

# 琉球大学学術リポジトリ

## インドネシア・中部ジャワのチェプー森林区におけるチーク林生産と市場の展開

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## Development of Teak Wood Production and Marketing in Cepu Forest District, Central Java, Indonesia

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**Abstract:** The present research was conducted to investigate the trend and recent condition of teak wood production and marketing in Central Java using Cepu Forest District (CFD) as a case study. Two comparisons are made in this paper to determine price trend to reflect true market value of teak log. CFD produces a good quality of timber. The average annual production of teak log was about 45,769 m<sup>3</sup> among which more than 60% of their logs were categorized as grade AIII. More than 80% of the total log was sold in domestic market. Teak logs are marketed using four selling system: direct selling, selling by contract, big and small auctions. After the economic crisis, a large amount of teak logs coming from illegal logging has impact to be an excess of supply of teak log over its demand in Java. As a consequence, the real price of teak logs which was taken by CFD from their auctions sharply dropped and never reaches to the same level as before. The most important thing is a high indication that many teak stands in CFD were harvested as consequence of a high illegal logging attacked their teak plantations during the economic crisis. A high rate of unplanned harvesting especially to the remaining stands in illegal-logging areas brought unbalance distribution of the teak growing stock. In present day, more than half of stands in CFD are under age class I and it gives a bad sign for unsustainable harvest in the future.

**Key words:**

Teak log, the price trend, marketing system, illegal logging, Cepu Forest District.

### Introduction

Java teak (*Tectona grandis* Linn.) has been well known in the international market for a long period of time. Comparatively big diameters are harvested. There is a good yield, though the colour is more or less uniform. Teak plantation in Indonesia is managed by Perum Perhutani (PP), a state forest corporation. Teak plantations are widespread throughout Java Island mainly in Central and East Java. One famous forest district which produces a large amount and good quality of teak wood is Cepu Forest District (CFD).

The economic crisis attacking Indonesia since mid-1997, large teak plantation in Java has become subject for illegal logging and land encroachment (Oikawa, 2000; Kartodihardjo, 2000). The economic crisis has also a big impact to many aspects and sectors in Java i.e. real income and poverty (World Bank, 1998), labour force and unemployment (ILO, 1998), agriculture and forestry sector (Poppele *et al.*, 1999), forest resources (Sunderlin *et al.*, 2001; Pabiola, 2001). In this point, teak production and trade in Java, especially coming from the PP may change in that situation.

This research was conducted to investigate the trend and

recent condition of teak production and marketing in Java using CFD as a case study. The research was stressed on what harvesting system and how the PP's rule on producing teak log for the market. While teak log market was evaluated to know the log marketing system including type of selling, price, effectiveness and factors which affected to that system.

### Methods

This research was conducted by mainly using statistical data during 1995-2005 from Unit I Central Java in Semarang and CFD office in Cepu Town, Blora District. With respect to teak sustainability, trend analyses of teak plantation in CFD was conducted by comparing the growing stock and stand-structure pattern of teak plantation between 1995 and 2005. The trends of log production, marketing and its price for each log grades were also analyzed during those years. Two comparisons were made to determine if the log price trend reflects true market value. First comparison examines differences between log price coming from each marketing system i.e. direct selling, selling by contract, auction. The purpose of this comparison is to determine the best selling for teak timber. Second comparison examined whether the economic crisis has impact to log price

or not. To support those analyses, various official documents including policies and technical guides on harvesting, bucking, and marketing were reviewed. In addition, field visits to harvesting sites, log yards, and auctions process were conducted.

## Results and Discussion

### 1. Teak plantation management

The cutting rotation of teak plantations is designed on a 50-80 year of cutting cycle. Therefore, CFD arranges their teak plantations to have growing stock consisting of eight age classes (I to VIII-up) in which each class consists of 10 year-old-trees. An age class distribution system is used to guarantee stable production. To ensure sustainability of teak plantations, Forest Planning Section of PP conducts a "Sustained Yield Regulation Plan" for CFD. The main activities consist of planting, maintaining & thinning, harvesting, and forest protection. This plan is arranged for 10 years and then it is subdivided into annual technical operational plans. On managing teak plantation, PP implements yield regulation which is based on combination between area and volume. This yield regulation was established a very long time ago by Cotta (Cotta formula) that was used in forest in Saxony (Germany) at the beginning of 19th century (Simon, 1991). The Cotta formula was popular with a name periodic block method. With this method, yield of timber cutting is calculated for a certain period in order to make the cutting regulation more flexible, because it can be adjusted to market demand. The Cotta method regulates the cutting yield as well as relating it with regeneration. The goal of yield management is to manage harvests, so that total yields are more or less consistent over time. When annual allowable cut (AAC) has been designed based on the real growing stock, then the annual cutting plan will be designed, including the areas to be felled and expected volume of timber.

