

Financial analysis of private teak plantation investment in Thailand

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Abstract

This study was to explore investment return of private teak plantations by financial analysis of data gathered from teak owners. The financial analysis was carried out to estimate NPV at 10% discount rate and IRR by 4 factors of log prices, yields, costs and rotation periods. This study designed teak plantation models with 2x4 meters spacing and cutting rotation at age 15, 22 and 30 years for analysis. We set low and high levels for the yield and cost factors, and used FIO and broker prices for the price factor in order to investigate profitability. In the field survey, the teak logs were mostly sold to brokers at lower price ranging from 1,900 – 11,000 Baht/m³. The broker prices were quite lower than FIO prices in terms of logs over 15- year-old. The results of financial analysis showed all positive NPV value and profitable, and yield and price were critical factors affecting profit of teak plantation investment. The brokers bought teak logs by volume or tree system, the price by tree got lower profits than by volume. Therefore, the private plantation owner must concern how to get high yield and price. The teak plantation should be selected on suitable site to reduce risk of investment. It was recommended that the appropriate rotation should be 20-25 years. However, the MAI was also another factor to be taken in consideration on rotation. If it was continuously increasing, it was suggested that the rotation could be extended.

Keywords: teak, private plantation, smallholder, financial analysis, profit

Introduction

In the past, teak (*Tectona grandis* L. f.) wood of Thailand played an important economic role in timber supply and the wood products for domestic market as well as international market. Thailand forest cover has been decreasing drastically resulting in logging ban in terrestrial forest in 1989. Since then, Thailand turned to be log consuming country instead of producing country. Thailand imported logs and wood products from neighboring countries. In 1994, the Royal Forest Department (RFD) initiated a project, so called “Private Forest Plantation Promotion” to support farmers to establish forest plantation, aiming to produce logs and wood products to serve the demands, including for exporting if there was surplus production from domestic use. The project subsidized 3,000 Baht/rai (1 rai = 0.16 ha) to farmer who had participated in the project, within 5 years by releasing the money 800, 700, 600, 500 and 400 Baht/rai from 1st year to 5th year respectively. Teak was the most favorite tree species planted under this project because the price of teak log was more attractive comparing to other tree species. However, forest

owners who participated in the project, faced various problems such as poor growth rate, poor site selection, inefficient management knowledge/skill, and low price of small log/first thinning log. Many owners had abandoned their forest plantation.

Those problems restrained force to the expansion of private teak plantation. Many owners of the plantations changed the areas to plant cash crops or other tree species, such as cassava, sugarcane, and rubber plantation etc. Because they supposed that the crops were more profitable, easier to manage and quicker return than teak plantation. Pusudsavang (2002) reported that more than 50% of areas participated to the subsidy project were abandoned, but there were still some forest plantation owners who kept their teak plantation and some even established new teak plantations. The reasons why they still keep the plantations, were high growth rate in their plantations, environmental concern, higher price expected in future, easy and low cost maintenance and so on. Fig. 1 shows an example of private teak plantation.

Teak plantation was long term investment such as 20 or 30 years while the important parts to be considered for



Fig. 1. An example of private teak plantation

profitability calculation were time and interest rate. A key difference between the economic forestry and most agriculture land use was that the financial returns to forestry were often delayed for years (Friday et al. 2000). Therefore, we need to take time value of money into account when planning investment in forest. Financial calculation gave answer to hypothetical question. We have to reply the growth rates, prices and cost particular to our situation (Friday et al. 2000). In forestry, two main economic efficiency indicators were needed and used for different purposes. These were the Net Present Value (NPV) and the Internal Rate of Return (IRR). These indicators had been widely used in economic analysis (FAO 1979). Discounted Cash Flow (DCF) techniques provided the analytical basis for many forest investment decisions. The comparative financial tool probably most commonly used was Internal Rate Return (IRR) analysis. An IRR was the level of profit expected from an project investment, expressed as an equivalent annual percentage rate of interest on all the money invested in that project (Pandey and Brown 2000). Pitigala and Ganatilake (2002) assessed financial and economic feasibility of selected forest plantation species in Sri Lanka, and found that the NPV of at 10 % discount rate of Mahogany, teak and Eucalyptus resulted in positive, the teak showed the highest financial NPV.

