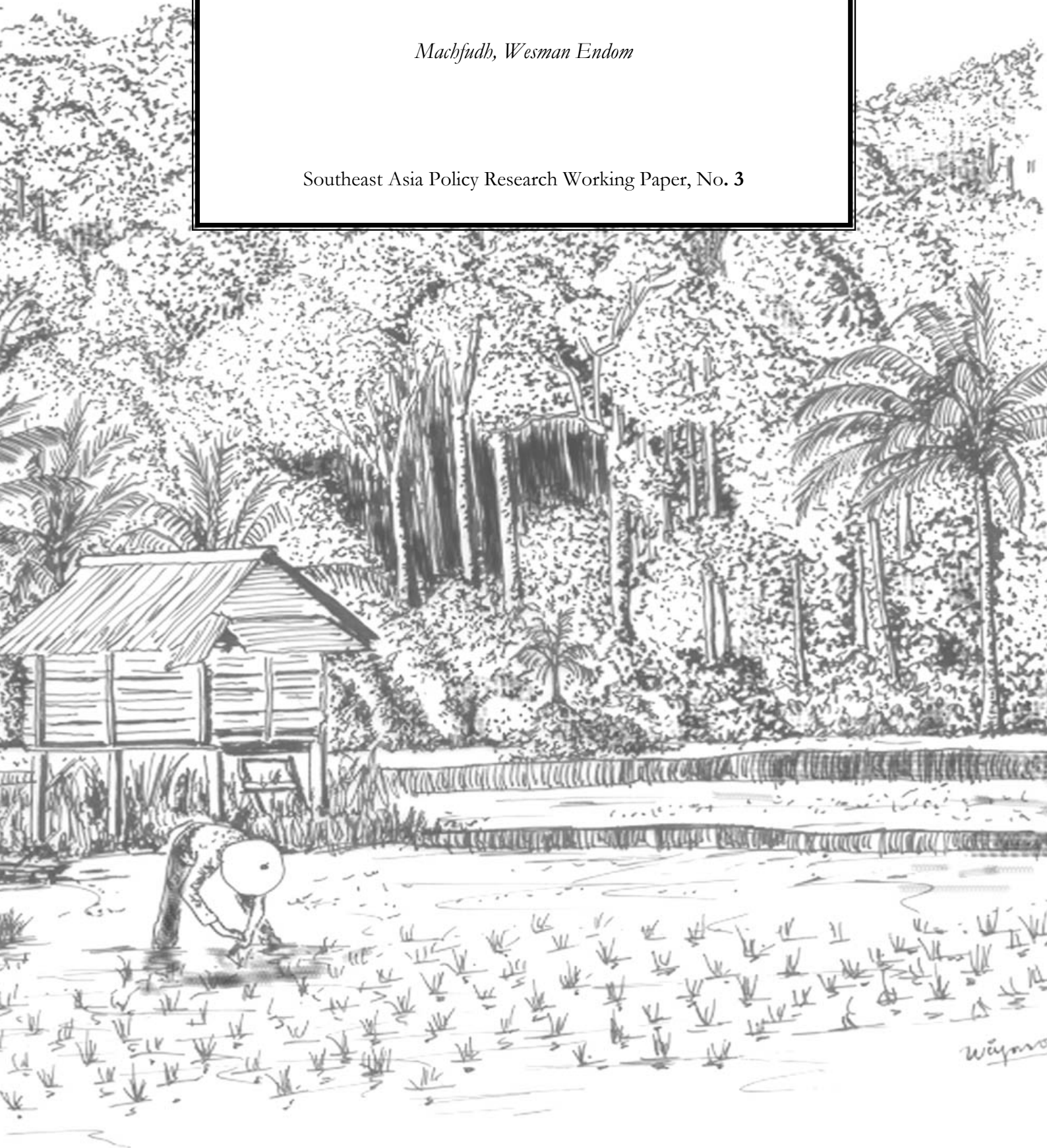


Economic Analysis of Large Scale Logging

Machfudh, Wesman Endom

Southeast Asia Policy Research Working Paper, No. 3



Acknowledgement

This report is part of the ASB Project in Indonesia. The Asian Development Bank, under RETA 5711, financially supported this specific work.

