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Economic Costs and Benefits of Allocating Forest Land for Industrial Tree Plantation Development in Indonesia

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Abbreviations and acronyms

AA Arara Abadi—Plantation Company associated with IKPP pulp mill and

APP Group

APP Asia Pulp and Paper

APRIL Asia Pacific Resources International Holdings
DR Dana Reiboisasi (Reforestation payment)

EB economic benefit(s)
EC economic cost(s)

GOI Government of Indonesia

HTI Hutan Tanaman Industri (Industrial Timber Plantation)

IIR Inti Indo Rayon—Plantation Company associated with TPL pulp mill

and RAPP Group until 2002

IKPP Indah Kiat Pulp and Paper mill

MAI mean annual increment

MHP Musi Hutan Persada—Plantation Company associated with TEL mill and

Barito Pacific Group

MHW mixed hard wood
MWP mean wood production

NGO non-governmental organization
NTFP non-timber forest product

PSDH Provisi Sumber Daya Hutan (Government tax for logged/harvested

wood)

RAPP Riau Andalan Pulp and Paper Group

SMG Sinar Mas Group

SPK Sumbangan Pihak Ketiga (Payment to third parties)

TEL Tanjung Enim Lestari mill
TEV total economic value
t tonne (metric ton)
TPL Toba Pulp Lestari mill

WKS Wira Karya Sakti—Plantation Company associated with Lontar Papyrus

pulp mill and APP Group

Glossary

belukar Indonesian term to refer to old fallow or degraded secondary

forests

existence value the value attached to maintaining the inherent value of nature

for future generations

externality benefits or costs generated as the result of an economic activity

that do not accrue directly to the parties involved in the activity; for example, environmental externalities are benefits or costs that manifest themselves through changes in the physical or biological environment regardless of the relationship of the

parties to the environmental regime impacted

harvest extraction of products from plantations

jungle rubber rubber trees (Hevea brasiliensis) planted as enrichment in

fallow

logged-over forest forested areas from which the timber with commercial value has

already been extracted

marginal costs the change in total cost associated with producing each extra

unit of output; calculated by dividing the change in total cost

by the change in output

marginal utility the added utility or satisfaction derived from the consumption

of an additional unit of a good

mean annual increment (MAI) the total increase of volume growth of trees per unit area (ha)

up to the end of the rotation period, divided by the number of

years in the rotation

monopsony a structure for an input (pulpwood) market for which there is

only one buyer—the (pulpwood) supply curve has a positive slope; 'monopsony power' is in the hands of the buyer that can force

prices down by restricting purchases

opportunity cost the cost of a resource X calculated at the best alternative use

of it. It actually represents the minimum amount of money that a given agent will be willing to accept for the resource, and is

therefore a measure of the value of such resource

optimal allocation resources are optimally allocated if they are in the 'optimal

situation' and any change in such allocation diminishes the welfare of at least one of the agents involved in the decision; thus, the allocation of resources is such that all agents are in

their best possible option

option value value attached to maintaining the natural landscape and its

resources so that future generations have the social option to

select the species best suited to their needs

shadow price adjusted price that takes into account market price distortions

and government objectives; also known as 'accounting price'; represents the opportunity cost of producing or consuming the

resource

social costs those costs met by society when goods are produced, e.g.

pollution

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Abstract

In the late 1980s, large amounts of money and areas of Indonesia's forestland were allocated for the development of fast-growing pulp plantations. The "financial" costs and benefits of this action—representing only a portion of the actual totals can be easily accounted, while the full "economic" benefits and costs remain hidden. Knowing the net economic benefits can provide useful inputs for the Government of Indonesia and other interest groups to revise current policies or regulations and setting new directions for future plantation projects that benefit the national economy in the long term.

This paper examines the total economic costs and benefits of five large pulp plantation projects in Sumatra, Indonesia. Four of the five plantation projects generate economic costs above their economic benefits. The estimated economic costs represent over 30 times the actual financial payments the Government receives from each company.

The allocation of over 1.4 million hectares of forestland for conversion into tree plantations generates net loses of over US\$3 billion for the country. This analysis clearly demonstrates that the Government of Indonesia should not allocate any more forestland for conversion into HTI pulp plantations.

INTRODUCTION

Pulp industries developed rapidly in Indonesia after large investments in this sector in the late 1980s. The total pulp production in the country rose from 3 million tonnes per year in 1997 (Barr 2001) to 5.6 million tonnes per year by 2002 (FAO 2003).

Large areas of State-owned forestlands were allocated through Industrial Timber Plantation (HTI) permits and nearly US\$100 million of State-owned capital was allocated to promote the development of industrial timber plantations in the country (Barr 2001). The total area allocated for the development of such plantations up to 2002 was 5.38 million ha (DEPHUT 2003), with approximately 41% of this concentrated on the island of Sumatra.

The large areas of forest land given in concessions comprise dryland logged-over forests and jungle rubber; swamp forests; some smallholders' rubber and oil-palm plantations; grasslands, and areas of agricultural fields and village settlements. The forest plantation companies were expected to produce the raw material required by the national pulp industries producing pulp for paper for both export and internal consumption. Pulp and paper exports generated US\$2 billion in export earnings for the country in 1997 (FWI and GFW 2002).

While the Government of Indonesia (GOI) can easily account the financial gains and losses that its investments in the pulp mills and related plantation companies have achieved, the economic benefits and costs remain hidden. The financial costs represent only a small portion of the actual total costs, leading to the perception of greater net benefits than is actually the case. The real costs include the direct financial costs of the investments and running the pulp mills and pulp plantation companies *plus* the costs—borne by the local people, Indonesia and the world—of the large areas of forest land allocated for the HTI projects.

Although several studies have looked at

the financial and economic aspects of the pulp and paper industry and analysed HTI plantations in Indonesia (Davis 1989; MoF 1994; Potter and Lee 1998; Kartodihardjo and Supriono 2000; Barr 2001; van Dijk 2003), there has been no study of the economic impacts of these HTI plantations on the country.

In this paper, I aim to calculate the total economic costs and benefits of five large HTI projects in Sumatra, Indonesia, taking into account the differences in the types of forest and landscape of the areas given in concession and the production capacity of their associated pulp mills. Specifically, I determine the main economic effects and impacts generated by the projects; analyse and compare the economic performance of five forest plantation case studies, and highlight the main elements determining their performance. The results provide useful inputs for the GOI and other interested parties to assess the net economic performance of the HTI projects for the country and revise current policies or regulations that guide new plantation projects targeting higher economic (not only financial) benefits for the country.

Proposed Approach

A graphical analysis is used to show the impacts of the HTI projects and the related goods and services affected. Market or shadow prices¹ are used to quantify such impacts when a market exists, otherwise a value is assigned using existent estimations of the value for the non-market products or services related to the areas under assessment.

Positive and negative impacts related to the HTI timber plantation companies are identified and measured in their respective markets in terms of goods produced and cost incurred, to allow comparisons among the cases.

¹ For definition see Glossary.

CONCEPTUAL FRAMEWORK

Economic Assessment

Economics, optimisation and scarcity are three interrelated concepts. Human needs increase over time and the way to satisfy such needs is to consume resources. Social development has been based on the consumption of resources. For various reasons (e.g. biophysical differences, natural extinction processes, high rates of consumption, social accumulation), some resources have become scarce-sometimes generally scarce, sometimes scarce in specific areas, and sometimes scarce for certain groups. Economic science has developed as a response to the need to optimally allocate scarce resources to satisfy the increasing needs of society. Optimal allocation is observed when there is no option to improve the situation for the agent or group of agents analysed given a specific amount of resources at a given moment².

When an investment project or a policy to guide investments is established, the decisionmaker is targeting specific objectives-for example, a family makes investments to assure its present and future welfare, a firm intends to maximise benefits, and governments invest public money to achieve specific socioeconomic objectives to improve the welfare of society. Any policy or programme, or any economic decision must be assessed in terms of the impact pursued. Economic assessment is the tool that analysts have to guide national-level decision processes and to analyse economic policies. It evaluates the contributions of a given policy, project or decision to the welfare of society. The value of any good, factor or resource to be used or produced by the project is valued in terms of its contribution to national welfare.

Reasons for Using Economic Assessment

Such economic and society welfare improvements are difficult to measure. Any action implies gains and losses, a given policy or investment decision can lead to opposite effects and impacts on different groups. A given action can improve the welfare of some, but reduce that of others; or it could increase the level of consumption of all the inhabitants (welfare improvements), but increase pollution in the country (welfare losses). If a given policy has no negative effects on any group, that policy is undoubtedly good for the people; however, such cases are rarely, if ever, observed in the real world. What we usually observe are some positive and some negative impacts. The important thing then is to know if the result of the combined impacts is leading society (as a whole) to a better-off or a worse-off situation.

Economic theory suggests that we add up the gains of all the agents who would be in a better situation, and all the losses of the agents who would be in a worse situation. If the result is a net gain, the policy or action should be applied, otherwise it should not. This economic assessment is conceptually based on 'welfare theory' and its definitions of welfare, utility and social behaviour.

Consequently, we analyse the total economic benefits (EB) caused by the production of the project (EB of the production) and the economic cost (EC) of inputs and factors used (EB and EC are usually analysed separately on their respective markets). The analysis focuses on consumption changes for different goods and services, and on the use of resources, inputs and productive factors. Instead of focusing on the effects on different consumers, it focuses on the effects on aggregated consumption and production. This analysis is also known as

² For definition see Glossary.

³ For a broad study of welfare theory, refer to Just et al. (1982) and Mishan (1988).

benefit-cost analysis using 'efficiency or shadow prices'.

The use of observed prices can lead to wrong (over- or under-valued) estimations⁴ of benefits and costs when we are working in a 'distorted' economy, characterised by market failures such as subsidies, taxes, monopolies, and externalities⁵. Nevertheless, the problem can be 'corrected' by analysing each market failure, and the effects on prices and traded quantities for a given good in a given market.

Types of Impact Included and Their Effects on Welfare

To value (put a price on) the benefits or costs of a given investment or action, taking into account all economic benefits, the theory suggests measurement of the changes in consumption (present and future) for all goods and services (market and non-market). Positive impacts on these goods and services are considered social benefits and negative impacts are considered social costs. Positive impacts on consumption are the result of a project generating goods or

services, while negative impacts would result from a project requiring a scarce input or factor. The latter is accounted as a cost, because the consumption of such elements is only possible if other agents in the society release them, thereby losing in economic terms.

Other positive and negative impacts are linked to the use of resources (indirect impacts on consumption) such as release or consumption of resources through substitution, savings, use or compromise of productive factors and inputs. These resources are valued in terms of the opportunity cost⁶ of using such resources.

Positive and negative impacts to identify correspond to (Castro and Mokate 1998):

- Increase/reduction in the consumption of market and non-market goods and services;
- Increase/reduction in exports (foreign exchange earnings increased or reduced);
- Reduction/increase in imports (foreign exchange savings or expenditure);
- Release/compromise of productive resources.

⁴ When perfect competency is observed, price reflects the marginal costs (for the producers) and the marginal utility (for the consumers). The existence of market failures results in observed prices not reflecting either marginal costs or marginal utility. In such cases, the price does not represent a true reflection of economic costs or benefits.

⁵ For definition see Glossary.

⁶ For definition see Glossary.

STUDY CASES

Determining the Economic Impacts at the Aggregated Scenario

Between 1984 and 1996, the GOI allocated a total area of nearly 1.4 million ha of forest land to five plantation companies in Sumatra (Fig. 1), to harvest (clear cut) the areas for the production of pulp wood and establish tree plantations. These concessions were granted to groups that were developing or expanding pulp or pulp and paper mills with the purpose of sustaining their production⁷. From 1984 onwards, the related pulp mills initiated operations and increased their installed capacity to make use of the large sources of raw material made available for their pulp production.

Supply and demand are integrated as a result of the fact that the same groups own both the mills and the companies holding the

HTI concessions. Consequently, the volume of pulpwood produced depends on the amount required by the pulp mills; so, supply volume is matched to the level of the demand. This implies that the price is not determined by market forces, but by the profit maximisation of the group managing the integrated chain of production. Since the system works as a monopsony, the pulpwood is undervalued (there is no other market), resulting in a transaction price (at the pulpwood market) below the optimal price.

The aggregated effect, observed at the pulpwood market, can be represented graphically (Fig. 2). The projects cause an increase in the supply of pulpwood, represented by a movement of the original supply curve from S to S'. The demand is also increased through

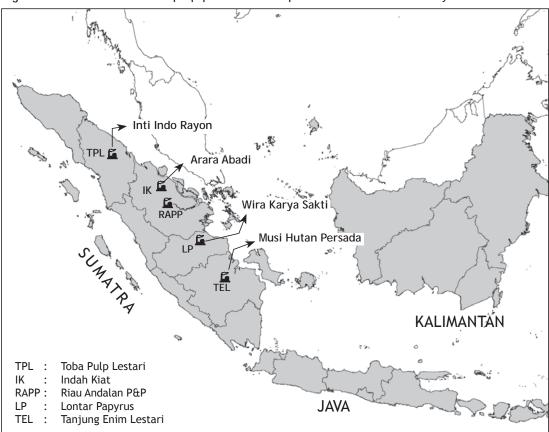


Figure 1. Location of the five pulp-plantation companies included in the study

⁷ Three pulp and paper mills, one pulp and rayon mill, and one pulp mill.



Log-yard of one of the HTI plantation companies in Sumatra (*Photo by Julia Maturana*)

the creation of the pulp mills and increases in installed capacity, represented with the movement of the demand curve from D to D'. The price of pulpwood remains unchanged, because the increase in supply is not observed—

the five pulpwood producers sell their product to their own mills.

The supply curve is inelastic with respect to the price because of the integrated nature of the market (i.e. producers and buyers are

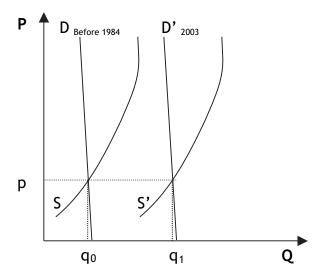


Figure 2. Pulpwood market Key: D = original demand (in this case before 1984, before concessions); D' = later demand (in this case in 2003); P = price axis; p = transaction price (assumed static over time); Q = quantity (of pulpwood) axis; q_0 = quantity (of pulpwood) produced (pre-1984); q_1 = quantity (of pulpwood) produced (in 2003); S = supply curve (pre-1984); S' = supply curve (2003).

linked). The final portion of the curve should be vertical once the maximum production allowed by the ecosystem (including plantations) has been reached. The demand curve is also drawn as a very inelastic line with respect to price and it is mainly determined by the installed capacity of the mills. The price elasticity of the demand for the pulpwood market in Indonesia calculated by FAO (1996) with large series of data is -0.09 (scale: 0 = totally inelastic; 1 = totally elastic).

Economic costs are related to the large amount (over 1.4 million ha) of forest land used. The effects can be observed in the forest land's (hypothetical) market. The price for the resource (concession-related costs) is established by the GOI taking into account nonmarket considerations given the non-existence of a market for the State forest land. The allocated HTI licenses (concessions) for these projects result in an increase in the demand for State forest land from q_0 to q_1 (shown in Fig. 3) by a movement of the demand curve from D to D'. The supply is represented as a horizontal curve capturing the fact that the area of State land offered does not depend on its demand but on the existing (available) area. The final vertical portion represents the limit for the supply of State forest land. The aggregated impacts of the HTI allocated area in concession would be the result of summing positive (economic benefits) and negative (economic costs) impacts, for which it is necessary to express them in numerical terms.

Estimation of Economic Benefits and Costs

All the plantation companies in the analysis obtained rights over approximately 300 000 ha of State forest land for similar periods of time (>40 years). Three of the concession areas were mainly covered by logged-over forests of mixed hard wood (MHW); one by pines and logged-over forests of MHW, and one mainly by grasslands (*Imperata cylindrica*) and degraded forests (*belukar*).

Economic benefits and costs are calculated for the period from 1984 to 2038. Three discount rates (4%, 8% and 12%) are used to show the values at year 0 (1984) to allow comparisons. All costs and prices are quoted in US dollars (2003). Three scenarios were created to test the sensitivity of the analysis: an initial scenario of stability; an optimistic scenario with increasing prices of the pulpwood and area planted; and a pessimistic scenario with decreasing prices and area planted.

Economic Benefits

The increase in the supply of pulpwood observed after the allocation of the State forest areas is matched by the demand from the mills (actually

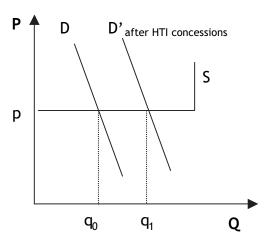


Figure 3. State forest land (hypothetical market)
Key: D = original demand (in this case before 1984, before concessions); D' = later demand (in this case in 2003); P = price (of forest land) axis; p = transaction price; Q = quantity (of forest land) axis; q_0 = quantity (of forest land) demanded (pre-1984); q_1 = quantity (of forest land) demanded (in 2003); S = supply (of forest land) curve.

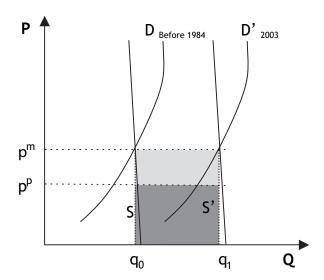


Figure 4. Pulpwood market

Key: see Figure 2; p^m = market price; p^p = perceived price.