Teak plantation owners need to plan profitable approach for their investment. Profitable calculation depends on yield, log price, time (rotation period) and interest rate. The owners have to clearly understand the use of economic tools to predict the economic return in the future. Therefore, the objective of this study was to analyze factors affecting on private teak plantation investment in smallholder so that the owners could make appropriate decision in the investment.

Materials and methods

A framework of financial analysis for private teak plantation investment was shown in Fig. 2. Data for study was based on 2 sources from reviewing the available data

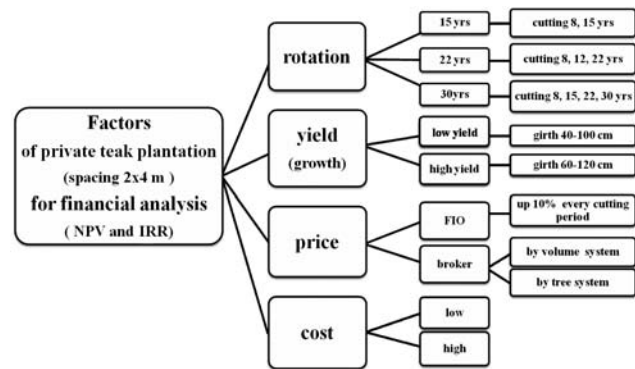


Fig. 2. A framework of financial analysis for private teak plantation investment

base and interviewing private teak plantation owners including questionnaire survey.

Indices from financial analysis were NPV at 10% discount rate and IRR. We used the set the model of teak plantations as 2x4 m spacing (200 trees/rai), which was popular spacing of private teak plantations. The followings were options by factor:-

- 1) Rotation periods: 15, 22 and 30 years,
- 2) Costs of plantation: low and high level,
- 3) Yields of teak: low and high level, and
- 4) Prices of teak log in 2 market sources: Forest Industry Organization (FIO) and private broker.

Pusudsavang (2009) showed relationship between teak growth and ages of private teak plantation through the field survey of private teak plantation (Fig. 3). For the yields in the study, we referred to the relationship and defined 2 levels; low and high yields for financial analysis (Table 1). Teak plantation costs were gathered by interviewing the owners on establishment and maintenance costs. The costs were classified into 2 levels; low and high costs for financial analysis. There were 2 market sources of teak selling in domestic market in Thailand, namely, FIO and brokers. Generally the brokers bought teak logs by volume or tree system. The study assumed that the FIO prices were annually increasing at 10% (Fig. 4), while the broker prices were set by volume and tree as current prices in the local market. Thinning of private teak plantation was assumed at 50 % of standing stock of thinning time (Table 2). The rotation periods of private teak plantations were mostly about 20-30 years and shorter than RFD. The study assumed in 3 types of rotations; 15, 22 and 30 years for financial analysis.

NPVs and IRRs were calculated. The discount rate was used 10% for NPV. The NPV is the difference between the present value of benefits and present value of cost. The NPV can be calculated by the following formula:-

$$NPV = \sum_{t=1}^n \frac{B_t - C_t}{(1+i)^t} \quad (1)$$

where B_t is benefit or income in the year t , C_t is cost in the year t , n is period of year in the rotation, and i is an interest

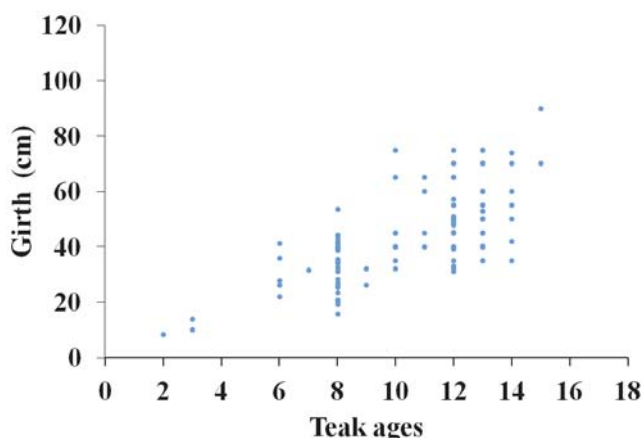


Fig. 3. Relationship between teak growth and ages of private teak plantation
Source: Psudsavang (2009)

Table 1. Yield classification by ages of private teak plantation into low and high yields

Level of Growth	Age (year)	Girth size (cm)	Log length (m)	Volume (m ³ /tree)
Low yield (poor growth)	8	40	4	0.05
	15	60	6	0.17
	22	80	8	0.41
	30	100	10	0.80
High yield (good growth)	8	60	4	0.11
	15	80	6	0.31
	22	100	8	0.64
	30	120	10	1.15

rate (discount rate).