© Copyright ICRAF Southeast Asia

Further information please contact:

ICRAF SE-Asia
Southeast Asian Regional Research Programme
PO Box 161
Bogor 16001
Indonesia
Tel: 62 251 625415, fax: 62 251 625416
Email: icraf-indonesia@cgiar.org
ICRAF Southeast Asia website: <http://www.icraf.cgiar.org/sea>

Cover design: Dwiati N. Rini

Illustration design: Wiyono

Disclaimer

This text is a 'working paper' reflecting research results obtained in the framework of ICRAF Southeast Asia project. Full responsibility for the contents remains with the authors.

ECONOMIC ANALYSIS OF LARGE SCALE LOGGING

Reported By

Machfudh & Wesman Endom

FOREST PRODUCT RESEARCH CENTER

AND

THE INTERNATIONAL CENTER FOR RESEARCH IN AGRO FORESTRY

(ICRAF)

1999

CONTENTS

I.	INTRODUCTION	1
II.	METHODOLOGY	2
III.	FORESTRY MANAGEMENT AND POLICIES	6
IV.	RESULTS AND DISCUSSIONS	9
V.	CONCLUSIONS	13
	REFERENCES	13
	APPENDICES	15

CONTENTS

I.	INTRODUCTION	1
II.	METHODOLOGY	2
III.	FORESTRY MANAGEMENT AND POLICIES	6
IV.	RESULTS AND DISCUSSIONS	9
V.	CONCLUSIONS	13
	REFERENCES	13
	APPENDICES	15

ECONOMIC ANALYSIS OF LARGE SCALE LOGGING

By

Machfudh & Wesman Endom
Center for Forest Products Research

I. INTRODUCTION

Deforestation is a major problem in tropical forests. Deforestation rates have almost doubled during the last decade from 7.6 million hectares per year in 1979 to 13.9 million hectares per year in 1989 (Myere, 1989), to 17 million hectares in 1993 (Dale et. al., 1993). They are expected to accelerate even more in the future. Logging done by enterprises and shifting cultivation are blamed to be the main cause of the deforestation.

Logging in Indonesia has been carried out more than 20 years, and millions cubic meters of woods have been extracted from the forests. Government policies on opening logging has multiple objectives: to open remote communities and regions, create jobs, source of income for country development, country defense, etc. Theoretically, logging done by HPHs would not create deforestation because all HPH should apply the Indonesian Selective Cutting and should do regeneration.

The process of deforestation is driven by complex demographic, biological, social, and economic forces. Impact of deforestation on the environment are serious, but impoverished people who live surrounding the forest are equally critical problem that need to be solved. Populations are expanding rapidly, but the most fertile and accessible lands are already intensively used. People have no choice but try to encroach forest lands. On the other hand, government policies often exacerbate land scarcity by fostering inequity in land tenure. These and other policy distortions foster the occupation of state forest lands.

Measuring impact of government policy is not easy. Practically, most government practitioners give more emphasis on micro-economic issues, marketing and trade get less and macro-economic links receive little or no coverage (Monke and Pearson, 1989). Successful policy analysis requires that the analysis should be conducted holistically. This means that policy analysis should be viewed in a global system. There are links among parameters of farming system, domestic and international markets, and macro-economic policy. An analyst should have to see what feedback and trade off within the whole system impacted by imposing new policies.

The objective of the study was to address issues of government policies on wood industries. The issues covers the impact of government policy on competitiveness and wood industries profit, and the influence of

policy on economic efficiency and comparative advantage. This study is part of a large project called slash-and-burn project. The project tries to evaluate impact of various government policies to private as well as social price of various land use system.