Notes: $q_1 = q_0 + 27$ million m³/year.

The dark grey area represents the financial influx for the plantation companies, determined by the perceived (actual) price and the quantities traded. The light grey area represents the non-perceived benefits and is determined by the undistorted price (US\$40) that represents the market value of the pulpwood. The economic benefit resulting from the increase in annual consumption (demand) of nearly 27 million m³ of pulpwood is obtained by summing the two areas.

the demand is determining the supply). The related benefits may be accounted as the area coloured in Figure 4 or by approximation:

$$EB_{T} = \sum_{t=1}^{T} (q_{1} - q_{0})_{t} \times p_{t}^{m}$$

The price to be used corresponds to the observed transaction (market) price (p^m) of the pulpwood each year (t). As mentioned before, the pulpwood market for these plantation companies is not a 'perfect competence' situation; on the contrary, the supplier faces a monopsony in the demand, which reduces the perceived price (p^p) to a level below the 'competence' price⁸ ($p^p < p^m$). Using the actually perceived price would lead to an underestimation of the benefits of the projects. In fact, the transaction price paid to Arara Abadi plantation company by its related pulp and paper mill, Indah Kiat, in 1998 and 1999, was about US\$8/m3 compared with the US\$42/m3 paid for external logs at the mill gate (Ometraco 2000), and wood costs in 2002 quoted by APP for both of its pulp and paper mills ranged between US\$34 and US\$36 per m³ (APP 2002). Using this information as reference, the price

used in the analysis was US\$40/m³ for the five plantation companies.

The quantities $(q_1 - q_0)_t$ correspond to the total volume of pulpwood trended each year by the five plantation companies. These volumes were calculated from the production capacities of the related pulp mills.

Economic Costs

The related costs are accounted in terms of the resources required to sustain the increase in the supply of wood: the 1.4 million ha of MHW, pine forests, degraded forests and grasslands allocated to the projects, valued in their respective markets. By approximation:

$$EC_{T} = \sum_{t=1}^{T} (q_{1} - q_{0})_{t} \times p_{t}^{s}$$

The price actually paid for the use of these forests (logging/harvesting permits, concession payments, fees and taxes, etc.) represents the current financial costs for the plantation companies and it is represented as p^c (current price) in Figure 5, determining the current costs (dark grey area) of using these resources. These

⁸ The monopsony sets the price for the inputs on the basis of its profit-maximisation framework, thereby forcing the price down.

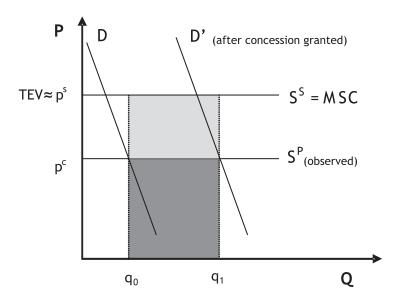


Figure 5. State forest land (hypothetical market)

Key: see Figure 3; p^c = current price; p^s = social price; S^P = supply curve (private); S^s = supply curve (social); MSC = marginal social cost; TEV = total economic value.

Notes: $q_1 = (q_0 + 1.4 \text{ million ha})$

The dark grey area represents the financial outflow of the plantation companies (current costs), determined by the p^c and the area in concession. The light grey area represents the non-perceived costs and is determined by the difference between the TEV and the p^c . The economic cost resulting from the compromise of over 1.4 million ha of State forests are obtained by summing the two areas.

costs range from US\$15 000 to US\$99 million per year per company, estimated from the payments per volume established by the GOI (PSDH, SPK and DR).

Given the non-existence of a market for the State forests, no market price can be observed. If a market existed, its price would reflect the value of such areas. Nevertheless, this market price would also fail to value the range of positive social benefits associated with the positive externalities of these forests, such as wilderness and biodiversity protection, recreation, pollination, biological control, habitat functions, historical information. Such values are recognised through the total economic value (TEV $\approx p^s$) estimation. The TEV for Indonesian logged-over forests determined by Simangunsong (2003) using a series of estimations from different authors correspond to US\$1283/ha per year.

The quantities $(q_1 - q_0)_t$ correspond to the total area of State forests given in concession to the plantation companies.

To calculate the aggregated economic costs and benefits of these projects, the individual quantities of pulpwood produced and areas of forests used by each company are determined. In doing this, the following assumptions were made.

The area to measure the economic cost EC $(q_1 - q_0)$ has been determined as a function of the logged volumes of wood:

Economic Cost_t = Area Logged_t \times TEV_t

The TEV was obtained from Simangungsong (2003) who determines the TEV for logged-over forests in Indonesia. The categories included are: direct use value (timber, fuelwood, non-timber forest products [NTFP] and water consumption); indirect use value (soil and water conservation, carbon sink, flood protection and water transportation); and non-use value (option and existence values⁹).

Estimations Case by Case

⁹ For definitions see Glossary.

Economic Benefit_t = Volume of Production_t \times Price_t

The price corresponds to a fixed market price for the pulpwood estimated at US\$40/m³. This price changes for the optimistic and pessimistic scenarios.

The volume of production includes the total volume of wood logged from the natural areas, harvested from the plantations, and obtained from other sources:

Volume of production_t = Logged volume_t + Harvested volume_t + Other sources_t

Plantation companies match mill requirements with natural wood before their tree plantations are ready to harvest, and it is assumed that they prefer to use logged wood even if their plantations are ready. This assumption is made taking into account that costs of logging from natural forests are almost half of those of harvesting from plantations (van Dijk 2003), so:

Logged volume_t = Mill requirement_t (if Available Natural Forest_{t-1} \geq Mill requirement_t)

Logged volume_t = Available Natural Forest_{t-1} (if Available Natural Forest_{t-1} < Mill requirement,)

Where:

Available Natural Forest $_t$ =

 $\frac{\textit{Area}_t \times \textit{Feasibility}_t \times \textit{MWP}}{\textit{Conversion Rate}_t}$

(If Logged volume $_t = 0$)

or

Available Natural Forest t =

 $\frac{\textit{Area}_{t} \times \textit{Feasibility}_{t} \times \textit{MWP}_{t}}{\textit{Conversion Rate}_{t}} - \textit{Logged Volume}_{t}$

(if Logged Volume $t \neq 0$)

Where, Area corresponds to the number of hectares given in concession; the term Feasibility captures changes in the amount of area that can be actually logged and it depends on the size of the area kept as conservation and people's settlements and crops; the mean wood

 $\begin{aligned} &\textit{Mill requirement}_{t} = \textit{Production capacity}_{t} \times \\ &\textit{Quota}_{t} \times \textit{Running}_{t} \end{aligned}$

The production capacity was obtained from actual data up to 2003 and then adjusted by the expected increases with the information from each company or maintained at current levels. The *Quota* captures whether there are one or more plantation companies supplying raw material to the related pulpwood mill. The *Running* value shows whether or not the mill was running at full capacity in each year.

The harvested volume will depend on the planted area and the remaining mill requirements:

 $Harvested\ volume_t = Harvestable\ volume_t$ (if Mill $requirement_t$ - Logged $volume_t$ - Other $sources_t > Harvestable\ volume_t$)

Harvested volume_t = Mill requirement_t - Logged volume_t - Other sources_t (if Mill requirement_t - Logged volume_t - Other sources_t ≤ Harvestable volume_t)

Where:

Harvestable volume $_{t-1}$ + Harvestable volume $_{t-1}$ +

Planted Area $_{t-7} \times MI_{t-7} \times Survival \ Factor_{t-7}$ Conversion Rate $_{t-7}$

The Planted Area was obtained directly from each plantation company and represents the area quoted by them as planted each year from the first year of operations up to 2003. The values after 2003 represent the maximum average value obtained from the period previously quoted and are restricted by the total area of land that it is feasible for each company to plant. The mean of increment (*MI*) was derived from the mean annual increment (MAI)¹⁰ of each plantation company for each of the planted species and landscape units (peat or dryland areas)—it changes over time according

production (*MWP*) value represents the wood productivity of the area and corresponds to the volume of wood that can be logged from each hectare of natural forest (average). This value was obtained from the plantation companies information and cross-checked with data available for each of the areas when possible.

¹⁰ For definition see Glossary.

to the information of each company. The Survival Factor was also obtained from each of the plantation companies for each planted species and each of the landscape units. The Conversion Rate is the calculated factor to convert 1 m³ of wood into 1 tonne of pulp—it changes depending on the type of raw material (planted or logged wood) and for each of the planted species. The term 't-7' captures the rotation period of the planted species in analysis—for most of the cases it is seven years except for one case where the rotation period varies.

Inti Indo Rayon in North Sumatra

A total area of 284 060 ha was conceded in 1984, 1992 and 1994 to the plantation company Inti Indo Rayon in North Sumatra through HTI permits allowing clear cutting and settlement of industrial tree plantations.

The concession areas are distributed among five districts, with about 50% of the area concentrated in the district of Tapanuli Utara. The areas were covered by pines (30%), MHW

(68%) and nearly 6000 ha of grassland (2%).

The plantation company initiated operations in 1988 to supply the related pulp mill company Indorayon (now Toba Pulp Lestari). The mill's demand was about 800 000 m³ of pulpwood per year until 1993, when it increased its demand through expansion to nearly 1 million m³.

Around 70% of the allocated area corresponds to cropland and settlements, and a conservation zone, leaving only about 86 000 ha feasible for logging and conversion.

The average area planted up to 2003 was near 5000 ha/year with a total area planted of about 53 000 ha.

The mill faced social difficulties in 1998 during the economic and political crisis, and it was closed down from 1999 until the beginning of 2003, when it resumed operations.

The economic benefit (EB) of the TPL concession project for the Indonesian society for a total period of 48 years (1988-2035) was calculated for each year (see Annex I.1) and then brought to the year-0 (1984) value (in US dollars):



Inti Indo Rayon Eucalyptus sp. plantation in North Sumatra (Photo by Julia Maturana)

 $EB_{(4\%)}^{TPL}$ = US\$511,588,592

 $EB_{(8\%)}^{TPL}$ = US\$241,626,464

 $EB_{(12\%)}^{TPL}$ = US\$138,027,774

The economic costs (EC) at the three discount rates are:

 $EC_{(4\%)}^{TPL}$ = US\$1,398,888,431

 $EC_{(8\%)}^{TPL}$ = US\$557,121,027

 $EC_{(12\%)}^{TPL}$ = US\$263,921,323

The estimated benefit-cost ratios for this project are 0.37, 0.43 and 0.52 for the three different discount rates (4%, 8% and 12%, respectively).

Arara Abadi in Riau

A total area of 299 975 ha was conceded in 1996 to the plantation company Arara Abadi (AA) in the province of Riau, though the Forestry Division of the related pulp and paper mill

Indah Kiat made the first plantations in 1984 with provisional permits from the GOI.

The concession areas are distributed among seven districts, with about 72% of the area allocated in the districts of Siak and Pelalawan. The areas were covered by MHW species with about 60% being swamp forests with an average wood production of > 150 m³/ ha (AA personal communication).

The plantation company supplies the related pulp mill's demand, which has risen from near 540 000 m³ of pulpwood/year in 1984 to near 9 million m³/year in 2003.

From the total allocated area, some 28% comprises crops, settlements and a conservation zone, leaving about 216 000 ha feasible for logging and conversion.

The maximum average area planted up to 2003 was near 18 000 ha/year, with a total area planted of about 228 000 ha (including replanted areas).

The economic benefit of the AA concession project for the society for a total period of 55 years (1984-2038) at the year-0 (1984) value in US dollars, corresponds to (see also Annex I.2):



IIR trucks carrying logs in North Sumatra (Photo by Julia Maturana)

 $EB_{(4\%)}^{AA}$ = US\$1,935,837,869

 $EB_{(8\%)}^{AA}$ = US\$793,918,705

 $EB_{(12\%)}^{AA}$ = US\$398,513,520

The economic costs at the three discount rates are:

 $EC_{(4\%)}^{AA}$ = US\$3,169,867,526

 $EC_{(8\%)}^{AA}$ = US\$1,169,452,455

 $EC_{(12\%)}^{AA}$ = US\$533,947,366

The estimated benefit-cost ratios for this project are 0.61, 0.68 and 0.75, respectively.

Riau Andalan Pulp and Paper in Riau

A total area of 330 000 ha was allocated in concession to the plantation company associated with the Riau Andalan Pulp and Paper Group (RAPP) pulp and paper mill in Riau.

The allocated areas are distributed among five districts, with about 70% of the area concentrated in the districts of Pelalawan and Kuantan Singingi. The areas were covered by

MHW logged-over forests with about 70% of those in swamp areas.

The company initiated its plantations in 1993 and began supplying pulpwood to the related pulp and paper mill in 1995. The mill's yearly demand was about 3 million m³ of pulp wood in 1995 increasing to 9 million m³ in 2003.

A total area of about 251 000 ha could be converted into raw material for the mill, while nearly 79 000 ha (24% of the concession area) comprises crops, settlements and conservation area.

The maximum average area planted up to 2002 was near 14 000 ha/year, with a total area planted of about 110 000 ha.

The economic benefits of the RAPP concession project for the Indonesian society (in US dollars), for a total period of 44 years (1995-2038) calculated at the year 1984 value (Annex I.3) are:

 $EB_{(4\%)}^{RAPP}$ = US\$ 1,336,119,511

 $EB_{(8\%)}^{RAPP}$ = US\$\$ 556,385,589

 $EB_{(12\%)}^{RAPP}$ = US\$\$ 269,709,028

The economic costs at the three discount rates are:



The MHW logged-over forests allocated for HTI development were still rich in forest products. Here some villagers are extracting logs for selling to the sawmills in Riau (*Photo by Nicholas Hosgood*)

 $EC_{(4\%)}^{RAPP}$ = US\$3,547,376,172

 $EC^{RAPP}_{(8\%)}$ = US\$1,222,022,515

 $EC_{(12\%)}^{RAPP}$ = US\$495,253,977

The estimated benefit-cost ratios for this project are 0.38, 0.46 and 0.54, respectively.

Wira Karya Sakti in Jambi

The plantation company Wira Karya Sakti in Jambi initiated its logging operations in 1989 through special permits for conversion of small areas until 1996 when a formal concession permit was obtained.

The final land allocation was 203 449 ha distributed among four districts, with over 60% of the total area concentrated in the district of Tanjung Jabung Barat. The areas were covered by MHW logged-over forests with about 70% of these being swamp forests.

Lontar Papyrus pulp and paper mill's initial demand was about 2 million m³ of pulpwood per year in 1994 and has increased to over 3 million m³ in 2003.

A total area of nearly 161 000 ha is available for conversion, while nearly 43 000 ha (21% of the concession area) comprises settlements and crops, and conservation areas.

The maximum average area planted from 1992 to 2003 was near 13 000 ha/year, with a total area planted of about 96 000 ha.

The economic benefits of the WKS concession project for the society for a total period of 45 years (1994-2038) calculated at the year 1984 value (in US\$), correspond to (Annex I.4):

 $EB_{(4\%)}^{WKS}$ = US\$1,106,100,135

 $EB_{(8\%)}^{WKS}$ = US\$426,455,511

 $EB_{(12\%)}^{WKS}$ = US\$196,769,551

The economic costs at the three discount rates are:

 $EC_{(4\%)}^{WKS}$ = US\$2,257,196,475

 $EC_{(8\%)}^{WKS}$ = US\$780,475,981

 $EC_{(12\%)}^{WKS}$ = US\$319,480,269



Mixed hard wood logs extracted from swamp forests in Jambi (Photo by Julia Maturana)

The estimated benefit-cost ratios for this project are 0.49, 0.55 and 0.62, respectively.

Musi Hutan Persada in South Sumatra

The plantation company Musi Hutan Persada, in South Sumatra, initiated its plantations in 1991 and obtained concession rights over a total area of 296 400 ha in 1996.

The areas are distributed over five districts, with over 50% of the area concentrated in the district of Muara Enim. The areas were covered by nearly 50% of highly degraded forests (belukar) and 50% grassland.

In 1999, the plantation company started to supply the associated Tanjung Enim Lestari pulp mill, which had a yearly requirement of near 2 million m³ of pulp wood. Mill requirements increased to reach 4.5 million m³ of pulp wood/year in 2003.

Nearly 32% of the concession comprises crops, settlements and conservation areas. From the remaining 68%, and taking in to consideration the area of grassland, some 100 000 ha are considered feasible for logging and conversion with a very low wood production rate of 20.3 m³/ha. (This production rate was calculated using the average standing volume increment for Indonesian forests quoted by Simangungsong (2003) and a period of 10 years.)

The average area planted is near 24 000 ha/year, with a total area planted of 193 500 ha from 1991 to 1998 (including replanted areas).

The economic benefits of the MHP concession project for the society (in US dollars), for a total period of 41 years (1998-2038) calculated at the year 1984 value correspond to (Annex I.5):

$$EB_{(4\%)}^{MHP}$$
 = US\$1,789,920,969 $EB_{(8\%)}^{MHP}$ = US\$594,828,448 $EB_{(12\%)}^{MHP}$ = US\$232,016,988

The economic costs at the three discount rates are:

$$EC_{(4\%)}^{MHP}$$
 = US\$770,295,134 $EC_{(8\%)}^{MHP}$ = US\$271,596,775 $EC_{(12\%)}^{MHP}$ = US\$112,471,049

The estimated benefit-cost ratios for this project correspond to 2.32, 2.19 and 2.06, respectively.

