

The Revival of Industrial Forest Plantations in Indonesia's Kalimantan Provinces

Will they help eliminate fiber shortfalls
at Sumatran pulp mills or feed the China market?



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**Romain Pirard
Christian Cossalter**

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This document has been produced with the financial assistance of European Community through Asia Pro Eco Programme. The views expressed herein are those of the authors and can therefore in no way be taken to reflect the official opinion of the European Commission.

The views expressed in this publication are those of the authors and do not necessarily represent the official position or policy of CIFOR

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ABBREVIATIONS AND ACRONYMS

ADT	Air-dried tonne
APKI	Asosiasi Pulp dan Kertas Indonesia (Indonesian Pulp & Paper Association)
APP	Asia Pulp & Paper Company Ltd.
APRIL	Asia Pacific Resources International Ltd.
BDT	Bone dry tonne
BHKP	Bleached Hardwood Kraft Pulp
CSIRO	Commonwealth Scientific and Industrial Research Organization
GMT	Green metric tonne
Gol	Government of Indonesia
HPH	<i>Hak Pengusahaan Hutan</i> (forest concession license)
HTI	<i>Hutan Tanaman Industri</i> (industrial timber plantation)
HTI pulp	HTI plantation for pulpwood production
HTI trans	HTI plantation established as part of the Indonesian Transmigration Programme
IKPP	Indah Kiat Pulp & Paper
IPK	<i>Izin Pemanfaatan Kayu</i> (wood utilization permit)
Kab	<i>Kabupaten</i> (regency or district)
Kec	<i>Kecamatan</i> (subdistrict)
LPI	<i>Lembaga Penilaian Independen</i> (independent body in charge of auditing HTI plantations for the Ministry of Forestry)
LPPP	Lontar Papyrus Pulp & Paper Industries
MAI	Mean annual increment
MBBM	Marga Buana Bumi Mulia
MDF	Medium density fiberboard
MoF	Ministry of Forestry
MTH	Mixed tropical hardwood
RAPP	Riau Andalan Pulp & Paper
RKT	<i>Rencana Karya Tahunan</i> (annual work plan)
UFS	United Fiber System

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INTRODUCTION

Context of the study

In a context of rapid degradation and loss of commercially valuable forests, especially in the lowlands of Sumatra and Kalimantan, the international donor community has worked closely with the Indonesian Ministry of Forestry (MoF) since 2000 to downsize and restructure the country's timber processing sector. The plywood industry, more than any other industry segment, bears the brunt of this effort. In contrast, the wood pulp industry still appears to be a top government priority, and it is clear that downsizing this industry is not on the Government of Indonesia's current agenda. Indeed, the signal being sent by government agencies and the wood pulp industry is that there is still room for further expansion of existing pulp mills as well as for building mills at new locations owing to the expected increased supplies from industrial timber plantations (Mansur 2006).

Currently there are applications by United Fiber System to build a new 600,000-tonne pulp mill in South Kalimantan and to purchase and expand the Kiani Kertas pulp mill in East Kalimantan and plans by Korindo to build a new 250,000-tonne pulp mill in Central Kalimantan. Asia Pulp & Paper (APP) and Asia Pacific Resources International Ltd (APRIL) have also signaled that they may seek to expand their pulp capacity in Indonesia. To a significant degree, these planned pulp capacity expansion projects are being driven by China's growing demand for wood pulp (He and Barr 2004).

In less than two decades, thanks to strong government support, Indonesia has been able to join the group of leading countries in the global pulp and paper sector. According to the Ministry of Industry, in 2003 the Indonesian wood pulp industry had an aggregate installed capacity of 6.3 million Air-Dried Metric Tonnes (ADT) yr⁻¹, which was approximately tenfold the country's aggregate capacity of twenty years before (Mansur 2006). This makes Indonesia the world's ninth largest pulp producer, with Bleached Hardwood Kraft Pulp (BHKP) being by far the most common grade. This industry segment counts fourteen officially registered producers, only nine of which are currently operating. The six largest account for over 90 percent of the country's total capacity. During the same period, the installed capacity of the paper and board industry grew at an average rate of 15 percent per annum to reach 10.0 million tons in 2003 (Ibid). At present, Indonesia ranks as the twelfth largest paper and paperboard producer.

Approximately 40 percent of the pulp production and 35 percent of the paper and board production are exported (APKI 2003). Approximately three-quarters of the exports go to other Asian countries, primarily to Japan, China and South Korea. China's imports of Indonesian wood pulp have grown especially rapidly in recent years, increasing from 90,000 ADT in 1995 to 1.3 million ADT in 2005, valued at US\$ 644 million (UN COMTRADE database).

Over the past decade, Asia Pulp & Paper Company Ltd. (APP) and Asia Pacific Resources International Holdings Ltd. (APRIL) have emerged as leading players in the pulp and paper sector not only in Indonesian but also and increasingly in China. APP is also developing its presence as a paper producer in India.

As of early 2005, APP controlled an area close to 900,000 hectares in Indonesia (gross area), with concession rights or through partner companies (Aida Greenbury, APP, pers. com. March 2005). In Indonesia, the group operates two pulp mills and seven paper and packaging mills. The group's two pulp mills -- PT Indah Kiat Pulp & Paper Mills Tbk (IKPP) and PT Lontar Papyrus Pulp & Paper Industry (LPPP) -- are located in Sumatra's Riau and Jambi provinces, respectively, and both are integrated with paper production. The group's paper and packaging mills are concentrated in Java, with PT Pindo Deli Pulp & Paper Mills in West Java; PT Indah Kiat Pulp & Paper operating two paper mills in Banten; and PT Pabrik Kertas Tjiwi Kimia Tbk and PT Ekamas Fortuna in East Java. APP also operates numerous paper and packaging mills in China, in addition to a large-scale wood pulp mill in Hainan province (with a capacity of 1.1 million ADT of BHKP in 2005).

In the Sumatran province of Riau, APRIL operates one large pulp and paper mill, PT Riau Andalan Pulp & Paper (RAPP), for which the allocated plantation concession rights, at the end of June 2006, were 326,340 ha of forest land. At the same date, the group had access to a further 380,087 ha of forest through partner companies and development agreements with local communities (APRIL 2006b). In addition, APRIL operates another smaller pulp mill, PT Toba Pulp Lestari, located in the province of North Sumatra. In China, APRIL's affiliate RGM Group also produces printing and writing paper and operates the Shandong Rizhao pulp mill, which it is reportedly planning to expand.

As of early 2005, the Government of Indonesia had allocated licenses for approximately 5.4 million ha of forest land in ten provinces to approximately 40 companies under the its *Hutan Tanaman Industri* (HTI), or Industrial Forest Plantation, programme.

Among other obligations, HTI license-holders are required to maintain 30 percent of the area for protection and for local community uses, and the most suitable land on the remaining area must be converted into plantations as clear-felling progresses. We estimate that in early 2005, the nine Indonesian pulp companies currently in operation had access to approximately 45 to 50 percent of the total HTI area either directly through concessions licensed in their name or indirectly through joint ventures or other forms of partnership. We also estimate that at that time, between 950,000 ha to 1.0 million ha of plantation were standing within those concessions having formal and well-established business links with mills currently in operation.

We further estimate that in early 2005, Indonesia had an additional aggregate area of close to 250,000 ha of medium-sized pulpwood plantations which, because of their history and location, are underutilized and in some cases under low-intensity management. In some cases, this is because they are not linked to stable markets. Several of these plantations were established in Kalimantan in the 1990s in preparation for proposed new pulp mills. However, with the exception of Kiani Kertas, which is affiliated with the Tanjung Redeb Hutani plantation, none of the planned pulp mills originally associated with these Kalimantan pulpwood plantations has so far been built. In 2005, the United Fiber System and the Korindo proposals, together with the possible expansion of Kiani Kertas, were the only Kalimantan proposals publicly reported to be under active consideration, although the Government was actively encouraging new investment in the sector (Greenlees 2005). It is only recently that the situation with respect to these plantations has started to change, with APP and APRIL taking over the management of several of these plantation estates. The focus of this paper is on the Kalimantan plantations which are changing hands and those which have not yet secured markets.

At 2005 installed capacity levels, Indonesia's pulp mills require a harvested wood volume of about 32 million cubic meters (m^3)¹ to run at full capacity. Approximately three-quarters of this volume go to the three largest mills, which are situated in Riau and Jambi, two neighbouring provinces of central Sumatra. PT Indah Kiat Pulp & Paper Mills Tbk (IKPP), the first Indonesian 'mega pulp mill,' started producing in 1984 with an installed capacity of 105,000 ADT yr^{-1} , which today has reached almost 2.0 million ADT yr^{-1} . Asia Pulp & Paper Company Ltd. (APP), the holding company of IKPP, reported

that plantation-grown wood accounted for 20 percent of the overall mill supply in 2003 and 2004, and 35 percent in 2005 (APP confidential document, Jakarta, 2005). The two other largest 'mega mills' of the Riau-Jambi region, PT Riau Andalan Pulp & Paper (RAPP) with an installed capacity of 2.0 million ADT yr^{-1} and PT Lontar Papyrus Pulp & Paper Industry (LPPPI) with an installed capacity of 0.75 million ADT yr^{-1} , were launched in the mid-1990s. With only a part of their wood supply coming from plantations (e.g. approximately 30 percent for RAPP in 2004, Canecio Munoz, pers. com. March 2005), these two mills have put very heavy pressure on local natural forests.

Both APP and APRIL have publicized very optimistic projections about the capacity of Sumatran plantations to procure a sustainable supply of fiber for their Sumatran pulp mills. In 2004 APP published a *Sustainability Action Plan* which confirmed previous commitments of the Group to become fully reliant on renewable, plantation-grown wood after 2007 (APP 2004). Until recently, plantation development has been slow, and we estimate that APP projections to bring acacia plantations online with the mills' demands, at the set date, are based on extremely ambitious targets. More realistic scenarios foresee a continuation of a high reliance of IKPP on mixed tropical hardwood.

In 2002, APRIL also committed itself to have a mature plantation base in Riau capable of generating 'sufficient fiber to support 2 million tonnes [of pulp] production capacity by 2009' (APRIL 2006a). In the final section of this report, entitled 'Supply and Demand Scenarios', we estimate that in 2009 APRIL's plantations will not produce sufficient wood to reach the 2.0 million ADT yr^{-1} pulp production target. The shortfall of plantation wood will amount to 2.88 million m^3 . Furthermore, APRIL is going to face a difficult challenge in its effort to expand its plantation estate to the total area required for supporting, in continuity, a 2.0 million ADT yr^{-1} pulp capacity. Figures reported in APRIL's 2006 Sustainability Report show a tight land resource situation when comparing the amount of suitable land still available in APRIL's concessions and partners' concessions (Joint Ventures and Community Fiber Farms) to what we estimate the company will need to meet its pulp production plans. This is the case even though in calculating the need for future expansion we have assumed full achievement of APRIL's very optimistic plantation productivity targets.

It has become clear, through discussions with APRIL executives, that APRIL has no public commitment to utilize only plantation-based

fiber in its pulp production beyond the above-mentioned 2009 target, which the company applies only to the 2.0 million ADT yr⁻¹ of capacity that is currently installed. It stands to reason that if APRIL expands the Kerinci mill, the company has no intention to stop using mixed tropical hardwood for the additional capacity that comes online.

Pacific Fiber, a company whose ownership structure is very similar to that of APRIL, purchased the PT ITCI and Adindo plantations in East Kalimantan in early to mid-2005, according to APRIL officials interviewed for this study. APRIL has apparently done so with the intention to supply fiber to the group's affiliated planned pulp mill in Rizhao, Shandong Province on the east coast of China. Similarly APP purchased the Finnantara Intiga plantations from Stora Enso in West Kalimantan in October 2004 (information confirmed by Smartwood in Oct. 2006). In this case, it is still unclear whether this new fiber source is going to supply primarily the Indah Kiat mill in Sumatra or APP's newly built 1.1 million ADT yr⁻¹ pulp mill in China's Hainan province, since both mills suffer from chronic shortfalls of plantation-grown wood (Barr and Cossalter 2004).

The primary option that APP and APRIL seem to be pursuing to resolve the shortfall of plantation wood at their Sumatran mills is to target additional large areas of Sumatran natural forests as instant new sources of wood fiber, thereby allowing the expansion of their acacia plantations to continue. Access to additional areas of natural forest is achieved in most cases through joint ventures with local 'cooperatives' and other forestry concession holders. Most of this natural forest is peat swamp forest.

Aim of the study

This study was initiated with the hypothesis that there are alternative solutions to provide the volumes of pulpwood that APP and APRIL's Sumatra pulp mills will require without converting additional areas of natural forest with high biodiversity richness and values to local populations. One potentially economic option would be to source the wood from the industrial forest plantations which were established in Kalimantan in the mid-1990s with fast-growing species (*Acacia*, *Eucalyptus*, *Gmelina*). The main problem in pursuing this option is that very little has been known about the current condition of these Kalimantan plantations and especially their ownership, productivity, current and potential commercial output of wood, as well as the costs that

would be involved for delivering their wood to Riau Province, thus preventing useful recommendations on their possible use.

This study aims to fill these gaps.

This study was undertaken during a one-year period ending in March 2005 and was officially supported by the Forest Research and Development Agency (FORDA) through letters of recommendation.

Methods

Basic information was first collected at the Ministry of Forestry on Kalimantan plantations with HTI-pulp status but no affiliation to a pulp company. The plantations identified were: Finnantara Intiga, Korintiga Hutani, Hutan Rindang Banua, ITCI Hutani Manunggal, Surya Hutani Jaya, Tanjung Redeb Hutani, Adindo Hutani Lestari, Sinar Kalbar Raya, Basuki Rakhmat. An exception was made to include Tanjung Redeb Hutani, which is affiliated to the Kiani Kertas pulp mill but its wood production is not sold regularly to this market.

All of these companies were contacted to discuss the project and to organize field visits. Sinar Kalbar Raya appeared to have ceased operation, and Basuki Rakhmat could not be contacted. Interviews were conducted at the headquarters of the seven other companies to trace their history and obtain information on current operations and strategy. Five companies agreed to arrange field visits to check the condition of their plantations and transport infrastructure, and to hold interviews with local forestry officers and contractors. Adindo Hutani Lestari and Hutan Rindang Banua declined such visits.

This study is largely based on the companies' own data, obtained through interviews, and from their annual plans (*Rencana Kerja Tahunan*, RKT). It was not possible to independently check the extent to which the data were reliable—especially the reported amounts of planted hectares. The assumptions we have made on plantation productivity are largely based on our visual observations of the site conditions and of maintenance operations.

We discuss two different scenarios for each plantation estate as far as plantation yield and wood marketing are concerned. One scenario assesses the most likely wood flow from the plantation during the seven year period beginning in 2005 on the basis of the reported standing volume and the age-class structure at the time of the study. A second scenario attempts to assess the long-term potential wood flow on the basis of the total

plantable area within the HTI plantation concessions, as of 2005.

It should be noted that this report was prepared in 2005, and that figures for 2005 and subsequent years are projections based on a set of assumptions detailed with each set of projections. CIFOR has not been able to verify the extent to which actual figures for these years correspond to the projections reported here. We also want to acknowledge as a caveat that future wood flows from the above-mentioned HTI plantation sites might

be subject to a number of other factors which cannot be assessed with certainty. Most of the plantations under review were established in the mid-1990s, and therefore a large portion of their area had already reached maturity in 2005 and, in some instances, well before 2005. We have assumed in our discussion of potential scenarios that trees over seven years of age were harvested at once during 2005. We have not been able to verify whether these assumptions have proven to be correct.

ITCI HUTANI MANUNGGAL²

History of the plantation

The ITCI group has been involved in commercial wood production in Indonesia since the 1970s. Through the first two decades of its operations, the company mainly managed HPH (*Hak Pengusahaan Hutan*) timber concessions in East Kalimantan for plywood production.³ Initially the company was partially controlled by the US multinational Weyerhaeuser Corporation. Later ITCI ownership was shared between Nusamba (including the Indonesian entrepreneur Mohamed 'Bob' Hasan), Bambang Trihatmodjo (ex-President Suharto's eldest son), and Yayasan Kartika Eka Paksi (an Indonesian army cooperative) (Barr 1998).

During the 1980s, the group planted mosaics of sengon (*Paraserianthes falcataria*), eucalypts (mainly *Eucalyptus deglupta*), acacia (mainly *Acacia mangium*), mahogany (*Swietenia macrophylla*) and other species in the degraded areas of the HPH concession site. In 1993 ITCI obtained a license for a HTI (*Hutan Tanaman Industri*) -pulp plantation concession on these ex-HPH lands.⁴ This new company ITCI Hutani Manunggal was a joint venture between ITCI and the state-owned forestry company Inhutani I, with shares divided 60/40 respectively. Using funds from the Government-controlled Reforestation Fund⁵, the company planted mainly *Eucalyptus deglupta*, with gmelina (*Gmelina arborea*) as firebreaks and to inhibit the spread of diseases. Sengon was growing naturally along roads in the concession and was a source of commercial timber.

The concession is located in East Kalimantan near Balikpapan. It is included in two districts: Kabupaten Penajam Paser Utara (Kec Sepaku) and Kabupaten Kutai Kertanegara (Kec Kota Bangun, Muara Muntai, Sebulu, Tenggarong, Loa Kulu). The plantation area has a 'tropical humid' climate and is 10-450 m above sea level (asl).

The temporary license issued in 1993 was for 161,000 ha (gross) with 125,000 ha net plantable area, and the final license (SK Menhut 184) was issued in 1996. A range of factors, such as unfavorable topography⁶, claims on the land by local communities and encroachment of oil palm plantations have reduced the plantable area over the years. Ministerial Decree SK 43 issued 15 February 2000 stated a 107,000 ha total area, with a plantable area of 89,000 ha.

The possibility of accessing Reforestation Fund allocations may have been a major influence in ITCI's decision to develop an industrial plantation in spite of several site

constraints. Funds allocated in 1993 were Rp 747,500 ha⁻¹, and were increased through several steps to Rp 1,170,000 ha⁻¹ until termination in September 1998. These allocations constitute interest-free loans by the government, with the principal repayable after harvesting.