Other activities on managing teak plantation which also produces timber and gives substantial contribution to the total timber production are thinning. Thinning processes are done periodically. The time of thinning depends on the planted species and the length of the cutting cycle. Thinning is planned according to age-class of teak stand. The age-class of teak stand covers 10 years for each class. In the first age-class, thinning is planned every third year, in age-class II every fourth year, in age-classes III and IV every fifth year, and in age-classes V and up (until harvesting at about 80 years) every tenth year. The degree of thinning depends on the stand condition which is determined by soil fertility (called bonita) and other environmental conditions in the area. Usually for good stand stock, thinning will be more intensive and it gives a high yield of timber. Thinning activity is also planned on

annual plan which contains the teak plantations to be thinned and the expected volume of timber from that thinning area.

Unfortunately, when teak plantation is attacked by disturbances (illegal logging, land clearing, firing, etc.) this plantation becomes unproductive. It could not be maintained until mature and therefore the PP will conduct specific treatment on that area. PP will do clear cutting of the teak plantation and replace new plant in this area. This unplanned felling will produce timber as many as the remaining stands and the areas of that cutting. According to PP's guiding rule, there are three types of unplanned clear-felling applicable to teak plantation which are as follows; (1) felling type B is clear-felling on unproductive forest (rare of stands) arising from illegal logging, (2) felling type C is clear-felling of teak which would be replace by others species because the compartment is unsuitable as future teak forest, (3) felling type D is clear-felling when teak stands have been destroyed by land encroachers, animals, fire, or other natural disasters.

### 2. Harvesting types and the trend of timber production

PP conducts harvesting based on the actual condition of teak-growing-stock on each compartment. Annual final felling (called felling type A) is conducted based on AAC which was planned before to certain compartment which has mature teak stands (50-80 years-old). However, when disruptive agents such as illegal loggers, land encroachers, and fire attack immature stands in certain compartment, this compartment becomes low productive. In this case the PP will conduct unplanned clear-felling (felling type B, C and D) to the remaining stands in this compartment.

Table 1 lists the annual harvesting and production of teak logs in CFD based on felling types from 1995 to 2005. The annual production of teak log was about 45,768 m<sup>3</sup>. This table shows the most important source of teak log was final clear-felling (felling type A) which gave average contribution of about 55.06% of the total production. The remaining log coming from felling type B, C, D and thinning (E) which contributed to total log production were 23.02% and 21.91%, respectively. The annual final clear felling which was decided on AAC for CFD was about 225 ha with log production of 112.08 m<sup>3</sup>/ha. It indicated that teak plantation in CFD has a high yield of log per ha. The most interesting is felling type B, C, and D which was conducted as unplanned felling. Table 1 shows that large area of teak plantations in CFD have been felled by these felling types, especially during 1999-2002. As is mentioned before that felling type B, C and D are conducted in unproductive teak plantation arising from illegal logging, unsuitable as future teak forest and teak plantation have been destroyed by land encroachers, animals, fire, or other natural disasters. To support the evidence, Table 2 shows that a high intensity of illegal logging have been occurred during 1995-

2002 in CFD and other forest districts in Central Java. A high intensity of illegal logging caused decreasing standing stock per hectare and this led to many areas of teak plantation unproductive (few stands). Because of few stands, this teak plantation could not be maintained until mature. Therefore, CFD manager conducted felling type B, C or D in this area and it is followed by replanting activity. Massive illegal logging of teak stands occurred and it was reflected by low rate of log production from felling type B, C, D which reached only 10.88 m<sup>3</sup>/ha on average (see Table 1). Although felling type B, C, and D produced log on low rate per ha, the log coming from these felling types had significant contribution to the total log production. Table 1 shows the average contribution of felling type B, C, and D to the total log production was 23.02%. From 2000 to 2002, these felling types have the biggest contribution to teak log production in CFD.