Aggregated Economic Benefits and Costs for the Country

The aggregated impacts for Indonesia for the allocation of over 1.4 million ha of State land to these five plantation companies for the production of pulpwood are negative (Table 1 and Fig. 6). The economic costs are much higher than the related economic benefits.

The economic benefits of these projects, related to the production of nearly 554 million m³ of wood, valued at 1984 prices with the three different discount rates (12%, 8% and 4% per year) represent from US\$1.2 billion to US\$6.7 billion. The economic costs associated with the conversion of nearly 815 000 ha of logged-over forests, pine and highly degraded forests, range from US\$1.7 billion to US\$11.1 billion.

Table 1. Economic costs and benefits (US\$ million) for each plantation company and aggregated (stable scenario)

Disc.		TPL		AA	F	RAPP	١	NKS	M	IHP	Aggre		
	EB	EC	EB	EC	EB	EC	EB	EC	EB	EC	EB	EC	EB/EC
12%	138	264	399	534	270	495	197	319	232	112	1,235.036 861	1,725.073 984	0.72
8%	242	557	794	1,169	556	1,222	426	780	595	272	2,613.214 717	4,000.668 752	0.65
4%	512	12 1,399 1,936		3,170	1,336	1,336 3,547		2,257	1,790	770	6,679.567 076	11,143.623 738	0.60

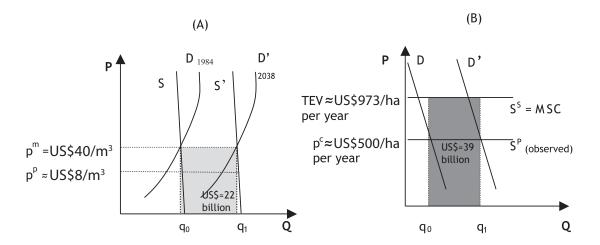


Figure 6. (A) Pulpwood market, and (B) State forest land (hypothetical) market Key: see Figures 2, 3, 4 and 5.

Notes:

Pulpwood $q_1 = q_0 + 554$ million m³. State forest $q_1 = q_0 + 815$ 000 ha logged-over forest.



Natural forest area recently logged and planted with Acacia sp. in Sumatra (Photo by Julia Maturana)

DISCUSSION

Economic Benefits

The economic benefits were calculated using the volume of pulp wood (m³) produced per year for the length of each of the concession periods. This volume was calculated by adding the logged (from the available resources) and harvested (from the plantations) amounts of wood available each year, taking into consideration (for each specific area) the standing volume of logged-over forests, the percentage of forested area, the percentage of previously occupied area, the mean annual increment (MAI), tree mortality rates, conversion factors and mill requirements.

The price used to value the pulpwood corresponds to the market price for this product when sold on the open market. It was obtained from information of purchased pulpwood in Sumatra from external sources (not the integrated plantation companies). Rather than making assumptions on the behaviour of pulpwood prices in the future, a fixed price of US\$40/m³ was used to determine the economic benefits for each year and each plantation company. Depending on whether the real price each year is higher or lower than the price used here, it would increase or reduce the total economic benefits of these projects for the country. Maintaining a fixed price is over- or under-estimating the actual economic benefits, but this has no relevance for the purpose of comparing among the plantation companies.

Using the real market price, instead of the price actually paid by the pulp mills to the related plantation companies, captures the economic value of this product for Indonesian society and, therefore, it is the right price to use for the economic valuation of these resources. Using the 'paid' price would seriously underestimate the benefits of these projects for the country.

Discount rates of 4%, 8% and 12% were used to calculate the year-0 values of the total economic benefits of the projects. These rates cover a range of rates used in former studies (Shyamsundar and Kramer 1996; Kremen *et al.* 2000; Ferraro 2002; Beukering *et al.* 2003;

Simangungsong 2003) looking at the valuation of forest resources or areas in Indonesia and other low-income nations¹¹. Increments in the discount rate (from 4% to 8% and 12%) reduce the base-year value of the economic benefits calculated.

Decreases in the MAI of the tree plantations and tree survival factor (the percentage of planted trees that survive to harvest) were not considered for successive rotations; on the contrary, the MAI used (companies' information) increases with the time to reach a maximum expected MAI that remains constant until the end of the total period in consideration. Given the fact that it is very improbable that yields will not decline during successive rotation periods (SAM 2004), the economic benefits calculated here may well be at the higher limit or overestimated.

Additional benefits of these projects related to the protection of conservation areas within their concessions are not accounted here. None of the five plantation companies acknowledged having taken any action to protect the conservation areas from illegal logging or other objective incursions; furthermore, some of these plantation companies are accused by NGOs and other observers of encouraging illegal logging in these areas for their own benefit.

The possible benefits of planting trees are not accounted either. Most of the companies' areas for developing tree plantations are converted from natural forests, resulting in associated economic benefits below the economic costs of deforestation. On the other hand, the conversion of grasslands into tree plantations is not necessarily economically beneficial; grassland areas act as carbon sinks and are also important for soil conservationboth functions lost and damaged during the process of plantation (WRM 2000, 2003; Cossalter and Pye-Smith 2003). The rotation period of the tree plantations under consideration is also too short (7-8 years) to allow the capture of any of the benefits related to tree establishment: no fuel wood or NTFPs are available from these plantations; the soil and water might be more

 $^{^{11}}$ Discount rates used in the cited studies were: 3%, 5%, 6%, 7%, 8%, 10%, 15% and 20%.

damaged by the heavy machinery, fertilizers and pesticides, and drying techniques (for the swamp areas) than conserved; carbon is released with the first conversion and with subsequent conversions of the areas, resulting not only in a reduction in the ability of the ecosystem to fix carbon dioxide, but also in its absorption capacity (WRM 2000); and no option or existence values are attained.

Economic Costs

The economic costs were calculated using the total economic value (TEV) of Indonesian logged-over forests and the total area logged, by each company, each year. The TEVs were estimated by Simangungsong (2003) taking in to consideration the values related to timber, fuelwood and NTFPs; water consumption; soil and water conservation, carbon sink, flood protection and water transportation functions; option value, and existence value. All these values were considered to remain present as a characteristic of the logged-over forests given in concession and to be lost with the concession, logging and conversion of such areas.

The number of functions included in the estimations of the TEV is well below the total number of functions that these forests serve or provide. There are at least 23 different functions that these forested areas retain (Petrick and Quinn 1994; Groot et al. 2002; Rose and Chapman 2003) of which only a few are included in the TEV estimated by Simangungsong (2003). Additionally, the TEV calculated for the functions included is very conservative compared to estimated TEVs for other areas. The TEV estimated by Simangungsong (2003) for the Indonesian primary forests, which is used as a reference to derive the TEV for the loggedover forests, is below several TEVs calculated for similar functions in other areas (see, for example, Aylward et al. 1995; Norton-Griffiths and Southey 1995; Reyes et al. 2002; Pearce et al. 2003; Beukering et al. 2003).

The above suggests that the economic costs calculated for the five plantation companies in this analysis are low; using other TEVs as reference would lead to higher calculated economic costs of these projects.

On the other hand, the economic costs are calculated using only the area (number of hectares) logged by the plantation companies,



Natural forests given in concession for the development of HTI plantations in Sumatra (Photo by Julia Maturana)

excluding those areas considered to be grasslands, croplands and settlements, as well as the areas that should remain (by law) as conservation forests. Such reductions lead to the valuation of about half of the total area of State land given in concession to these projects. The inclusion of the grassland areas and their valuation with a positive price would result in higher economic costs of these projects, mainly for MHP in South Sumatra. Values of grassland areas are related to their carbon-sink functions and agricultural uses, among others (WRM 2003).

Labour and the allocated financial amounts are also important inputs (costs) that were required for developing these plantation projects. The labour required by these projects is only accounted as an economic cost if it is considered to be a 'scarce' resource in the country. As labour is abundant in Indonesia and it is not being displaced from other productive activities, it does not represent a cost for the society. It is not accounted as an economic benefit either. These projects are not 'generating' labour, but generating jobs and so the people are only shifting from their former economic activities (not necessarily as employees). It is only a flux in the economy and, therefore, not accounted as an economic benefit. The financial amounts required to set up these projects also represent a flux in the economy and it are not accounted per se; they are, however, accounted indirectly in the evaluation of the economic impacts of these projects.

Comparing the Five Plantation Projects

The benefit-cost ratios of all the projects, with the exception of MHP, are closer to unity for the higher discount-rates used. Higher discount-rates imply a higher valuation of the benefits perceived in the present and lower valuation of the benefits in the future. The behaviour of the benefit-cost ratios is explained by the benefits tending to decrease over time, while the costs tend to increase. However, when both increase, costs increase relatively more than the benefits. All the companies in this analysis, with the exception of MHP, are performing badly in economic terms—TPL being the company with the worst performance.

The TPL plantation company is causing high economic loss to Indonesian society, with economic costs being almost three times the obtained economic benefits for the lowest discount rate (4%). The economic costs of this project are about half or even one-third of the costs of the other projects (with the exception of MHP), but unlike the other companies, TPL brings very little economic benefit to the country, showing the lowest benefits of the five plantation companies in this analysis. The reason for this very low economic benefit is explained by the size of the area planted: this company is generating costs from logging and using over 80 000 ha of land, while producing benefits from an average area planted of less than half of that. This is having a direct effect on the benefits related to the production. As mentioned earlier in this document, the area planted each year (for 2004 onwards) used in the analysis was calculated as the maximum average of area actually planted up to 2003. These estimations were made using actual data for each company and it assumes that the company will perform (in the near future) similarly to how it has performed until 2003.

RAPP, WKS and AA follow (in that order) after TPL, with economic costs being 2.65, 2.04 and 1.64 times their economic benefits (Table 1). The differences are mainly due to the size of the area logged, compared to the size of the area planted.

The only company appearing to have positive economic returns for the country is MHP, with economic benefits being double their economic costs. This company shows the second largest economic benefits, generating over US\$1.7 billion for the country (with the lowest discount rate) and the lowest economic costs (half or one-third of those of the other companies). The main reason for these low economic costs is the difference in the kind of natural coverage of the areas allocated in concession to this company. While the other companies obtained concessions over areas largely covered with logged-over forests, swamp forests and pines, the MHP area was half grassland and half highly degraded forests. Given the nature of the TEV used to value the areas in this analysis, the conversion of grasslands has no attached economic cost, and the 'highly degraded forests' of South Sumatra are valued at about half of what the logged-over forests and pine areas of the other companies are. The value attached to timber as a product to be obtained from these areas was not considered, neither were the option or existence values; the carbon-sink value was reduced by half. However, this company is performing the best in terms of planted area, which has an effect on the volume of pulpwood produced and, hence, on the economic benefits.

Data and Assumptions

The area planted each year corresponds to actual data until 2003 and it was obtained from each of the plantation companies. From 2004 onwards, the maximum average for the former period was used. Other factors, such as the mean annual increment (MAI), survival rate and conversion rate were also obtained from each plantation company. The production capacity corresponds to the actual installed capacity of the related mills each year until 2003, remaining stable from that year onwards, except for WKS, for which an increase of 50 000 tones of pulp from 2007 onwards is accounted. This is based on Lontar Papyrus's (the mill associated with WKS) own plans for increases in their installed capacity. All the mills are accounted as running at 98% of their installed capacity.

The area feasible for logging was calculated excluding the area acknowledged to be kept for conservation, settlements and crops. This information was also obtained from each of the plantation companies. The mean wood production (MWP) of the logged-over forests in Riau and Jambi was estimated at 75 m³/ha for the drylands and 150 m³/ha for the swamp areas; for the areas of North Sumatra, an MWP of 91.5 m³/ha for the MHW and 200 m³/ha for the pine forests was used; the areas in South Sumatra were estimated to produce 20 m³/ha on average. These numbers are based on the companies' statements of their actual MWP and taking into consideration the standing stock of logged-over areas in Indonesia (Simangunsong 2003).

Changing the assumption that plantation companies match mill requirements with natural wood to a case where the companies use natural wood only if they do not have planted wood available does not significantly change the results. The benefit-cost ratios of RAPP and WKS remain unaltered and those for IIR and AA improve but remain less than 1. At the aggregated scenario, the benefit-cost ratios change from 0.60 to 0.61, from 0.65 to 0.67 and from 0.72 to 0.74 for discount rates of 4%; 8% and 12%, respectively (Table 2).

Scenarios

The optimistic scenario represents the best case for the companies in terms of total area planted, and a sustained increase of 1% in the pulpwood price each year. In this case, the area planted by each company reaches the maximum 'feasible to plant' around the year 2010, after sustained increases of 10% each year. The feasible to plant area corresponds to the dryland and swamp areas, excluding only the areas allocated for conservation, settlements, crops and infrastructure¹². This implies that the companies would have resolved all the claims (conflict issues) in their areas-which affected over 95 000 ha in 2003 (APRIL 2004; Maturana et al. in press)—, and planted those areas with pulp-purpose trees. It also implies something that is seriously in doubt presently, namely that the companies are able and willing to grow trees over 100% of their swamp areas, which has proven difficult, costly and extremely prone to fires. Although under this scenario, the economic benefits increase, the country will still be losing in economic terms (Table 3). This implies that even in the best case, with all the plantation companies planting the maximum area feasible, these projects would generate a net economic loss for the country.

This scenario also demonstrates that two companies, AA and RAPP, are not capable of sustaining their own mill requirements with planted wood alone, but only 57% and 45%, respectively. Although the remaining need could be fed with planted wood from 'outside'

Table 2. Economic costs and benefits (US\$ million) for each company and aggregated, assuming that the company will harvest planted wood whenever available (stable scenario)

Disc.	T	ΓPL		AA	R	APP	V	VKS	М	HP	Aggr	egated	
	EB	EC	EB	EC	EB	EC	EB	EC	EB	EC	EB	EC	EB/EC
12%	134	226	398	507	270	495	197	319	232	109	1,230.870 429	1,656.083 301	0.74
8%	232	494	794	1,118	556	1,221	426	779	595	264	2,603.254 097	3,876.354 112	0.67
4%	486	1,305	1,936	3,071	1,336	3,546	1,106	2,254	1,790	748	6,653.918 102	10,923.962 008	0.61

¹² Except for RAPP, for which their quoted figure of 167 610 ha was used (APRIL 2004).

their concession areas (as their own statements mention), converting areas outside their concessions also has an associated economic cost, resulting in higher economic costs for the country.

The pessimistic scenario calculates the economic benefits and costs of these projects

for constant reductions in the pulpwood price (from US40/m^3$ to US26/m^3$) and yearly reductions of 1% in the planted area, using as a basis the maximum average area planted for each company. In this scenario, the benefits are reduced (Table 3).

Table 3. Economic costs and benefits (US\$ million) for each plantation company and aggregated for the three scenarios in consideration

Scenario	Disc.		TPL		AA	F	RAPP	V	/KS	M	HP	Aggre		
		EB	EC	EB	EC	EB	EC	EB	EC	EB	EC	EB	EC	EB/EC
Stable	12%	138	264	399	534	270	495	197	319	232	112	1,235.036 861	1,725.073 984	0.72
	8%	242	557	794	1,169	556	1,222	426	780	595	272	2,613.214 717	4,000.668 752	0.65
	4%	512	1,399	1,936	3,170	1,336	3,547	1,106	2,257	1,790	770	6,679.567 076	11,143.623 738	0.60
Optimistic	12%	142	264	429	534	294	495	217	319	245	112	1,326.588 068	1,725.073 984	0.77
	8%	257	557	911	1,169	657	1,222	504	780	642	272	2,971.307 534	4,000.668 752	0.74
	4%	576	1,399	2,458	3,170	1,801	3,547	1,451	2,257	1,997	770	8,283.775 346	11,143.623 738	0.74
Pessimistic	12%	135	264	385	534	262	495	189	319	219	112	1,190.583 662	1,725.073 984	0.69
	8%	230	557	743	1,169	525	1,222	395	780	548	272	2,440.170 123	4,000.668 752	0.61
	4%	462	1,399	1,701	3,170	0 1,189 3,547 95		959	2,257	1,582	770	5,893.782 108	11,143.623 738	0.53

CONCLUSIONS

This study used specific information and data related to each of the plantation companies in the analysis and the areas in concession to demonstrate that the allocation of the 1.4 million ha of forest land, for the development of industrial tree plantations in Indonesia, represents an economic loss for the country. The economic benefits generated by the increases in the production of pulpwood, calculated using an efficiency price of US\$40/m³ of wood, are well below the economic costs incurred in the conversion of this land.

Measuring only the 'observable' financial benefits can lead to wrong perceptions and decisions. The allocation of logged-over forest lands for the development of industrial tree plantations may appear to be very beneficial¹³ for the country, if financial benefits and costs alone are accounted. While the allocated forest land was perceived to be producing no direct 'observable' benefits for the Government, these projects would create direct benefits, including the payments for concession and conversion, the capture of foreign investment in the development of the related pulp industry, and increases in the production and exports of pulp and paper. In fact, however, and when economic costs and benefits are calculated, we can see that these projects are generating costs that are 1.67 times over the generated benefits.

Four of the five plantation projects analysed generate economic costs above their economic benefits. Of those, AA has the highest benefit-cost ratio (0.61), followed by WKS (0.49) and RAPP (0.38); TPL has the lowest (0.37). MHP in South Sumatra is the only company (in this study) with a positive benefit-cost ratio (2.32).