The positive number of NPV value shows how investment is profitable. If NPV is less than zero or minus, the investment is unprofitable. The IRR is used to estimate the discount rate of return that makes the NPV equal to zero in Eq.1. The IRR can be calculated by the following formula:-

$$\sum_{t=1}^n \frac{B_t - C_t}{(1 + IRR)^t} = 0 \quad (2)$$

Results and Discussion

1. Teak yields of private plantation

Growth rate of private teak plantation varied from one to others depending on site quality, management and silvicultural practices etc. In first stage of private forest plantation promotion project, most of participating farmers were lack of knowledge such as site selection, silvicultural and managerial practices, etc. The girths and heights at 8, 15, 22 and 30 years of teak plantation were used to calculate

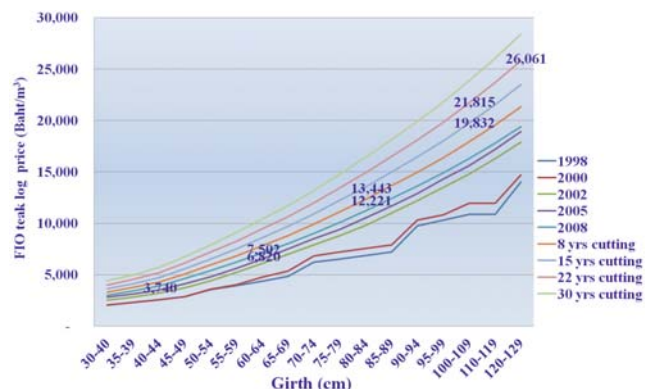


Fig. 4. The prices of FIO teak log (The prices were assumed 10% price increasing in each cutting years)

Table 2. Assigned model of tree cutting and thinning of private teak plantation

Rotation (year)	Purposes of cutting	Cutting year	No of thinning* (tree)	Total no. of tree
15	thinning	8	100	200
	final cutting	15	100	
22	1 st thinning	8	100	200
	2 nd thinning	15	50	
	final cutting	22	50	
30	1 st thinning	8	100	200
	2 nd thinning	15	50	
	3 rd thinning	22	25	
	final cutting	30	25	

*Thinning ratio 50%.

the low and high yields. The yields of teak plantation were shown in Table 3.

2. Teak log prices

Thailand had been imported natural teak wood from her neighboring country, Laos and Myanmar, which were very expensive. Recently, the price of teak log ranged from 25,000 to 50,000 Baht/m³ and prices had continued increasing every year. This provided the private teak plantation logs with an opportunity to compete with teak log imported by wood factories in the country. The teak prices depended on size, age and quality. The private teak plantation logs were mostly ages of 10–20 years or first thinning logs, and they showed small log size and low prices. The private teak plantations were established mostly in small scale areas (about 5–20 rai) and scattered in northern, central and northeastern regions of Thailand.

The teak logs of private plantations were normally sold to brokers at the planting site. The prices ranged from 1,900 to 11,000 Baht/m³, and were quite low compared with FIO

Table 3. Yield estimation of private teak plantation in 3 rotation periods

Low yield case							
Cutting year	Volume (m ³ /tree)	Rotation (year)					
		15		22		30	
		Cutting* (tree)	Yield (m ³ /rai)	Cutting* (tree)	Yield (m ³ /rai)	Cutting* (tree)	Yield (m ³ /rai)
8	0.05	100	5.00	100	5.00	100	5.00
15	0.17	100	17.00	50	8.50	50	8.50
22	0.41			50	20.50	25	10.25
30	0.80					25	20.00
	total	200	22.00	200	34.00	200	43.75
High yield case							
Cutting year	Volume (m ³ /tree)	Rotation (year)					
		15		22		30	
		Cutting* (tree)	Yield (m ³ /rai)	Cutting* (tree)	Yield (m ³ /rai)	Cutting* (tree)	Yield (m ³ /rai)
8	0.11	100	11.00	100	11.00	100	11.00
15	0.31	100	31.00	50	15.50	50	15.50
22	0.64			50	32.00	25	16.00
30	1.15					25	28.75
	total	200	42.00	200	58.50	200	71.25