II. METHODOLOGY

A. Location of the study

The study took place in Jambi Province, Bungo Tebo District (Kabupaten). Four concession holders were selected as samples, namely: PT Rimba Karya Indah, PT Dalek Esa Hutani, PT Gaya Wahana Timber, and PT Sylvagama.

PT Rimba Karya Indah started to operate in 1987. Administratively, its forest is located in Kabupaten Batanghari and Kabupaten Bungotobo. Of its 87,000 hectares concession, 77,493 hectares are categorised as forested area, and 9,507 hectares are categorised as an area with no vegetation. The average log production is about 53,900 m³/year. Relative to the other HPH samples, PT RKI is a relatively new concession holder.

PT Dalek Esa Hutani is located in the Sungai Pelapat-Sungai Tabir forest group and in the Sungai Kenggatal – Sungai Batanghari forest group. Geographically, it is located in 102° 15' – 103° 00' East Longitude and 0° 55' – 1° 30' South Latitude. The area of the forest are 67,000 hectares and 90,000 hectares, respectively. Administratively, PT Dalek Esa Hutani forest is in the Kecamatan Tebo Tengah, Bungo Tebo district, Jambi province. About 85.71% of the forest is categorised as production forest. The main forest is categorised as protective forest (14.28%). Based on forest function, PT Dalek Esa Hutani forests are classified as primary forest (41.47%), secondary forest (42.93%), shrub and bush (10.84%), agriculture/dry land (4.76%). Up to 1996, total log production coming from the forest are 881,019 m³. Expected log production up to 1996 was 1,079,970 m³. PT Dalek Esa Hutani started to operate in 1974 and since 1993, it got an extension to operate for the next 20 years. The area for the extension is on the same place but it has to reserve an area about 50,000 hectares for the Kuamang Kuning Transmigration project.

PT Gaya Wahana Timber operates logging based on its SK HPH No. 365/Kpts/Um/7/1974. It is located in the Muaratebo, next to PT Dalek Esa Hutani area. Total area of PT Gaya Wahana Forest are 100,000 hectares and it consists of forested area about 60,000 hectares and the remains (40,000 hectares) are categorised as an area with no vegetation. Average log production is about 13,600 m³/year. PT Gaya Wahana Timber emphasised on its own wood industries. Due to low standing volume on its remained forest, the company stopped doing logging. The company became a group of the Rimba Karya Indah

Group. Although the Gaya Wahana Timber company is a member of the RKI group, it does not mean that the supply of raw materials comes from the RKI. Only part of the raw material comes from the PT RKI. The rest comes from some HPHs which are non-RKI group members. The industry is located in Desa Kemingkin Luar, Jambi. The main products are sawn timber, mixed wood, block boards, laminated but joint, and *cf* plywood. The industry started to operate in 1985.

PT Sylvagama started to operate in 1975. It is located in Batang Tebo – S Kemang Bungo forest group. The Sylvagama concession forests area is about 50,000 hectares in which 38,000 hectares are forested land and 12,000 hectares are classified as other used. The average production was about 10,000 m³. The Sylvagama was operated by the University of Gajah Mada. Some research were conducted in the Sylvagama's forest. Since 1997, the Sylvagama status was changed from a concession forest for production into a forest research station. No more logging activities commercially is allowed in the Sylvagama forest.

Looking at the profile of the above HPHs, it is the author's believed that the samples are diverse enough for the study. Spatial location of the HPHs can be seen on Appendix A.

B. Approaches

To meet the objective of the study, a Policy Analysis Matrices (PAM) approach (Monke and Pearson, 1989) was applied. The PAM is a system of double-entry bookkeeping. To operate the PAM, accounting matrices of revenues, costs, and profits of each sample were constructed. The matrices are constructed based input-output, private and social prices, and private and social budget matrices of the company system. Input-output (I-O) matrices represent basic structure of the forest management system. Quantities contained in the I-O matrices represents technology used to produce forest management products. Level of desegregation depends on the data available. It is usually best to desegregate as much as possible to facilitate sensitivity analysis.