The Government of Indonesia is 'selling' its forest resources to the plantation companies for a price below its value. The current payments for the use and conversion of logged-over areas (PSDH, SPK and DR) are far from representing the actual economic costs of using such resources. The estimated economic costs represent over 30 times the actual financial payments that the Indonesian Government receives from each company (current economic costs in Annexes I.1-I.5). The plantation

company IIR should pay over US\$92 million per year on average, instead of the approximately US\$2 million corresponding to the actual financial costs that this company is asked to pay. AA and RAPP should pay near US\$200 million and US\$290 million per year compared to the approximately US\$6 million and US\$8 million dollars (on average) they are asked to pay; WKS should pay nearly US\$180 million per year and not the near US\$6 million dollars it does pay; and MHP should pay nearly US\$67 million per year and not the US\$2 million dollars it actually spends.

The only plantation company producing benefits large enough to cover its incurred costs is MHP in South Sumatra. This company would be able to pay for the economic costs and still produce over US\$98 million per year in net economic benefits. The allocation of the nearly 300 000 ha of highly degraded forests and grasslands for conversion to industrial tree plantations in South Sumatra is the only one of the five plantation projects studied that is beneficial for the country. The allocation of the other over 1 million ha for the same purpose is detrimental to the country.

Allocating the logged-over areas of Riau, Jambi and North Sumatra for conversion into tree plantations was a mistake, and the people of Indonesia will lose over US\$3 billion (for a 4% discount rate) from 1984 to 2038. Because the economic costs are higher than the related economic benefits, the plantation companies in economic deficit cannot afford to pay for their actual costs. The best present option for the country is to allow these companies to operate, avoiding higher net economic costs (because the economic costs would remain the same while the benefits would become zero).

Despite the fact that there is not much that can be done to achieve a positive economic performance for these companies with concessions already granted, this assessment becomes critical when considering future policies and decisions related to the allocation of new areas for HTI development. This analysis clearly demonstrates that the Government of Indonesia should not allocate any more logged-over land for conversion into HTI plantations,

 $^{^{13}}$ For an analysis of the financial aspects of these projects and the related mills see Barr (2001).

if it wants to benefit the country and its people.

This research can provide evidence for interested parties, NGOs and civil society to help avoid further sales of resources at prices below costs. It can help the Indonesian people to ensure that their Government takes the right decisions when investing their assets (money,

natural resources, environmental quality, etc.) and that new policy related to natural resources results in positive economic returns for the country. The development of HTI plantations on logged-over forests should either pay the related economic costs for the country or not be allowed to happen.

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Natural coverage

Species 1 MTHW

Species 2 Pines

Species 3

I.1. Inti Indo Rayon

Plantation Company: Inti Indo Rayon

Planted species

Species 1 Eucalyptus sp.

Species 2

Species 3

Related Mill Company: Toba Pulp Lestari/Indorayon Kabupatens: SIMALUNGUN

(Districts)

TAPUT TOBASA TAPSEL DAIRI

EB (1984)12% = US\$138,027,774 EB (1984)8%= U\$\$241,626,464 EB (1984)4% = U\$\$511,588,592

Current EC EB total = US\$1,441,227,324 Total = US\$93,727,296

BCR 0.52 EEC (1984)12% = US\$263,921,323 EEC (1984)8% = U\$\$557,121,027 EEC (1984)4% = U\$\$1,398,888,431 0.43 0.37 Estimated EC

Total = US\$4,442,146,638

	F DEMAND FITNESS VOLUME OF PRODUCTION							HARVESTABLE VOLUME						MILL REQUIREMENT ANF AVAILABLE NATURAL FOREST VOLUME																					
DF	D	EMAND FIT	NESS	VOLU	ME OF PRODUCT	TION		1				MILL R	EQUIREN	IENT	ANF				NATURAL I	OREST VOL			- ECON	NOMIC BENE	FITS		1			ECONOMIC (1			
								SI	pecies 1:	Eucalyptu	s sp.				Restricted	Spec	ies 1: MTH\	N			Species	2: Pines	_				Species 1: Eu	ucalyptus sp.	Species	1: MTHW	Species	s 2: Pines			
	Year	Vol. Produced	Mill requirement	Harv. Vol. (tonnes		Other	Harvestable (tonnes of	Planted area	MI (m³/ha)	Surviva	Conv. Rate (m³ wood/t	Prod. Cap. (tonnes of	Quota (%)	Running (%)	(tonnes of		Feaseble (%)	Mean Wood	Conv. Rate (m³/t pulp)	Con. Area (ha)		Mean Wood Conv. Prod. Rate	EB (US\$)	Price (US\$/m³)	Vol. of Prod.	Current EC (US\$)	Cost Harvest	Total Harvest	Cost Log. (US\$/m³)	Total Log. (m³)	Cost Log. (US\$/m³)	Total Log.	EEC (US\$)	Area	TEV (US\$/ha)
		(tonnes of	(tonnes of	pulp)	` pulp)	Sources (tonnes	pulp, cumm.)	(ha)	(III /IIa)	(%)	pulp)	pulp)	(/0)	(/0)	pulp)	Area (ha)	(70)	Prod.	(III'7t puip)	(IIa)	(%)	(m³/ha) (m³/t	(03\$)	(03\$/111')	(m³ of	(03\$)	(US\$/m³)	(m³)	(03\$/111')	(1117)	(03\$/111')	(m³)	(034)	Logged (ha)	(03\$/11a)
0.00	1004	pulp)	pulp)			of pulp)			100	0.00	1				4 047 000			(m³/ha)	4.5	00.000	0.00	pulp)		40	wood)		CO 40	0.00	£44.00	0.00	#2 FC	0.00	* 0		C4 000
0.00	1984 1985	0	0	0	0	0		0	126 126	0.85		0	0	0	1,247,000 1,247,000			91.5 91.5	4.5 4.5	86,000 86,000	0.29	200 4	\$0	40	0	\$0	\$0.46 \$0.46	0.00	\$11.22 \$11.22	0.00	\$3.56 \$3.56	0.00	\$0 \$0	0	\$1,283 \$1,283
0.00	1986	0	0	0	0	0		0	126	0.85	4	0	0	0	1,247,000			91.5	4.5	86,000	0.29	200 4	\$0	40	0	\$0	\$0.46	0.00	\$11.22	0.00	\$3.56	0.00	\$0	0	\$1,283
0.00	1987	0	0	0	0	0		182	126	0.85	4	0	0	0	1,247,000			91.5	4.5	86,000	0.29	200 4	\$0	40	0	\$0	\$0.46	0.00	\$11.22	0.00	\$3.56	0.00	\$0	0	\$1,283
1.00	1988	21,600 176,400	21,600	0	21,600 176,400	0		2,941 6.089	126	0.85	4	180,000 180,000	1	0.12	1,225,400 1.049.000			91.5 91.5	4.5	86,000 86,000	0.29	200 4	\$3,456,000		86,400 705,600	\$307,469 \$2,510,995	\$0.46 \$0.46	0.00	\$11.22	0.00	\$3.56 \$3.56	86,400.00 705.600.00	\$554,256 \$5.080.680	432	\$1,283
1.00	1909	176,400	176,400 176,400	0	176,400	0		6.246		0.85	4	180,000	1	0.96	872.600			91.5	4.5	86,000	0.29	200 4	\$28,224,000		705,600	\$2,510,995	\$0.46	0.00	\$11.22 \$11.22	0.00	\$3.56	705,600.00	\$9,607,104	3,528 3,528	\$1,283 \$1,283
1.00	1991	176,400	176,400	0	176,400	0	0.00	4,832		0.85	4	180,000	1	0.98	696,200			91.5	4.5	86,000	0.29	200 4	\$28,224,000	40	705,600	\$2,510,995	\$0.46	0.00	\$11.22	0.00	\$3.56	705,600.00	\$14,133,528	3,528	\$1,283
1.00	1992	176,400	176,400	0	176,400	0	0.00	3,002	126	0.85	4	180,000	1	0.98	1,652,314	192,060	0.29	91.5	4.5	86,000	0.29	200 4	\$29,988,000		749,700	\$6,967,919	\$0.46	0.00	\$11.22	553,474.67	\$3.56	213,622.52	\$23,264,660	7,117	\$1,283
1.00	1993	235,200	235,200	0	235,200	0	0.00	3,123	_	0.85	4	240,000	1	0.98	1,417,114	192,060	0.29	91.5	4.5	86,000	0.29	200 4	\$39,984,000	_	999,600	\$9,290,559	\$0.46	0.00	\$11.22	737,966.22	\$3.56	284,830.02	\$35,439,502	9,489	\$1,283
1.00	1994	235,200 235,200	235,200 235,200	0	235,200 235,200	0	4,873.05 83,618.33	4,696	126	0.85	4	240,000 240,000	1	0.98	1,217,294 982.094	6,000 6,000	0.29	91.5 91.5	4.5	86,000 86,000	0.29	200 4	\$39,984,000 \$39,984,000	40	999,600 999,600	\$9,290,559 \$9,290,559	\$0.46 \$0.46	0.00	\$11.22	737,966.22 737,966.22	\$3.56 \$3.56	284,830.02 284,830.02	\$47,614,344 \$59.789.186	9,489 9.489	\$1,283 \$1,283
1.00	1996	235,200	235,200	0	235,200	0	246,659.33	5,008	126	0.85	4	240,000	1	0.98	746.894	6,000	0.29	91.5	4.5	86.000	0.29	200	\$39,984,000	40	999,600	\$9,290,559	\$0.46	0.00	\$11.22	737,966.22	\$3.56	284.830.02	\$71,964,028	9,489	\$1,283
1.00	1997	235,200	235,200	0	235,200	0	413,895.98	5,389		0.85	4	240,000	1	0.98	511,694	6,000	0.29	91.5	4.5	86,000	0.29	200 4	\$39,984,000	40	999,600	\$9,290,559	\$0.46	0.00	\$11.22	737,966.22	\$3.56	284,830.02	\$84,138,870	9,489	\$1,283
1.00	1998	84,000	84,000	0	84,000	0	543,272.78	4,686		0.85	4	240,000	1	0.35	427,694	6,000	0.29	91.5	4.5	86,000	0.29	200 4	\$14,280,000	40	357,000	\$3,318,057	\$0.46	0.00	\$11.22	263,559.37	\$3.56	101,725.01	\$88,487,028	3,389	\$1,283
0.00	1999	0	0	0	0	0	623,651.33	724		0.85	4	240,000	1	0	427,694	6,000	0.29	91.5	4.5	86,000	0.29	200 4	\$0	40	0	\$0	\$0.46	0.00	\$11.22	0.00	\$3.56	0.00	\$88,487,028	0	\$1,283
0.00	2000	0	0	0	0	0	707,269.66 833,005.06	355	126 126	0.85	4	240,000 240,000	1	0	427,694 427,694	6,000 6,000	0.29	91.5 91.5	4.5 4.5	86,000 86.000	0.29	200 4	\$0	40	0	\$0	\$0.46 \$0.46	0.00	\$11.22 \$11.22	0.00	\$3.56 \$3.56	0.00	\$88,487,028 \$88,487,028	0	\$1,283 \$1,283
0.00	2002	0	0	0	0	0	970,012.73	603		0.85	4	240,000	1	0	427,094	6,000	0.29	91.5	4.5	86.000	0.29	200	\$0	40	0	\$0	\$0.46	0.00	\$11.22	0.00	\$3.56	0.00	\$88,487,028	0	\$1,283
1.00	2003	153,600	153,600	0	153,600	0	1,104,096.58	500		0.85	4	240,000	1	0.64	274,094	6,000	0.29	91.5	4.5	86,000	0.29	200 4	\$26,112,000	40	652,800	\$6,067,304	\$0.46	0.00	\$11.22	481,937.13	\$3.56	186,011.44	\$96,437,946	6,197	\$1,283
1.00	2004	235,200	235,200	0	235,200	0	1,248,387.05	3,000		0.85		240,000	1	0.98	38,894	6,000	0.29	91.5	4.5	86,000	0.29	200 4	\$39,984,000	40	999,600	\$9,290,559	\$0.46	0.00	\$11.22	737,966.22	\$3.56	284,830.02	\$108,612,788	9,489	\$1,283
1.00	2005	235,200	235,200	196,306	38,894	0	1,373,860.06	5,000		0.85		240,000	1	0.98	0	6,000	0.29	91.5	4.5	0	0.29	200 4	\$38,409,876	40		\$2,321,663	\$0.46	785,224.80	\$11.22	175,022.10	\$3.56	0.00	\$111,066,923	1,913	\$1,283
1.00	2006	235,200 235,200	235,200 235,200	235,200 235,200	0	0	1,196,930.93 961.730.93	5,000 5,000		0.85	_	240,000	1	0.98	0	6,000 6,000	0.29 0.29	91.5 91.5	4.5 4.5	0	0.29	200 4	\$37,632,000 \$37.632.000	40	,	\$429,691 \$429,691	\$0.46 \$0.46	940,800.00 940.800.00	\$11.22 \$11.22	0.00	\$3.56 \$3.56	0.00	\$111,066,923 \$111,066,923	0	\$1,283 \$1,283
1.00	2007	235,200	235,200	235,200	0	0	736,033.37	5,000		0.85		240,000	1	0.00	0	6,000	0.29	91.5	4.5	0	0.29	200 2	\$37,632,000			\$429,691	\$0.46	940,800.00	\$11.22	0.00	\$3.56	0.00	\$111,066,923	0	\$1,283
1.00	2009	235,200	235,200	235,200	0	0	516,984.05	5,000		0.85		240,000	1	0.98	0	6,000	0.29	91.5	4.5	0	0.29	200 4	\$37,632,000	40	,	\$429,691	\$0.46	,	\$11.22	0.00	\$3.56	0.00	\$111,066,923	0	\$1,283
1.00	2010	235,200	235,200	235,200	0	0	299,634.05	5,000				240,000	1	0.30	0	6,000	0.29	91.5	4.5	0	0.29	200 4	\$37,632,000	40		\$429,691	\$0.46		\$11.22	0.00	\$3.56	0.00	\$111,066,923	0	\$1,283
0.73	2011	171,534	235,200	171,534	0	0	171,534.05	5,000				240,000	1	0.00	0	6,000	0.29	91.5	4.5	0	0.29	200 4	\$27,445,448			\$313,379	\$0.46		\$11.22	0.00	\$3.56	0.00	\$111,066,923	0	\$1,283
0.76 0.76	2012	178,500 178,500	235,200 235,200	178,500 178,500	0	0	178,500.00 178,500.00	5,000 5.000		0.85		240,000 240,000	1	0.98	0	6,000 6,000	0.29 0.29	91.5 91.5	4.5 4.5	0	0.29 0.29	200 4	\$28,560,000 \$28,560,000	40	,	\$326,105 \$326,105	\$0.46 \$0.46	,	\$11.22 \$11.22	0.00	\$3.56 \$3.56	0.00	\$111,066,923 \$111,066,923	0	\$1,283 \$1,283
0.76		178,500	235,200	178,500	0	0	178,500.00	5,000		0.85		240,000	1	0.00	0	6,000	0.29	91.5	4.5	0		200 2	\$28,560,000	40		\$326,105	\$0.46	,	\$11.22	0.00	\$3.56	0.00	\$111,066,923	0	\$1,283
	2015	178,500	235,200	178,500	0	0	178,500.00	5,000				240,000	1	0.98	0	6,000	0.29	91.5	4.5	0		200 4	\$28,560,000			\$326,105	\$0.46		\$11.22	0.00	\$3.56	0.00	\$111,066,923		\$1,283
	2016	178,500	235,200	178,500	0	0	178,500.00	5,000		0.85		240,000	1		0	6,000	0.29	91.5	4.5	0		200 4	\$28,560,000			\$326,105	\$0.46	,	\$11.22	0.00	\$3.56		\$111,066,923		\$1,283
0.90	2017	212,500	235,200	212,500	0	0	212,500.00	5,000				240,000	1		0	6,000	0.29	91.5	4.5	0		200 4	\$34,000,000			\$388,220	\$0.46	,	\$11.22	0.00	\$3.56		\$111,066,923		\$1,283
	2018	212,500 212,500	235,200 235,200	212,500 212,500	0	0	212,500.00 212,500.00	5,000 5,000		0.85		240,000 240,000	1		0	6,000 6,000	0.29	91.5 91.5	4.5 4.5	0	0.20	200 4	\$34,000,000 \$34,000,000	40		\$388,220 \$388,220	\$0.46 \$0.46	,	\$11.22 \$11.22	0.00	\$3.56 \$3.56	0.00	\$111,066,923 \$111,066,923		\$1,283 \$1,283
0.90	2019	212,500	235,200	212,500	0	0	212,500.00	5,000				240,000	1	0.00	0	6.000	0.29	91.5	4.5	0	0.29	200 2	\$34,000,000			\$388,220	\$0.46		\$11.22	0.00	\$3.56	0.00	\$111,000,923	0	\$1,283
0.90	2021	212,500	235,200	212,500	0	0	212,500.00	5,000		0.85		240,000	1		0	6,000	0.29	91.5	4.5	0		200 4	\$34,000,000	40		\$388,220	\$0.46		\$11.22	0.00	\$3.56		\$111,066,923	0	\$1,283
0.90	2022	212,500	235,200	212,500	0	0	212,500.00	5,000	200	0.85	4	240,000	1	0.98	0	6,000	0.29	91.5	4.5	0		200 4	\$34,000,000	40	850,000	\$388,220	\$0.46	850,000.00	\$11.22	0.00	\$3.56	0.00	\$111,066,923		\$1,283
0.90	2023	212,500	235,200	212,500	0	0	212,500.00	5,000		0.85		240,000	1	0.00	0	6,000	0.29	91.5	4.5	0	0.20	200 4	\$34,000,000	40	,	\$388,220	\$0.46	,	\$11.22	0.00	\$3.56	0.00	\$111,066,923		\$1,283
0.90	2024	212,500	235,200	212,500	0	0	212,500.00	5,000				240,000	1	0.98	0	6,000	0.29	91.5	4.5	0	0.20	200 4	\$34,000,000			\$388,220	\$0.46		\$11.22	0.00	\$3.56		\$111,066,923		\$1,283
0.90	2025	212,500 212,500	235,200 235,200	212,500 212,500	0	0	212,500.00 212,500.00	5,000 5,000	_		_	240,000 240,000	1		0	6,000 6,000	0.29 0.29	91.5 91.5	4.5 4.5	0	0.29	200 4	\$34,000,000 \$34,000,000	_		\$388,220 \$388,220	\$0.46 \$0.46		\$11.22 \$11.22	0.00	\$3.56 \$3.56	0.00	\$111,066,923 \$111,066,923		\$1,283 \$1,283
0.90	2020	212,500	235,200	212,500	0	0	212,500.00	5,000		0.85		240,000	1	0.98	0	6,000	0.29	91.5	4.5	0	0.29	200 2	\$34,000,000	40		\$388,220	\$0.46		\$11.22	0.00	\$3.56	0.00	\$111,066,923	0	\$1,283
0.90	2028	212,500	235,200	212,500	0	0	212,500.00	5,000		0.85		240,000	1	0.98	0	6,000	0.29	91.5	4.5	0	0.29	200 4	\$34,000,000	40		\$388,220	\$0.46		\$11.22	0.00	\$3.56	0.00	\$111,066,923	0	\$1,283
0.90	2029	212,500	235,200	212,500	0	0	212,500.00	5,000	200	0.85	4	240,000	1	0.98	0	6,000	0.29	91.5	4.5	0	0.29	200 4	\$34,000,000	40	850,000	\$388,220	\$0.46	850,000.00	\$11.22	0.00	\$3.56	0.00	\$111,066,923	0	\$1,283
0.90	2030	212,500	235,200	212,500	0	0	212,500.00	5,000		0.85		240,000	1	0.00	0	6,000	0.29	91.5	4.5	0	0.20	200 4	\$34,000,000	40		\$388,220	\$0.46		\$11.22	0.00	\$3.56		\$111,066,923	0	\$1,283
0.90	2031	212,500	235,200	212,500	0	0	212,500.00	5,000	_	0.85		240,000	1	0.98	0	6,000	0.29	91.5	4.5	0	0.29	200 4	\$34,000,000		,	\$388,220	\$0.46	850,000.00	\$11.22	0.00	\$3.56	0.00	\$111,066,923	0	\$1,283
0.90	2032	212,500 212,500	235,200 235,200	212,500 212,500	0	0	212,500.00 212,500.00	5,000 5,000		0.85		240,000 240,000	1 1	0.98	0	6,000 6,000	0.29	91.5 91.5	4.5 4.5	0	0.29	200 4	\$34,000,000	40	850,000 850.000	\$388,220 \$388,220	\$0.46 \$0.46	850,000.00 850,000.00	\$11.22 \$11.22	0.00	\$3.56 \$3.56	0.00	\$111,066,923 \$111,066,923	0	\$1,283 \$1,283
0.90	2034	212,500	235,200	212,500	0	0	212,500.00	5.000		0.85		240,000	1	0.98	0	6,000	0.29	91.5	4.5	0	0.29	200 4	\$34,000,000		,	\$388,220	\$0.46		\$11.22	0.00	\$3.56	0.00	\$111,066,923	0	\$1,283
0.90	2035	212,500	235,200	212,500	0	0	212,500.00	5,000		0.85	4	240,000	1	0.98	0	6,000	0.29	91.5	4.5	0	0.29	200 4	\$34,000,000			\$388,220	\$0.46	,	\$11.22	0.00	\$3.56		\$111,066,923	0	\$1,283
				_					_	_			_	_									_												