According to the company's claim, fires in 1997/98 destroyed about 50,000 ha of plantation in the concession. However, this figure remains highly uncertain. Many HTI concessions benefited from the Reforestation Fund but did not plant as much area as reported, and these fires may have been an opportunity to report burnt planted areas that were in reality natural forest regrowth. Following the fires, the company shifted from planting *Eucalyptus deglupta* to *Acacia mangium*.

In 2002/03, ITCI Hutani Manunggal was considered to be in difficulty by the Ministry of Forestry and received three warnings followed by the withdrawal of the license. In 2004, the company contended that opportunities were present for the marketing of the wood production, with the Alam Jaya Lestari chipping mill and the Kiani Kertas pulp mill representing potential buyers for the company's wood. In response, the Ministry of Forestry reclassified the plantation and reinstated the license.

According to ITCI officials, the company's original plan in 1993 was to manage a pulpwood plantation to supply fiber to an affiliated pulp mill. Owing, at that time, a plantable area of 125,000 ha, the group had plans to build a mill with a capacity of 500,000 to 600,000 Adt yr⁻¹. The project was officially abandoned due to low productivity of the plantations, and the onset of the 1997 financial crisis. Soils were of poor quality, the topography was unfavorable, and planting and plantation maintenance were substandard despite support from the Restoration Fund.

There are reasons to believe that the company's original scenario was improbable from the start. Having previously managed the site when it was a HPH timber concession, ITCI was aware that site constraints would reduce the efficiency of forest management and would render transport highly uncertain during the rainy season. More probably, ITCI Hutani Manunggal was established to supply fiber to the Kiani Kertas mill. ITCI Hutani Manunggal and the plantation company affiliated to Kiani Kertas pulp mill were set up the same year. Mohamed 'Bob' Hasan, a close business associate of President Soeharto, was the owner of Kiani Kertas and had shares in ITCI through the Nusamba holding company.

ITCI Hutani Manunggal started to sell wood in 1998 with a wide variation in annual

production over the years, as shown in Table 1. During the period 1998-2003, the main buyers were Kiani Kertas, Alam Jaya Lestari chipping mill and Sumalindo MDF mill.

Table 1. Annual production 1998-2003 at ITCI Hutani Manunggal

Year	Area (ha)	Production (ADT)	Productivity (ADT ha ⁻¹)
1998	163	13,924	85
1999	255	21,807	86
2000	563	28,576	51
2001	644	81,027	126
2002	195	12,919	66
2003	1664	111,749	67

Source: ITCI Hutani Manunggal.

Condition of the plantation

There is no remaining natural forest in the plantable area of the concession. Since the 1997/98 fires, the plantation consists mainly of *Acacia mangium*. The concession counts an additional 3,000 ha of sengon and over 4,000 ha of acacia planted before 1993. The later is to supply the furniture market in Surabaya.

Acacia mangium seeds produced on site are of Papua New Guinea and Queensland origins. The plantation condition is poor, and many areas have regenerated naturally. A difficult topography is partly responsible for irregular tree spacing. Invading weeds indicate a lack of maintenance which is officially due to high costs and the unavailability of local

manpower. The low population density makes it difficult for the company to attract daily workers, as local people prefer to work in the coal mines or the oil palm plantations, or even harvest *ulin* trees. These are usually viewed as easier jobs.

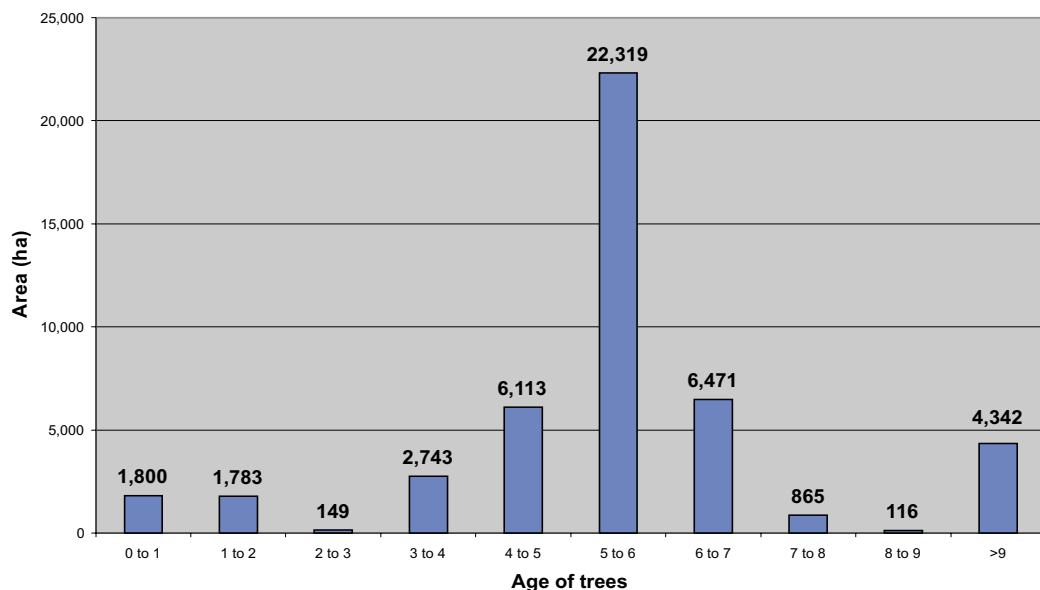
In the years immediately following the 1997/98 financial crisis, cash-flow problems made it impossible to maintain the plantation properly. Priority was given to first-year maintenance, but this was not enough. The financial problems at the company level are due to several factors: fires that destroyed part of the plantation, the end of Reforestation Fund subsidies, and the low income from wood sales.

In late-2004, we assessed the production potential of the existing plantation to be approximately 80 ADT ha⁻¹, equivalent to 123 m³ ha⁻¹ and we foresee the commercial harvest to remain below 100 ADT ha⁻¹ for many years⁷.

As of December 2004, the concession had 2,303 km of road infrastructure, of which 525 km were principal roads and the remainder secondary roads. Gravel roads were generally in good condition and were well maintained. An asphalt road was constructed along the western boundary. However, only 20 percent of the plantation could be harvested during the rainy season due to the difficult topography (Table 2) and the predominantly clay roads.

There are several transport options for the wood grown in ITCI Hutani Manunggal plantations: (i) hauling by truck to the MDF

Figure 1. Standing area of *Acacia mangium* by age classes (total 46,697 ha) at ITCI Hutani Manunggal in June 2004



Source: ITCI Hutani Manunggal.

Table 2. Topography in the original concession boundaries (including non-plantable areas) at ITCI Hutani Manunggal

Slope 0-8%	Slope 8-15%	Slope 15-25%	Slope 25-40%	Slope > 40%
24.4%	45.2%	21.5%	6.4%	2.5%

Source: ITCI Hutani Manunggal.

mill site on the banks of the Mahakam River, from where wood can be loaded on barges and transported to Samarinda city and the sea; (ii) hauling by truck to the chipping mill located on the south of the concession, from where chips are loaded on boats to the sea; and (iii) hauling by truck to the log pond Kenangan at the extreme south of the concession.

Production and marketing

According to interviews with company officials in the year preceding March 2005, harvesting and transport of the wood are usually contracted to different companies. The production is sold to three markets: Kiani Kertas pulp mill, Alam Jaya Lestari chipping mill and Japan, and Sumalindo MDF mill.

Kiani Kertas pulp mill⁸

The pulp mill launched its production in 1996 and part of its wood supply initially came from ITCI Hutani Manunggal. Subsequently, wood deliveries to Kiani Kertas were stopped because payments were delayed and low prices were offered to the contractor. Wood sales resumed in 2004 when Kiani Kertas agreed to sign a Letter of Credit with the contractor responsible for the harvesting operations at ITCI Hutani Manunggal. The sales were approximately 12,000 t in 2004. The relatively low price paid by the contractor to ITCI Hutani Manunggal, \$10

ADT⁻¹, was partly justified since the contractor was responsible for road maintenance and even road reconstruction in some areas⁹.

The wood sold to Kiani Kertas can either come from the north of the concession via the Mahakam River, or from the south of the concession via the log pond at Kenangan. From the log pond at Kenangan, barges are rented by the contractor in charge of the harvest for approximately Rp 240 million per trip. Barge capacity is 3,000 t with a cost of Rp 80,000 t⁻¹; when barges are not fully loaded, the cost can reach Rp 100,000 t⁻¹. Table 3 details production and marketing costs reported in 2004.

Alam Jaya Lestari chipping mill and Japan¹⁰

The chipping mill was established in 2002 with three Indonesian investors. The main investor has a Japanese connection for marketing to Japan. This market, secured with a 5-year contract to be renewed, has been the decisive factor for the investment. The market is guaranteed whatever the future chip production. However, emerging demands from Japan for certification could become a problem in the future. On the other hand, the Japanese pulp industry tends to shift from an eucalypt wood supply from South America, Africa and Australia, to acacia, as the pulp is reported to be of better quality.

The wood is harvested either by a contractor or directly by Alam Jaya Lestari. Alam Jaya Lestari transports wood to its mill, and transport to Japan is handled by the distributor. As in the case of harvesting by a contractor for sale to Kiani Kertas, the cost of the wood is relatively low (Table 4). The reasons are the same.

Through 2004, the chipping mill could produce 40,000 t month⁻¹, and it normally ran 20 hours a day. Production was still limited (150,000 t in 2004) because of the production

Table 3. Production and marketing costs from ITCI Hutani Manunggal to Kiani Kertas (logs)

Fee paid by the contractor to the plantation	Harvest and loading on truck	Transport by road to Mahakam River (log pond Senuni)*	Transport from Mahakam River (log pond Senuni) to Kiani Kertas (without loading)	Transport by road to log pond Kenangan**	Transport by barge from log pond Kenangan to Kiani Kertas (without loading)	Total to Kiani Kertas (including all loading operations)***
\$10 ADT ⁻¹ (\$7.5 m ⁻³)	\$15 ADT ⁻¹ (\$11.25 m ⁻³)	\$1-\$3.5 m ⁻³	> \$6.5 m ⁻³	\$1-\$4 m ⁻³	\$9 ADT ⁻¹ (\$6.75 m ⁻³)	\$30-\$32 m ⁻³

Source: ITCI Hutani Manunggal and PT Rimba Karya Utama (contractor).

Note: The conversion factor is 750 kg m⁻³, after 2 weeks drying in open air (from logging to Kiani Kertas).

*Transport distance on road varies between 20 km and 70 km.

** Transport distance on road varies between 20 km and 80 km.

***Not including road maintenance costs in the concession, paid by the contractor.

Table 4. Production and marketing costs from ITCI Hutani Manunggal to Japan via Alam Jaya Lestari chipping mill

Fee paid by the contractor to the plantation	Harvest and loading on truck	Transport by road to the chipping mill ⁷	Chip processing (high fixed costs then lower prices with higher production)	Total wood production and chip processing	Transport from chipping mill to Japan	Total when shipped to Japan (included all loading operations)
\$10 ADT ⁻¹ (\$6.5 m ⁻³)	\$15 ADT ⁻¹ (\$11.25 m ⁻³)	\$1-\$5 ADT ⁻¹ (\$1-3.5 m ⁻³)	\$2 ADT ⁻¹	\$28-\$32 ADT ⁻¹	\$30-\$35 t ⁻¹ (bone dry) (\$20-\$23.5 ADT ⁻¹)	\$51-\$58 ADT ⁻¹

Source: Alam Jaya Lestari, and the authors' assumptions for chip production cost.

Note: The conversion factor is 1.5 t ADT 1 BDT (with moisture content between 35% and 40% after several weeks, and 650 kg m⁻³.) If the moisture content is lower than 35% the chipping mill pays a bonus to the plantation. Transport distance varies between 10 km and 70 km.

hazards during the rainy season. According to company officials interviewed during this study, three ships with 17,000 t of chips normally leave every two months. The owner was confident in the future of the plantation, and indicated that the mill capacity would double soon as the wood production could be optimised during the dry season¹². Moreover, an agreement was signed with ITCI Hutani Manunggal for a guaranteed 200,000 ADT wood supply for ten years. In 2004, the Japanese group Marubeni was reportedly interested in financing a further increase of the mill capacity, but many uncertainties about ITCI Hutani Manunggal's future operations remain. The main concern at that time was that Kiani Kertas might be able to take control of the plantation through political maneuvers. This was based on the fact that both the plantation and Kiani Kertas are now controlled by interests associated with the Indonesian army. Another concern is that regional labour costs might be increased by decree.

Kiani Kertas has tried to purchase chips from Alam Jaya Lestari, but the price offered was too low (\$40 ADT⁻¹). The chipping mill has also been concerned by payment uncertainties, especially as legal redress is viewed as ineffective due to Kiani Kertas's political connections. In contrast, the Japanese buyers propose to pay 50 percent of the price before shipping.

Investment for the chipping mill has been around US\$ 5 million, including heavy equipment for loading and log manipulation. In 2004, the Alam Jaya Lestari chipping mill had 150 workers. A study was then underway for the construction of an additional chipping mill to be located on the Mahakam River. However, the project is viewed as having a high level of risk since barge transport on the Mahakam River to Samarinda city is expensive.

Sumalindo MDF mill

Wood sales to the MDF mill ranged from 2000 to 3000 t month⁻¹ until 2003, then the commercial relations stopped for unknown reasons. When research was conducted for this study, no accurate data were available about the marketing costs. However, it was estimated in 2004 that the total cost of production to the mill to be about \$29-\$31 ADT⁻¹, including loading and transport costs.

RAPP pulp mill in Sumatra

APRIL group, the owner of the RAPP pulp mill in Sumatra, acknowledges that its strategy is to expand its pulp capacities both in China and Indonesia. APRIL states that its concession area in Sumatra is sufficient to build up a plantation resource base which would sustain its RAPP mill, over the long-term, at current capacities. APRIL's officials say that the current move of the group to control additional plantations in Kalimantan is to provide an additional supply of fiber for new expansions in pulp capacities.

We estimate transportation costs from Balikpapan to Riau (Sumatra) to be almost equivalent to the cost from Samarinda to Riau, that is, \$10 t⁻¹ in 2004.

Short- and long-term scenarios¹³

Short-term (2005-2011) production from existing plantations

We have made the following assumptions to project the potential pulpwood production until 2011 (see Table 5):

- Trees are harvested at age 7.
- Trees more than 7 years old are not used for the pulpwood market.
- The commercial harvest is 80 ADT ha⁻¹, or 123 m³ ha⁻¹.

Table 5. Projected pulpwood production from standing plantations at December 2004 at ITCI Hutani Manunggal

	Year of production						
	2005	2006	2007	2008	2009	2010	2011
Production (m ³)	795,933	2,745,237	751,899	337,389	18,327	219,309	221,400

Source : Derived from ITCI Hutani Manunggal data with assumptions as noted in text.

Long-term production: best scenario from 2012 onwards

This section projects the volume of pulpwood that could potentially be produced if the maximum available area were planted in 2005 and the following years. The 'best scenario' is based on the following optimistic assumptions:

- The entire plantable area is managed.
- The plantation is managed to produce an even flow of wood.
- The MAI (Mean Annual Increment) is increased from a current 15-17 m³ ha⁻¹ to 20 m³ ha⁻¹, which, based on our assessment of the local conditions, is the highest realistic yield figure.
- The rotation period is 7 years.
- The planting operations started in 2005.
- 4,000 ha are deducted from the plantable area because of persistent social conflicts (see next section).

The resulting annual production is estimated at 1.7 million m³, from a harvested and replanted area of 12,142 ha⁻¹ yr⁻¹.

Social aspects¹⁴

Villages are located on the borders of the concession site according to the boundaries designed by the Ministerial Decree of 1999. Discrepancies with the locally recognized boundaries have caused claims on 1,000 ha of land in Maridan zone, where local people have prevented the company from replanting, and on 3,000 ha to the north, where the company may abandon attempts to plant.

Through at least late 2004, according to company documents, there was no plan to initiate partnerships with local people to plant acacias. For planting and maintenance operations, 300-400 workers are employed full-time, including 100 migrants from Java. Harvesting operations employ 800 workers, of which 600 are Javanese migrants.