Table 1 can not suggest that CFD was consistent to use AAC for harvesting teak in the past 11-years. They more consider the current condition of teak growing stock and how

to provide stable production of timber for each year. Dynamic fluctuation of area which was felled using type B, C, D and thinning (E) has strong indication for that hypothesis. As a consequence, unbalance of growing stock occurred and it will lead to unsustainable harvest and reduce log production in the future.

By comparing growing stock in 1995 and 2005 we might conclude that many area of teak plantation in CFD was lost during that time. Except age class I, growing stock on all age classes have decreased (see Fig. 1). Decreasing growing stock on age classes V to VIII-up were resulted in clear final felling which was conducted by PP from 1995 to 2005. However, extremely decreasing growing stock from age class II to age class IV and increase of growing stock on age class I in other side leave us a big question on under what situation and why it occurred. If CFD works on normal AAC, the current growing stock is apparently as same as in 1995. From the current growing stock we can conclude that sustainable yield of teak timber can not be reached in the future harvest.

Table 1. Harvesting area and log production of teak plantations in Cepu Forest District from 1995 to 2005

Year	Felling Types									Total log production m <sup>3</sup>	Percentage of log production		
	A			B, C and D			E				A	B,C,D	E
	ha	m <sup>3</sup>	m <sup>3</sup> /ha	ha	m <sup>3</sup>	m <sup>3</sup> /ha	ha	m <sup>3</sup>	m <sup>3</sup> /ha		%	%	%
1995	289	38,846	134.42	765	6,972	9.11	3,077	17,597	5.72	63,414.9	61.26	10.99	27.75
1996	256	36,552	142.78	616	1,773	2.88	2,927	9,514	3.25	47,838.1	76.41	3.71	19.89
1997	353	47,698	135.12	879	3,237	3.68	3,722	11,879	3.19	62,814.1	75.94	5.15	18.91
1998	295	30,740	104.20	474	1,874	3.95	3,235	11,193	3.46	43,807.1	70.17	4.28	25.55
1999	221	19,432	87.93	724	17,659	24.39	3,373	8,506	2.52	45,596.7	42.62	38.73	18.65
2000	155	16,388	105.73	1,655	22,628	13.67	3,079	7,959	2.58	46,974.8	34.89	48.17	16.94
2001	119	15,493	130.19	1,290	30,903	23.96	3,445	2,852	0.83	49,248.1	31.46	62.75	5.79
2002	105	9,311	88.67	1,060	15,313	14.45	2,620	9,195	3.51	33,817.9	27.53	45.28	27.19
2003	171	18,304	107.04	391	4,087	10.45	1,868	7,618	4.08	30,008.7	61.00	13.62	25.39
2004	323	30,996	95.96	1,052	658	0.63	2,210	14,426	6.53	46,080.0	67.27	1.43	31.31
2005	192	19,351	100.79	520	6,488	12.48	1,955	8,015	4.10	33,853.7	57.16	19.16	23.67
Average	225	25,737	112.08	857	10,145	10.88	2,865	9,887	3.62	45,768.6	55.06	23.02	21.91

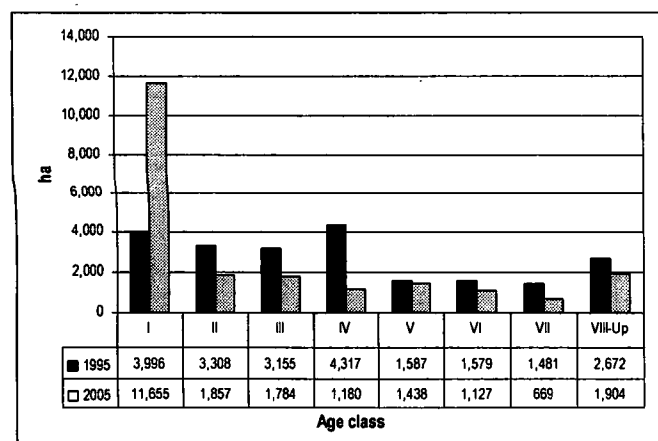
Source: Perum Perhutani Unit I Jawa Tengah (2000, 2003, 2006)

Notes: A = Final clear-felling of mature stands (commonly on age classes between V and VIII-up)  
B, C, D = Unplanned clear-felling on degraded or unproductive forest  
E = Thinning

Table 2. Illegal logging in some forest districts as the main producers of teak logs in Central Java (in number of trees)

