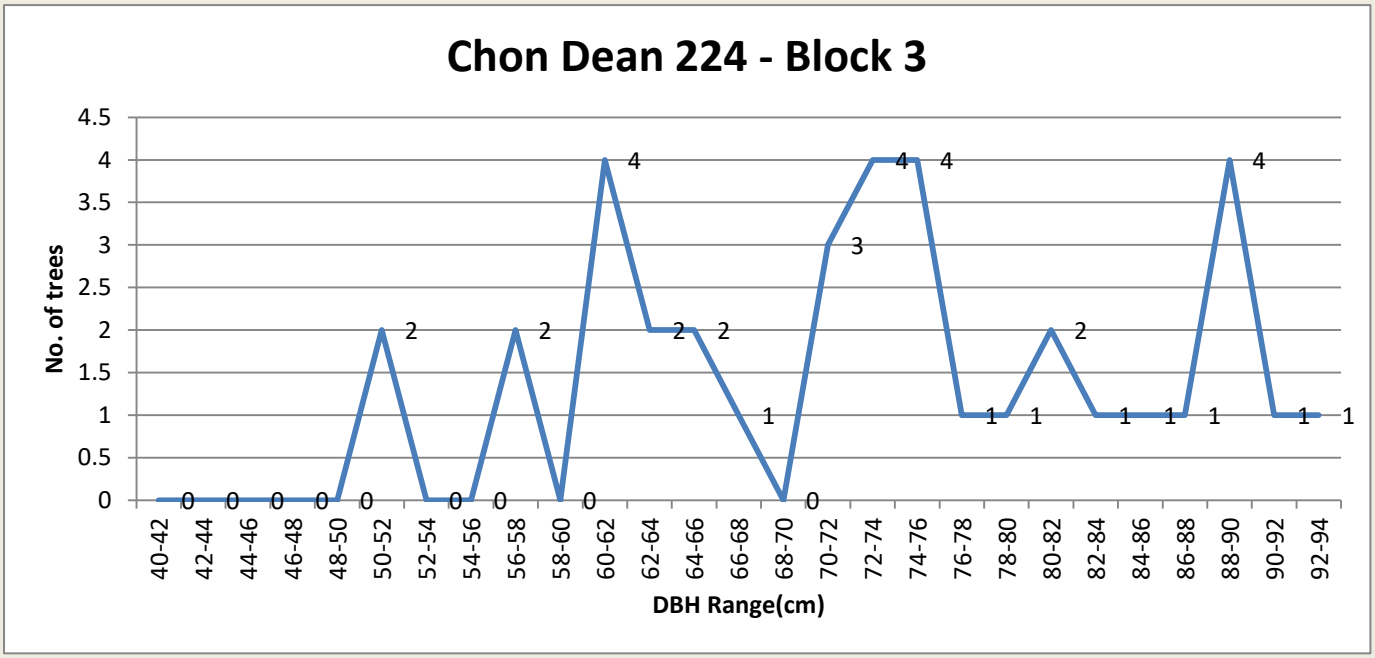
Plot number (P)	Block B2			Block B3		
	No.of trees	Mean GBH (cm)	Mean height(m)	No.of Trees	Mean GBH (cm)	Mean height (m)
1	9	60.1		8	63.6	
2	6	58.5		7	80.1	
3	5	71.8		7	74	
4	8	66.6.		6	74.2	
5	9	66.3		7	76.6	
6	**5**	**79.4**				
7	**9**	**72.4**				
8	**7**	**64**				
9	**7**	**66.4**				
10	**7**	**68.7**				
11	**7**	**70.8**				
12	**8**	**59.3**				
13	**7**	**63.7**				
Mean TOTAL	**7.1 93**	**66.8 cm (DBH 21.3 cm)**	**Mean 14m**	**7 (35)**	**Mean 73.7 (DBH 23.5)**	**15.5 m**

Graph 3.1 Number of trees against to mean ranged GBH values in Blocks in Chon Dean 224



Out of 93 of trees, 41 trees are having more than 66.8 GBH (21.3 cm dbh).

It can be assumed that in block no.2. out of 912 trees, There are 402 trees having more than GBH of 66.8cm category



Out of 35 of trees, 14 trees are having more than GBH 73.7 cm (dbh-23.5cm) .It can be assumed that in block no.3. out of 310 trees, There are 224 trees having more than 73.7 cm GBH category

Table2.2. Estimated number of trees having more than 66.8 cm GBH in Chon dean 224 teak Plantation.