Private and social price matrices represent Prices Company's pay for inputs to their forest management system and prices received for the forest management products produced both privately and socially. Private and social budget matrices show costs and revenues of the forest management system. It is constructed based on quantities indicated in the I-O matrices and prices in the Prices table. The data on the budget table are linked through formulas. Private prices are the prices that households and firms actually face, so private profitability – the NPV at private prices—is a measure of production incentives. Social profitability, calculated at economic (shadow) prices, removes the impact of policy distortions and market imperfections on incentives

for adoption and investment. Thus social profitability – the NPV at social prices – is an indicator of potential profitability (or comparative advantage). Divergences, the difference between private profitability and social profitability, are indicators of distortions, arising either from policy or from market imperfections and failures. The structure of the PAM is described in the following table 1.

Table 1. Policy Analysis Matrix

	Costs			
	Revenues	Tradable inputs	Domestic factors	Profits
Private prices	A	B	C	D
Social prices	E	F	G	H
Effects of divergences and efficient policy	I	J	K	L

$$\text{Private profits (D)} = A - B - C$$

$$\text{Social profits (H)} = E - F - G$$

$$\text{Output transfers (I)} = A - E$$

$$\text{Input transfers (J)} = B - F$$

$$\text{Factor transfers (K)} = C - G$$

$$\text{Net transfers (L)} = D - H.$$

C. Data Collections

Three methods of data collection were conducted. The first method was a survey. It was done by sending checklists to each sample (HPH). The checklists cover physical and price quantities of activities such as administration, regeneration, logging, marketing, and other expenses that are not covered in the four mentioned activities. The second method was an interview. The interview was done by making discussion to the concession managers, staffs and field workers. Interview was also done with government office staffs in Jambi, concession staffs in Jakarta, and also scientist in the Forestry Research and Development Agency (FORDA). The objective of the interview was to complete unfilled checklists and to do cross checking. The third method was conducted by noting from some sources which covers 1996 accounting book of each HPH, FORDA records, ITTO reports, the World Bank reports, and other secondary data sources.

D. Data Analysis

The collected data was organised using the Excel software. The data were classified into tradable input and domestic input. Five tables were set. The first table was in input-output (I-O) table. This table

consist of data about physical quantities of each parameter. The second table was private-price (P-price) table. The third table was private-budget (P-budget) table. This table was results of multiplying I-O table times P-price. The fourth table was social-price (S-price) table, and the last table was social-budget (S-budget) table. The layout employs the diamondback method, which arranged tables along the diagonal of the spreadsheet. So long as the rows and columns in each table do not overlap with those in the others, the structure of any particular table can be altered without disrupting the basic relationships of the spreadsheet. The structure of the tables is nearly identical except for minor editorial changes to the units of measure and the addition of Cost and Profits in the Budget table. Calculation of each tables were built by using formulas. By doing this, then a manipulation of data for doing sensitivity analysis could be done easily. Calculation of final products would automatically be done by the software. Once the tables were set, a PAM matrix were constructed. The PAM analysis were applied for 25 years period. This is to be compatible with other analysis of the ASB project.

There were two main data analysis (1) companies profile analysis in term on their competitiveness and comparative advantages under current situation, and (2) impact of applying so me possible policies. The competitiveness and comparative advantages of the companies were conducted by evaluating the companies' PAM matrices for the following indicators:

- a. Private profits;
- b. Social profits; and
- c. Policy transfer which covers output transfers, input transfers, factor transfers, and net transfers.