KPH (Forest district)	Year							
	1995	1996	1997	1998	1999	2000	2001	2002
Balapulang	3,142	2,437	1,297	69,256	32,852	105,517	69,795	73,461
Pemalang	4,508	2,695	2,021	17,570	60,825	12,387	36,212	24,309
Cepu	6,425	6,976	6,171	90,245	536,255	80,386	64,846	9,111
Kebonharjo	4,217	2,669	3,586	82,094	191,442	15,563	16,354	18,606
Mantingan	6,234	5,135	5,326	69,427	91,627	94,239	189,019	23,809
Randublatung	7,470	6,458	6,613	88,171	82,788	38,291	290,063	98,599
Blora	11,724	15,437	14,323	52,160	38,684	48,596	59,795	12,910
Pati	14,943	18,579	35,723	283,562	1,101,787	717,989	663,175	669,541
Purwodadi	12,890	13,469	11,492	26,387	31,853	70,981	116,868	55,824
Semarang	10,388	8,522	15,679	37,449	58,422	34,375	25,186	29,215
Total	81,941	82,377	102,231	816,321	2,226,535	1,218,324	1,531,313	1,015,385

Source: Perum Perhutani Unit I Jawa Tengah (2000, 2003)



Source: Perum Perhutani KPH Cepu (1996, 2006)

Fig. 1. Comparison of teak growing stock on different age classes between 1995 and 2005 in Cepu Forest District

### 3. Log grading and timber production

After felling, teak stems are bucked into log. To produce a high quality of log, bucking is conducted based on grading rule

provided by the PP Central Office. By considering the references of domestic and foreign customers, the rules have been revised from time to time to meet the requirements of both domestic and international trades. Round teak logs are specified into tree groups based on the diameter and length classes and six quality classes based on wood defect as presented in Table 3. Based on this grading rule, during 11 years (1995-2005) CFD produced teak logs which are classified to log grade as presented in Table 4. This table indicated that teak log from CFD has a high grade level, among which more than 60% was categorized big log (grade AIII). Meanwhile small log (AI) contributes only 16.95% of the total log production. A log grade AIII is commonly coming from final felling and felling type B, C, D in age class III and up, while a small log (AI) is commonly coming from thinning of the younger teak stands. Timber from branches and rejected logs becomes firewood.

When teak log are transported from field areas to log yard,

Table 3. Grading rule of teak log based on diameter, length, and quality classes

Log grade	Log Quality	Diameter classes (cm)	Length (m)	Notes
Small log (AI)	P / D / T / M	4 - 6	2.0 up	U = Primary class if defect ≤ 0% P = Fist class if defect ≤ 25% D = Second class if defect ≤ 35% T = Third class if defect ≤ 45% M = Fourth class if defect ≤ 55% L = Fifth class if defect ≤ 65%
		7 - 9	1.5 up	
		10 - 12	0.7 up	
		13 - 15	0.7 up	
		16 - 18	0.5 up	
Medium log (AII)	U / P / D / T / M	19 - 21	0.5 up	
		22 - 24	0.5 up	
		25 - 27		
Big log (AIII)	U / P / D / T / M / L	28 - 30	0.5 up	
		31		
		32		
Firewood		33 up	1.0	
		2 - 4		0.4
		5 - 8		
		9 - 15	0.4	

Source: Perum Perhutani (2004a)

Table 4. Teak log production in Cepu Forest District based on log grades from 1995 to 2005

Year	Log Grade						Total m <sup>3</sup>
	AI		AII		AIII		
	m <sup>3</sup>	%	m <sup>3</sup>	%	m <sup>3</sup>	%	
1995	10,151	16.07	13,078	20.70	39,944	63.23	63,173
1996	6,823	14.33	8,694	18.25	32,113	67.42	47,630
1997	7,886	12.60	11,291	18.04	43,408	69.36	62,585
1998	6,890	15.83	9,554	21.95	27,080	62.22	43,524
1999	7,914	17.61	10,857	24.15	26,181	58.24	44,952
2000	7,972	17.66	11,708	25.93	25,464	56.41	45,144
2001	6,017	12.62	11,662	24.45	30,014	62.93	47,693
2002	6,790	20.26	8,469	25.27	18,251	54.46	33,510
2003	5,766	19.42	6,213	20.92	17,715	59.66	29,694
2004	11,073	24.46	9,259	20.46	24,929	55.08	45,261
2005	5,192	15.55	7,806	23.37	20,399	61.08	33,397
Average	7,498	16.95	9,872	22.14	27,773	60.92	45,142

