

Forestry Management Review of AsiaTeak Plantations in Thailand – November 2019

CD1, CD224 & Kaochanoke-T Estates, Chon Daen, Thailand

Report by Dr.Nimal Ruwanpathirana

Executive Summary

AsiaTeak Group appointed me as an Independent Forestry Consultant in November 2019. The purpose of this appointment was to provide independent observation, advice and valuation of the teak plantation assets of AsiaTeak Group. In addition I will assist AsiaTeak to develop its forestry management plan with a view maximizing the growth and commercial value of its teak trees within the strict timescales of the new client contracts introduced during 2019. My consultancy will cover the following aspects:

1. On-site Forestry Management Reviews in Sri Lanka & Thailand annually in Oct/Nov
2. On-site Tree audits in Sri Lanka & Thailand annually in Feb/March
3. Valuation of tree assets for investment purpose
4. Ad-hoc site inspections, consultation and advice

I visited the above estates with Mr. Paul Rockwood, Managing Director and Mr. Jayalath, Director of Plantations on 23rd/24th Nov 2019. For this Forest Management Review, we carry forest inventory instruments and tools to determine the wood growth increments and the last year forest inventory data and the relevant maps etc. Our objective of this field inspection and study is to review all the aspects of plantation management such as conditions of trees including growth rate, pruning/thinning, weeding/soil conditions & harrowing, irrigation, pests and diseases, fire management, security and finally quality of timber in the existing plantation.



Figure 1: Team of the Study



Figure 2: Cross section of timber taken from teak plantation in CD1 which contain 68.45% heartwood and CD224 contain 40.6% heartwood in Thailand

Main Methodology

Field inspection was carried out in each and every block for gathering information by following methods.

1. Close observations and examination of plantation and its environment.
2. Tree inventory data such as tree height, DBH, tree form factor, number of stems per hectare, dead and damage trees, were collected.
3. The danger of fire and pest (termite) were examined.
4. Sample timber discs from fallen tree stem were cut and taken for laboratory investigation.

In summary these plantations are in good overall condition with strong growth and form characteristics. There are however, several improvements that should be carried out within the following 12 months which will enhance the tree growth and form and consequently the eventual commercial return from the timber. These are detailed in the Conclusions & Recommendations section of this report but the most important of these are as follows:

Chon Daen 1	Soil improvement in all blocks Soil erosion prevention in blocks 4, 5, 6, 7 & 8 Selective thinning, all blocks Termite control in blocks 1, 2 & 3 Removal of timber debris, all blocks Pruning of adventitious shoots
Chon Daen 224	Selective thinning Removal of previously identified trees
Kaochanoke	Recommend that only Block B should be considered

My next visit to the Thai plantations is planned for 1st week Feb 2020 where I will supervise and report on the annual tree audit. Following this I will provide investment valuations by 31st March 2020.

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Figure 3: Circular plot of 500m² used to find number of trees/ha



Figure 4: Marking trees for thinning left without removing from site, which was cut for collection of wood samples.

Results with observations for Chon Daen 1 estate



Figure 5: View of Chon Daen 1 Teak Estate



Figure 6: Few trees were observed by uprooted due to wind or shallow root system or roots might be damaged by fungus.



Figure 7: Termite colony in plantation site



Figure 8: Termite invading the teak stem

Figure 9: Due to wood debris laying plantation ground, infestation of termite may damage to the tree root system which result to slowdown growth of tree or some time die the tree with subsequent attraction of fungus





Figure 10: It is recommended to prune the adventitious shoots up to at least 4-5m to get more knot free timber production.



Figure 11: Canopy is not closed or there are no competition among the branches of upper canopy in many areas of the plantation hence thinning is only recommended where the canopy is closed.



Figure 12: Harrowing the site between tree rows for improving the soil condition turns into the soil erosion which should be prevented by putting barriers of suitable materials.



Figure 13: Tree root system is exposed.



Figure 14: Dead/ Poor(weak)/ thin(whip)/ broken / badly form stem/ diseased or when more number of trees per ha than to standards, should be removed from bottom of tree (6 inches above ground level) not from upper part of stem

Results of forest inventory for Chon Daen 1 Table 1:

Form factor calculation with single felled tree

1	Tree Total height with branches	15m
2	Tree stem height up to first large branch (Diameter 19cm)	11.2 m
3	Diameter at breast height (ob)	27.8 cm
4	Mid diameter of 11.2m stem (ob)	5.6m
5	Small end diameter of 11.2 m stem(ob)	19 cm
6	Bark thickness at one radius point	13mm
7	Stem volume for (no.2) with bark	0.3897 m ³
8	Stem volume for (no.2) without bark	0.295 m ³
9	Stem (11.2m) and branches(4.8m) volume	0.44 m ³
10	Form factor based on (7) and its cylindrical volume	0.574
11	Form factor based on (7) and cylindrical volume of (1) height	0.428
12	Form factor based on (9) and cylindrical volume of (1) height	0.518