Impact of applying some possible government policies was done by doing sensitivity analysis. Sensitivity analysis were done by doing the following scenarios:

1. Sensitivity analysis to know competitiveness of HPH. Manipulation of interest rates and exchange rate were tools to do the sensitivity analysis. Two interest rates, 15% and 20% of P-price and S-price respectively, were evaluated for their impacts on the 25 years PAM of each company. Two exchange rates, Rp. 2400,-/\$1, and Rp. 3600/\$1, were exchange rates for doing manipulations.
2. Sensitivity analysis to know influence of policy on economic efficiency. Sensitivity analysis for understanding impact of policy on economic efficiency was done by doing manipulation of salary, taxes, and fuel cost. These three parameters have important role in input of cash-flow of each company. Salary was increased into 2%/year and 5%/year, and also x% increase of salary so that the company would get zero profit. Taxes/subsidies was estimated to increase 1%, 5%, and 10% per year. Fuel cost increase up to 5% was used for sensitivity analysis in changing fuel cost.

III. FORESTRY MANAGEMENT AND POLICIES

A. Management Systems

Prior to the World War II, virtually all commercial activity in Indonesia's forest was confined to large teak plantation established in Java under Dutch colonial rule. While sizeable tracts of forest land had been cleared in Sumatra for rubber plantations, mechanised logging was uncommon. The natural tropical forest estate on Kalimantan remained largely undisturbed through the years. As late as 1967, little of the Kalimantan forest had been exploited, although loggers had long known of the existence of rich stands of trees, particularly in East Kalimantan, where the natural forest is dominated by trees of the family *Dipterocarpaceae*, which includes a number of commercially valuable species: *Shorea spp.*, *Dipterocarpus spp.*, and *Dryobalanops spp.* Logs from the most common of these species are commercially known as 'meranti' in Indonesia.

In the period of 1960 to 1965, log harvest averaged but 2.5 million cubic meter per annum. But with the 1967 reopening of the economy to foreign investment and of the forest to both domestic and foreign investors, forest exploitation proceeded at a rapid rate. Since this time, forests are contracted to interested investors. By 1970, between 7 and 10 percent of the total forest area was being utilised, and production of tropical hardwood logs had quadrupled, to 10 million cubic meters (World Bank 1970:62). The harvest again doubled from 1970 to 1975, with most of the increase from the timber-rich province of East Kalimantan, where production of light hardwoods, primarily of family *Dipterocarpaceae*, peaked at 10 million cubic meters in 1978. At the zenith of Indonesia's timber boom in 1979, 25 million cubic meters of logs were taken from the tropical forest.

The national log harvest fell sharply from the 1979 peak owing to several factors discussed in ascending order of importance.

Emphasis upon wood production in the two decades prior to 1985 embodied several objectives: generation of foreign exchange, fiscal resources and employment opportunities, promotion of industrialisation through forest-based industry, and regional development.

A final policy goal became prominent only after 1978: promotion of forest-based industrialisation.

1. Size and duration of concessions

Size of timber concessions varies from 50,000 hectares to more than 500,000 hectares. The average size is about 100,000 hectares. The duration of timber concessions in Indonesia is

ordinarily 20 years. Companies can propose an extension to their concession for another 20 years after government evaluate the company's performance.

2. Harvesting Methods and Allowable cut

The prescribed method for harvest of tropical timber in Indonesia is said to be based on the notion of 'sustained yield', developed to apply to temperate forests. Holders of timber exploitation licenses in Indonesia which have their area located on dry land forest are allowed to use only one method of harvesting logs: the Indonesia Selective Logging System with Man-made Regeneration (In Indonesia known as Tebang Pilih Indonesia, TPI). The method is one variant of a group of selective – as opposed to uniform – cutting systems. The TPI embodies a 35-year harvesting cycle and forms the basis for the determination of the Annual Allowable Cut (AAC) for each concessionaire by the Forestry Department. The TPI prescribes the selection of large stems (those with diameter of 50 cm or more) of so-called 'primar', or commercially desirable, species. Limiting the harvest to large stems of desirable species means that, with each entry, only a small proportion of the standing stock is removed. Between harvest, the forest is left to develop as it will, with the expectation that subsequent harvest yields (nominally, after 35 years) will be at least the same as in the initial harvest. Thus, the assumption underlying the TPI is that natural regeneration will allow 'sustained yield' of wood products from the forest from one cutting cycle to another. Man-made regeneration is applied only on opened forest lands such as on skidding road, unused main road, log yards, etc.