Source: Perum Perhutani Unit I Jawa Tengah (2000, 2003)

it is separated based on purposes. The highest grade of teak log is separated firstly to supply the PP's wood industries. It was about 20% of the total log production. Except teak log for their own wood industries, all teak logs in log yard for market are grouped into lots based on grade. Each lot of teak log has a number and they are administered with log grade category and volume. In this case, log yard is also provided as log showroom for buyers who seek timber. It is also used as "reference" by bidders who will bid teak log before they come to the log auction. PP Central Office in Jakarta provides standard price of teak log as guiding price for log selling. There are two standard prices of teak log called *Harga Jual Dasar* (HJD) and *Harga Penawaran Lelang* (HPL). HJD is price basis for direct and contract log selling, while HPL is "preservation price" or price basis for both a big and small auctions. These standards price of log will be evaluated every six months (in January and July).

#### 4. Marketing system and timber prices

Based on marketing guiding rule ((Perum Perhutani, 2000, 2004b) provided by the PP Central Office, marketing system of teak log can be broadly described as follows; (a) direct selling by issuing purchase license to big, medium, and small wood industries and cooperatives, (b) selling by contract with big and medium industries and cooperatives which products especially for export, (c) auction, can be big auction by joining several forest district or small auctions in each forest district. Direct selling and especially selling by contract are commonly conducted to medium and big wood processing industries which is highly export oriented. Purchasing teak log by contract was commonly conducted by wood processing firms which have contract selling of wood products with importer. It was conducted by the firms to provide safety-source and better

quality of raw material. Direct and contract selling are issued by the Head of Forest District (Administratur/ADM). For direct and contract selling, PP will issue license to applicant industrial buyers for their future purchase of logs. Such a license, detailing the origin and quota of available logs, is required so that the buyers can proceed to choose logs. Initial payment of deposit and tax must be paid by buyer before purchasing is done. Following the down payment, a final invoice is provided by PP for detailing the logs purchased. After required payment is received by PP, delivery order is issued by PP with a detail list of each log that was purchased. Auction is conducted every month on form oven bidding. Big auctions are placed in some cities in Central Java i.e. Semarang, Solo and Jogjakarta, while small auctions are placed in small town nearest forest district i.e. Blora and Cepu Towns. Small auction is especially provided for small wood industries surrounding forest district. Auctions are prepared by Marketing Section of PP in Unit level. Before auction, all log lots in log yard which will be bid were administered and have minimum price (as seller's reserve price) for bidding. Marketing Section of PP will announce days and places for auctions. In those times, bidders will be given log- bidding's catalogue which consists of log-lots' list and their reservation prices. On bidding process, the bidder who bid the highest price for each log lot is winner and pay teak log on that lot for him. Selling log by auction is expected to give a high price of teak timber. To participate in auction or bidding, a highly competent and experience on bidding process are needed. Wood traders have such an expertise and therefore log bidding on both a big and small auctions were dominated by wood-trader's firms. Wood traders are very common in Java as intermediary between wood producers and wood processing industries.

Table 5. Teak log selling from Cepu Forest District for each marketing system in 1995-2005

Year	Big auction		Small auction		Selling by contract		Direct selling		Total Selling
	m <sup>3</sup>	%	m <sup>3</sup>	%	m <sup>3</sup>	%	m <sup>3</sup>	%	m <sup>3</sup>
1995	14,754	38.37	4,252	11.06	1,043	2.71	18,405	47.86	38,454
1996	16,527	47.76	5,449	15.75	1,280	3.70	11,348	32.79	34,604
1997	23,626	47.46	6,660	13.38	263	0.53	19,230	38.63	49,779
1998	12,445	32.43	2,752	7.17	543	1.41	22,639	58.99	38,379
1999	14,005	48.13	2,329	8.01	640	2.20	12,122	41.66	29,097
2000	19,946	48.26	897	2.17	50	0.12	20,438	49.45	41,331
2001	13,999	41.35	430	1.27	1,385	4.09	18,044	53.29	33,856
2002	27,333	64.52	1,269	3.00	1,247	2.94	12,515	29.54	42,364
2003	19,205	48.60	3,348	8.47	1,217	3.08	15,748	39.85	39,518
2004	5,592	16.13	53	0.15	578	1.67	28,450	82.05	34,673
2005	7,412	22.54	326	0.99	3,286	9.99	21,852	66.47	32,876
Average	15,895	41.41	2,524	6.49	1,048	2.95	18,254	49.14	37,721