Notes: ANF = available natural forest.

Cap. = capacity. Con. = concession.

Conv. = conversion. DF = demand fitness.

F. = factor. Harv. = harvesting; harvested.

Log. = logging; logged.
MI = mean increment (mean annual increment, MAI * years in rotation).
MTHW = mixed tropical hard wood.

Prod. = production.

TEV = total economic value.

Vol. = volume.

I.2. Arara Abadi

Species 2

Species 3

Related Mill Company: Indah Kiat

Kabupatens: KAMPAR

Plantation Company: Arara Abadi

Planted species Natural coverage Species 1 MTHW Species 1 Acacia sp. Species 2 Species 3

(Districts) PELALAWAN SIAK **BENGKALIS ROKAN HILIR** DUMAI

PEKANBARU

EB (1984)12% = US\$398,513,520 EB (1984)8% = US\$793,918,705 EB (1984)4% = US\$1,935,837,869

EB total = US\$6,187,130,263

Current EC EC total = US\$358,214,408

Estimated EC EC total = US\$11,164,245,409

EC (1984)8% =

EC (1984)12% = US\$533,947,366 0.75

EC (1984)4% = US\$3,169,867,526 0.61

US\$1,169,452,455 0.68

AVAILABLE NATURAL FOREST VOLUME HARVESTED VOLUME ECONOMIC COSTS MILL REQUIREMENT ANF **ECONOMIC BENEFITS** DEMAND FITNESS **VOLUME OF PRODUCTION** Species 1: Acacia sp. Species 1: MTHW Species 1: Acacia sp. Species 1: MTHW Year Mill requirement Harv. Vol. Logged Vol. Survival F. | Conv. Rate Prod. Cap. (tonnes of oncession Vol. of Prod Current EC Cost Harv. Cost Log. Total Log. Prod. (tonnes of pulp) (tonnes (tonnes of Sources (tonnes of area (m³/ha) m³ wood/ (t pulp) (%) (%) pulp) Area (%) Prod. (m³/t pulp) (US\$/m3) (m³ of (US\$) (US\$/m3) (m³) (US\$/m3) (m³) (US\$) Logged (US\$/ha) (tonnes of pulp) pulp) (tonnes (ha) pulp) (m³/Ha) wood) pulp, cumm.) of pulp) pulp) 1.00 1984 117 600 117 600 117 600 415 4.40 120 000 0.98 674 400 40.000 0.72 123.75 4.50 \$21 168 000 00 40 529,200 \$5.935.446 \$0.46 \$11.22 529.200.00 \$5 486 575 4,276 \$1,283 131.6 0.73 0.00 \$21,168,000.00 1.00 1985 117.600 117 600 117.600 351 131.6 0.73 4.40 120,000 0.98 556.800 40,000 0.72 123.75 4.50 40 529,200 \$5,935,446 \$0.46 0.00 \$11.22 529,200.00 \$10,973,149 4,276 \$1,283 1.00 1986 117.600 117,600 117.600 1.350 145.6 0.73 4.40 120.000 0.98 439,200 40,000 0.72 123.75 4.50 \$21,168,000.00 529,200 \$5,935,446 0.00 \$11.22 529,200.00 \$16,459,724 4,276 \$1,283 \$0.46 1.00 117.600 117.600 1987 117.600 1.848 145.6 0.73 4.40 0.98 321.600 \$21,168,000.00 40 529.200 \$5.935.446 \$21,946,298 4,276 120.000 40.000 0.72 123.75 4.50 \$0.46 0.00 \$11.22 529.200.00 \$1.283 1988 117 600 117 600 117 600 2,125 166.6 4.40 120.000 204.000 40.000 123.75 4.50 \$21,168,000.00 529,200 \$5.935.446 \$0.46 0.00 \$11.22 529,200.00 \$27,432,873 4,276 \$1,283 1989 117,600 117,600 117,600 7,847 166.6 0.98 \$21,168,000.00 529,200 \$5,935,446 \$32,919,447 120.000 86,400 40.000 123.75 4.50 0.00 529.200.0 4,276 \$1,283 1990 86,400 17 600 86,400 15,622 180.6 0.73 4 40 120,000 40,000 123.75 4.50 \$15,552,000.00 388,800 \$4,360,736 \$0.46 0.00 \$11.22 388.800.0 \$36,950,400 3,142 \$1.283 0.08 117.600 1991 9.086 9.085.78 187.6 0.98 39.97 11.099 40.000 0.72 123.75 4.50 \$1.599.097.92 \$18.259 \$0.46 39.977.45 \$36.950.400 9.086 0.73 4.40 120.000 \$11.22 \$1.283 0.07 7 685 117 600 7 684 60 1992 7 685 9.134 187 6 0.73 4.40 120 000 0.98 40.000 0.72 123 75 4.50 \$1.352.490.05 33.812 \$15,443 \$0.46 33.812.25 \$11.22 \$36 950 400 \$1,283 0.28 1993 32,700 117 600 32.700 32.700.44 8.962 187.6 0.73 4.40 120,000 0.98 40.000 0.72 123.75 4.50 \$5,755,276.80 40 143.882 \$65.715 \$0.46 143.881.92 \$11.22 \$36,950,400 0 \$1,283 1994 44,756 372,400 0.98 40,000 196,926 44.756 44.756.00 11,662 187.6 4.40 380.000 0.72 4.50 \$7.877.055.5 \$89.942 \$0.46 196.926.39 \$36.950.400 \$1,283 1995 58,897 372,400 58,897 58,896.89 13.484 187.6 0.73 4.40 380.000 0.98 40,000 0.72 123.75 4.50 \$10,365,852.00 40 259,146 \$118,360 \$0.46 259,146.30 \$11.22 \$36,950,400 0 \$1,283 0.54 1996 217 495 401 800 217 495 217 495 25 0.98 40 000 4.50 \$38 279 164 61 956 979 \$437 081 \$36,950,400 15 328 201.6 0.73 4 40 410 000 0.72 123 75 40 \$0.46 956 979 12 \$11 22 0.00 0 \$1,283 0.75 1997 469.353 622,300 469,353 469.352.53 19.184 201.6 0.73 4.40 635 000 0.98 5 147 505 259.975 0.72 123.75 4.50 \$82,606,044.99 40 2 065 151 \$943.216 \$0.46 2,065,151.12 \$11.22 \$36.950.400 0 \$1,283 1.00 1998 622,300 622,300 622,300 346.388.72 12,959 201.6 0.73 4.40 635.000 0.98 4,525,205 259,975 0.72 123.75 4.50 \$112,014,000.00 40 2,800,350 \$31,408,404 \$0.46 0.00 \$11.22 2,800,350.00 \$65.983.524 22,629 \$1,283 1999 622,300 622,300 622,300 631.466.38 19.087 201.6 4.40 635.000 0.98 3,902,905 259.975 0.72 123.75 4.50 \$112,014,000.00 \$31,408,404 0.00 \$11.22 \$95.016.64 22,629 \$1,283 2000 622,300 622,300 622,300 911,156.60 14,697 201.6 0.73 4.40 635,000 0.98 259.975 0.72 123.75 4.50 \$112,014,000.00 40 2,800,350 \$31,408,404 \$0.46 0.00 \$11.22 2,800,350.00 \$124,049,771 22.629 3.280.60 \$1.283 2001 4 40 0.98 \$352 800 000 00 8 820 000 \$98 924 108 \$215 492 680 1 960 000 1 960 000 1 960 000 1 275 118 94 22.836 201.6 0.73 2 000 000 1 320 605 259.975 0.72 123.75 4.50 \$0.46 0.00 \$11.22 | 8,820,000.00 71.273 \$1.283 2002 1 960 000 1.960.000 639 395 1,320,605 695 964 62 4.40 2.000.000 0.98 259.975 123 75 4.50 \$350,242,420.00 8.756.061 \$67 937 828 \$0.46 2 813 338 00 \$11.22 5,942,722.50 \$277 104 906 48,022 \$1,283 2003 1,570,637 1,960,000 1,570,637 1,570,637.24 18,000 215.6 4.40 2,000,000 259,975 123.75 4.50 \$276,432,155.01 6,910,804 \$3,156,369 6,910,803.88 \$11.22 \$277.104.906 \$1,283 2004 1,960,000 643,407 643,407 643,407.08 18,000 229.6 4.40 2,000,000 259,975 123.75 4.50 \$113,239,645.7 2,830,991 \$1,292,998 \$0.46 2,830,991.14 \$277,104,906 \$1,283 2005 434,637 1.960.00 434,637 434,637.10 18.000 229.6 2,000,000 259.975 123.75 4.50 \$76,496,128,77 1.912.403 \$873.45 1,912,403.22 \$277,104,900 \$1,283 2 000 000 0.98 2006 1 960 000 640 144 18 000 4.50 \$112 665 416 69 2 816 635 2 816 635 42 \$277 104 906 640 144 640 144 41 259.975 123 75 \$1,286,441 \$0.46 \$1,283 2007 492.917 1.960.000 492.917 492.916.99 18.000 243.6 4.40 2.000.000 0.98 259.975 123 75 4.50 \$86,753,389,69 2.168.835 \$990.57 2.168.834.74 \$11 22 \$277 104 906 \$1,283 2008 765,896 1,960,000 765,896 765,895.87 18,000 2,000,000 259,975 123.75 4.50 \$134,797,673.04 3,369,942 \$1,539,152 3,369,941.83 \$277,104,906 \$1,283 2009 774,430 1.960.000 774,430 774,429.93 18,000 243.6 2,000,000 259,975 123.75 4.50 \$136,299,668.29 3,407,492 \$1,556,302 \$0.46 3,407,491.71 \$277,104,906 \$1,283 645,624 2,000,000 0.98 123.75 \$0.46 2,840,745.60 2010 1.960.000 645.624 645.624.00 18.000 263.2 4.40 259.975 4.50 \$113.629.824.00 2.840.746 \$1,297,453 \$11.22 \$277,104,906 \$1.283 687 548 1 960 000 687 548 687 547 64 18 000 2 000 000 0.98 \$121 008 384 00 3 025 210 3 025 209 60 \$277 104 906 263 2 4 40 259 975 123 75 4.50 \$1 381 703 \$0.46 \$11.22 \$1.283 0.35 2012 687 548 1.960.000 687 548 687 547 64 18.000 263.2 0.73 4.40 2 000 000 0.98 259.975 0.72 123 75 4.50 \$121.008.384.00 3.025.21 \$1.381.70 \$0.46 3.025.209.60 \$11.22 \$277 104 906 \$1,283 2013 729,471 1,960,000 729,471 729,471.27 18,000 263.2 0.73 2,000,000 0.98 259,975 0.72 123.75 4.50 \$128,386,944.00 40 3,209,674 \$1,465,953 \$0.46 3,209,673.60 \$11.22 \$277,104,906 0 \$1,283 4.40 0.98 2014 729,471 1,960,000 729,471 729,471.27 18,000 263.2 0.73 4.40 2,000,000 259,975 0.72 123.75 4.50 \$128,386,944.00 3,209,674 \$1,465,953 \$0.46 3,209,673.60 \$11.22 \$277,104,906 \$1,283 729,471 0.73 0.98 0 \$1,283 2015 1.960.000 729.471 729.471.2 18.000 263.2 4.40 2.000.000 259.975 0.72 123.75 4.50 \$128.386.944.00 40 3.209.674 \$1,465,953 \$0.46 3.209.673.60 \$11.22 0.00 \$277.104.906 2016 729.471 1 960 000 729 471 729 471 27 18 000 263.2 0.73 4 40 2 000 000 0.98 259.975 0.72 123.75 4.50 \$128.386.944.00 40 3,209,674 \$1 465 953 \$0.46 3.209.673.60 \$11.22 0.00 \$277 104 906 0 \$1,283 0.40 788.164 1.960.000 788.164 788.164.36 18.000 263.2 0.73 4.40 2 000 000 0.98 259.975 0.72 123.75 4.50 \$138.716.928.00 40 3.467.923 \$1.583.903 \$0.46 3.467.923.20 \$11.22 0.00 \$277 104 906 0 \$1,283 2018 788,164 1,960,000 788,164 788,164.36 18,000 263.2 0.73 4.40 2,000,000 0.98 0.72 123.75 4.50 \$138,716,928.00 40 3,467,923 \$0.46 3,467,923.20 \$11.22 \$277,104,906 0 \$1,283 259.975 \$1.583.903 2019 788,164 1,960,000 788,164 788,164.36 18,000 0.73 4.40 2,000,000 0.98 259,975 0.72 4.50 \$138,716,928.00 3,467,923 \$1,583,903 \$0.46 3,467,923.20 0.00 \$277,104,906 263.2 123.75 \$11.22 0 \$1.283 0.73 3,467,923.20 0 \$1,283 2020 788.164 1.960.000 788.164 788.164.36 18.000 263.2 4.40 2.000.000 0.98 259.975 0.72 123.75 4.50 \$138.716.928.00 40 3,467,923 \$1.583.903 \$0.46 \$11.22 0.00 \$277.104.906 0.40 0 \$1,283 2021 788.164 1 960 000 788 164 788.164.36 18 000 263.2 0.73 4 40 2 000 000 0.98 259,975 0.72 123.75 4.50 \$138.716.928.00 40 3.467.923 \$1 583 903 \$0.46 3.467.923.20 \$11.22 \$277 104 906 0.40 788,164 1.960.000 788,164 788,164.36 18,000 263.2 4.40 2,000,000 0.98 259,975 123.75 4.50 \$138,716,928,00 3.467.923 \$1,583,903 \$0.46 3,467,923.20 \$11.22 \$277.104.906 \$1,283 788,164 1,960,000 788,164 788,164.36 18,000 4.40 2,000,000 0.98 4.50 \$138,716,928.00 3,467,923.20 \$277,104,906 2023 263.2 259.975 123.75 3.467.923 \$1.583.903 \$1,283 0.98 2024 788,164 1,960,000 788,164 788,164.36 18,000 4.40 2,000,000 259,975 4.50 \$138,716,928.00 3,467,923 \$1,583,903 3,467,923.20 \$277,104,906 \$1,283 263.2 123.75 \$0.46 788.164 1.960.000 788.164 788.164.36 18.000 2.000.000 0.98 259.975 123.75 4.50 \$138,716,928,00 3.467.923 \$1.583.903 \$0.46 3.467.923.20 \$277,104,906 \$1,283 2025 263.2 2.000.000 2026 788.164 1 960 000 788.164 788.164.36 18 000 263.2 259,975 123.75 4.50 \$138,716,928,00 3.467.923 \$1 583 903 3.467.923.20 \$277 104 906 \$1,283 788,164 1,960,000 788,164 788,164.36 18,000 2,000,000 0.98 259,975 123.75 4.50 \$138,716,928.00 3,467,923 \$1,583,903 3,467,923.20 \$277,104,906 \$1,283 263.2 4.40 18,000 2,000,000 \$138,716,928.00 3,467,923.20 2028 263.2 259,975 \$1.583.903 \$277,104,900 \$1,283 0.98 2029 788,164 1,960,000 788,164 788,164.36 18,000 2,000,000 259,975 123.75 4.50 \$138,716,928.00 3,467,923 \$1,583,903 3,467,923.20 \$277,104,906 \$1,283 263.2 \$0.46 2030 788 164 1 960 000 788 164 788 164 36 18 000 2 000 000 0.98 259 975 123 75 4.50 \$138 716 928 00 3 467 923 \$1 583 903 \$0.46 3 467 923 20 \$11 22 \$277 104 906 \$1,283 263.2 4 40 788.164 1.960.000 788.164 788.164.36 18 000 263.2 4.40 2 000 000 0.98 259.975 123.75 4.50 \$138.716.928.00 3.467.923 \$1 583 903 \$0.46 3.467.923.20 \$11.22 \$277 104 906 \$1,283 0.40 788,164 1,960,000 788,164 788,164.36 18,000 263.2 4.40 2,000,000 0.98 259.975 123.75 4.50 \$138,716,928.00 3,467,923 \$1,583,903 \$0.46 3,467,923.20 \$11.22 \$277,104,906 \$1,283 2,000,000 0.98 3,467,923.20 2033 788,164 1.960.00 788.164 18.000 263.2 0.73 259.975 123.75 \$138,716,928,00 40 \$1.583.903 \$0.46 \$277,104,906 0 \$1,283 788,164 1,960,000 788,164.36 2,000,000 0.98 4.50 \$138,716,928.00 \$1,583,903 3,467,923.20 \$277,104,906 0 | \$1,283 2034 788.164 18.000 263.2 4.40 259.975 0.72 123.75 3.467.923 \$0.46 \$11.22 0.00 0.73 0.40 788 164 1 960 000 788 164 788 164 36 0.73 2 000 000 0.98 259 975 0.72 123 75 \$138 716 928 00 40 3 467 923 \$1 583 903 \$0.46 3 467 923 20 \$11.22 \$277 104 906 0 \$1.283 2035 18 000 263.2 4 40 4.50 0.00 0.40 2036 788.164 1 960 000 788 164 788 164 36 18 000 263.2 0.73 4 40 2 000 000 0.98 259.975 0.72 123 75 4 50 \$138 716 928 00 40 3,467,923 \$1.583.903 \$0.46 3.467.923.20 \$11.22 0.00 \$277 104 906 0 \$1,283 0.40 788,164 1,960,000 788,164 788,164.36 18,000 263.2 0.73 4.40 2,000,000 0.98 259,975 0.72 123.75 4.50 \$138,716,928.00 40 3,467,923 \$1,583,903 \$0.46 3,467,923.20 \$11.22 0.00 \$277,104,906 \$1,283 788.164 1.960.000 788.164 788,164.36 18.000 263.2 0.73 4.40 2,000,000 259.975 \$138.716.928.00 40 3.467.923 \$0.46 3.467.923.20 0.00 \$277.104.906