Alam Jaya Lestari chipping mill, July 2004



Overmature Acacia mangium still standing at ITCI Hutani Manunggal, July 2004



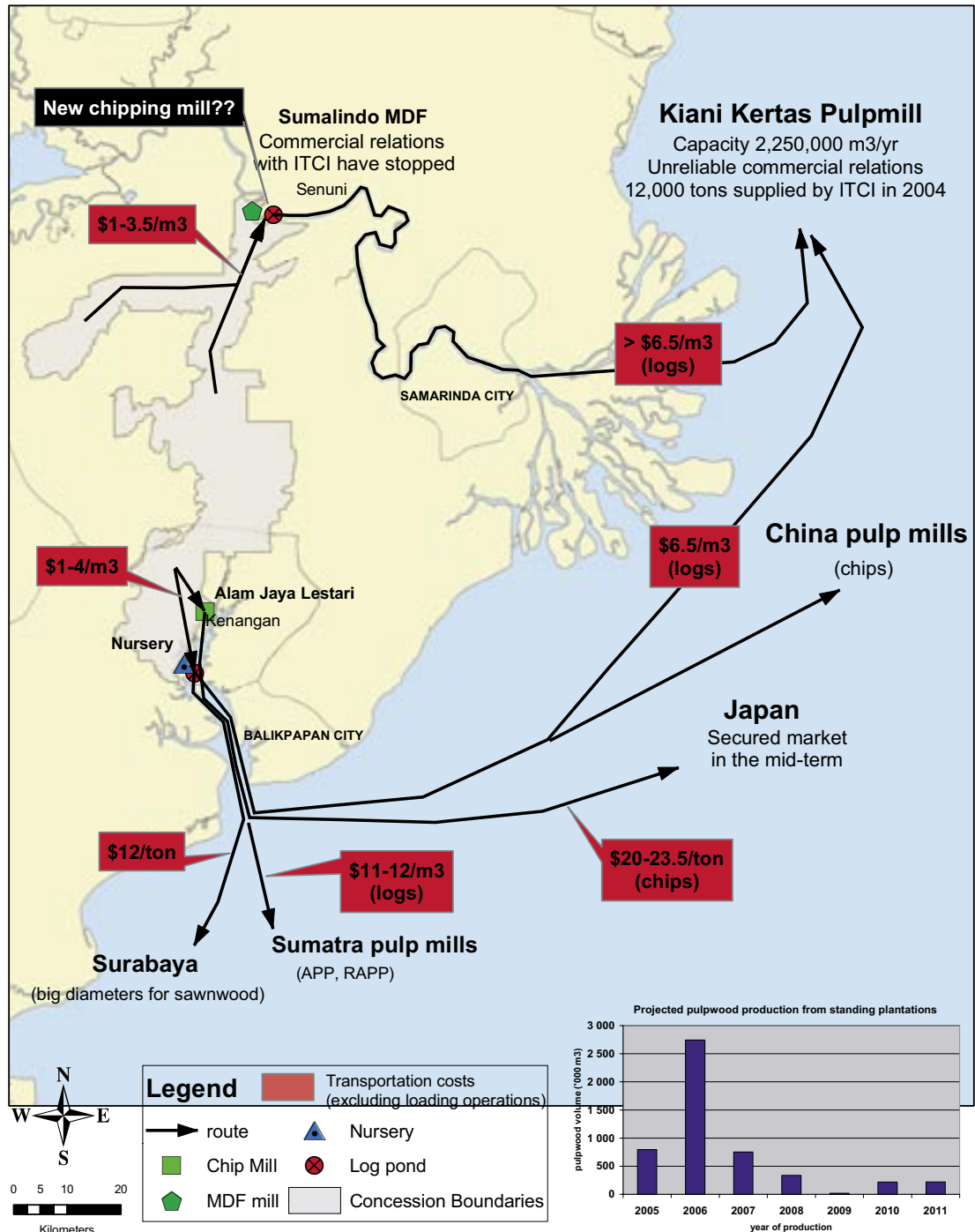
Irregular planting spaces and lack of weeding at ITCI Hutani Manunggal, July 2004



Harvest operations at ITCI Hutani Manunggal, July 2004

ITCI Hutani Manunggal

Projected Pulpwood Production 2005-2011 + Best scenario: 1.7 million m³/year from 2012 onwards



Map 1. ITCI

TANJUNG REDEB HUTANI¹⁵

History of the plantation

Incorporated in 1992, Tanjung Redeb Hutani was controlled by Bob Hasan's Kalimantan group, which managed multiple HPH timber concessions and had activities in the plywood and wood pulp industries. The company's HTI pulpwood plantation was established through a 60/40 partnership between Kalimantan and the state forestry enterprise Inhutani I. Following the 1997/98 financial crisis, Tanjung Redeb Hutani and all other Kalimantan group companies were placed under the Indonesian Bank Restructuring Agency (IBRA) due to the heavy debts owed to the government by Bob Hasan (Barr and Setiono 2001).

In 2003, IBRA sold the Kalimantan group's stake in Tanjung Redeb Hutani and other forest-related companies - including the Kiani Kertas pulp mill -- to a consortium of investors led by Nusantara Energi (with the remaining 40% of shares still held by Inhutani), a group linked to the Generals Prabowo Subianto and Luhut Binsar Panjaitan (Pak Suheldi, pers. com., 2005). At the same time, Nusantara Energi bought Kiani Kertas shares, with an agreement that the Rp 1.7 trillion debt (approximately \$200,000) would be repaid with interest in four years to the government-owned Bank Mandiri. Nusantara Energi also owns Kiani Lestari, a company that holds a forest concession in East Kalimantan and works as a contractor for Tanjung Redeb Hutani.

The present Tanjung Redeb Hutani area used to be divided in several HPH forest concessions owned by the following companies: Inhutani I, Hanurata, Rejosaribumi, Sentosa Kalimantan Jaya and Tabalar Wood Industries, among others. As part of the national policy to rehabilitate logged-over forests, the Ministry of Forestry issued a license in 1993 to establish an industrial HTI pulp plantation in this area. Tanjung Redeb Hutani used funds provided by the Reforestation Fund¹⁶ mainly to plant *Acacia mangium* and smaller areas of *Gmelina arborea*.

According the company's Annual Work Plan (RKT 2005), the concession is located in East Kalimantan, latitude 1°30'-2°30'N, longitude 117°05'-118°00'E and 200-800 m asl. It is close to the coast and on both sides of the Berau River. It is included in the district Kabupaten Berau, and the subdistricts Kec Sambaliung, Kec Tubaan, Kec Talisayan, Kec Gunung Tabur and Kec Teluk Bayur. The climate is 'Tropical Humid'.

Plantation operations began in 1993. The final HTI pulp license (SK Menhut 641) was

issued in 1996 for an area of 180,000 ha with 90,000 ha plantable. The concession contains 32,000 ha of conservation forest for a large water catchment area which supplies water to the Kiani Kertas mill.

Tanjung Redeb Hutani was established to fulfill the fiber needs of the affiliated pulp mill Kiani Kertas. The mill started in 1996 with a capacity of 525,000 ADT yr⁻¹ (Pak Mansur, Director of APKI, pers. com., 2005)¹⁷. Until 1999, the mill was partially supplied with mixed tropical hardwood from the clearing of the remaining degraded forests inside the Tanjung Redeb Hutani concession. According to company officials, the reported productivity during this initial conversion phase was over 40 m³ ha⁻¹. The first acacia wood production occurred in 2000, after Kiani Kertas largely stopped using wood from natural forests. The 90,000 ha of plantable area in the concession needed a mean annual increment of 25 m³ ha⁻¹ for Tanjung Redeb Hutani to provide the pulp mill's requirement. Although this appeared feasible, it was not achieved.

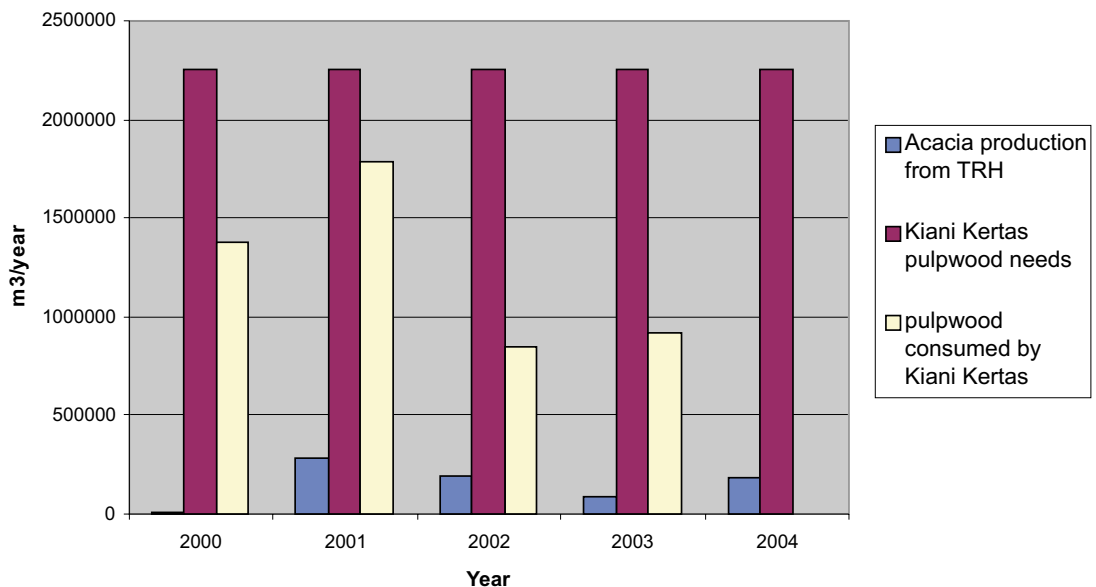
According to company officials interviewed during this study, poor relations between Tanjung Redeb Hutani and Kiani Kertas have resulted in suboptimal management of the Tanjung Redeb Hutani concession. The concession was not entirely planted, and Kiani Kertas is reported not to have purchased all the wood available from the concession in recent years. According to company officials interviewed during this study, initial agreements between Kiani Kertas and Tanjung Redeb Hutani on wood purchases by the pulp mill and conditions of payment were disrupted due to a contractual dispute between the two companies. As a result, wood supplies to the mill were stopped. Kiani Kertas had to purchase fiber from outside sources, including Australia and Malaysia (Sabah), and Tanjung Redeb Hutani had to sell its wood to other markets. Attempts to sell sawnwood to buyers in Surabaya in East Java failed since the acacia trees were not mature enough. About 5,000 ADT were sold to the chipping mill Chip Deco on Tarakan Island, just north of Berau, in 2003.

Table 6. Annual production of *Acacia mangium* at Tanjung Redeb Hutani, 2000-2004

Year	Area (ha)	Production (m ³)	Productivity (m ³ ha ⁻¹)
2000	-	10,650	-
2001	2,960	283,705	96
2002	2,497	196,899	79
2003	1,333	87,504	66
2004	2,875	187,883	65

Source: Tanjung Redeb Hutani.

Figure 2. Tanjung Redeb Hutani acacia production compared to Kiani Kertas's pulpwood needs and effective production



Source: adapted from Tanjung Redeb Hutani and Ministry of Industry data.

Figure 2 shows clearly how little fiber has been provided by Tanjung Redeb Hutani to the Kiani Kertas mill, even though pulp production has been very low compared to the installed mill capacity. This is notable considering that the Reforestation Fund provided large amounts of capital to Tanjung Redeb Hutani in the 1990s.

Condition of the plantation

Plantation establishment at Tanjung Redeb Hutani took place after the conversion of natural forests. According to company officials interviewed for this study, Kiani Kertas largely stopped using mixed tropical hardwood (MTH) in 1999. At the beginning of 2005, fully 22,000 ha of degraded forests targeted for conversion were still available. The reasons why Kiani Kertas stopped using MTH are not clear¹⁸. In early 2005, the new management indicated that they may consider resuming harvest of MTH in the near future. According to Tanjung Redeb Hutani, permits for clear-cutting (IPK permits) were issued in 2004 and 2005 on small areas in the extreme west of their concession. These IPK permits were mainly allocated to Inhutani I, for harvest of trees with diameters over 20 cm. In early 2005, it appeared likely that additional IPK permits would be allocated to Tanjung Redeb Hutani for supplying MTH. According to Tanjung Redeb Hutani management, production of MTH should average 50-60 m³ ha⁻¹ for trees with diameters below 20 cm¹⁹. The company reportedly planned to use small portable chipping mills on site to maximise wood use.

Plantation activities began in 1993 and were at their height in 1996-98 with more than 13,000 ha yr⁻¹. Subsequently, planting programmes decreased due to the financial problems of the group. During the 1997-98 fires, losses were limited to several hundred hectares of plantation only, a remarkably low figure for East Kalimantan. Moreover, in most instances, the acacia trees were burnt at their base only, and therefore the mortality rate within the plantation was low. Fires destroyed larger areas of degraded natural forests.

According to company officials interviewed for this study, uncertainty in wood sales revenues imposed very strong limits to the funds that Tanjung Redeb Hutani could channel to plantation management. For example, in 2004 wood production reportedly was less than 200,000 m³ when the target was over 600,000 m³ (Table 6). On the other hand, company officials claimed that Tanjung Redeb Hutani has always used its own budget to finance the management of the 32,000 ha water catchment area which supplies water to the Kiani Kertas mill.

According to the Tanjung Redeb Hutani officials interviewed during this study, the new owner of both the plantation and the pulp mill was not fully aware of the need to secure a future wood supply through investment in plantations. This might prove to be a problem for Kiani Kertas since all the other East Kalimantan potential sources of pulpwood are already under the control of other players for their own needs.

The field visit revealed an obvious downside to the lack of investment in plantation management, especially from 1998 onwards. Until 2002, each of the four main plantation blocks had a nursery. As the planting programme was downsized due to financial constraints, three nurseries were closed down. The remaining nursery has a capacity of 20 million plants per year, meaning that it can potentially grow enough plants for almost 15,000 ha with a stocking density of 1,350 plants ha⁻¹.

Productivity, mortality rates and growth rates vary significantly between sites planted in the same year due to different microclimates and soil qualities. Soils are mainly red-yellow podzolics. The south part of the concession is the most fertile. However, overall condition of the plantation was found to be extremely poor. Trees were not fertilized. At best they were weeded once, three months after planting. Pioneer species had invaded the entire plantation. After harvest many sites were left unplanted for one or two years, making site preparation for replanting much more expensive than it should have been. To save on costs, pioneer trees grown during the first rotation were left standing in the replanted area.

Where trees were maintained during the first three years, according to the company's silvicultural prescriptions, tree growth contrasted sharply with the rest of the plantation. However, this growth could be achieved in a limited area only.

Financial constraints have led the company to test the re-establishment of acacia stands through natural regeneration, a technique which holds some promise according to the company's technical staff. The trees are being selected when less than one year old.

Research and development was active, especially in tree improvement and silviculture. Suitable seed sources of *A. mangium* from Papua New Guinea, Queensland and Irian Jaya were identified. However, inferior quality seeds purchased from Musi Hutan Persada in South Sumatra and from a Ministry of Forestry production centre near Banjarmasin were still used for routine planting. *Gmelina arborea* seeds were produced locally. Few diseases have been reported; most of these have been root rots ('jamur akar putih').

Table 7. Topography at Tanjung Redeb Hutani

Slope 0-8%	Slope 8-15%	Slope 15-25%	Slope 25-40%	Slope > 40%
22.7%	44.2%	19.4%	12.0%	1.7%

Source: Tanjung Redeb Hutani.

As of December 2004, the total road infrastructure (including roads constructed by forest concessions and coal mining companies) was 1,483 km, of which 452 km were principal roads and the remainder secondary roads (RKT 2005). These were poorly maintained. Transport by trucks had to be stopped during the wet season. There is little chance that this situation can be improved in view of the amount of investment which would be required to render the road network practicable all year around. The concession can easily use the Berau River to Kiani Kertas, and several log ponds already exist. Production from the south part of the concession can be loaded at the coast.

Production and marketing

In 2005, the contractor Kiani Lestari initiated negotiations with other contractors to expand logging activities within the Tanjung Redeb Hutani concession area. This move suggests the possibility of an increase in pulpwood production.

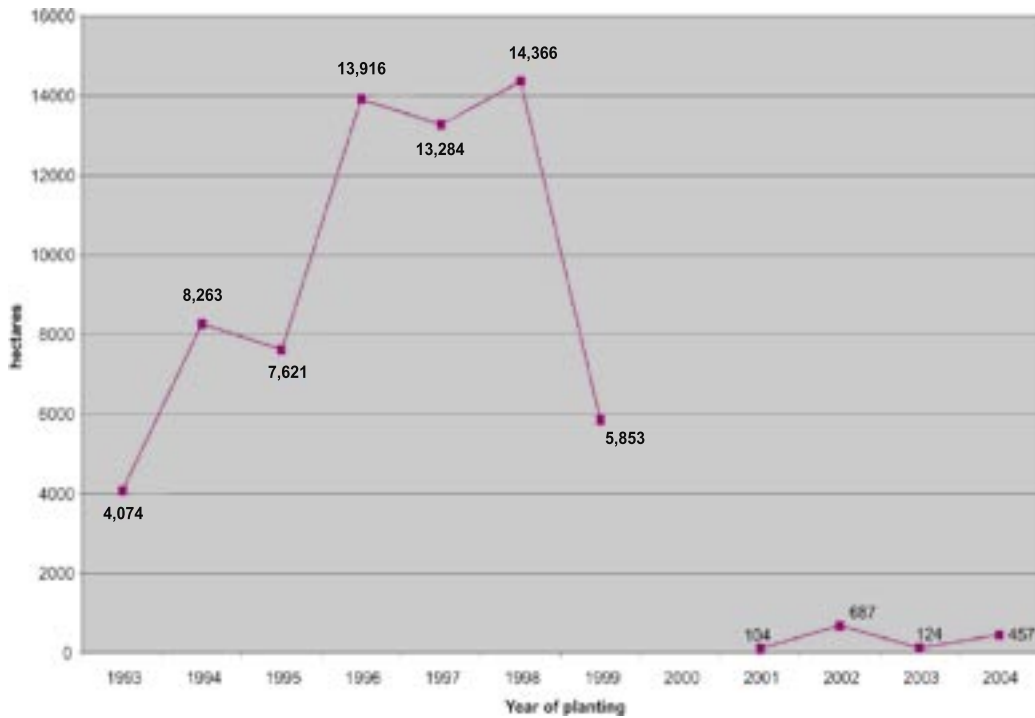
Kiani Kertas pulp mill

When Tanjung Redeb Hutani's plantation was initially established, it was intended that a majority of the wood produced would be sold to the affiliated pulp mill Kiani Kertas. Despite this affiliation, however, sales to the Kiani mill have been variable and uneven, reportedly due to poor relations between the two companies.

Since it began operating in 1996, Kiani Kertas has also experienced persistent difficulties covering its operating costs. These were compounded following the Asian economic crisis of 1997-98 when IBRA assumed control over the Kalimantan group's productive assets due to the group's heavy debts. During the same period, the Ministry of Forestry also stopped the Reforestation Fund. Thus Kiani Kertas entered into a period of cash-flow problems resulting in irregular payments to its suppliers and in a suboptimal pulp production.