Source: Perum Perhutani Unit I Jawa Tengah (2000, 2003, 2006)

Table 6. Average price of teak logs in different marketing system in 1995-2004

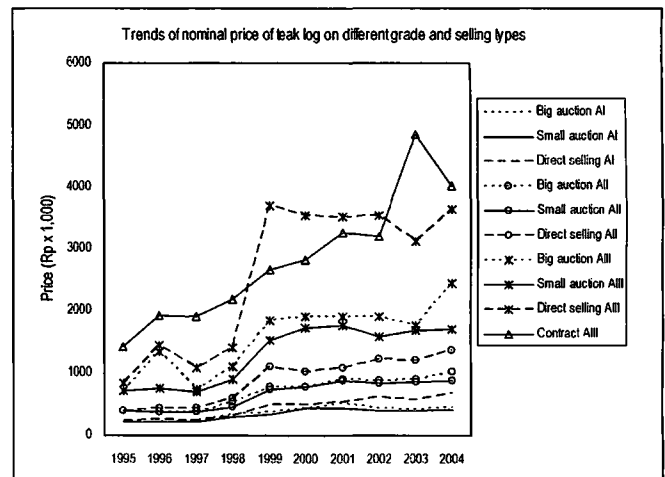
Market System	Log grade	Average price per m <sup>3</sup> (x Rp 1,000)										Trend price increase %
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
Big Auction	AI	223	216	234	348	375	448	511	444	429	461	6.82
	AII	410	378	381	537	774	777	897	880	893	1,017	8.61
	AIII	730	1,336	747	1,096	1,849	1,905	1,899	1,902	1,762	2,436	6.84
Small Auction	AI	228	220	226	298	333	443	447	395	406	415	6.39
	AII	395	382	378	464	736	784	887	840	861	887	8.47
	AIII	711	759	692	894	1,512	1,715	1,757	1,573	1,682	1,706	7.84
Selling by contract	AIII	1,414	1,928	1,905	2,175	2,659	2,824	3,262	3,195	5,852	4,013	8.09
Direct Selling	AI	237	255	236	323	509	492	544	629	588	685	9.92
	AII	403	441	437	605	1,098	1,027	1,085	1,219	1,199	1,363	11.13
	AIII	836	1,441	1,083	1,395	3,705	3,545	3,522	3,539	3,124	3,637	9.98
Average	AI	229	230	232	323	406	461	501	489	474	520	8.11
	AII	403	400	399	535	869	863	956	980	984	1,07	9.36
	AIII	923	1,366	1,107	1,390	2,431	2,497	2,610	2,552	3,105	2,948	9.93
Exchange rate	Rp/US\$	2,308	2,383	4,650	10,228	7,848	9,595	10,256	9,316	8,570	8,899	

Source: Perum Perhutani Unit I Jawa Tengah (2000, 2003, 2006)

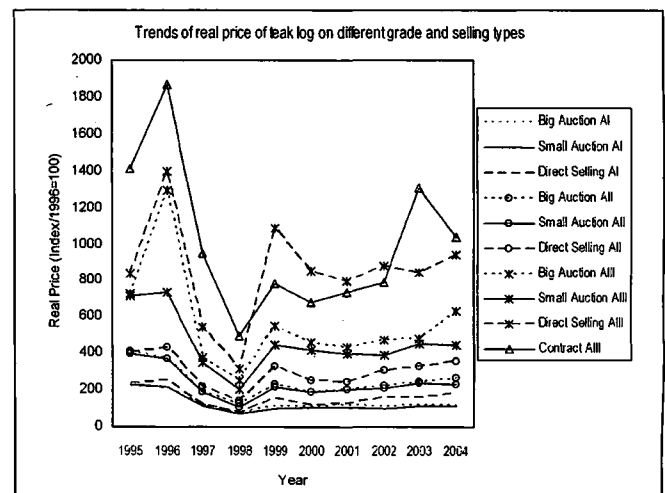
Table 5 lists log sale from CFD for each selling type during 11 years. This table indicated that direct selling and big auction were the main log sale from the CFD with average share about 49.14% and 41.41% of the total-log sale, respectively. Meanwhile small auction and selling by contract contribute only small portions. Although the share of each selling type fluctuated during 11-years period, it was indicated that log sale on small auction showed decreasing trend, especially after 1997. Furthermore, after 2004 direct selling dominated the log sale.