Notes: ANF = available natural forest.

Cap. = capacity. Conv. = conversion.

DF = demand fitness. F. = factor.

Harv. = harvesting; harvested.

Log. = logging; logged

MI = mean increment (mean annual increment, MAI * years in rotation).

MTHW = mixed tropical hard wood. Prod. = production.

TEV = total economic value.

Vol. = volume.

I.3. Riau Forestry

Plantation Company: RAPP

Natural coverage

Species 1 MTHW

Species 2

Species 3

Planted species

Species 1 Acacia sp.

Species 2

Species 3

Related Mill Company: RAPP

Kabupatens: PELALAWAN

KUANTAN SINGINGI (Districts)

KAMPAR INDRAGIRI HULU

SIAK

EB total = US\$4,114,463,362

EB (1984)12% = US\$269,709,028 EB (1984)8% = US\$556,385,589

EB (1984)4% = US\$1,336,119,511

Current EC EC total =US\$370,787,482

BCR
EC (1984)12% = US\$495,253,977 0.54
EC (1984)8% = US\$1,222,022,515 0.46
EC (1984)4% = US\$3,547,376,172 0.38
Estimated EC
EC total =US\$12,870,141,863

	DEMAND FITNESS VOLUME OF PRODUCTIO					DUCTION		MILL RE	MILL REQUIREMENT		ANF AVAILABLE NATURAL FOREST VOLUME					ECONOMIC BENEFITS			ECONOMIC COSTS										
1				il —	T			1	Species 1: Ac	cia sp.				Restricted		Spe	ecies 1: MTHW				T	s	pecies 1: Acaci	sp.	Species	1: MTHW			
DF	Year	Volume Prod.	Mill requirement	Harv. Vol.	Logged Vol.	Other Sources	Harvestable	Planted area	MI Surv	val F. Conv. Rate	Prod. Cap.	Quota		(tonnes of	Con. Area	Feaseble	Mean Wood Prod.	Conv. Rate	EB	Price	Vol. of Prod.	Current EC	Cost Harv.	Total Harv.	Cost Log.	Total Log.	Estimated EC	Area	TEV
		(tonnes pulp)	(tonnes pulp)	(tonnes	(tonnes pulp)	(tonnes pulp)	(tonnes of pulp,	(ha)	(m³/ha) () (m³ wood/t pulp	(tonnes of pulp)	(%)		pulp)	(ha)	(%)	(m³/ha)	(m³/t pulp)	(US\$)	(US\$/m³)	(m³ of	(US\$)	(US\$/m³)	(m³)	(US\$/m³)	(m³)	(US\$)	Logged (ha)	(US\$/ha)
				pulp)			cumm.)				_			<u> </u>			1				wood)	<u> </u>						(na)	
0.00	1984 1985	0	0		0	0				4.4		1 1	-				120		\$0.00	40	0	\$0	\$0.46 \$0.46	0.00	\$11.22 \$11.22	0.00	\$0	0 '	\$1,283 \$1,283
0.00	1986	0	0	$\left\{ \left[\begin{array}{c} 0 \\ 0 \end{array} \right]$	0	0		1		4.4		1	0		+		120	4.50	\$0.00	40	0	\$0	\$0.46	0.00	\$11.22 \$11.22	0.00	\$0	0	\$1,283
0.00	1987	0	0		0	0				4.4	. 11	1	0				120		\$0.00	40	0	\$0	\$0.46	0.00	\$11.22	0.00	\$0	0	\$1,283
0.00	1988	0	0	0	0	0				4.4	0	1	0	0			120	4.50	\$0.00	40	0	\$0	\$0.46	0.00	\$11.22	0.00	\$0	0	\$1,283
0.00	1989	0	0	0	0	0				4.4		1	0	0			120	4.50	\$0.00	40	0	\$0	\$0.46	0.00	\$11.22	0.00	\$0	0 '	\$1,283
0.00	1990	0	0	0	0	0	0.00			4.4		1 1	0	0			120	4.50	\$0.00	40	0	\$0	\$0.46	0.00	\$11.22	0.00	\$0	0 '	\$1,283
0.00	1991 1992	0	0		0	0	0.00			4.4		1 1	0	1			120 120	4.50 4.50	\$0.00	40	0	\$0	\$0.46 \$0.46	0.00	\$11.22 \$11.22	0.00	\$0	0	\$1,283 \$1,283
0.00	1993	0	0	$\left\{ \left[\begin{array}{c} 0 \\ 0 \end{array} \right]$	0	0	0.00	389	161	0.70 4.4		1	0	6.688.000	330,000	0.76			\$0.00	40	0	\$0	\$0.46	0.00	\$11.22	0.00	\$0	0	\$1,283
0.00	1994	0	0		0	0	0.00	1,220	161	0.70 4.4		1	0	6,688,000	330,000	0.76			\$0.00	40	0	\$0	\$0.46	0.00	\$11.22	0.00	\$0	0	\$1,283
1.00	1995	301,000	301,000	0	301,000	0	0.00	7,192	161	0.70 4.4	700,000	1	0.43	6,387,000	330,000	0.76	120	4.50	\$54,180,000.00	40	1,354,500	\$15,191,917	\$0.46	0.00	\$11.22	1,354,500.00	\$14,481,863	11,288	\$1,283
1.00	1996	469,000	469,000	0	469,000	0	0.00	12,941	161	0.70 4.4			0.67	5,918,000	330,000	0.76			\$84,420,000.00	40	2,110,500	\$23,671,126	\$0.46	0.00	\$11.22	2,110,500.00	\$37,046,625	17,588	\$1,283
1.00	1997	560,000	560,000	0	560,000	0	0.00	17,048	161	0.70 4.4			0.80	5,358,000	330,000	0.76			\$100,800,000.00	40	_,-,,	\$28,264,031	\$0.46	0.00	\$11.22	2,520,000.00	\$63,989,625	21,000	\$1,283
1.00	1998 1999	1,170,000	1,170,000 1,274,000		1,170,000 1,274,000	0	0.00	12,148	161	0.70 4.4			0.90	4,188,000	330,000	0.76			\$210,600,000.00	40	5,265,000	\$59,051,636	\$0.46	0.00	\$11.22	5,265,000.00 5,733,000.00	\$120,281,250	43,875 47,775	\$1,283
1.00	2000	1,274,000 1,274,000	1,274,000	11 0	1,274,000	0	9.949.47	13,675 6.981	161	0.70 4.4 0.70 4.4	,,,,,,,		0.96	2,914,000	330,000 330,000	0.76 0.76			\$229,320,000.00 \$229,320,000.00	40	5,733,000 5,733,000	\$64,300,670 \$64,300,670	\$0.46 \$0.46	0.00	\$11.22 \$11.22	5,733,000.00	\$181,576,575 \$242.871.900	47,775	\$1,283 \$1,283
1.00	2001	1,274,000	1,274,000		1,274,000	0	41.153.47	13,498	161	0.70 4.4	7,		0.98	366,000	330,000	0.76	+		\$229,320,000.00	40	5,733,000	\$64,300,670	\$0.46	0.00	\$11.22	5,733,000.00	\$304,167,225	47,775	\$1,283
0.30	2002	591,104	1,960,000	225,104		0	225,103.58	21,576	161	0.70 4.4			0.98	0	330,000	0.76			\$105,498,229.56	40		\$18,924,933	\$0.46	990,455.74	\$11.22	1,647,000.00	\$321,776,400	13,725	\$1,283
0.17	2003	330,993	1,960,000	330,993	0	0	330,992.55	14,000	161	0.70 4.4	2,000,000) 1	0.98	0	330,000	0.76	120	4.50	\$58,254,687.96	40	1,456,367	\$665,166	\$0.46	1,456,367.20	\$11.22	0.00	\$321,776,400	0	\$1,283
0.22	2004	436,037	1,960,000	436,037	0	0	436,037.47	14,000	161	0.70 4.4	2,000,000) 1	0.98	0	330,000	0.76	120	4.50	\$76,742,594.88	40	1,918,565	\$876,265	\$0.46	1,918,564.87	\$11.22	0.00	\$321,776,400	0	\$1,283
0.16	2005	310,710	1,960,000	310,710		0	310,709.95	14,000	161	0.70 4.4			0.98	0	330,000	0.76		1 1	\$54,684,950.88	40	.,00.,.2.	\$624,406	\$0.46	1,367,123.77	\$11.22	0.00	\$321,776,400		\$1,283
0.18	2006	349,766	1,960,000	349,766		0	349,766.10	14,000	161	0.70 4.4		_	0.98		330,000	0.76			\$61,558,833.00	40	, , .	\$702,894	-	1,538,970.83	\$11.22	0.00	\$321,776,400	0 '	\$1,283
0.09	2007	178,553	1,960,000 1,960,000	178,553		0	178,553.35 345,238.96	14,000 14,000	161	0.70 4.4 0.70 4.4			0.98	1	330,000 330,000	0.76 0.76			\$31,425,390.36 \$60,762,056.88	40	785,635 1,519,051	\$358,823 \$693,796	\$0.46 \$0.46	785,634.76 1,519,051.42	\$11.22 \$11.22	0.00	\$321,776,400 \$321,776,400	0	\$1,283
0.18	2009	345,239 551,850	1,960,000	345,239 551,850		0	551,850.33	14,000	161	0.70 4.4		_	0.98	11 0	330,000	0.76		1	\$97,125,658.56	40	 ' ' 	\$1,109,004	\$0.46	2,428,141.46	\$11.22	0.00	\$321,776,400	0	\$1,283 \$1,283
0.18	2010	358,079	1,960,000	358,079		0	358,078.64	14,000	231	0.70 4.4		_	0.98	1 0	330,000	0.76			\$63,021,840.00	40	1,575,546	\$719,599	\$0.46	1,575,546.00	\$11.22	0.00	\$321,776,400	0	\$1,283
0.18	2011	358,079	1,960,000	358,079		0	358,078.64	14,000	231	0.70 4.4			0.98	0	330,000	0.76			\$63,021,840.00	40	1,575,546	\$719,599	\$0.46	1,575,546.00	\$11.22	0.00	\$321,776,400	0	\$1,283
0.18	2012	358,079	1,960,000	358,079	0	0	358,078.64	14,000	231	0.70 4.4	2,000,000) 1	0.98	0	330,000	0.76	120	4.50	\$63,021,840.00	40	1,575,546	\$719,599	\$0.46	1,575,546.00	\$11.22	0.00	\$321,776,400	0	\$1,283
0.18	2013	358,079	1,960,000	358,079		0	358,078.64	14,000	231	0.70 4.4			0.98	0	330,000	0.76			\$63,021,840.00	40	1,0.0,0.0	\$719,599	\$0.46	1,575,546.00	\$11.22	0.00	\$321,776,400	0 '	\$1,283
0.18	2014	358,079	1,960,000	358,079		0	358,078.64	14,000	231	0.70 4.4		_	0.98	0	330,000	0.76			\$63,021,840.00	40	1,575,546	\$719,599	\$0.46	1,575,546.00	\$11.22	0.00	\$321,776,400	0 '	\$1,283
	2015	358,079	1,960,000	358,079		0	358,078.64	14,000 14,000	231	0.70 4.4 0.70 4.4		_	0.98		330,000	0.76			\$63,021,840.00	40	1,575,546 1,575,546	\$719,599	\$0.46 \$0.46	1,575,546.00 1,575,546.00	\$11.22 \$11.22	0.00	\$321,776,400 \$321,776,400	0	\$1,283
0.18	2017	358,079 513,765	1,960,000 1,960,000	358,079 513,765	0	0	358,078.64 513,765.00	14,000	231	0.70 4.4 0.70 4.4			0.98	11 0	330,000 330,000	0.76			\$63,021,840.00 \$90,422,640.00	40		\$719,599 \$1,032,468	\$0.46	2,260,566.00	\$11.22 \$11.22	0.00	\$321,776,400	0	\$1,283 \$1,283
0.26	2018	513,765	1,960,000	513,765	0	0	513,765.00	14,000	231	0.70 4.4		_		1 0	330,000	0.76			\$90,422,640.00	40		\$1,032,468	\$0.46	2,260,566.00	\$11.22	0.00	\$321,776,400	0	\$1,283
0.26	2019	513,765	1,960,000	513,765	0	0	513,765.00	14,000	231	0.70 4.4		_	0.98	0	330,000	0.76			\$90,422,640.00	40	2,260,566	\$1,032,468	\$0.46	2,260,566.00	\$11.22	0.00	\$321,776,400	0	\$1,283
0.26	2020	513,765	1,960,000	513,765	0	0	513,765.00	14,000	231	0.70 4.4	2,000,000) 1	0.98	0	330,000	0.76	120	4.50	\$90,422,640.00	40	2,260,566	\$1,032,468	\$0.46	2,260,566.00	\$11.22	0.00	\$321,776,400	0	\$1,283
0.26	2021	513,765	1,960,000	513,765	0	0	513,765.00	14,000	231	0.70 4.4		_	0.98	0	330,000	0.76			\$90,422,640.00	40	,,	\$1,032,468	\$0.46	2,260,566.00	\$11.22	0.00	\$321,776,400		\$1,283
0.26	2022	513,765	1,960,000	513,765	0	0	513,765.00	14,000	231	0.70 4.4		_	0.98		330,000	0.76			\$90,422,640.00	40	,,	\$1,032,468	\$0.46	2,260,566.00	\$11.22	0.00	\$321,776,400	0 '	\$1,283
0.26	2023	513,765 513,765	1,960,000 1,960,000	513,765 513,765	0	0	513,765.00 513,765.00	14,000	231	0.70 4.4 0.70 4.4	⊣		0.98		330,000 330,000	0.76			\$90,422,640.00 \$90,422,640.00	40	2,260,566	\$1,032,468 \$1,032,468	\$0.46 \$0.46	2,260,566.00 2,260,566.00	\$11.22 \$11.22	0.00	\$321,776,400 \$321,776,400	0	\$1,283
0.26	2024	513,765	1,960,000	513,765	0	0	513,765.00	14,000	231	0.70 4.4 0.70 4.4	⊣	_	0.96	11 6	330,000	0.76 0.76			\$90,422,640.00	40	_,,	\$1,032,468	\$0.46	2,260,566.00	\$11.22	0.00	\$321,776,400	0	\$1,283 \$1,283
	2026	513,765	1,960,000	513,765	0	0	513,765.00	14,000	231	0.70 4.4	⊣	_	0.98		330,000	0.76			\$90,422,640.00	40	2,260,566	\$1,032,468	\$0.46	2,260,566.00	\$11.22	0.00	\$321,776,400	0	\$1,283
0.26	2027	513,765	1,960,000	513,765	0	0	513,765.00	14,000	231	0.70 4.4			0.98	0	330,000	0.76			\$90,422,640.00	40		04 000 400	\$0.46		\$11.22	0.00	0004 770 400	0	\$1,283
0.26 0.26	2028	513,765	1,960,000	513,765	0	0	513,765.00	14,000	231	0.70 4.4	2,000,000		0.98	0	330,000	0.76	120		\$90,422,640.00	40	2,260,566	\$1,032,468	\$0.46	2,260,566.00	\$11.22	0.00	\$321,776,400	0	\$1,283
0.26	2029	513,765	1,960,000	513,765		0	513,765.00	14,000	231	0.70 4.4			0.98	0	330,000	0.76			\$90,422,640.00	40		\$1,032,468			\$11.22	0.00	\$321,776,400		\$1,283
0.26	2030	513,765	1,960,000	513,765		0	513,765.00	14,000	231	0.70 4.4			0.98	1 0	330,000	0.76			\$90,422,640.00	40		\$1,032,468			\$11.22	0.00	\$321,776,400		\$1,283
0.26 0.26	2031	513,765 513,765	1,960,000 1,960,000	513,765		0	513,765.00 513,765.00	14,000	231	0.70 4.4			0.98		330,000	0.76			\$90,422,640.00	40		\$1,032,468			\$11.22 \$11.22	0.00	\$321,776,400 \$321,776,400		\$1,283
0.26	2032	513,765 513,765	1,960,000	513,765 513,765		0	513,765.00 513,765.00	14,000 14,000	231	0.70 4.4 0.70 4.4			0.98		330,000 330,000	0.76			\$90,422,640.00 \$90,422,640.00	40		\$1,032,468 \$1,032,468			\$11.22 \$11.22	0.00	\$321,776,400		\$1,283 \$1,283
0.26	2034	513,765	1,960,000	513,765		0	513,765.00	14,000	231	0.70 4.4			0.98	11 0	330,000	0.76			\$90,422,640.00	40		\$1,032,468			\$11.22	0.00			\$1,283
0.26	2035	513,765	1,960,000	513,765		0	513,765.00	14,000	231	0.70 4.4				1 0	330,000	0.76			\$90,422,640.00	40		\$1,032,468			\$11.22	0.00	\$321,776,400		\$1,283
0.26	2036	513,765	1,960,000	513,765		0	513,765.00	14,000	231	0.70 4.4			0.98	0	330,000	0.76			\$90,422,640.00	40		\$1,032,468			\$11.22	0.00			\$1,283
0.26	2037	513,765	1,960,000	513,765		0	513,765.00	14,000	231	0.70 4.4			0.98	0	330,000	0.76			\$90,422,640.00		2,260,566	\$1,032,468		2,260,566.00	\$11.22	0.00			\$1,283
0.26	2038	513,765	1,960,000	513,765	0	0	513,765.00	14,000	231	0.70 4.4	2,000,000) 1	0.98]0	330,000	0.76	120	4.50	\$90,422,640.00	40	2,260,566	\$1,032,468	\$0.46	2,260,566.00	\$11.22	0.00	\$321,776,400	. 0	\$1,283
Notes:	ANF = a	available natura	al forest.		Harv. = har	vesting; harvested.																							