B. Marketing Systems

The main products of the logging companies in Indonesia are logs. The logs are either exported or domestically used as raw material for wood industries. Only since 1985, the export of logs are banned. Objectives of this policy is to slow down exploitation of forest resources and to expand domestic processing of forestry resources with a view to increasing value-added prior to being exported. Since this time, domestic wood industries such as sawmill, plywood, and other wood products, grows rapidly. The results have been the establishment of a large export of wood products, particularly plywood sector.

C. Policies Instruments

To meet the objective of the national development, some instruments have been issued. The instruments can be categorised into a group of

instruments set by the Forestry Department (in this study is called Forestry Policies), and a group of instruments set by non-forestry department (non-forestry policies). Table 2 shows different type of taxes/fees applied for timber sector.

1. Forestry Policies

a. Royalties and license fees

Two types of royalties are collected from timber concessionaires operating on government-owned forest stands. The first is the ordinary royalty called Iuran Hasil Hutan (IHH, forest product fees). The IHH is imposed at a uniform *ad valorem* rate of 6 % of posted prices (check prices) drawn up to every quarter for all timber species by the Department of Trade. The rate is uniform for all logs regardless of species, primarily to simplify royalty administration. The timber license fee (Iuran Hak Pengusahaan Hutan, IHPH) is collected annually from concessionaires at a rate of 1,000 rupiah (Rp.) per hectare of concession area.

b. Reforestation fees

Every concession holders has to give reforestation deposit fees through the Department of Forestry. The deposit is charged based on the amount of logs extracted from the forest at a rate of \$4.00 per cubic meter. The deposit may be refunded to extractive firms when they present verification of adequate replanting programs. For all practical purposes, the reforestation deposit is merely another tax.

2. Non-forestry policies

The Department of Finance formulates and implements policies pertaining to generally applicable taxes. Three general tax policy instruments have significant implications both for government revenues from timber and for decision-making in extraction of wood and non-wood products of the tropical forest: income tax incentives, export taxes, and rural property taxes (IPEDA).

a. Export tax

Export tax is imposed only for wood products (sawn timbers, plywood, etc.) since export logs are prohibited.

Table 2. Structure of taxes and royalties on timber sector.

Type of tax charge	Rate and base
Timber royalty	6% of posted of export prices (all species).
Timber license fee	Rp. 1000 per hectare.
Timber export tax	Logs: 20% of posted export prices (no longer being applied, log export is prohibited).
IPEDA (property tax)	20% of value of all timber royalties
Grading and scaling fees	Rp. 250,- per cubic meter.
Replanting deposit	US\$ 4.00 per cubic meter of logs extracted by concession holders
Tax on expatriate forest workers	US\$ 100 per month for each foreign employee

b. Property taxes

The forestry sector has been an important source of rural property tax (IPEDA) revenues since the early seventies. In recent years the sector's share in total IPEDA collections has varied between 15% and 22%. Since 1979, IPEDA liabilities of concessionaires have been defined as one-fifth the amount of timber royalties paid by the firms.

IV. RESULTS AND DISCUSSIONS

A. Sample performance

As mentioned in the methodology, the samples vary in their size, annual production, amount of investment, forest land situation, etc. I-O, P-prices, P-budget, S-price, S-budget, and parity prices tables of each individual sample can be seen on Appendix B. Calculations of the tables were based on assumptions as shown on Table 3. To let a comparison among the samples, a ratio which use their PAM entries defined in domestic currency units per physical unit of the commodity was constructed. Therefore, the ratio is a pure number free of any commodity or monetary designation. Hence, a comparison of the samples can be done. Table 4 shows how each sample performance is.