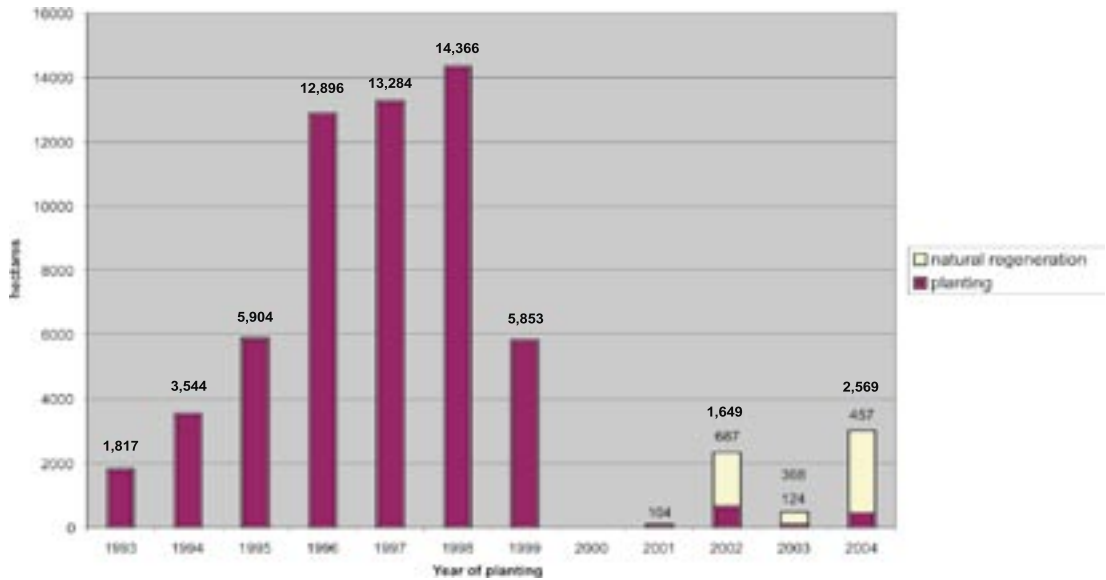
Following IBRA's sale of the Kalimantan group's debts to the current owners in 2003, Kiani Kertas reportedly owed some US\$ 201 million in outstanding debts to Bank Mandiri, Indonesia's largest government-owned bank. To raise capital needed to pay off the debt to Bank Mandiri, Kiani's owners have sought to sell a significant equity stake in the mill since late-2004. News accounts have reported Kiani to be in negotiations with a number of prospective buyers, although none of these had resulted in a purchase by the end of 2006. In October 2005, one prospective buyer - Singapore-based United Fiber System (UFS) - entered into a

Figure 3. Plantation rates for the first rotation at Tanjung Redeb Hutani at December 2004



Source: Tanjung Redeb Hutani

Figure 4. Standing area of *Acacia mangium* and *Gmelina arborea* 1993-2004 at Tanjung Redeb Hutani at December 2004



Source: Tanjung Redeb Hutani.

contractual arrangement to manage production at the mill.

According to company officials interviewed in late-2004, Kiani Kertas had adopted a new strategy to source all of its wood from domestic sources. As a first step, Kiani Kertas had stopped buying chips from Australia and was then reportedly pressuring Tanjung Redeb Hutani to increase its production and Kiani Lestari to invest in new harvesting equipment.

According to company officials, Kiani Kertas had also identified several Inhutani plantations in Kalimantan that could supply logs. The prices offered by these public companies are reportedly very low (\$22 ADT⁻¹ including \$10 t⁻¹ for freight, according to prices reported in early 2005) compared to prevailing market prices. The pulp mill also reportedly intends to buy logs from the HTI trans Belantara Pusaka, which is located inland. This company is reported to have 9,000 ha of mature plantation, with a plantable area of 12,000 ha. Transport will include 80 km on roads and eight hours on barges.

According to company officials, Tanjung Redeb Hutani at the beginning of 2005 was delivering its wood to Kiani Kertas at \$27-\$32 ADT⁻¹. The harvest was contracted for a fee of \$14 ADT⁻¹. Transport was also contracted. Fees to the contractor were expected to increase; therefore, the wood price is also likely to have risen since then. At the time this study was conducted, it was still uncertain whether Kiani Kertas would agree to pay for Tanjung Redeb Hutani's wood at a higher price.

Wood harvested in the two Tanjung Redeb Hutani concession areas located north of the Berau River is transported by truck to one of the log ponds less than 50 km away. Transporting the wood by barge to the pulp mill takes less than one day. Barge transport costed approximately \$5 m⁻³ in early 2005, including loading and unloading.

Wood from the two other concession areas located south of the Berau River is usually transported by truck to the pulp mill, at a maximum distance of 70 km. Wood from plantations located at the extreme south of the concession can be loaded at a log pond on the coast and transported by barge to the pulp mill in half a day.

Through at least the end of 2004, Kiani Kertas also purchased chips from the Malaysian province of Sabah (200,000 ADT in 2004) at \$33 ADT⁻¹, including \$11 ADT⁻¹ in transportation costs. Transport from the chip mill in Sabah to the Kiani mill takes four to five days. In previous years, Kiani Kertas also purchased chips from Australia, reportedly at a 2003 price of \$108 t⁻¹ (bone dry) or approximately \$50 m⁻³, and on a small scale from several Inhutani plantations (Lampung and Sumatra, as well as South, Central and East Kalimantan).

Chip Deco chipping mill

Chip Deco is an old chipping mill located on Tarakan Island, just north of Berau and at a close distance to Tanjung Redeb Hutani. Its capacity is less than 100,000 ADT yr⁻¹. According to company officials, Chip Deco bought wood from Tanjung Redeb Hutani in 2003 and might want to buy more in the future. Transport to the mill takes less than three days from log ponds on the Berau River.

According to its 2005 Annual Work Plan (RKT), Tanjung Redeb Hutani planned to harvest 8,880 ha with an estimated volume of 745,000 m³, for a yield of 84 m³ ha⁻¹, and planned to plant 4,717 ha of *Acacia mangium* and 3,953 ha of *Gmelina arborea*.

Short- and long-term scenarios²⁰

Short-term (2005-2011) production from existing plantations

To project the potential pulpwood production (see Table 8), we have made the following assumptions:

- Trees are harvested at age 7 years, or older for trees planted between 1995 and 1998.
- Trees planted in 1993 and 1994 are not used for the pulpwood market.
- Stands planted in 1995 yield 115 m³ of commercial wood ha⁻¹; stands planted in 1996 yield 105 m³ of commercial wood ha⁻¹; stands planted in 1997 yield 95 m³ of commercial wood ha⁻¹. These are all harvested in 2005.
- Stands planted from 1998 onwards yield 60 m³ of commercial wood ha⁻¹ due to lack of maintenance.

Table 8: Projected pulpwood production from standing plantations at Tanjung Redeb Hutani, December 2004

	Year of production						
	2005	2006	2007	2008	2009	2010	2011
Production (m ³)	4,156,980	351,180	missing	62,400	140,160	25,520	181,560

Source: Derived from Tanjung Redeb Hutani data with assumptions as noted in text

Long-term production: best scenario from 2012 onwards

This section projects the volume of commercial wood that could potentially be produced if the maximum available area were planted in 2005 and the following years. The 'best scenario' is based on the following optimistic assumptions:

- The entire plantable area is managed.
- The plantation is managed to produce an even flow of wood.
- The MAI (Mean Annual Increment) is 20 m³ ha⁻¹.
- The rotation period is 7 years.
- Planting operations started in 2005.

The resulting projected annual production is 1.8 million m³, from a harvested and planted area of 12,850 ha yr⁻¹.

Social aspects

There have been reports that the area allocated to Tanjung Redeb Hutani for the development of its plantation has been subject to land tenure claims by local communities. Details about the claims on lands inside the concession are not readily available in the public domain and, therefore, it is difficult to assess the implications of such claims with any precision. According to company staff interviewed during this study, these claims may not exceed 3,000 ha, and only a small portion of these claims is legally registered.

In the southern part of the concession, 200m of land on both sides of the main road has been left for the neighbouring population. This area covers less than 1,000 ha and is mostly deforested. With the exceptions of a limited number of small teak plantations, there are no agricultural or plantation activities along this road. In 2003, the population in the eleven subdistricts in and around the Tanjung Redeb Hutani concession amounted to 136,628 people.

In 2002, Tanjung Redeb Hutani laid off most of its workers for financial reasons. Through late 2004 when this study was conducted, the company had kept 276 permanent staff only. At that time, the concession had a very low level of activity.

According to company officials, Tanjung Redeb Hutani has encouraged neighbouring communities to plant *Acacia mangium* at their own expense. Plants have been provided by the company, and the trees have been harvested and transported by local contractors (manually in most of the cases). Depending on the proximity to the main road, the contractor pays from Rp 50,000 to Rp 80,000 ADT⁻¹, equivalent to \$5.5-\$9 t⁻¹ to the community. This is low compared to the price paid for chipwood from other sources. In early 2005, Kiani Kertas paid \$22 ADT⁻¹ for chipwood delivered at the mill gate.



Seven-year-old Acacia mangium plantation at Tanjung Redeb Hutani



Natural regeneration at Tanjung Redeb Hutani, before tree selection



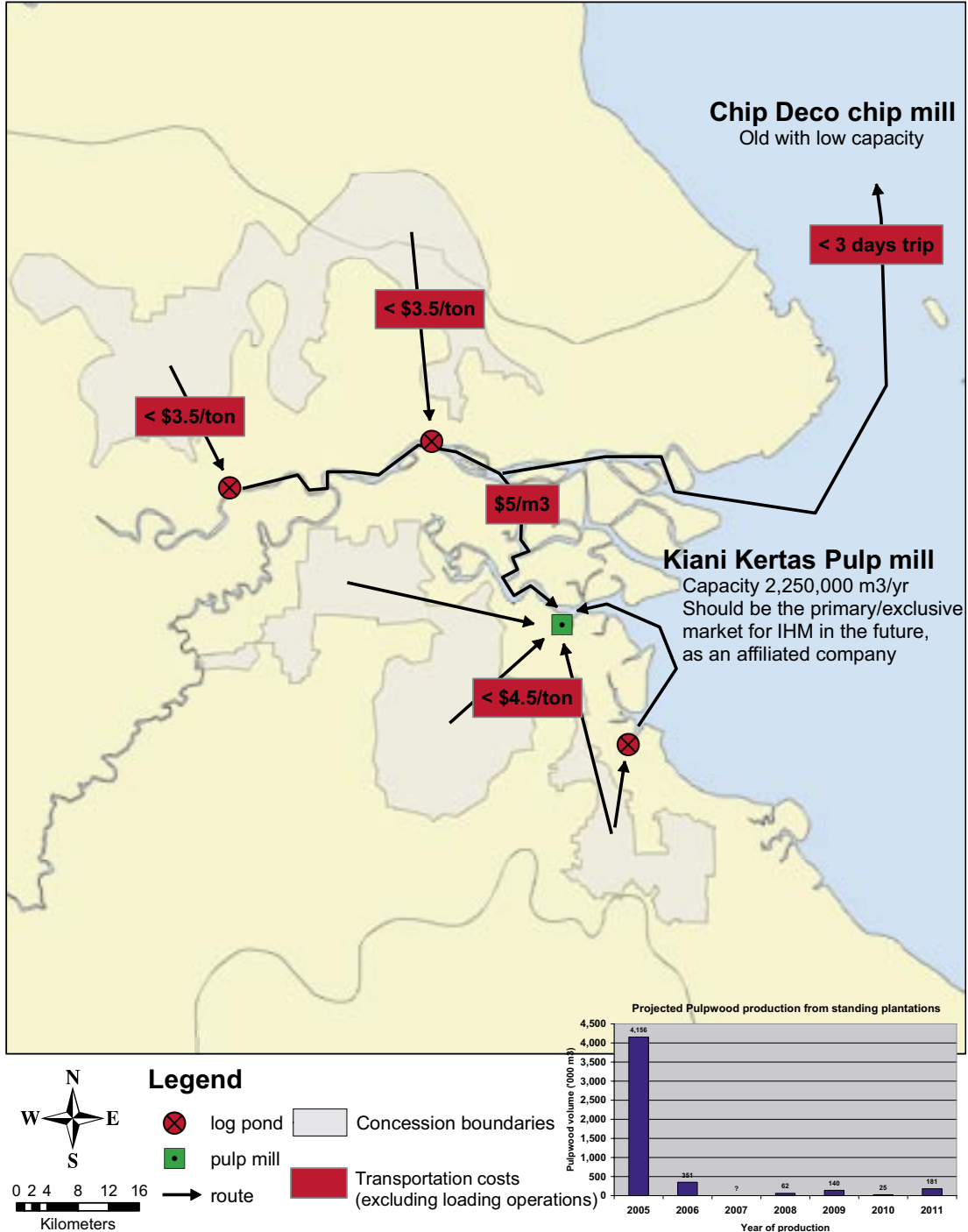
Recent planting of acacia at Tanjung Redeb Hutani



Acacia plantation recently harvested at Tanjung Redeb Hutani, with remaining pioneer species trees

Tanjung Redeb Hutani

Projected Pulpwood Production 2005-2011 +
Best scenario: 1.8 million m³/year from 2012 onwards



Map 2. Tanjung Redeb Hutani

SURYA HUTANI JAYA²¹

History of the plantation

Sumalindo is an Indonesian company that manages forest concessions and HTI plantation concessions in East Kalimantan. The company used to be controlled by the Astra group, but the Hasko group took over in 2002 with its subsidiary Sumber Graja Sejahtera holding 75% of the shares (Sumalindo financial reports, available Jakarta Stock Exchange). In 1990 Sumalindo established Surya Hutani Jaya as a joint venture with Inhutani, with shares held 60/40 respectively, to manage a HTI pulp plantation in East Kalimantan.

The Surya Hutani Jaya concession is located approximately two hours from Samarinda, spreading to the north of the Mahakam River for more than 100 km. The concession is contained in two districts: Kabupaten Kutai Kertanegara and Kabupaten Kutai Timur, and the subdistricts Kec Muara Bengkal, Kec Muara Kaman and Kec Sebulu. The altitude is 25-250 m (asl) and the climate is 'Tropical Humid'.

Surya Hutani Jaya obtained a temporary HTI concession license in 1990 to develop an area of 180,000 ha. The final license (SK MenHut 156) was issued in 1996. In 1999, new concession boundaries were established in consultation with local authorities (*Bupati*) and neighbouring villages. As a result, the concession area was reduced to 156,000 ha with a plantable area of 72,782 ha. Surya Hutani Jaya seems to have revised its management plan on the basis of the new boundaries, though the revised license had not yet been formalized at the time this study was conducted.

The company received also funds from the Reforestation Fund for plantation establishment on degraded forest areas.²² However, there is a lack of clarity regarding the area of plantation that was established with money from the Reforestation Fund. The company reports that

36,000 ha of plantations were burnt by the 1997/98 fires. However, it is possible that this area also includes burnt areas of natural forest regrowth.

The concession was initially planted with eucalypts, which had a lower than expected productivity; with *Gmelina*, appreciated for its various uses; and with acacia. After the 1997/98 fires, *Acacia mangium* became the dominant plantation species. Planting of eucalypts continued in the form of trials. Table 9 shows the condition of the acacia plantations at Surya Hutani Jaya from 1990 to 1998.

During an initial phase, degraded forests in Surya Hutani Jaya's concession were clear-cut using IPK land clearing permits held by Inhutani. The wood was supplied to Sumalindo plywood mills.

Surya Hutani Jaya's license was revoked by the Ministry of Forestry in 2002 because loans from the Reforestation Fund had not been repaid and because the plantation was in poor condition due to poor maintenance and fires. According to Surya Hutani Jaya, this action occurred without consulting the company or local authorities and did not involve an independent auditor (LPI). The company claims that in 2003 the governor of East Kalimantan gave a dispensation to keep Surya Hutani Jaya operating. Sumalindo subsequently asked for a restructuring of the debt repayment and undertook minimum field operations. In 2004, the company's license was reinstated, as were the licenses for several other HTIs plantation concessions in the same situation.

In October 2004, Surya Hutani Jaya was sold to PT Arara Abadi, a company of the Sinar Mas group. PT Arara Abadi inherited both the Reforestation Fund debts and the claims on Kiani Kertas for past wood sales. PT Arara Abadi reportedly bought 60 percent of Surya Hutani Jaya shares through a subsidiary, PT Borneo Manggala Utama, while Inhutani continued to hold the remaining 40 percent share.

Table 9. Condition of acacia plantations at Surya Hutani Jaya, 1990-1998

Condition of plantation	Year of planting									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	Total
	Area (ha)									
Destroyed by fire	317	2,316	4,669	4,668	8,425	5,056	7,987	2,576		36,014
Dead	31	118	100	622	417	1,241	518	1,275		4,322
Sandy soil						1,605	1,235	716		3,556
Wetland						955		386		1,341
Claimed							1,964	564		2,528
R&D area	7	130	225	327	136	333	50	92		1,300
Good for harvest	248	2,389	8,333	10,943	8,285	5,520	2,795	6,491	2,385	47,389
Total	603	4,953	13,327	16,560	17,263	14,710	14,549	12,100	2,385	96,450

Source: Surya Hutani Jaya.

Initially, Surya Hutani Jaya's plan was to manage a pulpwood plantation that would supply fiber to a pulp mill to be built in the southern part of the concession area. The planned capacity for the pulp mill was 500,000 ADT yr⁻¹. Sumalindo used to be controlled by Bob Hasan through the Astra group. This might explain why, in 1995, Sumalindo decided to abandon the pulp mill project and to build instead a MDF mill to be supplied by the plantations under the control of Sumalindo. These included Sumalindo Lestari and Sumalindo Hutani Jaya located in East Kalimantan. Other alternative sources of fiber supply for the MDF mill were wood wastes from local plywood mills and sawmills, and wood produced by thinning operations at Surya Hutani Jaya. According to Surya Hutani Jaya staff, the sale of their company to PT Arara Abadi can be explained by the fact that Sumalindo had several other viable options of wood supply for its MDF mill.

Condition of the plantation

When the research for this study was conducted in late-2004, 49,000 ha of very degraded natural forests remained in the concession area. The planted area is rather compact, with *Acacia mangium* being the main species and *Gmelina arborea* being planted on a smaller scale in sites where soil pH is high. Several hundred hectares of eucalypt trials were planted recently since improved technology at Asia Pulp & Paper's mills allows for a pulp mixture of acacia and eucalypt wood.

The western part of the concession has 47,000 ha of sandy soils in low land prone to occasional floods. These sites are not included in the total plantable area. Conservation forests cover 7,335 ha in hilly sites and close to rivers.

Seeds of *A. mangium* are supplied by Wirakarya Sakti, a company related to the Sinar Mas group. The seeds are of Papua New

Table 10. Topography at Surya Hutani Jaya (including non-plantable areas*), as of 2004

	Slope 0-8%	Slope 8-15%	Slope 15-25%	Slope >25%
Area (ha)	39,941	54,636	62,118	6,079
Area (%)	24.5	33.6	38.2	3.7

Source: Surya Hutani Jaya.

*Data for the plantable area are not available, but the maps indicate that most of the plantable area has slopes ranging from 8% to 25%.