Estate	Block no.	Larger no. of trees,
Chon Daean 224	B2	402(44%) more than 66.8cm GBH in Blocks and its %
	B3	224 (72%) more than 73.7cm GBH in Block and its %
	Estate total	*50% more than mean GBH of 66.8 cm*

Table 2.3. Sample plots information, planted area and tree inventory data in year 2023 of Chon Dean 224

Estate	Block no.	Total trees in block	Estimated planted area (ha)	No. of Plots	Plots area in block (m2)	No. of trees measured for GBH in Block	No of trees for ha.	Average GBH (cm)	Average height appro.(m)
Chon Daean 224	B2	912	1.92	14	2016 (12x12m x14)	93	461	66.8 (21.3 DBH)	
	B3	310	0.64	5	720 (12x12mx5)	35	486	73.7 (23.5 DBH)	
	Total	**1222**	**2.56**	**19**	**2736**	**128**			
	Ave.						**473**	**70.2 (22.4 DBH)**	**15m +**

Table 2.4 Comparison of tree parameters between year 2022 and 2023 in Chon Dean 224 estate

Estate	Block no.	No. of Plots	Year 2022				Year 2023			
			No. of trees measured for GBH	No of trees for ha.	Average GBH(DBH)(cm)	Ave. Height (m)	No. of trees measured for GBH	No of trees for ha.	Average GBH (cm)	Variance in GBH (DBH) (cm) 2023 vs 2022
Chon Daean 224	B2	14	94	461	66.7		93	461	66.8	0.1
	B3	5	35	486	72.4		35	486	73.7	1.3
	Estate average		64	**473**	**69.5**		**64**	**473**	**70.2 (DBH 22.4cm)**	**0.7**
	total	19	129				128			

Table 2.5.Thailand Teak Plantation tree count.
Comparison Tree Audit 2020-2023

Total tree number (good/reserved trees) were not counted in this year and estimated total tree number is used in this year

Estate Name	Block number	Geophysics count trees 2020				Geophysics count trees 2022			
		Total good trees	Marked for thinning	Reserved trees	Total trees	Total good trees	Marked for thinning	Reserved trees	Total trees(estimated)
Chon Dean 224	B2	787	135	0	922				912
	B3	290	23	0	313				310
	Total all blocks	**1077**	**158**	**0**	**1235**				**1222**

Table 2.6. Determination of site index based on growth parameters of past years of Chon Dean 224.
Chon Dean 224 plantation age (planted in 2006) is assumed 17 years old.

Estate	Block no.	No. of Plots	2017	2018	2019	2020	2021	2022	2023	GBH differences from 2018 to 2022 and (Mean Increment of GBH) (cm) and periodic increment of GBH{}
			Ave. DBH (cm)	Ave.GBH (DBH)(cm)	Ave.GBH (DBH) (cm)	Ave.GBH (DBH) (cm)	Ave. GBH (DBH(cm)	Ave. GBH (DBH)(cm)	Ave. GBH (DBH)(cm)	
Chon Daean 224	B2	14		54 (17.2)		60.3 (19.2)	61.8 (19.7)	66.7 (21.1)	66.8 (21.3)	12.8 (3.9){2.6}
	B3	5		62.5 (19.9)		66.2 (21.1)	66.9 (21.3)	72.4 (23.1)	73.7 (23.5)	11.2 (4.3) {2.2}
	Estate average			58.2 (18.5)		**63.2 (20.1)**	**64.3 (20.5)**	**69.5(22.1)**	**70.25 (22.4)**	**12.0 (4.1) {2.4}**

Figure 1.5 Adventitious shoots within the butt log of stem need to be pruned.

Table 2.7 .Tree volume and other growth parameters of plantations were estimated based on age of plantation, form factors and inventory data of plantation

Tree age or inventory year 2022		AGE OF THE PLANTATION IS 17 YEARS OLD, Planted year 2006 (according to owner) AND FORM FACTORIS 0.45						
Block N0.	Total trees	No. of stems/ha	DBH (cm)	Height (m)	Per Tree volume (m3)	Trees volume m3/ha	Total volume in block (m^3)	MAI (m^3/ha/year)
B2	912	461	21.3	14	0..22	101.4	200.64	5.96
B3	310	486	23.5	15.5	0.30	145.8	93	8.6

Recommendation

3. It is observed that average growth of GBH has been declined to 0.7cm in the last year from 5.2cm. To obtain the GBH of 90 cm tree at end of next three years. More attention needs to be paid on growth parameters.
4. Boundaries of sample plots should be demarcated by concrete large peg or posts for easy reference.
5. To produce premium timber quality logs, Pruning of the adventitious shoots should be carried out only after required training given under close supervision.
6. Control fire or fire lines must be properly maintained.
7. One tree in samples plot 10 has been lost in block 2. There are no missing trees in sample plots area in Block 3.

Last year the current annual increment (GBH) of two sites is 0.7cm. This is significant growth reduction compared with 2022 (5.2 cm) . It is necessary to monitor this growth trend in this year (Please refers the growth parameters described in results section of this report).

Finally it can be concluded that this teak plantation is healthy and good condition. It is recommended to study the requirement of applying thinning for Plantation because this plantation is much more potential to get more growth increment particularly for diameter growth for next five years if the plantation is maintained and managed scientifically.

Dr.Nimal Ruwanpathirana (Ph.D., M.Sc (forestry), B.sc (Bio. Science)
Consultant for forest management and wood science