Timber Investigation



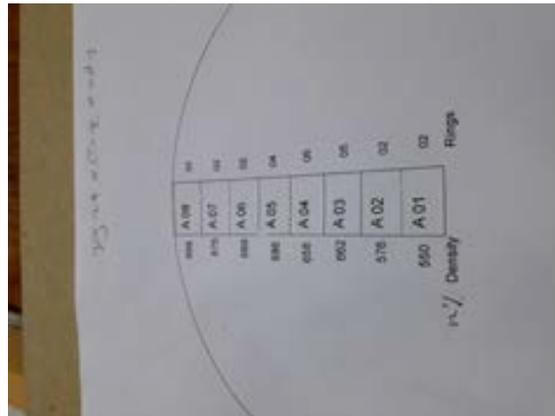
Figure 15: Counting annual rings of teak timber disc

(i) Tree annual ring counting

(ii) Wood density measurement



(a) Wood samples for density measurement taken from pith to bark. (b) Volume of wood sample



(c) Wood oven dry weight (d) Wood density data from pith to bark in Chong Daen

Table 2: Circular plot (500 m²) tree inventory information in Block No: 1-9 of Chong Daen 1 estate

Chon Daen 1 Estate	Block No:	Trees/ha	Average DBH (cm) (only few trees)	Average Height (m)	2019 Permanent sample inventory
					DBH (cm)
	1	428	27	15	23.9
	2	364	26	14	23.4
	3	470	25	13	23.4
	4	410	27	14-15	25.3
	5	410	27	14	23.7
	6	453	25	15-16	24.6
	7	432	25	13-15	24.3
	8	376	28	15-16	29.2
Average		417	26.2	14.2	24.7

Results and Observations of Block No:1, 2 and 3 Chon Daen 224 estate



Figure 16: General view of Chong Daen 224 estate



Figure 17: View of forest canopy, still no canopy competition



Figure 18: Ground level view of Chon Daen 224 estate. Dry leaves may results the surface fire.



Figure 19: Red demarcation mark indicates that this tree has been marked for thinning but it has not happened yet.

Table 3: Circular plot (500m²) tree inventory information in Block No.1, 2 and 3 Chong Daen 224 estate.

Chon Daen 224 Estate	Block No:	Plots No:	Trees/ha	Average height (m) (only few trees)	Average DBH (cm)	2019 permanent sample inventory DBH(cm)
	1	1	680	10-12	20.6	
		2	600	12-13	20.3	
		3	680	12	22.04	
	Block 1 average		653	11.8	20.9	19.8
	2	1	580	10-12	19.7	
		2	620	10-11	18.4	
	Block 2 average		600	10.7	19	
	3	1	640	14	22.9	
	Block 3 average		640	14	22.9	
	Grand average		631	12.1	20.9	

Results and observation of block no. A, B, D and E of Kaochanoke-T group



Figure 20: Majority of stems have defects, such as longitudinal checks, flutes, protuberances in A,D,E Blocks



Figure 21: Majority of stems have defects, such as longitudinal checks, flutes, protuberances in A,D,E Blocks in Kaochanoke-T group



Figure 22: Major defects in first log of tree stem in Block A,D and E in Kaochanoke-T group



Figure 23: General view of block B which is comparatively better than block AD and E in Kaochanoke-T group. However this plantation also found 45% trees are good, 40% trees are moderate and 15% trees are damage