Log price paid by buyers is different according to log grades and selling types. Table 6 shows that the average log-price paid by direct selling and selling by contract was consistently higher price than selling by auction. This indicates that direct and contract selling give better price than big and small auctions. The price that paid for selling by small auction was only one-third of the price in direct selling. Meanwhile big auction giving better price with differences was about half of the direct-selling prices. The following graphs (see Fig. 2a and 2b) which demonstrated the prices trend shows that auction sales prices have been substantially lower than direct and contract sales. This is a clear indication that auction did not give maximum price for teak log. Concerning log grade, there are also significant differences of price among grades. An average, log grade AIII has price 2 to 3 times higher than log grade AII, while log grade AII has price two times higher than log grade AI (see Table 6).

The analysis of the price trend of teak log during 1995-2005 was conducted based on two approaches i.e. nominal price (in Indonesia *Rupiah*) and real price. Using nominal price, the log prices for all grades in all selling types fluctuated, but in



(a)



(b)

Source: Perum Perhutani Unit I Jawa Tengah (2000, 2003, 2006)

Fig.2. Trend of nominal price (a) and real price (b) of teak logs on different grade and selling type

general the prices trend has increased (see Table 6 and Fig. 2a). In general, the price trend increased about 9.93% for log grade AIII, 9.36% for log grade AII, and 8.11% for log grade AI per year. The highest increase of log price occurred for log grade AII in direct selling which accounted for 11.13% per year, while the lowest increase occurred for AI in small auction which accounted for 6.39% per year.

Fig. 2a shows that in 1997 the log price was stagnant and then a high increase in 1998. Of course, it has relation with the economic crisis and social-political problem in Indonesia including many teak plantations which were logged and cleared illegally on a large area. By considering to rupiah devaluation and its exchange rate to US \$ (see Table 6), teak log on real price actually decreased during that time (see Fig. 2b). In real price, log price was downfall to the lowest level in 1998 when the economic crisis attacked Indonesia and gave hyper devaluation to rupiah. After that time, the log price never reached back at same level of 1996.

To describe why and what factors which affected the teak log market, we have to analyze supply and demand situation for teak log during that time. There is no exact data concerning teak demand for both Central Java and whole Java, but we predict it is a high level of demand. It was indicated by many wood-processing industries in Central Java which a high contribution to job creation, income generation, produce and export earnings. Many wood processing industries use teak wood as main source. In 2000, Central Java has 8,183 furniture clusters with 38,769 workers. More than 80% of those wood industries were informal enterprises (CERMED, 2002). Jepara District as one of the centre of teak furniture producer in Central Java has more than 3,000 teak-processing firms which consume teak timber of around 600,000 m<sup>3</sup> per year (Sandee, et al., 2002). In Central Java Province, wood furniture is the largest contributor to provincial exports, accounting for 27.16% of total exports in 2000. It dropped to 21.57% in 2001 but this was still the highest share of total exports (CEMSED, 2002). A high local-content industry such as wood furniture production survived better than other firms during the economic crisis (CEMSED, 2002). A high demand of teak log, of course, could not be fulfilled by PP whose maximum supply teak log was only 200,000 m<sup>3</sup> per year for whole forest districts in Central Java or 500,000 m<sup>3</sup> per year for whole Java (Perum Perhutani, 2005). Other source of teak logs came from private forest, but it did not fulfill demand for timber in Java. It can be indicated by a high rate of illegal logging. Anon (1996) and Astraatmaja (2001) stated that unbalanced supply-demand of timber in Java has occurred over a long period of time. Disparity between the potential output from legal logging and the requirements of the growing wood industry in Java created a "black market" for timber and this gave a financial incentive for illegal logging. For furniture industry, using illegal wood is

an enormous cost saver. Therefore, acquiring cheaper (illegal) wood makes a huge difference to price and profit. Thus, there is correlation between a high activity of teak processing industries and illegal logging. Based on Table 2, massive illegal logging was conducted in Central Java where many forest districts are the main producers of teak logs and many teak processing industries are installed. Using conservative assumption, when each tree in illegal logging as it presented in Table 2 has a volume of 0.5 m<sup>3</sup>, it means that domestic market was "fluidized" by a large amount of teak log. As an example, in 2000 more than one million m<sup>3</sup> teak log came to market. This study concluded that many teak logs came from illegal logging after the crisis has impact to exceed supply of teak log in Java and it created low price of teak log. Because its supplies do not reflect the real production of teak, and therefore the price of teak log in domestic market did not reflect the real market value of teak timber. Although domestic market was suddenly "fluidized" by teak logs coming from illegal logging which have lower prices, teak log from PP is still interested by many buyers because of some reason i.e. a high quality, and a big dimension. In this time, we determine that teak log from PP was only purchased by buyers who commit to use legal log. These buyers commonly have export products' oriented and their partnership's importers also have same commitment. Therefore, starting in 2004, PP developed marketing policy to intensify more direct selling and selling by contract. This can be seen in Table 5 that those selling have a big share to the total selling of teak logs during 2004-2005.