Table 3. Macroeconomic assumptions used as a base for the analysis

Nominal Interest rate (%)	20%
Social Interest Rate (%)	15%
Official Exchange Rate (Rp./US\$)	2400

Table 4. Comparison of indicator of the samples

	Dalk	GWT	RKI	Sylv
Private Cost Ratio (PCR)	0.31	0.19	0.10	0.27
Domestic Resource Cost Ratio (DCR)	0.12	0.17	0.02	0.17
Nominal Protection Coefficient On Output (NPCO)	0.66	0.61	0.77	0.66
Nominal Protection Coefficient on Tradable input (NPCI)	0.11	0.83	0.52	0.41
Effective Protection Coefficient (EPC)	0.78	0.74	0.79	1.00
Profitability Coefficient (PC)	0.61	0.61	0.73	0.84
Subsidy Ratio to Producers (SRP)	-0.28	-0.34	-0.24	-0.04

From the above Table 4, it shows that the samples have similar pattern. By using this technique, this means that a single PAM which is constructed by averaging each individual sample's PAM might representative enough for doing analysis. Table 4 is a PAM constructed by averaging the four samples' PAM.

Table 4. A PAM of large scale logging

	Output	Input	Domestic	Profit
Private	1.47E+08	14414618	15571360	1.17E_08
Social	2.98E+08	29717501	6963670	2.61E+08
Divergen	-1.51E+08	-15302883	8607690	-1.44E+08

Table 5. Average ratios (based on averaged PAM)

Parameters	Value
PCR	0.117677
DRC	0.022958
NPCO	0.440598
NPCI	0.485055
EPC	0.436242
PCR	0.393951
SRP	-0.539299

B. Competitiveness of large scale logging

Competitiveness of large scale logging companies can be seen from result of calculating private profit and calculation of PCR. Table 4 and 5 show that private profit is positive and the PCR is greater than 0 and less than 1. These means that large scale logging companies are competitive enough under existing policies. Analysis of the sensitivity by manipulating value of interest rate (decreased into 15%) and increasing exchange rate up to Rp. 3600/US\$1 indicated that the private profit is still positive. This means that under the situation, the logging system is truly competitive.

C. Economy Efficiency

Economic efficiency can be measured by calculating social profitability or comparative advantage. Table 4 and 5 shows that the social profit is positive and the DCR is less than 1 and greater than 0. These means that large scale logging companies are efficient enough. Sensitivity analysis for the increase of fuel cost, taxes up to 10% indicted that the logging system is still efficient enough.

D. Policy transfer

1. Output transfer

Output transfer of the system is shown from divergence on the output and from NPCO. The value of output divergence is negative. This means that social tradable output is greater than private tradable output. This means that there is a distortion or failure market in the system. By looking at the value of the NPCO which have value about 0.44, it means that policies are decreasing the market price to a level of about 66 percent lower than the world price. Kind of distortion might be because of

trade restriction and taxes/fees applied too much for the private. To increase the status of market price, re-evaluating on taxes or restriction might be better to be done. Acting for the evaluation might be by removing trade restriction or reduce export tax. Since export raw log is prohibited, so there is no export tax for raw logs. The only evaluation could be done for removing trade restriction or loosing the restriction step-by-step. Consequences of this is that the objective of the national development in the forestry sector might be influenced. The existence of domestic wood industries might be down. This will impact on raw resources supply.

2. Tradable input transfer

Social valuation of tradable input means comparable world prices for the input. Value of divergence of the tradable input is negative. This means that there is distortion. Kind of distortions might be in the form of trade restriction, taxes or under-valuation of the exchange rate. The NPCI of this system is about 0.48. This means that average market price for these inputs are 48% of the world prices. Current policies reduce input cost.