Guinea origin and seem well-adapted to the local conditions. If needed, Surya Hutani Jaya may be able to reactivate its own local seed production.

Acacia is being planted at 3m x 2.5m spacing. The average survival rate is 80 percent five years after planting. Growth yield is low and may remain so for areas planted up to 2004. In 2004 the company obtained an estimated commercial volume of 57 m³ ha⁻¹, over 2,878 ha of plantation harvested at an average age of 6.7 years. We assume that the areas planted up to 2004 will have, at time of harvest, a commercial wood yield of approximately 60 m³ ha⁻¹.

The road conditions could not be checked. In December 2004, according to the company's Annual Work Plan (RKT 2005), there were 2,738 km of roads comprising provincial roads (18 km), principal roads (141 km), secondary roads (469 km) and logging roads (2,110 km).

Production and marketing

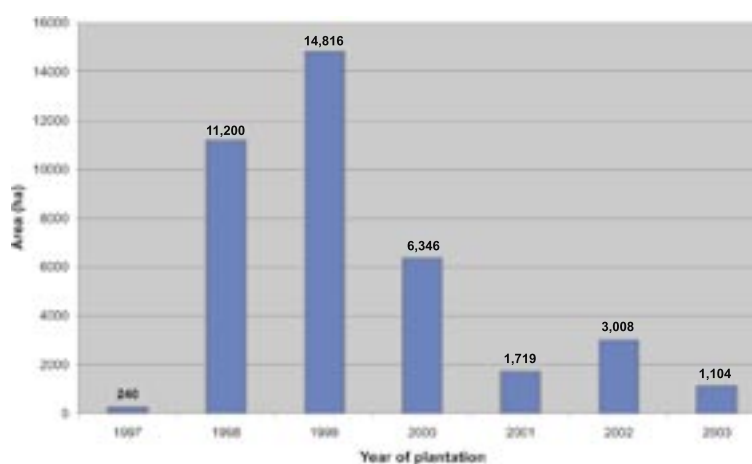
Surya Hutani Jaya initiated commercial wood production in 1997, and wood was sold to Kiani Kertas pulp mill and the Sumalindo MDF mill. Because of the change in ownership in 2004, it is conceivable that Surya Hutani Jaya plantations could supply either Indah Kiat and Lontar Papyrus pulp mills in Sumatra, or the APP pulp mill located on Hainan Island, China.

Table 11. Annual wood production at Surya Hutani Jaya, 1990-1997

Year of harvest	Annual harvested area (ha) per year of planting								Total	Production (m ³)	Yield (m ³ ha ⁻¹)
	1990	1991	1992	1993	1994	1995	1996	1997			
1997	248	1,452							1,700	578,817	40
1998		937	8,333	3,486					12,756		
1999				7,457	1,202				8,659	481,254	56
2000					7,083				7,083	314,067	44
2001						5,520	1,399		6,919	135,433	20
2002							1,396	2,850	4,246	155,566	37
Total	248	2,389	8,333	10,943	8,285	5,520	2,795	2,850	41,363	1,665,137	40

Source: Surya Hutani Jaya (January 2003).

Figure 5. Standing area of pulpwood (mostly *Acacia mangium*) by year of planting at Surya Hutani Jaya, as of 2004 (total area = 38,433 ha)



Source: Surya Hutani Jaya, confirmed by Arara Abadi management.

Kiani Kertas pulp mill

The Kiani Kertas pulp mill started operating in 1998, with wood supplies coming from Surya Hutani Jaya, ITCI Hutani Manunggal and Tanjung Redeb Hutani in East Kalimantan, and other sources in Malaysia. When this study was conducted in 2004, Surya Hutani Jaya was reportedly still holding \$1 million in debts for the wood sales to Kiani Kertas, making it unlikely that Surya Hutani Jaya will sell more wood to Kiani Kertas unless these outstanding obligations are resolved. The transport costs by river and sea to Kiani Kertas mill will be similar to those for wood delivery from ITCI Hutani Manunggal, i.e., about \$6.5 m³ from the Mahakam River (not including loading). The wood is loaded on barges at the Mahakam River near the MDF mill.

Sumalindo MDF mill

According to company officials, when Sumalindo established its MDF mill in the late-1990s, the price paid for the wood from Surya Hutani Jaya plantation was Rp 95,000 ADT¹, equivalent to

\$11 ADT¹. In 2002, harvest and transport costs by another Sumalindo subsidiary reportedly was Rp 125,000 ADT¹, equivalent to \$14.5 t⁻¹, or Rp 104,000 m⁻³, equivalent to \$12 m⁻³ for a transport distance of 45 to 150 km by road²³. Sumalindo was selling the wood to the MDF mill at cost.

Indah Kiat pulp mill in Riau, Sumatra

Confidential sources from within Asia Pulp & Paper (APP) indicate that the industrial plantations purchased in Kalimantan by APP-related companies are not aimed at supplying pulp mills in Sumatra. APP seems to believe that wood resources in Sumatra will still be sufficient in the coming years to supply its Riau and Jambi mills. Wood transport from Surya Hutani Jaya to Sumatra by road, river and sea may be considered too expensive (Table 12).

During interviews for this study, company officials indicated that Surya Hutani Jaya does not consider it to be economically feasible to transport wood by road from the north of the concession to the Mahakam River, for a total distance of about 180 km. (The distance

Table 12. Transport costs from Surya Hutani Jaya concession to Riau, Sumatra (logs)

Transport from concession to Mahakam River (including loading on truck, and average distance 90 km)	Transport from Mahakam River to Samarinda (not including loading on barge)	Loading on barge on river plus loading on ship at Samarinda	Transport from Samarinda to Riau Sumatra (not including loading on ship)	Total transport cost from concession to Riau, Sumatra (including loading costs, on average)
\$6.5 ADT ¹ (\$5 m ⁻³)	\$4 ADT ¹ (\$3 m ⁻³)	\$2.5 m ⁻³	\$15 ADT ¹ (\$11-\$12 m ⁻³)	\$21.5-\$22.5m ⁻³

Source: Old and new management at Surya Hutani Jaya.

Note: The conversion factor is 750 kg m⁻³.

between the log pond and the closest boundary of the concession is more than 30 km.) The road currently owned by Surya Hutani Jaya was built by Sumalindo to link the concession to the affiliated MDF mill. Road construction costs have included financial compensation to concerned landholders.

The Kedang Rantau River, a tributary of the Mahakam, passes close to the extreme north of the concession. Surya Hutani Jaya is considering using this river for transporting wood from the northern part of the plantation, which accounts for approximately one-third of the planted areas. Types of barges to be used and the resulting costs were still being negotiated when this report was prepared. Barges 92 m in length cannot pass the bridges crossing the Mahakam River, upstream from Samarinda. Barges 61 m in length can pass these bridges but may be too large to navigate on the Kedang Rantau tributary. Transport by barge from the Mahakam River to Samarinda takes 15 to 25 hours. The wood is transferred from barges to ships for further transport to China.

The nearest chipping mill to the concession is Alam Jaya Lestari in Balikpapan. Because of the high transport costs to either Sumatra or China, Surya Hutani Jaya has a strong incentive to process the wood into chips before it is loaded on barges. The location for a chipping mill is not decided yet, but the log pond on the Mahakam River seems to be the best option. Small portable mills are another alternative.

According to company officials interviewed for this study, it is possible that APP may consider constructing a local pulp mill using Surya Hutani Jaya plantations as the main source of wood. This of course will depend on how much wood Surya Hutani Jaya will be able to produce. It will also depend on whether the current wood shortfall of APP pulp mills in Sumatra and China is successfully resolved. Finally, the economic feasibility of transporting wood from Surya Hutani Jaya to Sumatra and China will be an important parameter. PT Arara Abadi made an extensive survey of Surya Hutani Jaya prior to its purchase. However, much information is still unavailable

on road conditions, the state of certain plantation areas, and logistics (the size of barges or ships) and the costs to transport the wood to various markets.

Short- and long-term scenarios²⁴

Short-term (2005-2011) production from existing plantations

To project the potential pulpwood production for 2005-2011 (see Table 13), we have made the following assumptions:

- Trees are harvested at age 7 years.
- Trees planted in 1997 were harvested in 2005 at age 8 years.
- The commercial output of 1997 plantations is 60 m³ ha⁻¹. (This assessment is based on Surya Hutani Jaya's data.)

Long-term production: best scenario from 2012 onwards

This section projects the volume of commercial wood that could potentially be produced if the maximum available area were planted in 2005 and the following years. Surya Hutani Jaya's management reportedly intends to plant, every year, an equivalent area in the northern and southern parts of the concession in order to reduce the risks and secure an even flow of wood. The 'best scenario' is based on the following optimistic assumptions:

- The entire plantable area will be managed.
- The plantation will be managed to produce an even flow of wood.
- The MAI (Mean Annual Increment) is 20 m³ ha⁻¹ (a very optimistic assumption considering the local conditions).
- The rotation period is 6 years.
- Planting and harvesting operations started in 2005.

The resulting projected annual production is 1,456,000 m³ from a harvested and planted area of 12,130 ha yr⁻¹. If the area of 8,643 ha claimed by local people (see below) is removed from the plantable area, the resulting annual production is reduced to 1,280,000 m³ from a harvested and planted area of 10,670 ha yr⁻¹.

Table 13. Projected pulpwood production from standing plantations in early 2005 at Surya Hutani Jaya

	Production year						
	2005	2006	2007	2008	2009	2010	2011
Yield (m ³)	686,400	888,960	380,760	103,140	180,480	686,400	0

Source: Derived from Surya Hutani Jaya data with assumptions as noted in text.

Social aspects

The largest part of the local population is in the south between the southern border of the concession and the Mahakam River. Many villagers claim that they have ancestral rights for land located within the current Surya Hutani Jaya boundaries. Previous claims have already resulted in a reduction of the total area and the issuance of a new license. At the time this study was conducted, a total of 8,643 ha were

then being disputed, mainly on plantable land in the extreme south of the concession.

Local villages include Javanese transmigrants who are farmers, plantation workers or illegal loggers of *ulin* trees. There are also a number of villages inhabited by Dayak and Kutai people who are involved in illegal logging or plantation work, and to a lesser extent, shifting cultivation.



Poor maintenance of Acacia mangium at Surya Hutani Jaya



Logged area at Surya Hutani Jaya



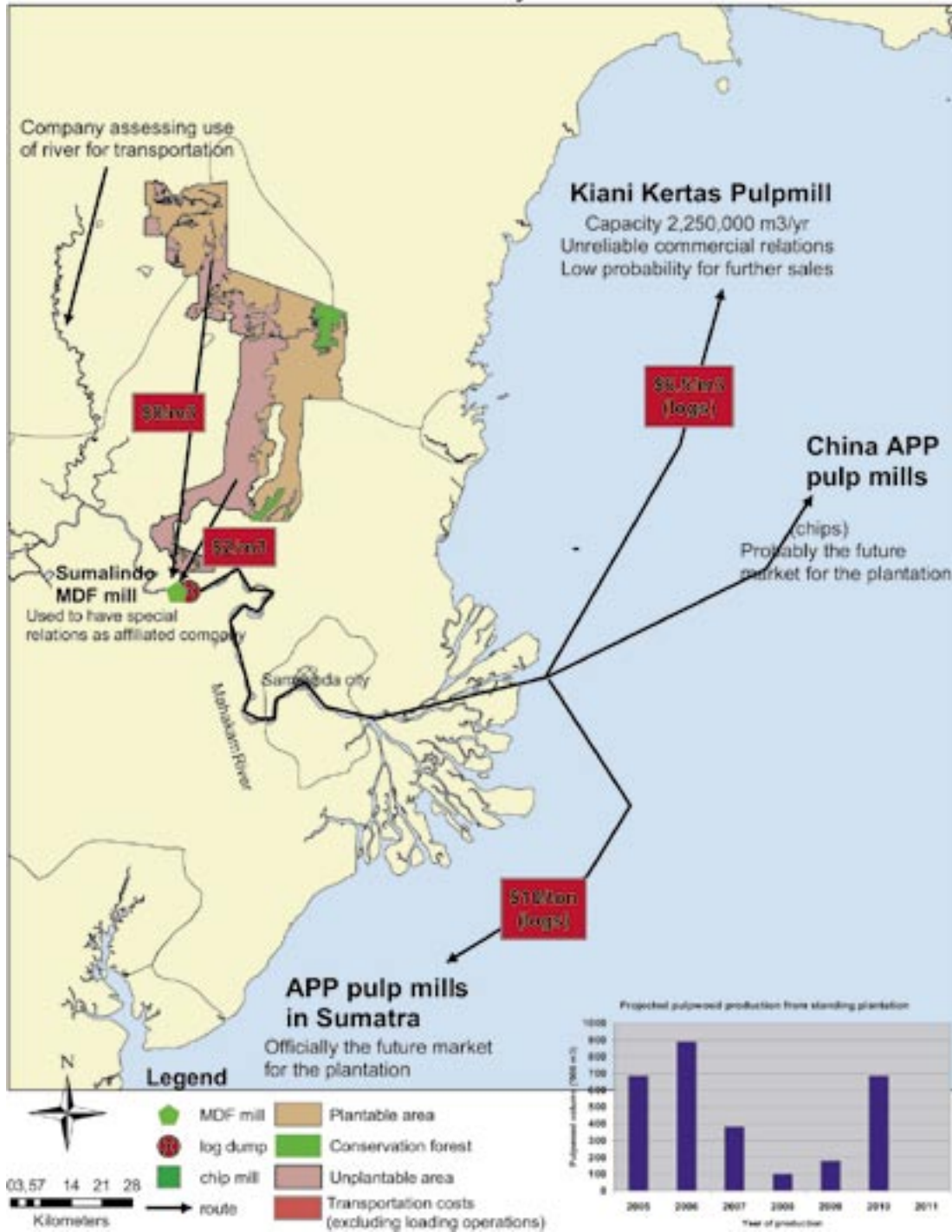
The Mahakam River may be used for wood transportation at Surya Hutani Jaya



New planting of Acacia mangium at Surya Hutani Jaya

Surya Hutani Jaya

Projected Pulpwood Production 2005-2011 +
Best scenario: 1.45 million m³/year from 2012 onwards



Map 3. Surya Hutani Jaya

FINNANTARA INTIGA²⁵

History of the plantation

Finnantara Intiga was established in 1993 as a joint venture between Stora Enso (through its subsidiary Nordic Forest), Gudang Garam, and the state-owned forestry company Inhutani III, with shares divided according to a 30/30/40 split, respectively (Company director, pers. com., May 2003). In 2000, Nordic Forest became the principal owner, with 67 percent of the company, and Inhutani III held the remaining shares.

The first harvest occurred in December 2003 on a small scale. Less than 25,000 m³ of wood were sold. An important turning point came in 2004 when Stora Enso was to decide if it would expand the planted area or stop the operations on the basis of the information gathered on the overall project viability during the first six months of commercial production. Stora Enso decided to pull out. In October 2004, Global Fiber, a company related to Asia Pulp & Paper, bought the concession to use it as a resource base for APP's pulp mills in Sumatra and China.

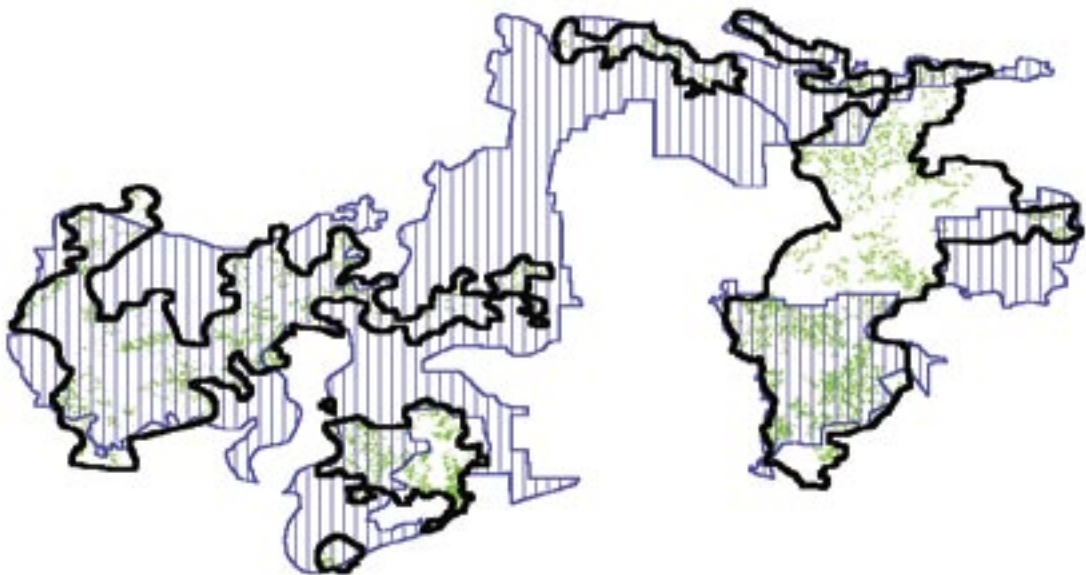
The concession is located in West Kalimantan, east of Pontianak and a four-hour drive by road. According to the company's Annual Work Plan (RKT 2005), the concession lies in two districts, Kabupaten Sanggau (Kec Bonti, Jangkang, Mukok, Sekadau Hilir, Belitang Hilir and Sanggau Kapuas) and Kabupaten Sintang (Kec Belitang Hulu, Ketungau Hulu,

Ketungau Tengah, Ketungau Hilir and Sepauk). It is close to the equator, 0°00' - 0°40'S and 110°30'-111°30'E. The altitude is 64-385 m asl. Rainfall is 175-412 mm per month and average temperature is 26°C. The topography is variable (Table 14).

The final license (SK Menhut 750) issued in 1996 covers 299,700 ha, with 142,000 ha plantable (according to the mapping carried out in 2001). Planting acacia trees was not imposed on the local population since the project emphasised socially responsible attitudes towards local communities. The presence of many Dayak villages, and a *de facto* control of the land by local communities, resulted in the decision to give back part of the lands. In 2002, the two district heads and the governor of the province approved an Addendum to the boundaries of the concession which resulted in a new total area of 187,000 ha (Figure 6).