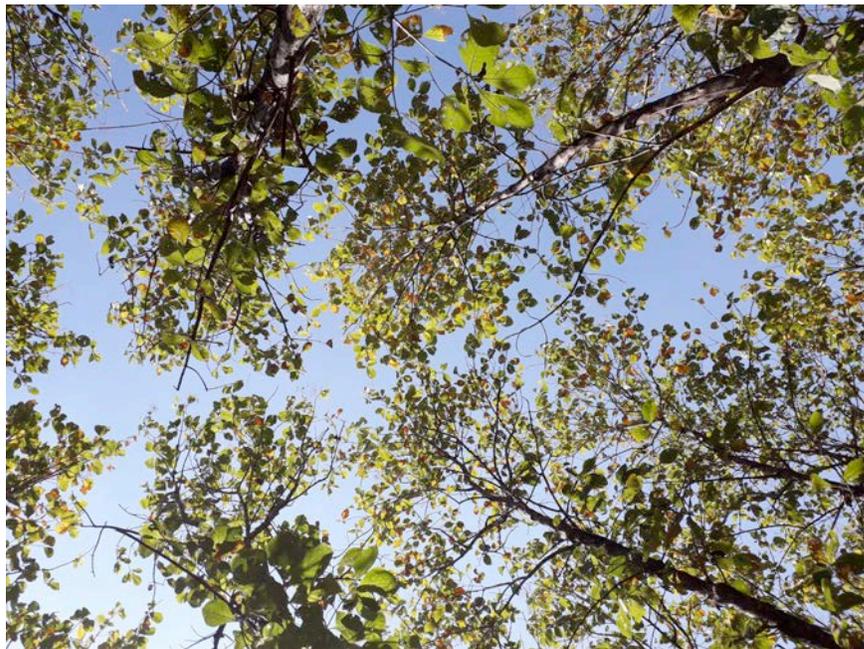


Figure 24: View of canopy in block B in Kaochanoke-T group

Table 4: Circular plot (500 m²) tree inventory information in Block No: A, B, D and E of Kaochanoke-T group

Estate	Block No:	Plots No:	Trees/ha	Average height (m) (only few trees)	Average DBH (cm)	Remarks on % of trees having main stem damage for saw timber production
Kaochanoke-T group.	A	1	600	12	22.38	
	Block A average		600	12	22.38	30% trees are good 30% trees are moderate 40% trees are damage
	B	1	740	13	22.4	
		2	680	12	24.4	
	Block B average		710	12.5	23.4	45% trees are good 40% trees are moderate 15% trees are damage
	Block D average	1	600	10-11	22.33	10% trees are good 10% trees are moderate 80% trees are damage
	Block E average	1	660	10-11	19.5	10% trees are good 10% trees are moderate 80% trees are damage
Grand average			642	11.3	21.9	

Conclusions & Recommendations

Chon Daen 1 Estate		
No	Conclusion	Recommendations
1	Age of plantation was estimated by mean of annual rings. However there are several false rings recognized in cross section of stem. It is believed that age of the plantation is around 20 years.	Anatomical structure of annual rings will have to be further investigated to determine correct tree age after preparation of microscopic wood slides of stem discs.
2	Number of trees per hectare is around 417. Mean DBH and Height of the tree are 26 cm and 14.2 m respectively. The tree volume is around 0.384 m ³ with over bark. The growths of trees have to be enhanced.	Canopy and root competition must be studied and application of soil improvement method and soil erosion prevention methods must be applied particularly where site has steep slope. (See figure 12-13. Erosion of the soil conditions due to the harrowing carried out in the past.) Proper selective thinning method has to be applied to encourage the best trees to grow vigorously at least for next five years. (See figure 11)

3	Block wise, correct extent of land must be measured and included into map.	Existing map can be used to calculate the land area of block.
4	Fire management practice was noticed in the surrounding teak plantation.	Control fire or fire lines must be properly maintained.
5	Several teak trees have uprooted and termite infection and its damage observed (Figure 6, 7 and 8)	Timber debris must be used to control of erosion or removed from site not helping termite colony development. Root system of Uprooted trees should be closely monitored at regular basis if found that termite causes or help for decaying of roots. Termite control consultancy is required.
6	Demarcation mark of red colour on tree trunk indicates that some trees have been marked for thinning but those trees have not been thinned yet. (See figure 19). Some trees, marked for thinning are cut as the way how pollarded system is practiced. This does not help for growth increment.	When excess trees build canopy and root competition among the trees in plantation, those inferior trees must be thinned out (must remove the whole tree) in order to give space for good trees to grow freely and produce larger cylindrical bole. Selective thinning must be applied after careful site inspection.
7	It is recommended to prune the adventitious shoots up to at least 4-5m to get more knot free timber production. See figure 10.	Pruning of the adventitious shoots should be carried out only after required training given for field staff under close supervision.
8	Timber density at Breast Height of stem is close to pith 550Kg/m ³ and increase toward bark 675 kg/m ³ . The stem at BH sapwood and heartwood area as % is 31.5 and 68.4 respectively.	This is almost similar to middle age teak wood density. Heartwood % need to be increased further that can be expected with aging.
9	To obtain 0.8m ³ tree volume, we need a tree with 16 m height and 35 cm Breast Height diameter (O.B) without bark.	Proper forest management practice has to be applied after studying the thinning regime which can be decided after estimation of exact age, number of stems /ha, degree of canopy closer, tree inventory data and tree annual rings information.