3. Factor transfer

Factor transfer can be seen through the difference of private factor valuation from social valuation of factor transfer. The result shows that there is a positive value of the divergence. Social valuations are estimates of social opportunity costs on primary factors. Carefully examination of private factor prices appear to be a critical here.

4. Net transfer

Net transfer is a measure of the extent of inefficiency of the system. Using a profitability coefficient (PC) approach, it can be known that the PC value is 0.34. This means that incentive to the private is less than incentive to the social market. The net transfer evaluation can also be done based on the subsidy ratio to producers (SRP). The SRP is the net policy transfer as a proportional of total social revenues.

E. The strengths and weaknesses of the analysis

Analysis of large scale logging companies, as done in this study, might not means that the data are exactly represent the real situation of the companies. One of the reason is that, in general sense, most companies in Indonesia have an ability to do not totally open in giving information, especially information that deal with cash-flow. This due to that most companies belong to a family and public or outsiders have no opportunity to access freely for the company's cash-flow information. Although some data are generated from company's

accounting book, it does not mean that the accounting book is 100% true. Despite all of these, the proxy which covers some source of data might provide close approach to the real situation.

Results of the study should be re-evaluated since the economy of Indonesia currently is in bad condition. The valuation of the study was made when the exchange rate was about Rp. 2400/US dollar. By most assessments of economic fundamentals, the Indonesian Rupiah was not greatly overvalued at that time. The collapse of Indonesian rupiah was unfavourable. By January 1998, the Rupiah had fallen to over Rp. 17,000 per US dollar. After a recovery below Rp. 10,000, it had fallen again to over Rp 14,000 per dollar in June 1998.

V. CONCLUSIONS

The following are conclusions that can be drawn from the above discussions.

1. Companies on large scale logging in Indonesia are relatively competitive. Sensitivity analysis on the change of interest rate and official exchange rate indicated low influence on private profit.
2. Analysis on efficiency or comparative advantage indicated that logging in Indonesia have a relatively high efficiency. Social profitability of the companies are positive and a relatively less influenced by changing in domestic factors such as changing in salary and taxes. Changing in fuel price which has world market indicated low influence to the efficiency.
3. Evaluation on policy transfer indicated that policies in forestry decreased market price of log to a level below the world market, reduce input cost.
4. The study was conducted right before the Indonesian economy collapsed. Restudying of this after the Indonesian economy recover is suggested.

REFERENCES

Dale, V. H., R. A. Houghton, A Grainger, A.E. Lugo and S. Brown. 1993. Emission of greenhouse gases from tropical deforestation and subsequent uses of the land. In: Sustainable Agriculture and the Environment in the Humid Tropics. Washington, DC. National Academy of Science. P. 215-260.

Gillis, M. 1988. Indonesia: public policies, resource management, and the tropical forest. In Repetto, R and M. Gillis (Edits.): Public policies and the misuse of forest resources. Cambridge University Press. P. 43-

The ITTO. 1996. Annual Review and Assessment of the World Tropical Timber Situation.

Monke, E. A., and S. R. Pearson. 1989. The Policy Analysis Matrix for Agricultural Development. Cornell University Press. Ithaca.

Myers, N. 1989. Deforestation Rates in Tropical Forest and Their Climatic Implications. London Friends of the Earth. UK.

World Bank. 1970. The Indonesian Economy 1970-1972. Vol 1. The Main Report. Washington, D.C. IBRD. November 27.

The World Bank. 1997. Commodity Price Data. Commodity Policy and Analysis Unit. International Economics Department. World Bank. [HTTP://www.worldbank.org/html/eccp/ieccp.html](http://www.worldbank.org/html/eccp/ieccp.html). Washington, DC.

WORLD AGROFORESTRY CENTRE (ICRAF)
SOUTHEAST ASIA REGIONAL OFFICE WORKING PAPERS



Funded by the
Asian Development Bank
RETA 5711