Notes: ANF = available natural forest.

Cap. = capacity. Con. = concession.

Conv. = conversion. DF = demand fitness. F. = factor.

Harv. = harvesting; harvested.

Log. = logging; logged.

MI = mean increment (mean annual increment, MAI * years in rotation).

MTHW = mixed tropical hard wood.

Prod. = production.
TEV = total economic value.

Vol. = volume.

Plantation Company: Wira Karya Sakti

Natural coverage

Species 1 MTHW

Species 2

Species 3

Planted species

Species 1 Acacia sp.

Species 2

Species 3

Related Mill Company: Lontar Papyrus
Kabupatens: TAN JAB BARAT

(Districts) BATANG HARI MUARO JAMBI

TAN JAB TIMUR

EB (1984)12% = U\$\$,196,769,551 EB (1984)8% = U\$\$,426,455,511 EB (1984)4% = U\$\$,1,106,100,135

 Current EC
 Estimated EC

 EB total = US\$3,720,852,925
 EC total = US\$256,481,789
 EC total = US\$8,197,029,284

EC (1984)12% = US\$319,480,269

US\$780,475,981

US\$2,257,196,475 0.49

EC (1984)8% =

EC (1984)4% =

0.62

DEMAND FITNESS HARVESTABLE VOLUME MILL REQUIREMENT AVAILABLE NF VOLUME **ECONOMIC BENEFITS ECONOMIC COSTS VOLUME OF PRODUCTION** ANF Species 1: Acacia sp. Species 1: MTHW Species 1: Acacia sp. Species 1: MTHW Prod. Cap. Harv. Vol. Logged Survival F. | Conv. Rate Quota Con. Area Mean Wood Current EC Cost Harv Cost Log. Total Log. Area Logged (tonnes Vol. Sources (tonnes pulp, area (%) (m³ wood/t (tonnes (%) (%) (ha) (%) Prod (m³/t pulp) (US\$/m³) (m³ of wood) (US\$) (US\$/m3) (US\$/m³) (US\$) (US\$/ha) (tonnes of (tonnes of pulp) (tonnes pulp) pulp) (m³/ha) pulp) pulp) pulp) pulp) 4.40 123.75 123.75 \$0.46 \$0.46 4.40 \$1,283 0.00 4 40 123.75 4 50 \$0.00 \$0.46 0.00 \$11.22 0.00 \$1,283 0.00 1987 4.40 123.75 4.50 \$0.00 \$0.46 0.00 \$11.22 0.00 \$1,283 0.00 4.40 123.75 4.50 \$0.00 \$0.46 0.00 \$11.22 0.00 \$1,283 4.40 123.75 4.50 0.00 0.00 1989 \$0.00 \$0.46 0.00 \$11.22 \$1,283 4.40 123.75 4.50 \$0.46 0.00 1990 \$0.00 0.00 \$11.22 \$1,283 4 40 123.75 \$0.46 \$1,283 869,000 4.40 123.75 4.50 \$0.46 \$1,283 110.07 186.9 0.67 0.79 0.00 869,000 40,000 123.75 4.50 \$0.46 0.00 \$1,283 \$0.00 \$11.22 401,800 186.9 410,000 0.98 467,200 4.50 1,808,100 \$20,279,442 \$18,745,796 1.00 401.800 401.800 124.42 0.67 4.40 40.000 123.75 \$72.324.000.00 \$0.46 1.808.100.00 14.611 \$1,283 1994 0.79 0.00 \$11.22 \$20,279,442 0.79 1995 401 800 401 800 401 800 1 516 52 186 9 0.67 4 40 410 000 0.98 65 400 40 000 123 75 4.50 \$72 324 000 00 1 808 100 \$0.46 0.00 \$11.22 1 808 100 00 \$37 491 593 14 611 \$1,283 0.16 1996 65.400 401 800 65.400 5.532.37 186.9 0.67 4 40 410.000 0.98 3.550.930 163,449 0.79 123.75 4 50 \$11,772,000.00 294.300 \$3,300,835 \$0.46 0.00 \$11.22 294.300.00 \$40.542.800 2.378 \$1,283 \$20,279,442 1997 401,800 401,800 401,800 8.319.06 186.9 4.40 410.000 0.98 ,149,130 163.449 0.79 123.75 4.50 \$72,324,000.00 1.808.10 \$0.46 1,808,100.00 \$59,288,596 \$1,283 401.800 401.800 1.808.100.00 401.800 410.000 2.747.330 163.449 0.79 123.75 4.50 \$72.324.000.00 1.808.10 \$20,279,442 \$0.46 \$78.034.393 14.611 8.855.87 0.98 0.00 \$1,283 \$11.22 1999 401.800 401.800 401.800 10.239.25 186.9 0.67 4.40 410.000 0.98 2.345.530 163,449 0.79 123.75 4.50 \$72.324.000.00 1 808 10 \$20,279,442 \$0.46 0.00 \$11.22 1 808 100 00 \$96.780.189 14.611 \$1,283 1.00 2000 401,800 401.800 401,800 3.841 14.099.07 186.9 0.67 4.40 410.000 0.98 1,943,730 163,449 0.79 123.75 4.50 \$72,324,000.00 1 808 10 \$20,279,442 \$0.46 0.00 \$11.22 1.808.100.00 \$115.525.985 14,611 \$1,283 686,000 18,948.42 0.67 0.98 163,449 0.79 123.75 4.50 3,087,000 3,087,000.00 \$1,283 686.000 686.000 1.257.730 \$123,480,000,00 \$34,623,438 \$0.46 0.00 \$11.22 \$147.531.004 24.945 686,000 686,000 686,000 50,541 17,988.50 4.40 700,000 0.98 163,449 4.50 \$123,480,000.00 3,087,000 \$34,623,438 3,087,000.00 \$179,536,022 24,945 1.00 2002 200.9 0.67 571.730 0.79 123.75 \$0.46 0.00 \$1,283 \$11.22 571 730 0.67 4 50 2,572,782.86 \$206 209 803 686 000 686 000 114 270 200.9 4 40 700 000 0.98 163 449 0.79 123 75 \$123 022 918 10 3 075 57 \$29 085 676 \$0.46 20,790 2003 207 991 10.260.50 502 790 09 \$1.283 2004 330.480 686.000 330 480 330 480 13.000.00 200.9 0.67 4.40 700.000 0.98 163.449 0.79 123.75 4.50 \$58.164.392.09 1 454 11 \$664.135 \$0.46 1.454.109.80 \$206,209,803 \$1,283 2005 252,036 686,000 252,036 252,036 3,000.00 200.9 700,000 0.98 163,449 123.75 4.50 \$44,358,344.36 1,108,95 \$506,494 \$0.46 1,108,958.61 0.00 \$206,209,803 \$1,283 291,407 700.000 0.98 163,449 0.79 123.75 \$51,287,584.1 1.282.19 \$585.614 1,282,189.60 \$11.22 \$206,209,803 \$1,283 2007 735,000 401,256 13,000.00 200.9 0.67 4.40 0.98 163,449 123.75 4.50 \$70,621,113.70 1,765,528 \$806,369 0.00 \$206,209,803 \$1,283 401.256 401.256 750.000 0.79 \$0.46 1.765.527.84 \$11.22 579 662 735 000 0.67 0.79 4 50 2 550 514 2 550 514 18 \$206 209 803 2008 579 662 13 000 00 200.9 750 000 0.98 163 449 123 75 \$102 020 567 09 \$1 164 895 \$0.46 \$11.22 0.00 \$1,283 579 662 4 40 40 0.75 2009 550.297 735 000 550 297 550 297 13 000 00 200.9 0.67 4 40 750.000 1 0.98 163 449 0.79 123.75 4 50 \$96,852,242.62 40 2,421,306 \$1.105.882 \$0.46 2,421,306.07 \$11.22 0.00 \$206.209.803 \$1,283 313,885 735,000 313,885 313,885 13,000.00 4.40 750,000 0.98 163,449 0.79 123.75 4.50 \$55,243,763.26 1,381,094 \$630,787 \$0.46 1,381,094.08 0.00 \$206,209,803 \$1,283 163,449 1,749,839 1,749,839.00 \$206,209,803 \$1,283 735,000 750,000 123.75 \$69,993,560.00 \$799,203 397,691 735,000 397,691 3,000.00 0.98 163,449 \$69,993,560.00 ,749,839 ,749,839.00 \$206,209,803 \$1,283 261.8 750.000 0.79 123.75 \$799.203 397 691 163 449 4 50 \$206 209 803 735 000 397 691 261.8 0.67 123 75 \$69 993 560 00 1 749 839 \$799 203 \$0.46 1 749 839 00 \$11.22 0.00 \$1,283 2013 13 000 00 4.40 750 000 0.98 0.79 0.54 2014 397.691 735 000 397 691 397 691 13 000 00 261.8 0.67 4 40 750.000 0.98 163.449 0.79 123.75 4 50 \$69 993 560 00 40 1 749 839 \$799.203 \$0.46 1.749.839.00 \$11.22 0.00 \$206 209 803 \$1,283 2015 397,691 735,000 397.691 397,691 13,000.00 0.67 4.40 750,000 0.98 163,449 0.79 123.75 4.50 \$69,993,560.00 1,749,839 \$799,203 \$0.46 1,749,839.00 \$11.22 0.00 \$206,209,803 \$1,283 261.8 163,449 397.691 735.000 13.000.00 750.000 0.98 0.79 123.75 \$69,993,560.00 1.749.839 \$799,203 \$0.46 1,749,839.00 \$11.22 \$206,209,803 \$1,283 735.000 518.245 3.000.00 4.40 0.98 163,449 4.50 \$1.041.471 2,280,278.00 0.00 \$206,209,803 \$1,283 518.245 518.245 750.000 0.79 123.75 \$91.211.120.00 2.280.278 \$0.46 735 000 163.449 4.50 \$1.041.471 \$206 209 803 518.245 518.245 518.245 3 000 00 750 000 0.98 123.75 \$91.211.120.00 2,280,27 \$0.46 2.280.278.00 \$11.22 \$1,283 518.245 735 000 518.245 518 245 13 000 00 261.8 750.000 0.98 163.449 0.79 123.75 4.50 \$91.211.120.00 2,280,278 \$1.041.471 2,280,278.00 \$206.209.803 \$1,283 2020 518,245 735,000 518,245 13,000.00 750,000 0.98 163,449 123.75 4.50 \$91,211,120.00 2,280,27 \$1,041,471 \$0.46 2,280,278.00 0.00 \$206,209,803 \$1,283 518.245 0.67 518,245 735.000 518.245 518,245 750,000 0.98 163,449 0.79 123.75 \$91.211.120.00 2,280,278 \$1,041,471 \$0.46 2,280,278.00 \$11.22 \$206,209,803 \$1,283 735.000 518.245 13.000.00 4.40 0.98 163,449 4.50 2,280.278 \$1,041,471 0.00 \$206,209,803 \$1,283 2022 518.245 518.245 261.8 0.67 750.000 0.79 123.75 \$91.211.120.00 \$0.46 2,280,278.00 \$11.22 735 000 0.67 163 449 0.79 4.50 \$1 041 471 \$206 209 803 2023 518.245 518.245 518.245 13 000 00 4.40 750 000 0.98 123.75 \$91,211,120,00 2,280,278 \$0.46 2,280,278.00 \$11.22 0.00 \$1,283 2024 518,245 735.000 518,245 518.245 13.000.00 261.8 0.67 4 40 750,000 0.98 163,449 0.79 123.75 4.50 \$91,211,120.00 2,280,278 \$1.041.471 \$0.46 2,280,278.00 \$11.22 0.00 \$206,209,803 \$1,283 518,245 735,000 518,245 3,000.00 750,000 0.98 163,449 4.50 \$91,211,120.00 \$1,041,471 \$206,209,803 \$1,283 123.75 2,280,278 2,280,278.00 163,449 518,245 735,000 518,245 3 000 00 750,000 0.98 0.79 123.75 \$91,211,120.00 2,280,27 \$1,041,471 2,280,278.00 \$206,209,803 \$1,283 518.245 \$11.22 2027 518.245 735.000 518.245 13.000.00 4.40 750.000 0.98 163,449 123.75 4.50 \$1.041.471 0.00 \$206,209,803 \$1,283 518.245 261.8 0.67 0.79 \$91.211.120.00 2.280.278 \$0.46 2,280,278.00 \$11.22 4.50 \$1.041.471 \$206,209,803 2028 518.245 735.000 518.245 518.245 13.000.00 261.8 0.67 4.40 750.000 0.98 163,449 0.79 123.75 \$91,211,120.00 2,280,278 \$0.46 2,280,278.00 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13,000.00 0.67 750,000 0.98 163,449 0.79 123.75 \$91,211,120.00 2,280,278 \$1,041,471 2,280,278.00 \$11.22 \$206,209,803 \$1,283 518,245 13,000.00 0.98 163,449 \$1,041,471 \$206,209,803 2035 518.245 735.000 518.245 750.000 0.79 0.79 123.75 \$91.211.120.00 2,280,278 2,280,278.00 \$1,283 123.75 2,280,278.00 735,000 0.98 163,449 2,280,278 \$1,041,471 \$206,209,803 \$1,283 2036 518.245 518.245 518.245 13.000.00 0.67 750.000 \$91,211,120,00 0.98 2,280,278 2,280,278 \$1,041.471 2,280,278.00 2,280,278.00 13 000 00 518 245 735 000 518 245 518 245 750 000 163 449 123.75 123.75 \$206 209 803 \$1,283 \$1.041.471 \$206,209,803 13.000 00 735 000 518,245 518,245

Notes.