* Thinning ratio 50%

Table 4. Teak log prices of FIO and broker at year 8, 15, 22 and 30

Yield level	Cutting year	Girth size (cm)	FIO price* (Baht/m ³)	Broker price (Baht/m ³)	Broker price (Baht/tree)
Low yield	8	40	1,870	1,900	200
	15	60	7,502	3,000	500
	22	80	13,443	6,500	900
	30	100	21,815	8,500	1,500
High yield	8	60	3,410	3,000	300
	15	80	12,221	6,500	700
	22	100	19,832	8,500	1,500
	30	120	26,061	11,000	2,000

* The FIO prices were derived from Fig. 4.

teak price. However, the logs could be sold in 3 different ways: 1) log volume (cubic meter), 2) number of standing trees, and 3) area size with standing stock. There were the 3 sources of teak log in markets; natural forest, private plantation and FIO plantation. The teak logs of private plantation were mostly sold to broker or middleman, because of convenience for owners in terms of cutting and transportation process, even if the price was lower than FIO. The FIO was a state enterprise which managed forest plantations, and sets prices of their teak logs by auction. The FIO teak price was comparatively higher than broker price. The prices of FIO and broker were shown in Table 4.

3. Establishment and maintenance costs of teak plantation

The major costs were establishment and maintenance activities which were seedling, planting, weeding, and fire

Table 5. The cost of establishment and maintenance activities

Year	Cost (Baht/rai)		Operation or type of cost
	Low cost	High cost	
1	2,000	3,500	teak plantation establishment (site preparing, planting, seedling and weeding)
2	600	1,200	weeding, fire protection, pruning
3	600	1,200	weeding, fire protection, pruning
4	400	800	fire control, pruning
5	400	800	fire control, pruning
6	200	400	fire control
7	200	400	fire control
8	3,000	5,000	logging, transportation
9	200	400	fire control
10	200	400	fire control
15	3,000	5,000	logging and transportation
22	3,000	5,000	logging and transportation
30	3,000	5,000	logging and transportation

protection. There were different costs of establishing private teak plantation ranging from 1,000 to 10,000 Baht/rai. The average cost ranged from 2,000 to 3,000 Baht/rai. We could say the cost of establishing teak plantation was much different, so this study conducted financial analysis on the plantation in 2 levels; low and high costs. The costs used in the study are shown in Table 5.

4. Income of private teak plantation

The income of private teak plantation was estimated

Table 6. Income estimation from FIO prices in low and high yield of each rotation periods

Rotation (year)	Cutting year	Girth Size (cm)	Log length (m)	Yield (m ³ /tree)	Tree cutting (tree)	Yield (m ³ /rai)	Log price (Baht/m ³)	Income (Baht)
Low yield (poor site or management)								
15	8	40	4	0.05	100	5.00	1,870	9,350
	15	60	6	0.17	100	17.00	7,502	127,534
22	8	40	4	0.05	100	5.00	1,870	9,350
	15	60	6	0.17	50	8.50	7,502	63,767
	22	80	8	0.41	50	20.50	13,443	275,582
30	8	40	4	0.05	100	5.00	1,870	9,350
	15	60	6	0.17	50	8.50	7,502	63,767
	22	80	8	0.41	25	10.30	13,443	137,791
	30	100	10	0.8	25	20.00	21,815	436,300
High yield (good site or management)								
15	8	60	4	0.11	100	11.00	3,410	37,510
	15	80	6	0.31	100	31.00	12,221	378,851
22	8	60	4	0.11	100	11.00	3,410	37,510
	15	80	6	0.31	50	15.50	12,221	189,426
	22	100	8	0.64	50	32.00	19,832	634,624
30	8	60	4	0.11	100	11.00	3,410	37,510
	15	80	6	0.31	50	15.50	12,221	189,426
	22	100	8	0.64	25	16.00	19,832	317,312
	30	120	10	1.15	25	28.80	26,061	749,254

Table 7. Income estimation from broker price in low and high yield of each rotation