Through land swapping, the new boundaries had the advantage of making the concession more compact. An area of approximately 10,000 ha of acacia was planted outside the original boundaries on the belief that the Addendum would be confirmed by law. However, the Ministry of Forestry never formalized this agreement. The new owner Global Fiber does not recognize the Addendum. The fact that the Finnantara Intiga concession is not located in an ex-HPH area, unlike most of the HTI pulp concessions in Kalimantan, explains why the area has a high population density and was already almost entirely deforested at the time the concession was allocated in 1993.

Figure 6. Finnantara Intiga concession according to the initial license (in blue) and Addendum (in bold). Planted areas are in green.



Source: Finnantara Intiga.

Stora Enso had initially planned to develop a plantation resource base and to obtain a license for an affiliated pulp mill. However, the pulp mill project was abandoned as a consequence of the Asian economic crisis and the period of political instability in Indonesia at the end of the 1990s. Investments in the plantation were continued since Finnantara Intiga potentially could be a strategic fiber reserve for pulp mills that Stora Enso was planning to purchase or to build elsewhere in Asia.

According to company officials, a team responsible for evaluating HTI plantations on behalf of the Ministry of Forestry visited the company in October 2002 and concluded that the plantation was viable. A third party assessor also visited the company in 2004 and reportedly also reached a positive conclusion.

Condition of the plantation

The concession was mapped in 2001, and it was found that 157,000 ha out of a total concession area of 299,000 ha were not plantable. The non-plantable areas of the concession include:

- 30,359 ha of secondary forest with rubber trees that the company has committed not to convert.
- 23,064 ha of conservation forest along rivers and 1,373 ha of heath forest (*hutan kerangas*) on sandy soil. Biodiversity assessment is currently underway.
- 6,615 ha of wetlands.
- 1,285 ha of customary forest (*hutan temawang*).

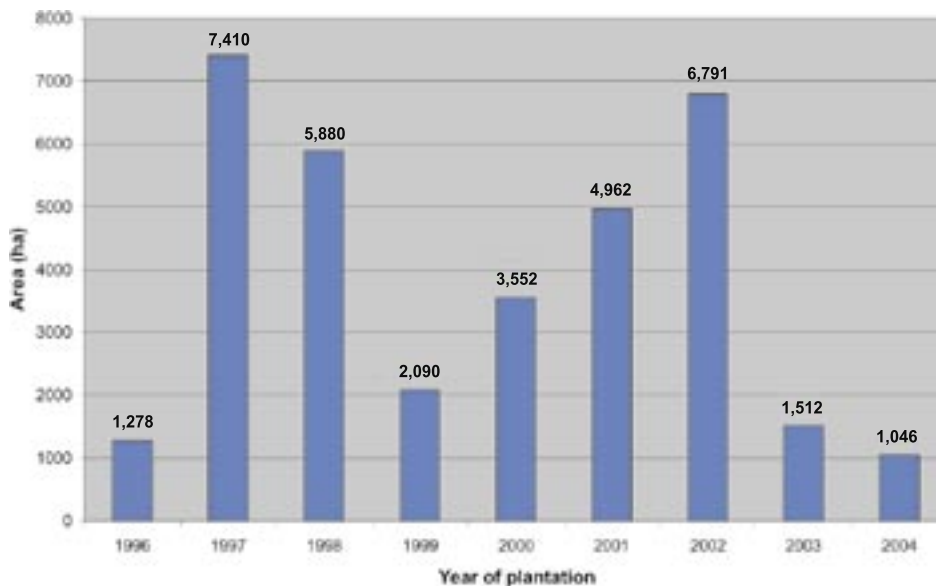
- Some 35,000 ha classified for dryland agriculture (*pertanian lahan kering*). Approval of both villagers and district authorities is legally required for a company to develop plantations on this type of land.

The plantation estate is scattered into a large number of small wood lots. According to company officials, communities have formally agreed to give access to the land to Finnantara Intiga for a period of 45 years. However, in many instances villagers decided to pursue other land use options after the first rotation had been harvested. Shifting cultivation was a very common practice, with plantings mixed with sengon or rubber.

Three species are planted by the company: *Acacia mangium* (85% to 90% of the total area) and smaller areas of *A. crassicarpa* and *Eucalyptus pellita*. In some sites, the two *Acacia* species are mixed. The seeds are of various origins, and this may partly explain important variations in growth and yield. With the change in ownership, the future supply of seeds will come from APP-related companies in Sumatra. When this study was conducted, the company planned to establish 11,033 ha in 2005.

During our field visit, we were able to observe that, in most instances, plantations were maintained. However, there was still room for improvement. Areas of mature trees were often invaded by weeds, and tree diameters were highly variable. Many recent plantings were done without prior complete land clearing. Trees that were several years old were usually maintained, but their growth was expected

Figure 7. Standing area of pulpwood plantation at Finnantara Intiga, 1996-2004 (total 34,521 ha)



Source: adapted from Finnantara Intiga.

Table 14. Topography at Finnantara Intiga

	Slope 0-8%	Slope 8-15%	Slope 15-25%	Slope >25%
Area (ha)	278,635	5,280	6,185	9,600
Area (%)	93	1.8	2.1	3.2

Source: Finnantara Intiga.

to be less than optimal. Trials of natural regeneration of acacias had been abandoned.

Since local people have been reluctant to scale down their basic practices, there were several examples of cultivation systems in which acacias were grown with agricultural crops, especially rice or singkong (tapioca). According to Finnantara Intiga, rice can be planted soon after the establishment of acacia without any significant impact on tree growth, and rice is also commonly cultivated between tree rotations.

In 2004, Finnantara Intiga harvested 2,400 ha of its plantation and produced 290,000 m³ of wood with an average yield of 121 m³ ha⁻¹. Most of the stands had been established in 1997 and 1998. Some were older. This age variation made it impossible to calculate with precision the Mean Annual Increment. However, Finnantara Intiga estimates that growth rates of 7-year-old trees were in the range of 80-135 m³ ha⁻¹.

In June 2004, Finnantara Intiga had 2,483 km of roads, including 151 km of principal roads, 563 km of secondary clay and gravel roads, and 1,769 km of logging roads. The topography is mainly flat or gently sloping (Table 14).

Production and marketing

Marketing in 2004

In 2004, Finnantara Intiga was actively seeking markets for its wood in order to generate cash flow. The plantation needed the cash flow

to survive, according to company officials interviewed during this study. In this context, several markets were tried even though, in several instances, only limited volumes were supplied (Table 15). Only one-third of the production was sold in 2004, owing to difficulties in transporting or marketing the wood, or both. The remaining stocks were either in the log ponds (38,000 m³ in Sukau in December 2004, and 24,000 m³ in Mukok in March 2005) or still along logging roads.

Market details:

- Bina Mandah Pratama is a chipping mill located in Cawan Island, Riau Province, Sumatra.
- Tanjung Enim Lestari is a pulp mill located in South Sumatra Province. Wood was transported by barge to Bandar Lampung city, and then by train to the mill.
- Riau Andalan Pulp and Paper is a pulp mill located in Riau Province, Sumatra.
- Adinaco Serasi and Novopan Indotama are particleboard mills located near Pontianak, West Kalimantan.
- Inpro Yasa Indonesia is a sawmill located near Semarang, Java.

Marketing from 2005 onwards

We expect that with APP having full control of the plantation, future wood delivery would go exclusively to APP's pulp mills in Sumatra or China, or both. The target for 2005, as reported

Table 15. Wood sales (m³) from Finnantara Intiga in 2004

Bina Mandah Pratama	Tanjung Enim Lestari	Riau Andalan Pulp and Paper	Adinaco Serasi	Novopan Indotama	Inpro Yasa Indonesia
23,716	18,174	40,751	2,174	2,839	12

Source: Finnantara Intiga.

Table 16. Shipping costs for pulpwood from Finnantara Intiga concession (includes barge loading)

Departure	Log pond close to the concession	Pontianak	Pontianak
Destination	Pontianak	Sumatra (Riau or Bandar Lampung)	Cawan Island
Price* (Rp ADT ⁻¹)	40,000	110,000	100,000
Estimated price (\$ m ⁻³)	3.3	9	8.5
Trip duration (days)	1-3	5-7	5-7

Source: Local contractors.

* Wood is weighed at destination. The conversion factor is 750 kg m⁻³.

by Finnantara Intiga's new management, was to produce 454,000 m³ of pulpwood²⁶, part of which will be processed into chips before being shipped to these distant markets.

There are three log ponds, Sukau, Mukok and Tayan, along the Kapuas River close to the concession; however, low dry-season water levels make transport by barge impossible during three months (July to September). Finnantara Intiga's management is considering road transport to avoid this constraint. However road transport is going to be a much more expensive alternative. There are almost 300 km from Sanggau to Pontianak. Another option would be to load the chips on the coast, at Sungai Pinyuh city, north of Pontianak, at a distance of more than 200 km from Sanggau. With this option, a further 130 km would have to be added for chips coming from Sintang.

The high water level on the Kapuas River, at the heart of the rainy season (November-January), prevents 55 to 67 metre-long barges with their full load (1,500 to 2,500 t) from passing under the bridge located between Mukok log pond and Pontianak. In normal conditions, when the level of water on the Kapuas River is neither too low nor too high, logs are chipped at Mukok with two portable chippers, each with a capacity of 60 m³ day⁻¹, and loaded directly on barges. However, this system is relatively expensive because the barges have to be enclosed to contain the chips. When the water level is too high, barges are loaded at half capacity with logs and receive an additional half load of logs once the bridge has been passed. Such an operation would pose serious logistic problems with chips, in addition to being uneconomical. Furthermore, the lack of space at the Mukok log pond prevents the construction of a high capacity chipping plant that would reduce handling costs.

When this study was conducted, barges were contracted. According to company officials, barge availability often decides what size of barge is to be used. However, the price remains the same regardless of the size.

Short- and long-term scenarios²⁷

Short-term (2005-2011) production from existing plantations

To project the potential pulpwood production for 2005-2011 (see Table 17), we have made the following assumptions:

- Trees harvested in 2005 were aged 7 years or older.
- Net yield (commercial output) is 120 m³ ha⁻¹ for 7-year-old trees.
- Net yield is 140 m³ ha⁻¹ for trees planted in 1996, and 130 m³ ha⁻¹ for trees planted in 1997. All of these were harvested in 2005.

Long-term production: best scenario from 2012 onwards

This section projects the volume of commercial wood that could potentially be produced if the maximum available area were planted in 2005 and the following years.

With respect to Finnantara Intiga, it is extremely difficult to make any realistic wood-flow projections, as new plantings will largely depend on the willingness of the local population to release land for new pulpwood plantations. The company's target may be as high as 100,000 ha of plantations, but the villagers may not be ready to release this much land. Our field visit leads us to believe that it is unlikely that local communities will enter into partnership unless they are strongly pressured. The intention of local authorities to issue permits for oil palm plantations within the concession boundaries is also likely to be a constraint.

The 'best scenario' is based on the following optimistic assumptions:

- 80,000 ha are planted, an arbitrary figure as explained above.
- An even flow of wood is produced.
- The MAI (Mean Annual Increment) is 20 m³ ha⁻¹.
- The rotation period is 7 years.
- Maximum planting and harvesting operations started in 2005.

The resulting annual production is 1.6 million m³, for a harvested and planted area of 11,428 ha yr⁻¹.

Table 17. Projected pulpwood production from standing plantations established in early 2005 at Finnantara Intiga

	Production year						
	2005	2006	2007	2008	2009	2010	2011
Yield (m ³)	1,847,800	250,800	426,200	595,400	814,900	181,400	125,500

Source: Derived from Finnantara Intiga data with assumptions as noted in text.

Social aspects

In 2002, some 126,800 people lived in and around the Finnantara Intiga concession. The average population density was 42 km⁻² (RKT 2005). Until 2002, land conversion contracts were signed between Finnantara Intiga and 132 villages, comprising 7,532 households (RKT 2003). Finnantara Intiga operates within a very specific social context for at least two reasons: (i) it has a population density higher than usual for an HTI pulp concession, and (ii) planting acacia trees is not imposed on the local population. Consequently the company faces very significant obstacles if it wishes to expand the planted area.

Certification

In 2003, Finnantara Intiga initiated the process for Forest Stewardship Council ecocertification. The full assessment was completed in 2004 by Smartwood. However, according to Smartwood representatives, the ecocertification could not be obtained since Finnantara Intiga belongs now to APP which does not meet FSC criteria (Smartwood, pers. com., October 2006).



Acacia mangium, 1.5 years old, at Finnantara Intiga



Acacia mangium, 5 years old with great variations in diameter, at Finnantara Intiga

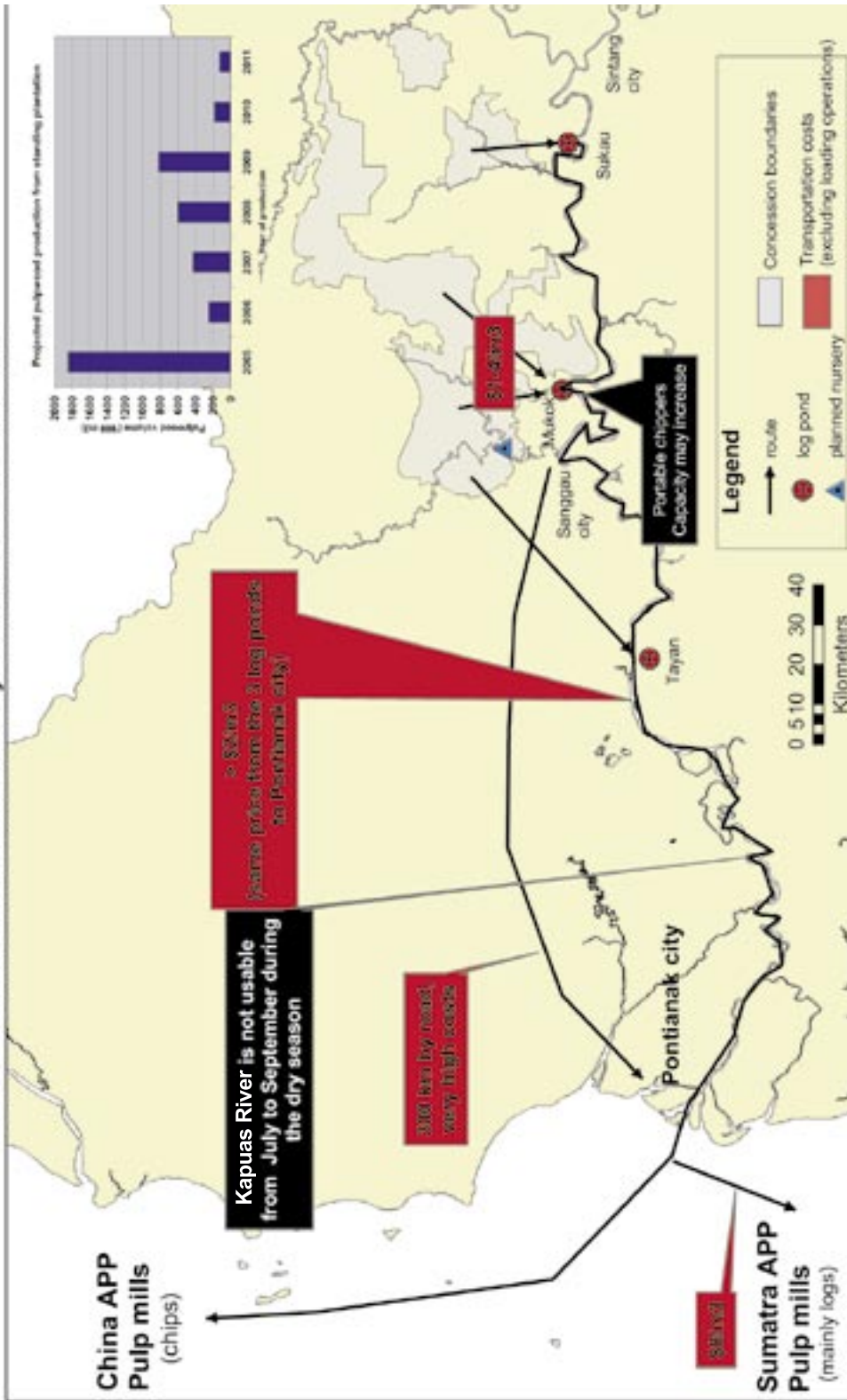


Acacia mangium, 7 years old with poor maintenance, at Finnantara Intiga



Acacia mangium planted on dry rice fields at Finnantara Intiga

Finnantara Intiga
 Projected pulpwood production 2005-2011 +
 Best scenario: 1.6 million m³/year from 2012 onwards



Map 4. Finnantara Intiga

KORINTIGA HUTANI²⁸

History of the plantation

The Korindo group is a diversified conglomerate based in Indonesia with significant South Korean-interests and activities in various sectors: real estate, sport shoes, finance, oil palm, forestry and wood-based industries (<http://www.korindo.co.id/>). In 1979, the group started producing plywood, and it now operates four plywood mills in Sumatra, Kalimantan and Irian Jaya. It also owns PT Aspex Kumbong, a paper mill in West Java with newsprint capacity of 440,000 ADT yr⁻¹, which began production in 1985. The HPH timber concession the group had in Central Kalimantan, for supplying its plywood mills, reportedly reached a stage close to depletion in native timber trees with, as a consequence, high operating costs for plywood production. Consequently, the Korindo group applied for a HTI plantation license on the same concession with the aim of building a pulp mill later on. The HTI license was obtained in 1998.

The concession is located north of Pangkalan Bun city, in Central Kalimantan, and is included in the district Kabupaten Kotawaringin Barat, and subdistricts Kec Arut Utara, Kec Arut Selatan and Kec Bulik. Its boundaries are included between latitude 1° 62' 30" and 2° 20' 00" S and longitude 111° 28' and 111° 55' E. Elevation ranges between 25-500 m asl. The climate is 'tropical humid' and average monthly rainfall (1988 to 1998) varies from 121 mm (August) to 325 mm (January). The temperature is about 26 °C throughout the year.