ANF = available natural forest.

MAI = mean annual increment.

MTHW = mixed tropical hard wood.

Prod. = production.

TEV = total economic value.

Vol. = volume.

Log. = logging; logged Cap. = capacity. Con. = concession.

Conv. = conversion.

DF = demand fitness
F. = factor.

Harv. = harvesting; harvested.

I.5. Musi Hutan Persada

Species 2

Species 3

Planted species

Species 1 Acacia sp.

Plantation Company: Musi Hutan Persada

Natural coverage

Species 1 Belukar

Species 2

Species 3

Related Mill Company: Tanjung Enim Lestari

Kabupatens: MUARA ENIM (Districts) LAHAT

OKU

MUSI BANYUASIN MUSI RAWAS

EB (1984)12% = US\$232,016,988 EB (1984)8% = US\$594,828,448 EB (1984)4% = US\$1,789,920,969

Current EC EC total = US\$85,145,294 EB total = US\$6,685,418,447

Estimated EC EC total = US\$2,737,393,486

US\$112,471,049

US\$271,596,775

US\$770,295,134

EC (1984)12% =

EC (1984)8% =

EC (1984)4% =

DEMAND FITNESS VOLUME OF PRODUCTION HARVESTABLE VOLUME MILL REQUIREMENT ANF AVAILABLE NATURAL FOREST VOLUME **ECONOMIC BENEFITS ECONOMIC COSTS** Species 1: Acacia sp. Species 1: Belukar Species 1: Belukar Restricted Species 1: Acacia sp. Planted Survival Conv. Rate Prod. Quota Con. Area Feaseble Mean Vol. of Prod. Current EC Cost Harv. Cost Log. Total Log. Estimated EC Area Logged TEV Volume Harv. Vol. Harvestable Running Logged DF Prod. equiremen F. (m³ wood/t Cap. (%) Rate (US\$/m3) (m3 of wood) (US\$/m3) (US\$/m3) (US\$/ha) (tonnes Vol. Sources (tonnes pulp. area (m³/ha) (%) (ha) (%) (US\$) Prod. (m³/t pulp) (tonnes (%) pulp) (tonnes (tonnes (tonnes cumm.) (tonnes (m³/ha) pulp) pulp) pulp) pulp) pulp) 4.50 20.3 0.00 1985 4.50 \$663 4.4 20.3 \$0.00 \$0.46 0.00 \$4.76 0.00 0.00 1986 4.4 20.3 4.50 \$0.00 \$0.46 0.00 0.00 \$663 0.00 20.3 4.50 0.00 0.00 \$0.00 \$0.46 0.00 1988 4.4 20.3 4.50 \$0.00 40 \$0 \$0.46 0.00 \$4.76 0.00 \$0 \$663 0.00 1989 20.3 4.50 \$0.00 \$0.46 0.00 \$4.76 0.00 \$663 0.00 1990 4.4 20.3 4.50 \$0.00 \$0.46 0.00 \$4.76 0.00 \$0 \$663 0.00 1991 27 928 200 0.95 20.3 4.50 0.00 0.00 \$663 \$0.00 \$0.46 0.00 1992 50.215 4.50 \$663 200 4 4 0.00 0.95 20.3 \$0.00 \$0.46 0.00 \$4.76 0.00 1993 24,025 200 0.95 4.4 20.3 4.50 \$0.00 \$0.46 0.00 0.00 \$663 0.00 1994 35,427 200 0.95 20.3 4.50 0.00 \$0.00 \$0.46 0.00 \$66 0.00 1995 24,869 200 0.95 4.4 20.3 4.50 \$0.00 \$0.46 0.00 \$4.76 0.00 \$0 \$663 1996 0.00 14,151 200 0.95 454,612 296,400 0.34 20.3 4.50 \$0.00 \$0.46 0.00 \$4.76 0.00 \$663 0.00 1997 14.276 200 0.95 4.4 454 612 296.400 0.34 20.3 4.50 \$0.00 \$0.46 0.00 \$4.76 0.00 \$663 1.00 1998 441,000 0 441,000 2,609 450,000 4.50 1 984 500 \$9,452,182 1,984,500.00 \$64,813,966 441.000 200 0.95 4.4 13.612 296.400 0.34 20.3 \$79.380.000.00 0.00 97.759 \$66 1.00 1999 13.612 450.000 0.98 \$663 441 000 441 000 1 205 982 24 188 200 20.3 4 50 \$77 670 446 93 1 941 761 \$1 150 631 \$0.46 1 880 508 37 61 252 80 427 388 0.95 44 296 400 0.34 \$4.76 \$66 814 488 3 017 1.00 2000 441,000 441 000 441,000 2,946,969 24,188 200 0.95 4.4 450,000 0.98 296,400 0.34 20.3 4.50 \$77,616,000.00 1,940,400 \$886.238 \$0.46 1,940,400.00 \$4.76 0.00 \$66 814 488 \$663 2001 588,000 588,000 588.000 3,543,412 200 0.95 600,000 0.34 20.3 4.50 \$103,488,000.00 2,587,200 \$1,181,651 2,587,200.00 \$66,814,488 24,188 296,400 \$0.46 0.00 1.00 2002 784.000 784,000 784 000 4,485,214 24,188 200 0.95 4.4 800.000 0.98 296,400 0.34 20.3 4.50 \$137.984.000.00 40 3.449.600 \$1,575,535 \$0.46 3,449,600.00 \$4.76 0.00 \$66.814.488 \$663 0 2003 1.00 980,000 980,000 980,000 4,775,103 24,188 200 0.95 4.4 1,000,000 0.98 296,400 0.34 20.3 4.50 \$172,480,000.00 4,312,000 \$1,969,418 \$0.46 4,312,000.00 \$4.76 0.00 \$66,814,488 \$663 1.00 2004 980.000 980.000 980.000 4.406.169 24,188 200 0.95 4.4 1 000 000 0.98 296,400 0.34 20.3 4.50 \$172,480,000,00 40 4.312.000 \$1,969,418 \$0.46 4.312.000.00 \$4.76 0.00 \$66 814 488 \$663 2005 980,000 4,042,632 24,188 200 0.95 1,000,000 0.34 20.3 \$172,480,000.00 4,312,000 \$1,969,418 4,312,000.00 \$66,814,488 980.000 980.000 296.400 2006 1.000.000 0.98 1.00 980 000 \$172 480 000 00 \$1 969 418 \$663 980 000 980 000 3 175 294 24 188 200 44 296 400 4 312 000 \$0.46 4 312 000 00 \$4.76 0.00 \$66 814 488 0.95 0.34 20.3 4 50 40 2007 980.000 980,000 980,000 3,239,754 24,188 200 0.95 1,000,000 0.98 296,400 20.3 4.50 \$172,480,000.00 4.312.00 \$1,969,418 4,312,000.00 0.00 \$66,814,488 \$663 1.00 2008 200 1,000,000 4,312,000.00 \$66,814,488 980.000 980.000 3.304.214 24.188 0.95 4.4 0.98 296.400 0.34 20.3 4.50 \$172,480,000,00 4.312.000 \$1,969,418 0.00 980.000 \$0.46 \$4.76 \$663 1.00 2009 980.000 980.000 980.000 3.368.674 24.188 200 0.95 4.4 1.000.000 0.98 0 296,400 0.34 20.3 4.50 \$172,480,000,00 40 4,312,000 \$1.969.418 \$0.46 4,312,000.00 \$4.76 0.00 \$66.814.488 \$663 1.00 2010 980,000 980,000 980,000 3,433,134 24,188 0.95 4.4 1,000,000 0.98 296,400 4.50 \$172,480,000.00 \$1,969,418 \$0.46 4,312,000.00 0.00 \$66,814,488 \$663 200 4,312,000 \$4.76 0.34 20.3 1.00 2011 0.95 \$0.46 980 000 980 000 980 000 3 497 595 24 188 200 4.4 1 000 000 0.98 296.400 0.34 20.3 4 50 \$172,480,000,00 4.312.000 \$1 969 418 4.312.000.00 \$4.76 0.00 \$66 814 488 \$663 1.00 2012 200 1,000,000 0.98 \$66,814,488 980.000 980.000 980.000 3.562.055 24.188 0.95 296,400 0.34 20.3 4.50 \$172,480,000,00 4.312.00 \$1,969,418 4.312.000.00 0.00 \$663 0.98 1.00 2013 980 000 1 000 000 \$663 980 000 980 000 3 626 515 24 188 200 0.95 4.4 296.400 0.34 20.3 4 50 \$172 480 000 00 4.312.000 \$1 969 418 \$0.46 4.312.000.00 \$4.76 0.00 \$66 814 488 2014 980.000 980.000 980,000 3,690,975 24,188 200 0.95 4.4 1,000,000 0.98 296,400 0.34 20.3 4.50 \$172,480,000.00 4.312.00 \$1,969,418 \$0.46 4,312,000.00 \$4.76 0.00 \$66,814,488 \$663 1.00 2015 980.000 3.755.436 200 0.95 4.4 1.000.000 4.50 \$172,480,000,00 4.312.000 \$1,969,418 4.312.000.00 0.00 \$66.814.488 980.000 980.000 24.188 0.98 296.400 0.34 20.3 \$0.46 \$663 1.00 2016 980.000 980,000 980.000 3.819.896 24,188 200 0.95 4.4 1.000.000 0.98 0 296,400 0.34 20.3 4.50 \$172,480,000.00 4,312,000 \$1,969,418 \$0.46 4,312,000.00 \$4.76 0.00 \$66.814.488 \$663 1.00 2017 980,000 980,000 980,000 3,884,356 4.4 1,000,000 0.98 296,400 4.50 \$172,480,000.00 \$1,969,418 4,312,000.00 0.00 \$66,814,488 \$663 24.188 200 0.95 4.312.000 \$0.46 \$4.76 0.34 20.3 2018 1.00 980 000 980 000 980 000 3.948.816 24 188 200 0.95 4.4 1 000 000 0.98 296.400 0.34 20.3 4 50 \$172,480,000,00 4.312.000 \$1 969 418 \$0.46 4.312.000.00 0.00 \$66 814 488 \$663 2019 1,000,000 1.00 980.000 980.000 4.013.277 24.188 200 0.95 0.98 296,400 0.34 20.3 4.50 \$172,480,000.00 4,312,000 \$1,969,418 4,312,000.00 \$66.814.488 \$66 2020 0.98 1.00 980 000 4 077 737 200 1 000 000 \$172,480,000,00 \$1 969 418 \$0.46 \$4.76 0.00 \$66 814 488 \$663 980 000 980 000 24.188 0.95 4.4 296.400 0.34 20.3 4.50 40 4.312.000 4.312.000.00 2021 980.000 980.000 980,000 4,142,197 24,188 200 0.95 4.4 1,000,000 0.98 296,400 0.34 20.3 4.50 \$172,480,000.00 4.312.00 \$1,969,418 \$0.46 4,312,000.00 \$4.76 0.00 \$66,814,488 \$663 2022 980.000 4.206.657 1.000.000 \$172,480,000,00 4.312.000 \$1,969,418 4.312.000.00 \$66.814.488 980.000 980.000 24.188 200 0.95 296.400 0.34 20.3 4.50 \$0.46 0.00 \$663 1.00 2023 980,000 980,000 980.000 4.271.117 24,188 200 0.95 4.4 1.000.000 0.98 296,400 0.34 20.3 4.50 \$172,480,000.00 40 4,312,000 \$1.969.418 \$0.46 4,312,000.00 0.00 \$66.814.488 \$663 0 \$4.76 1.00 2024 980,000 4,335,578 1,000,000 0.98 \$172,480,000.00 \$1,969,418 \$66,814,488 980.000 980.000 24.188 200 0.95 4.4 296.400 4.50 4.312.000 \$0.46 4.312.000.00 0.00 \$663 0.34 20.3 \$4.76 1.00 2025 980 000 980 000 980 000 4 400 038 24 188 200 0.95 4.4 1 000 000 0.98 296 400 0.34 20.3 4 50 \$172 480 000 00 4 312 000 \$1 969 418 \$0.46 4 312 000 00 \$4.76 0.00 \$66 814 488 \$663 2026 200 20.3 980,000 980.000 980.000 4.464.498 24,188 0.95 1.000.000 296,400 0.34 4.50 \$172,480,000.00 4,312,000 \$1,969,418 \$0.46 4,312,000.00 0.00 \$66.814.488 2027 4 528 958 1 000 000 0.98 \$172,480,000.00 1.00 980.000 980.000 980.000 24.188 200 0.95 4.4 296.400 0.34 20.3 4.50 40 4.312.000 \$1 969 418 \$0.46 4.312.000.00 \$4.76 0.00 \$66.814.488 \$663 2028 \$1,969,418 980,000 980.000 980.000 4.593.419 24,188 200 0.95 1.000.000 0.98 296,400 0.34 20.3 172,480,000.00 4,312,000 4,312,000.00 0.00 \$66.814.488 \$66 2029 4.657.879 1.00 980.000 980.000 200 0.95 1.000.000 0.98 296.400 0.34 20.3 4.50 \$172,480,000,00 4.312.000 \$1,969,418 \$0.46 4.312.000.00 0.00 \$66.814.488 980.000 24.188 4.4 \$4.76 \$663 1.00 2030 980,000 980,000 980.000 4,722,339 24,188 200 0.95 4.4 1.000.000 0.98 296,400 0.34 20.3 4.50 \$172,480,000.00 40 4,312,000 \$1,969,418 4,312,000.00 0.00 \$66,814,488 \$663 0 \$0.46 \$4.76 2031 980,000 4,786,799 1,000,000 \$172,480,000.00 \$66,814,488 1.00 980.000 980.000 4.4 0.98 296.400 \$1.969.418 4.312.000.00 0.00 \$663 24.188 200 0.95 0.34 20.3 4.50 40 4.312.000 \$0.46 \$4.76 2032 980 000 980 000 980 000 4.851.259 24.188 200 0.95 4.4 1 000 000 0.98 296.400 0.34 20.3 4 50 \$172,480,000,00 4.312.000 \$1 969 418 \$0.46 4,312,000.00 0.00 \$66 814 488 \$663 1.00 2033 980,000 980 000 980 000 4 915 720 24,188 200 0.95 4.4 1 000 000 0.98 296,400 0.34 20.3 4 50 \$172,480,000.00 4,312,000 \$1 969 418 \$0.46 4,312,000.00 0.00 \$66,814,488 0.98 1.00 2034 980 000 980 000 980 000 4 980 180 24 188 200 0.95 4.4 1 000 000 296.400 0.34 20.3 4 50 \$172 480 000 00 4.312.000 \$1 969 418 \$0.46 4.312.000.00 \$4.76 0.00 \$66 814 488 \$663 2035 1.000.000 0.98 \$663 1.00 980,000 980,000 980,000 5.044.640 24,188 200 0.95 4.4 296,400 0.34 20.3 4.50 \$172,480,000.00 4,312,000 \$1,969,418 \$0.46 4,312,000.00 \$4.76 0.00 \$66,814,488 1.00 2036 980.000 5.109.100 200 0.95 4.4 1.000.000 0.98 4.50 \$172,480,000,00 40 4.312.000 \$1,969,418 \$0.46 4,312,000.00 0.00 \$66.814.488 980.000 980.000 24,188 296,400 0.34 20.3 \$4.76 \$663 1.00 2037 980,000 980,000 980,000 5,173,561 24,188 200 0.95 4.4 1,000,000 0.98 0 296,400 0.34 20.3 4.50 \$172,480,000.00 4,312,000 \$1,969,418 \$0.46 4,312,000.00 0.00 \$66,814,488 \$663 1.00 2038 980,000 980,000 5,238,021 24,188 200 0.95 4.4 1,000,000 0 296,400 4.50 \$172,480,000.00 \$1,969,418 0.00 \$66,814,488 \$663 980.000 0.34 20.3 40 4.312.000 \$0.46 4.312.000.00

ANF = available natural forest.

Cap. = capacity.

Conv. = conversion.

DF = demand fitness.

F. = factor.

Con. = concession MI = mean increment (mean annual increment, MAI * years in rotation).

Prod. = production.

Harv. = harvesting; harvested. Log. = logging; logged. TEV = total economic value.

Vol. = volume

The allocation of large areas of State owned forest land for the development of Industrial Timber

Plantations (HTI) in Indonesia has been very important in supporting the economically-important pulp and paper industry. This allocation resulted in totally clearing vast areas of forests already logged for their prime timber and the elimination of the many environmental and social benefits these areas provide. This CIFOR working paper analyzes the economic costs and benefits of the allocation of nearly 1.4 million hectares of logged-over forests to five large pulpplantation companies in Sumatra. The results and conclusions may be particularly relevant for future forestry policy in Indonesia.