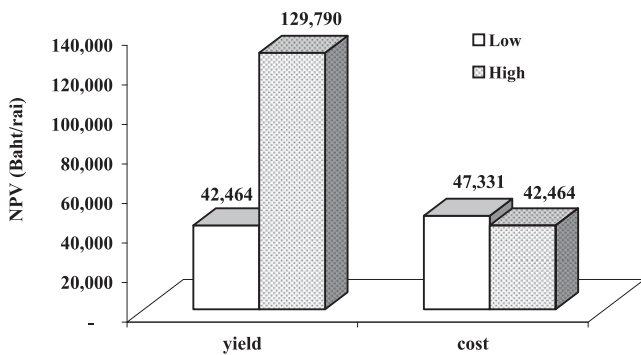
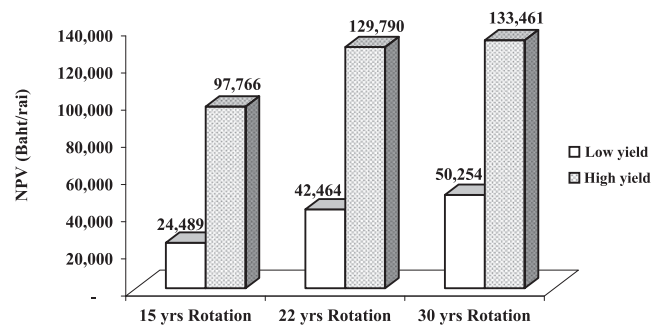
Rotation (year)	Cutting year	Girth size (cm)	Cutting (tree)	Yield (m ³ /rai)	Log price (Baht/m ³)	Income by volume (Baht)	Broker log price (Baht/tree)	Income by tree (Baht)
Low yield (poor site or management)								
15	8	40	100	5.00	1,900	9,500	200	20,000
	15	60	100	17.00	3,000	51,000	500	50,000
22	8	40	100	5.00	1,900	9,500	200	30,000
	15	60	50	8.50	3,000	25,500	500	25,000
	22	80	50	20.50	6,500	133,250	900	45,000
30	8	40	100	5.00	1,900	9,500	200	20,000
	15	60	50	8.50	3,000	25,500	500	25,000
	22	80	25	10.25	6,500	66,625	900	22,500
	30	100	25	20.00	8,500	170,000	1500	37,500
High yield (good site or management)								
15	8	60	100	11.00	3,000	33,000	300	30,000
	15	80	100	31.00	6,500	201,500	700	70,000
22	8	60	100	11.00	3,000	33,000	300	30,000
	15	80	50	15.50	6,500	100,750	700	35,000
	22	100	50	32.00	8,500	272,000	1500	75,000
30	8	60	100	11.00	3,000	33,000	300	30,000
	15	80	50	15.50	6,500	100,750	700	35,000
	22	100	25	16.00	8,500	136,000	1500	37,500
	30	120	25	28.80	11,000	316,800	2000	50,000

from above yield (Table 2, 3) and prices of each cutting year (Table 4), which were classified in low and high yield, FIO and broker prices and rotation of 15 22 and 30 year.

The incomes were shown as from FIO prices in Table 6, and as from broker prices in Table 7.

Table 8. The NPV of private teak plantation investment at 10% discount rate

Factors			NPV (Baht/rai) and IRR (%)		
Price	Cost	Yield	15 years	22 years	30 years
FIO price	high	low	24,489 (25%)	42,464 (25%)	50,254 (24%)
	high	high	97,766 (43%)	129,790 (37%)	133,461 (38%)
	low	low	29,111 (33%)	47,331 (31%)	55,236 (30%)
	low	high	102,387 (52%)	134,657 (49%)	138,443 (49%)
Broker price					
by volume	high	low	6,238 (17%)	15,889 (19%)	17,159 (18%)
	high	low	10,897 (23%)	9,826 (20%)	8,925 (19%)
by tree	high	high	53,230 (36%)	61,911 (34%)	63,072 (33%)
	high	high	20,350 (30%)	20,570 (27%)	18,543 (26%)
by volume	low	low	10,859 (25%)	20,755 (25%)	22,141 (24%)
	low	low	15,518 (34%)	14,693 (31%)	13,906 (30%)
by tree	low	high	57,851 (47%)	66,777 (44%)	68,053 (44%)
	low	high	24,971 (41%)	25,437 (39%)	23,524 (39%)

**Fig. 5.** NPV diagram of yield (high cost case) and cost (low yield) comparison of teak plantation in case of rotation 22 years and FIO prices**Fig. 6.** NPV diagram of comparison rotation of teak plantation in case of FIO prices and high cost

5. Net present value and internal rate of return

The NPVs and IRRs were shown in Table 8. The financial analysis resulted all of NPVs and IRRs were positive, the investments were profitable and varied by the factors. The yields and the prices were main factors affecting teak investment.