Besides excess supply, based on field observation, we found some problems existing in auction during bidding process. In normal condition, auction can increase price from the base to the highest price as it was expected by seller. It is occurred when haggling process among bidders is existed. The winner in this process is the bidder who gives the highest price. However, the price will not reach to a high level, if there is a lack of competition and some collusion among bidders during bidding process. Bidding process on log auctions were dominated by wood trader's firms. Many auctions have been followed by bidders who led to become companion among them. It is seemed as strategy for unfairness of bidding and therefore a lack competition between bidders were existed. A strategy to keep low of log price usually is conducted by "hidden cooperation" among wood traders. This strategy is easy conducted by wood traders when many times they follow log auction and each other become familiar. We predict that many wood traders who follow the auction are also actively purchase teak log from illegal logging. The result of the analysis suggests a systemic problem with the log auction. Low price which is given by auction send a clear signal that the auction is less competitive and therefore auction is not effective way to sell teak log.



## Conclusions

In CFD, the cutting rotation of teak plantation is designed for a 50-80 year. The annual production of teak log was about 45,769 m<sup>3</sup> among which more than 55% of that production coming from final clear-felling (felling type A). The remaining logs came from thinning and unplanned felling (felling type B, C and D). Many teak plantations were attacked by illegal logging during the economic crisis and had consequence to PP to conduct felling type B, C or D. As result, log came from these felling types dramatically increased during the period of 1999-2002 to more than 46% of the total log production. A high rate of harvesting, especially felling type B-D during that time, brought unbalance distribution of the growing stock of teak plantation in CFD in present time. More than half of growing stock is under age class I (less than 10-year-old tree). It gives a bad signal for unsustainable harvest in the future.

CFD produces a good quality of timber. More than 60% of their logs was categorized as grade AIII (big diameter with a high-grade level), while small log (AI) contributes only 16.95% of the total log production. From the total, more than 80% of log was sold in domestic market, while 20% of the best log was supplied to their wood industries. Teak log is marketed using four selling system i.e. direct selling, selling by contract, big and small auction. Direct and contract selling gave relatively a high price by comparison with auction for all log grade categories. Auction which is expected to give a high price of timber, actually gave lower price. Low price which is given by auction sends a clear signal that the auction is not competitive because domestic market for log was "fluidized" by a large amount of teak log coming from illegal logging. Other things, there were some problems existing in auction during bidding process.

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## インドネシア・中部ジャワのチェプー森林区におけるチーク林生産と市場の展開

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### 要約

この研究はチェプー森林区を事例にして中部ジャワにおけるチーク材生産と市場の動向及び現在の状況を検討するためになされ

たものである。この論文ではチーク丸太の実際の市場価格に反映する価格動向を決定するために二つの比較が行われている。チェプー森林区は良質の木材を生産している。チーク丸太の年平均生産は約45,769m<sup>3</sup>で、そのうちの60%以上は等級A IIIとして分類された。総丸太の80%以上は国内市場に売られた。チーク丸太は四つの販売方法、すなわち直接販売、契約（請負）販売、大競売、小競売で取引されている。経済危機後、ジャワでは違法伐採から生じた大量のチーク丸太がチーク丸太の需要を上回る供給過剰のインパクトを与えている。結果として、チェプー森林区から得られたチーク丸太の競売実価格は非常に下落し、そして以前と同様の価格水準には決して達していない。最も重要なことは、チェプー森林区の多くのチーク立木が経済危機の間、チーク人工林を襲った激しい違法伐採の結果として収穫されたという高い徴候があるということである。違法伐採の地域では特に残存立木に対する無計画収穫の割合が高く、そのことがチーク蓄積のアンバランスの分布をもたらした。今日、チェプー森林区における半分以上の立木が1 齢級以下であり、そしてそれは将来における持続不可能な収穫の悪いサインを発している。

キーワード：チーク丸太、価格動向、市場取引方法、違法伐採、チェプー森林区