The license (SK Menhut 219) issued in 1998 provided a concession with a total area of 92,150 ha (the GIS survey gives 87,361 ha), with an estimated plantable area of 56,000 ha²⁹. A total area of 25,000 ha has been set apart for conservation purposes (15,000 ha) and alternative land uses for local communities (10,000 ha). Korintiga Hutani was established as a joint venture with Inhutani. In September 1999 Korindo became the sole licensed concession holder.

According to the original plan, the Korindo pulp mill was to be launched in 2006, with a capacity of 500,000 ADT yr⁻¹. The objective was to supply wood pulp to the Aspex Kumbong paper mill in Java. This paper mill is using imported waste paper which over the years has become a commodity increasingly harder to obtain, due to an increase of the global demand, and less economical, due to rising prices. The capacity of the proposed pulp mill has been reduced.

A revised project for the Central Kalimantan pulp mill is the proposal to launch the production of Alkaline Peroxide Mechanical Pulp (APMP), with a capacity of 250,000 ADT per year. Subject to issuance of a pulp license, the mill construction was expected to take place in 2006-2007. Korindo has decided to postpone the issuance of the pulp processing license until an adequate fiber supply from plantations is secured. Other sources suggest that the availability of a sufficient volume of water for mill operations may also be a problem. The Korindo pulp mill could become the first mechanical pulp mill in Indonesia. Its comparative advantage would consist in a more efficient use of wood: 2.5 to 3 m³ for 1 ADT of pulp compared to the 4.3 to 4.5 m³ per ADT for the other existing Indonesian mills producing Bleached Hardwood Kraft Pulp.

The location for the pulp mill is still under debate. However, the fact that Korindo group has applied for a coal mining license in the Kumai area at the southern limit of the plantations may indicate that the pulp mill will be built in this area, most likely upstream of Kumai Harbour where water salinity is not a problem. Korindo is also planning to construct a paper mill in the same area with a capacity of 200,000 ADT yr⁻¹ of lightweight coated paper (LCW).

The current silvicultural and management practices in Korintiga Hutani plantations remain unclear. Officially plantations will have a 10-year rotation for a combined production of pulpwood and plywood. Trees with a diameter above 18 cm will be used to supply the Korindo plywood mill. The pulp mill will use trees with smaller diameters as well as trees being downgraded for quality reasons. This type of management plan has not yet been implemented in Indonesia. Therefore, at this stage, it is difficult to estimate with accuracy which part of the wood production will be processed into plywood and which part will go to the pulp mill. Furthermore, the company states that it will plant 7,000 ha annually, suggesting an 8-year rotation period in view of the total area available for plantations.

However, because most of the plantations are being established within a 100 km radius from the plywood mill, and because we know that Korindo has plans to adapt the mill machinery to plantation wood, plywood might be the priority objective and pulp a secondary product made from trees with lower quality.

The first small-scale plantings date back to 1998, and no production has been recorded yet. During conversion of the natural forest, native MTH trees with a diameter above 30

cm were used for plywood while there was no market for smaller trees. According to Korindo, the remaining natural forest will not be used for pulp production as the mill will be designed to use exclusively *Acacia* and *Eucalyptus*. In 2002, the clear-felling of 12,000 ha of natural forests enabled the concession to produce approximately 100,000 m³ of plywood. In 2005, IPK clear-cutting permits have been issued for approximately 11,000 ha of very degraded forests.

Condition of the plantation

Korintiga Hutani operations differ from those of most other plantations in Kalimantan in that the company continued planting after the Reforestation Fund was stopped. *Acacia mangium* and *Eucalyptus pellita* are the main

species. Small stands of *Hibiscus similis* have also been planted in the past (Table 18).

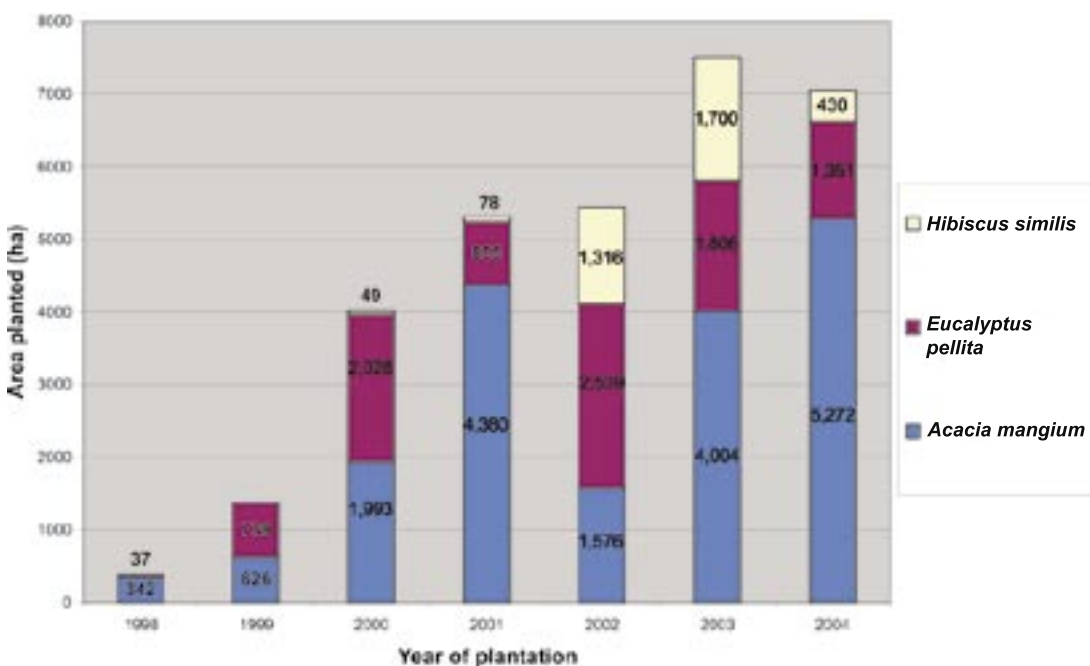
Seeds of different origins were initially provided by the CSIRO Tree Seed Center in Australia. Korintiga Hutani is now producing its own seeds. Clonal multiplication areas have been established for both eucalypts and acacias. *Acacia mangium*, the most planted species, is also being propagated by seeds. The Korintiga Hutani nursery is able to produce enough rooted cuttings and seeds for a yearly planting programme of 7,000-8,000 ha. Eucalypts may be planted on larger areas in the future as their wood is considered better for plywood and as mass production of clones seems to give satisfactory results. *Hibiscus* will only be used for plywood. Although *Hibiscus* provides a good quality pulp, its productivity is

Table 18. Standing area of *Acacia*, *Eucalyptus* and *Hibiscus* at Korintiga Hutani during 1998-2004 (ha)

	1998	1999	2000	2001	2002	2003	2004	Total
<i>Acacia mangium</i>	342	626	1,933	4,380	1,576	4,004	5,272	18,132
<i>Eucalyptus pellita</i>	37	739	2,028	855	2,539	1,806	1,351	9,355
<i>Hibiscus similis</i>	0	0	49	78	1,316	1,700	430	3,573
Total	379	1,365	4,015	5,315	5,433	7,513	7,054	31,105

Source: Korintiga Hutani.

Figure 8. Standing area of *Acacia*, *Eucalyptus* and *Hibiscus* by year of planting at Korintiga Hutani (total area = 31,105 ha)



Source: Korintiga Hutani.

considered too low in comparison to eucalypts and acacias. Therefore, Korintiga Hutani has stopped planting this species.

We visited areas planted each year since 1999 and our assessment was that the Korintiga Hutani plantations are in good overall condition. The trees tended to have a faster growth than those in the other plantations we visited. The 7-year-old plantations were well-maintained and free of competing vegetation. Strong winds had topped over a small number of acacia trees, resulting in some natural thinning. The acacia trees showed an even growth across all plantation sites. Eucalypt stands displayed greater variation, but since clones had started to be used, the variation in growth was expected to be reduced progressively. According to the company, the plantations in the hilly parts of the concession have lower productivity.

We did not obtain figures on the road infrastructure, but we could observe that, for the most part, roads were in good condition, maintained, and graveled. Most of the concession is on flat or gently sloping land (Table 20).

Production and marketing

The plantation company aims to supply its affiliated pulp or plywood mills. However, since the pulp project has been delayed, the wood production is, for the time being, available to other markets.

Korindo pulp mill

When this study was conducted, company officials reported that Korindo planned to build a mechanical pulp mill with a production capacity of 250,000 ADT yr⁻¹, and fiber needs of 750,000 m³ yr⁻¹. This could be supplied by a plantation with a total area of 37,500 ha yielding 20 m³ ha⁻¹ yr⁻¹. If the company were to combine pulpwood and plywood production, it would become more difficult to estimate accurately how many hectares will be needed in total.

We estimate that the cost for loading and transport by road to the Kumai area will be in the range of \$4.5 to \$8 ADT⁻¹ of wood, for distances in the range of 60-110 km.

Pulp mills in Riau, Sumatra

According to company officials, Korindo is not considering wood sales to pulp mills located in Riau or other parts of Sumatra, as the wood is to be used entirely for its own subsidiaries. However, should the pulp mill project experience further delays or even fail, the wood could potentially become available to other users, and especially APP and APRIL mills in Riau provinces. In this case, the wood would be transported to Kumai Harbour and loaded on ships with a maximum capacity of 5,000 t. We do not have information on transportation costs between Kumai Harbour and Riau, but we estimate this cost to be approximately \$12 ADT⁻¹ (not including loading operations), since transport costs from Pontianak to Riau, a slightly shorter distance, is about \$10.5 ADT⁻¹.

Short- and long-term scenarios³⁰

Short-term (2005-2011) production from existing plantations

To project the potential pulpwood production for 2005-2011 (see Table 21), we have used the following assumptions:

- Trees are harvested at age 7 years.
- The MAI (Mean Annual Increment) is 24 m³ ha⁻¹.
- The stands of *Hibiscus* are not used for pulpwood.

Long-term production: best scenario from 2012 onwards

This section projects the volume of commercial pulpwood that could potentially be produced if the maximum available area were planted in 2005 and the following years.

Table 19. Mean annual increment (m³ ha⁻¹)* at Korintiga Hutani (official figures)

	Age (yr)					
	1	2	3	4	5	6
<i>Acacia mangium</i>	7.7	19.3	31.8	38.1	37.5	34.1
<i>Eucalyptus pellita</i> seedlings	2.5	10.3	15.6	26.3	29.7	31.0
<i>Eucalyptus pellita</i> clones	15.6	34.2	-	-	-	-

Source: Korintiga Hutani based on measurements of 200 plots of 0.5 ha each (except for eucalypt clones).

*This is total volume, not commercial volume.

Table 20. Topography at Korintiga Hutani (including non-plantable areas)

	Slope 0-8%	Slope 9-15%	Slope 16-25%	Slope 26-40%	Slope >40%
Area (ha)	53,699	10,719	10,359	7,578	5,006
Area (%)	61.4	12.3	11.8	8.8	5.7

Source: Korintiga Hutani.

Table 21. Projected pulpwood production 2005-2011 at Korintiga Hutani from standing plantations as of November 2004 (excluding *Hibiscus*)

	Production year						
	2005	2006	2007	2008	2009	2010	2011
Yield (m ³)	63,672	229,320	665,448	879,480	691,320	976,080	1,112,664

Source: Derived from Korintiga Hutani data with assumptions as noted in text.

The 'best scenario' is based on the following optimistic assumptions:

- The entire plantable area is managed.
- Plantation management ensures an even flow of wood.
- The MAI reaches 26 m³ ha⁻¹.
- The rotation period will be 8 years.
- The planting and harvesting operations reach full operational capacity as of 2005.
- 300,000 m³ logs are supplied annually to the plywood mill, and therefore are deducted from the total pulpwood production.

The resulting annual production is 1,456,000 m³, for a harvested and planted area of 7,000 ha yr⁻¹.

Social aspects

Details of the population around the Korintiga Hutani concession are given in Table 22.

Many transmigrant villages are close to the western part of the concession. Dayak villages

are on the eastern part, along the River Arut and at a 2 to 3 km distance to the concession boundaries. According to company officials, many conflicts occur in this latter area, with local villagers entering into the concession using a number of small rivers and claiming traditional rights on the land. The company considers that these claims are 'weak'. However, as the threat is real, the company is trying to create a buffer zone between the eastern boundary and the River Arut. To do so, Korintiga Hutani has tried to convince local people to plant acacia and eucalypts in partnership, offering a payment of \$6 per dried ton of wood after harvest in addition to payment of salaries for those willing to work in these buffer plantations. This relatively favorable proposal (in comparison to arrangements concluded in other Indonesian projects) is to guarantee that the buffer zone will play its intended role. In return, the company hopes to avoid damage to its plantations in neighbouring areas.

Table 22. Population around Korintiga Hutani concession in 1997

Subdistrict	Number of people	Number of households
Kec Bulik	35,040	9,803
Kec Arut Utara	4,257	1,003
Kec Arut Selatan	63,186	15,999
Total	102,483	35,805

Source: Korintiga Hutani



Eucalyptus used for cutting at the nursery of Korintiga Hutani



Eucalyptus pellita, 7 years old, at Korintiga Hutani



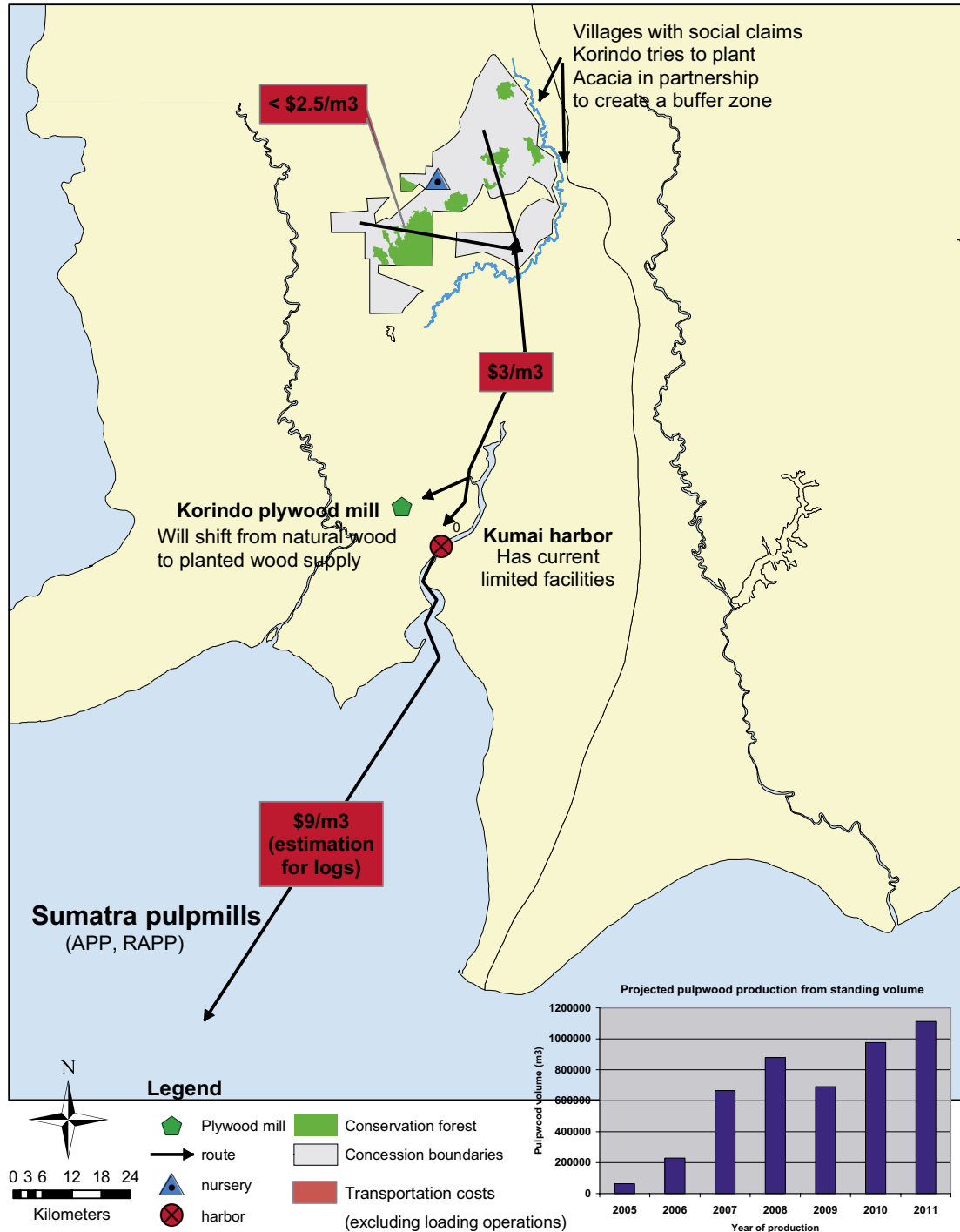
Acacia mangium, 7 years old, at Korintiga Hutani



Land clearing at Korintiga Hutani

Korintiga Hutani

Projected Pulpwood production 2005-2011 +
Best scenario: 1.5 million m³/year from 2012 onwards



Map 5. Korintiga Hutani

ADINDO HUTANI LESTARI

The management of Adindo Hutani Lestari did not wish to participate in the present study. However, local authorities were able to arrange a field visit, and the authors gathered data from a variety of sources, especially from the company's RKT annual workplans, interviews with officials from the East Kalimantan Provincial Forestry Bureau (*Dinas Kehutanan Propinsi*), and a confidential informant. It is noted that CIFOR has not been able to confirm the data in the following sections with company officials for Adindo Hutani Lestari.

History of the plantation

The company was created in 1993, as a joint venture HTI pulp concession between Adindo Foresta Indonesia and Inhutani I with 60/40 division of shares, respectively. Initially, former President Suharto's daughter Siti Hediati Haryadi was reportedly involved as one of the commissioners without formal shares in the capital.

The concession lies within the district Kabupaten Bulungan (Kec Bulungan Utara and Kec Bulungan Tengah). The site is close to the coast, at the same latitude as the islands of Nunukan and Tarakan. The altitude ranges between 5 and 500 m above sea level. A large swampy area stands between the concession and the sea. The climate is 'Tropical Humid'.