NPVs and IRRs were much fluctuated between high and low yield. For example, NPV was 42,464 Baht/rai (low yields) and 129,790 (high yields) under yields in case of FIO prices and high cost (Fig. 5). Thus, the yield factor highly affected investment profit. Such yield is related to mean annual increment (MAI), correspondent to growth rate. The teak plantation owner, therefore, needs to select suitable site.

The cost factors showed a few difference of NPVs between low and high costs. For example, NPV was 47,331 Baht/rai in low cost and 42,464 Baht/rai in high cost, cost

factors in case of FIO prices and low yields (Fig. 5). Although the costs increased for pruning and fire protection etc., the costs affected low in teak investment. The owner should pay more attention to yield increasing.

At rotation factors of 15, 22 and 30 years, NPVs and IRRs (FIO prices, high costs and low yields) were 24,489 Baht/rai (25%), 42,464 (25%) and 50,254 (24%) respectively in low yield, and were 97,766 (43%), 129,790 (39%), and 133,461 Baht/rai (38%) respectively in high yield (Fig. 6). By comparison among the NPVs of 3 rotations, there were big different between 15 and 22 years, but a few different between 22 and 30 years. The profit of 22 years (42,464 Baht/rai) was higher than 15 years (24,489), the rate of increase was 73 % (17,975). But the rate was only 18 % (7,790) between 22 and 30 years. The appropriate rotation should be 22 years among the 3 cases. The yield related to the MAI which varies depending on the site quality, therefore the period of 20-25 years rotation

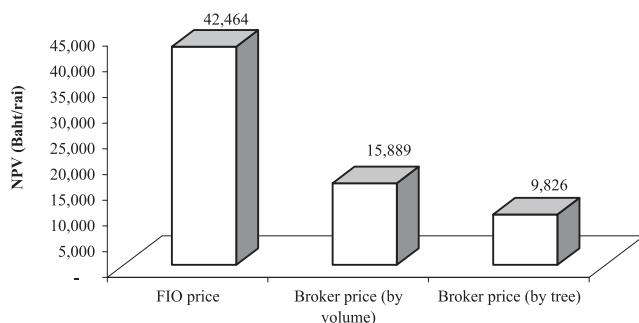


Fig. 7. NPV diagram of FIO and broker prices comparison of teak plantation in case of high cost, low yield and rotation 22 years

could be recommended,

The price factors showed big different values of NPV and IRR between FIO and broker prices. The NPV on FIO prices was higher than broker prices. For example, in case of low yield and high cost, the NPV were 42,464 Baht/rai, and broker prices were 15,889 Baht/rai (by volume) and 9,826 Baht/rai (by tree) (Fig. 7). The broker prices by volume were lower than FIO price, even if teak logs were big (Table 4). The selling price by tree made low profits than by volume. It means that the teak logs prices were depressed by brokers, and the owners might lose profits, especially in terms of selling by tree.

Conclusion

The financial analysis of private teak plantation investment showed effects of factors. The important factors were yield and price. The study tried to provide information which will help investors making decision whether to invest in teak plantation or not. The private sector should know and understand how to use economic tools (financial analysis) in order to assess factors affecting teak investment. The results of financial analysis showed all positive NPV value and profitable. However, it was suggested that owners should compare the profits from other cash crops and species. The price was an important factor for teak plantation owners to make decision on whether to keep their plantation or change to others. Broker prices of teak logs showed much lower level than FIO prices, and generally the selling price by tree produced lower profits than by volume. The private must concern how to get high yield and price. For high yield teak plantation, it needed suitable site or good quality site and good management. MAI was related to the yield factor, and

should be taken into consideration. As long as the MAI was continuously increasing, the rotation should be extended. We concluded that the appropriate rotation of teak plantation should be 20-25 years.

In Thailand, the private teak plantation mostly planted in small scale areas scattered over the country, where the broker or middle man took advantage to buy teak log at the plantation sites in very low price compared to general market prices. In order to sell teak log in fair price, local log market should be established. Recently, teak wood from natural forest was decreasing, therefore, teak wood from plantation had potential of replacing the products from natural forest and the price of planted teak wood was also increasing.

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