Chon Daen 224 Estate		
	Conclusions	Recommendations
10	It is roughly estimated that age of the plantation is 12-16 years.	Correct age of the plantation can be determined after microscopic slide of annual ring examination.
11	Average tree number /ha is 653, 600 and 640 in Block 1, 2 and 3 respectively.	There is no canopy competition in most of area of site. After estimating tree exact age, number of stems per hectare can be decided.
12	Average height is 11.8 m, 10.7 m and 14 m in Block 1, 2 and 3 respectively. Average DBHs are 20.9 cm, 19cm and 22.9 cm	After estimating tree exact age, growth rate performance can be evaluated.

	in Block 1, 2 and 3 respectively.	
13	Red demarcation mark indicates that some trees have been marked for thinning but those trees have not been thinned yet. (See figure 18). Some trees, marked for thinning are pollarded.	When canopy and root competition among the trees in plantation are built due to excess trees, those inferior excess trees must be thinned out (remove whole tree) in order to give space for good trees to grow freely and produce larger cylindrical bole. Selective thinning must be applied after careful site inspection.
14	Deformation of tree trunks were observed. This tree log cannot produce quality sawn timber and sawing lost will be high due to these defects.	Bad deformation of trees will have to be removed when thinning is carried out .
15	Fire management was in practice in the Surrounding other teak plantation. Thick layer of dry leaves was noticed on forest floor, which cause for surface fire.	Control fire or fire lines must be properly maintained. Inventory team must use safety boots to protect from snakes while working in the plantation. See figure 17.
16	Timber density at Breast Height of stem is 525 Kg/m ³ at pith and it increased toward bark (562 kg/m ³). The stem at BH, sapwood and heartwood area as % is 59.3 and 40.6 respectively.	This wood density is almost similar to teak of young age. Heartwood % need to be increased further that can be expected with aging.
17	To obtain 0.8m ³ tree volume, we need a tree with 16m height and 35 cm breast height diameter without bark.	Proper forest management practice has to be applied in order to increase tree growth. Thinning is one of important silvicultural operation. Thinning regime can be decided after estimation of exact age, number of stem /ha, canopy closer, tree inventory data and tree annual rings information.

Kaochanoke – T Estate		
	Conclusions	Recommendations
18	Average tree number /ha is 600, 710, 600 and 660 in Block A, B, D and E respectively in Kaochanoke-T group.	There is no canopy competition in most of area of site. After estimating tree exact age, number of stems per hectare can be decided.
19	Average height are 12 m, 12.5, 10.5 m and 10.5 m in Block A, B, D and E Kaochanoke-T group respectively. Average DBHs are 22.4 cm, 23.4cm, 22.3 cm and 19.5 cm in Block A, B, D and E Kaochanoke-T group respectively.	After estimating tree exact age, growth rate performance can be evaluated.

20	Trees with deformation trunks were observed in majority of trees and such tree logs cannot produce quality sawn timber and sawing loss will be high.	These trees will have to be considered for thinning								
21	<p>Deformation tree trunks were observed in four Blocks as follows:</p> <table border="1" data-bbox="266 445 659 932"> <tr> <td data-bbox="266 445 324 558">Block A</td> <td data-bbox="324 445 659 558">30% trees are good, 30% trees are moderate, 40% trees are damage</td> </tr> <tr> <td data-bbox="266 558 324 672">Block B</td> <td data-bbox="324 558 659 672">45% trees are good, 40% trees are moderate, 15% trees are damage</td> </tr> <tr> <td data-bbox="266 672 324 806">Block D</td> <td data-bbox="324 672 659 806">10% trees are good, 10% trees are moderate, 80% trees are damage</td> </tr> <tr> <td data-bbox="266 806 324 932">Block E</td> <td data-bbox="324 806 659 932">10% trees are good, 10% trees are moderate, 80% trees are damage</td> </tr> </table>	Block A	30% trees are good, 30% trees are moderate, 40% trees are damage	Block B	45% trees are good, 40% trees are moderate, 15% trees are damage	Block D	10% trees are good, 10% trees are moderate, 80% trees are damage	Block E	10% trees are good, 10% trees are moderate, 80% trees are damage	<p>Comparatively the best site is Block B having 710 stems/ha with 12.5 m height and 23.4 cm DBH. 15% of stems are bad deformation. 45 % of stems are good and 40% are moderate. We can expect 300 good trees per hectare from block B. However when we will do thinning we do not have chance to equally distribute of these good 300 trees in a hectare space. Sometime two –three good trees locate very closely together. This again disturbs the growth rate. Due to the shortage of enough number of good trees, good practice of thinning is questionable.</p> <p>Timber samples need to be determined exact age of plantation by preparation of microscopic wood slides.</p>
Block A	30% trees are good, 30% trees are moderate, 40% trees are damage									
Block B	45% trees are good, 40% trees are moderate, 15% trees are damage									
Block D	10% trees are good, 10% trees are moderate, 80% trees are damage									
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