The site had been harvested by Inhutani I for several years as a HPH timber concession. Subsequently the most degraded parts of the concession were allocated to the forest conversion programme. Planting started in 1995 with contributions from the Reforestation Fund.³¹ *Acacia mangium* (85% of the planting), *Gmelina arborea* and *Eucalyptus deglupta* have been the main plantation species. In the process of clear-felling, Inhutani I managed to sell the timber with commercial value. The remaining non-commercial timber, which could have been processed into chipwood, was burnt on site. The Kiani Kertas pulp mill in Berau was not yet operating at this time and could not benefit from this potential source of supply.

A temporary license for a total concession area of 201,000 ha was issued in 1993 and officially finalized (SK Menhut 88) in 1996. At this date, the company acknowledged a plantable area of 104,622 ha. This account excluded 88,399 ha of conservation forest, 5,300 ha of disputed lands and 3,500 ha of transmigration land. Another license (SK Menhut 935) in 1999 reduced the total area to 191,000 ha. Furthermore, there is an overlap with an oil palm plantation in the north part of the

concession. However, no final decision has been made yet regarding this latter conflict, even though the local *Bupati* is clearly in favor of allocating the disputed land to the oil palm plantation. The Adindo Hutani Lestari concession was never managed properly, and the condition of the plantation was found to be very poor. Planting and plantation maintenance operations stopped in 2000 for financial reasons. The license was suspended in 2002 and reinstated in 2004.

According to Jaakko Pöyry, Adindo Hutani Lestari's initial purpose was to supply fiber to a proposed pulp mill to be built nearby. Suboptimal site conditions, the 1997-98 Asian economic crisis and the construction, on a nearby site, of Kiani Kertas, have resulted in the withdrawal of the project.

No production had been reported when this study was conducted in 2004-05, and at that time there was no current silvicultural activity. The management was considering harvesting 3,000 ha of acacia in 2005. The lack of appropriate heavy equipment in the area is seen as an important obstacle.

Condition of the plantation

Until at least 2000, the concession had some natural forests left. Planting records are not available; however, it seems that planting rates have been very low, despite official targets to plant annually between 8,000-10,000 ha. According to RKT 1998/1999, *Acacia mangium* was planted on 11,730 ha in 1997. However, these figures have to be viewed cautiously as the Reforestation Fund was still allocating subsidies at this time. Annual work plans (RKT) report maintenance operations on 600 ha planted in 1995 and 4,600 ha planted in 1996. According to the annual plan for 2001, *Acacia mangium* had been planted on 3,121 ha, and maintenance operations on areas planted in 1998 and 1999 covered respectively 270 ha and 3,400 ha. Planted areas are in the north of the concession, close to Nunukan Island. Once again, these figures have to be considered cautiously, as no cross-check could be done.

The concession is well located as far as wood extraction is concerned, with Sebuku River and Sesayap River giving direct access to the sea from the north and central parts of the concession. From what can be seen on maps, the ground distance to Sebuku or Sesayap rivers in the north and central parts of the concession is within 30 km, and transport distance by river is less than 100 km. The southern part of the concession is very close to the sea.

Production and marketing

As there is no reliable data regarding the planted area and the condition of the plantation, we were not able to simulate future production.

Given Adindo Hutani Lestari's location, the Chip Deco chipping mill in Tarakan and Kiani Kertas pulp mill are the two most obvious markets for its wood. However, it seems that the price of \$30 m⁻³ (at mill gate) reportedly offered by Kiani Kertas in 2004 was considered insufficiently attractive to Adindo Hutani Lestari's management.

The APRIL group reportedly took control of the Adindo Hutani Lestari concession in 2005.

Short- and long-term scenarios³²

Short-term (2005-2011) production from existing plantations

A lack of information on the planted area and on the condition of the plantation precludes us from estimating future production.

Long-term production: best scenario from 2012 onwards

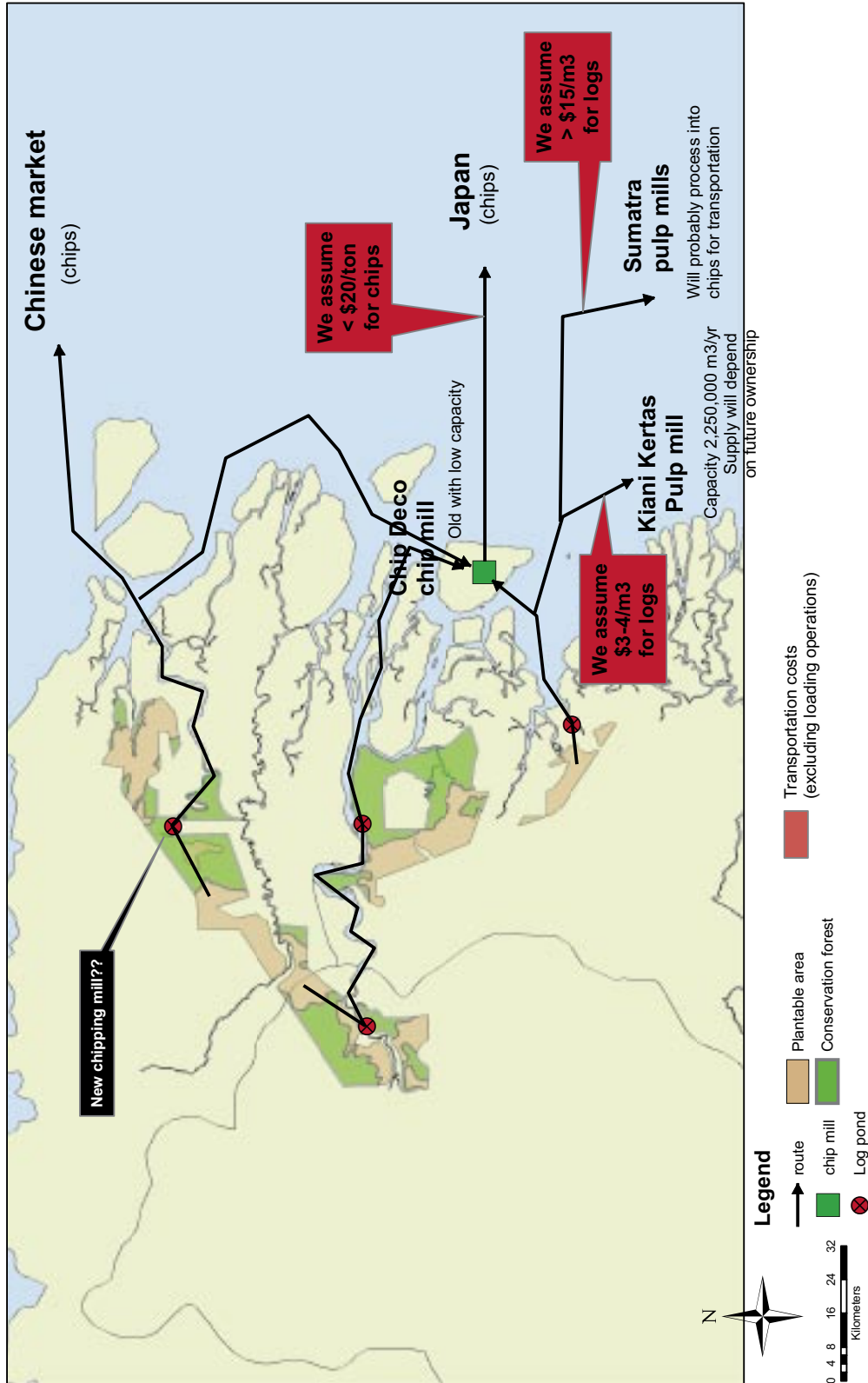
This section projects the volume of wood potentially available for the pulpwood market in 2012 from the area planted in 2005 and onwards, assuming the maximum available area is planted. The 'best scenario' is based on the following optimistic assumptions:

- Plantations have been made on the entire plantable area.
- Plantation management ensures an even flow of wood.
- The MAI (Mean Annual Increment) reaches 20 m³ ha⁻¹.
- The rotation period will be 7 years.
- Planting and harvesting operations reach full operational capacity as of 2005.

The resulting projected annual production is 2.1 million m³, for a harvested and planted area of 15,000 ha yr⁻¹.

Adindo Hutani Lestari

Best scenario: 2,100,000 m³/year from 2012



Map 6. Adindo Hutani Lestari

HUTAN RINDANG BANUA³³

The management of Hutan Rindang Banua did not allow the authors to visit their plantation site and declined to provide recent data on plantation development. Most of the information contained in this section is based on Jurgens *et al* (2005) and Jaakko Pöyry (2001).

History of the plantation

Initially, Hutan Rindang Banua was controlled by Probosutedjo, half-brother of former President Suharto. Its development benefited from the Reforestation Fund subsidies.³⁴ In 2002 United Fiber System Ltd. (UFS), a publicly listed Singaporean company, became the new holder of the concession license (Jurgens *et al* 2005). UFS also obtained a license to develop a pulp mill (Marga Buana Bumi Mulia, MBBM). Issuance of this industrial license has been controversial in a context where the industrial capacities of Indonesian forest industries exceed wood

resources. According to company officials, the South Kalimantan Province has provided strong support to the UFS industrial project.

The Hutan Rindang Banua concession is located in South Kalimantan close to the coast, at latitude 2° 15' -4° 00'S and longitude 114° 45' -116° 15'E, and 150 km southeast of Banjarmasin city.

The final license (SK Menhut 196) was issued in 1998 for 268,585 ha (gross), with 164,490 ha of net plantable area, according to the Jaakko Pöyry report in 2001. Most planting occurred between 1994 and 1999. Field activities have been reported as being relatively dormant since that period.³⁵

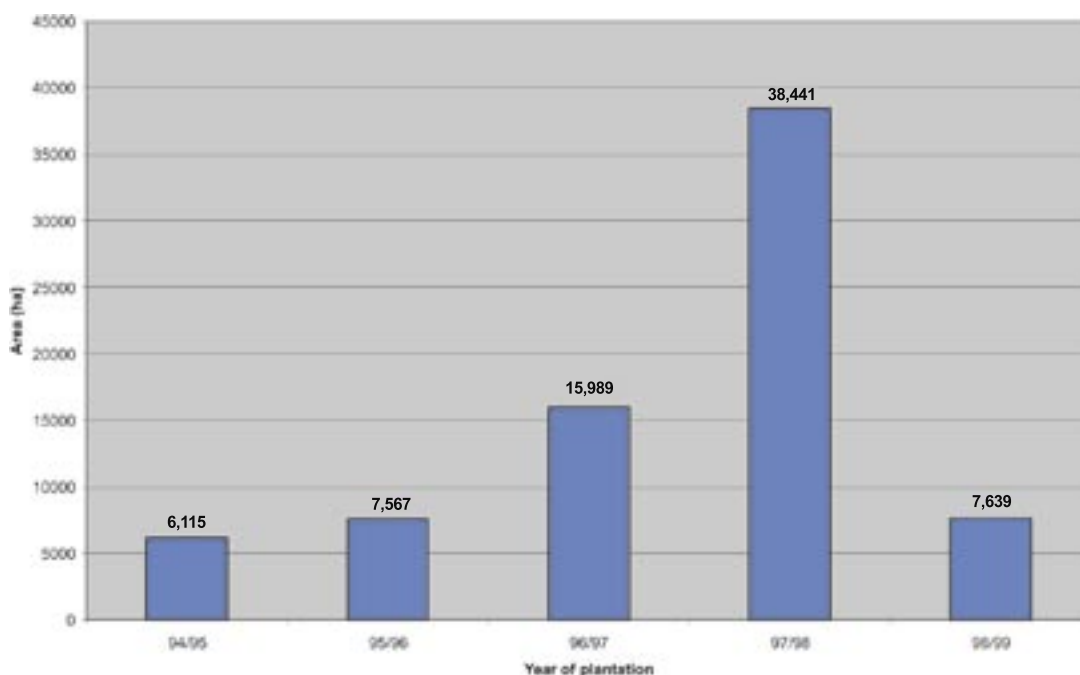
United Fiber System reportedly plans to build a 600,000 ADT bleached hardwood kraft pulp mill in South Kalimantan, which would rely exclusively on plantation-grown wood for its fiber supply. *Acacia mangium* is expected to be the main plantation species. In 2005, UFS also announced that it is building a 700,000 (bone dry) tonne yr⁻¹ wood chip mill on Pulau Laut in South Kalimantan (UFS 2006). The wood chip mill, which will be operated by UFS subsidiary PT Mangium Anugerah Lestari, is expected to begin operations in early 2007. Since 2005, UFS has also been engaged in negotiations to purchase the Kiani Kertas pulp mill in East Kalimantan (UFS 2006).

Table 23. Topography at Hutan Rindang Banua

	Slope 0-15%	Slope 16-40%	Slope >40%
Area (ha)	211,435	6,150	41,415
Area (%)	82%	2%	16%

Source: JP Management Consulting, January 2001.

Figure 9. Standing area of *Acacia mangium* by year of planting at Hutan Rindang Banua, as of 2001 (total area = 75,751 ha)



Source: Jaakko Pöyry Management Consulting, January 2001

Condition of the plantation

According to the Jaakko Pöyry report, 73,080 ha of natural forests remained in the concession in 2001, out of which 44,220 ha could be clear-felled to procure mixed tropical hardwood and to provide new ground for pulpwood plantations.

Jaakko Pöyry report discusses the figure of 75,751 ha given for planted areas (see Figure 9). The same report suggests that fires may have reduced the total planted area to 60,601 ha. The figure of 75,751 ha was based on satellite images from 1999 and 2000. A recent study by international environmental organizations suggests that the standing area remaining at the plantation site may, in fact, be much less than this.³⁶

The topography of the concession is mainly flat or gently sloping, although there are some steeper areas (Table 23).

Short- and long-term scenarios³⁷

Short-term (2005-2011) production from existing plantations

To project the potential pulpwood production for 2005-2011, we used the following assumptions:

- Trees are harvested at age 7 years or older.
- The MAI (Mean Annual Increment) is 16 m³ ha⁻¹ (Jaakko Pöyry report).

- Standing plantation areas are according to the Jaakko Pöyry report.

The standing volume in 2004 was approximately 7 million m³. At least until this study was conducted, there had been no planting after 1999, and thus the whole plantation was mature in 2005 and therefore potentially available for harvesting.

Long-term production: best scenario from 2012 onwards

This section projects the volume of commercial wood potentially available for the pulpwood market in 2012 from the area planted in 2005 and onwards, assuming that the maximum available area is planted.

The 'best scenario' is based on the following optimistic assumptions:

- Plantations have been established on the entire plantable area.
- Plantation management ensures an even flow of wood.
- The MAI (Mean Annual Increment) reaches 20 m³ ha⁻¹.
- The rotation period will be 7 years.
- Planting and harvesting operations reach full operational levels as of 2005.

The resulting projected annual production is 3.29 million m³, for a harvested and planted area of 23,500 ha yr⁻¹.

SUPPLY AND DEMAND SCENARIOS

Could the pulpwood supply from HTI plantations in Kalimantan decrease pressure on Sumatra's natural forests?

In the course of our study, several persons, among all those we have met in industry and government circles, have argued that (i) wood transport costs from Kalimantan to Sumatra are too high, and therefore Sumatran pulp mills cannot afford to buy wood from remote concessions in Kalimantan if they want to remain competitive in the international pulp and paper market; and (ii) most plantations in Kalimantan have failed and therefore have a rather low capacity to procure significant volumes of wood.

Our study provides a basis for discussing these points.

We first evaluate how much MTH the three large Sumatran mills—PT Indah Kiat Pulp & Paper (IKPP), PT Lontar Papyrus Pulp & Paper Industries (LPPPI) and PT Riau Andalan Pulp & Paper (RAPP)—are likely to consume in the coming years. In order to do so we analyse the wood supply projections that Asia Pulp & Paper Co. Ltd. (APP) and Asia Pacific Resources International Holdings Ltd. (APRIL) had made publicly available at the time this study was conducted.

Next we attempt to assess (i) the amount of pulpwood grown in Kalimantan plantations which potentially could become available to markets outside Kalimantan, and (ii) the total wood cost, including delivery to Riau Province.

Finally, we attempt to assess the additional costs to APP and APRIL for transporting Kalimantan logs and chips to Sumatra from 2006 to 2010, should the Indonesian government issue new policies aimed at optimizing the use of Indonesian plantation pulpwood for the sole benefit of the domestic industry rather than for export.

Current and future wood demand of PT Indah Kiat Pulp & Paper (IKPP) and PT Lontar Papyrus Pulp & Paper Industries (LPPPI)

In February 2004, APP published a *Sustainability Action Plan* which contained a 12-year sustainable wood supply plan for its two Sumatran pulp mills (APP 2004). According to this plan, the plantations of *Acacia crassicaarpa* and *Acacia mangium* that APP/SGM already had in the ground by the end of 2003 will be able to supply no less than 91 percent of the total wood requirement of both mills, from 2006 to 2010. Depending on the supply scenario adopted by IKPP (see Tables 24 and 25), the total volume of wood that the two mills would have to purchase from outside suppliers, from 2006 to 2009, would amount to either 3.7 million m³ over bark (ob) or 6.8 million m³ (ob).

APP's *Sustainability Action Plan* confirmed that the company had made a commitment to its stakeholders that after 2007 its mills will only accept 'renewable, plantation-grown fiber from socially, environmentally and legally responsible sources' (APP 2004). The same document indicated that APP/SMG³⁸ was taking action to this end by purchasing additional plantations in Riau Province and would possibly use wood surpluses in APP/SMG's Jambi plantations to offset the slight planned deficit at IKPP in 2010 and 2011. Furthermore, the Sustainability Action Plan stressed that Indonesia had a number of 'potential commercially viable and logistically feasible plantations available that could fill the supply gap and fulfill APP/SMG's commitment to become fully reliant on plantation-grown fiber after 2007' (APP 2004). This statement was followed by a list of five established plantation sources in South Sumatra and Kalimantan with an aggregated planted area of 222,530 ha. The first on the list was Finnantara Intiga plantations in West Kalimantan which APP bought from Stora Enso in 2005. However, at the time the present study was conducted, the future destination of Finnantara Intiga's wood was still unclear.

Table 24. Deficit summary for IKPP and LPPPI (Base cases)

Year	IKPP	LPPPI	TOTAL
	(m ³ ob/year)	(m ³ ob/year)	(m ³ ob/year)
2006	81,739	207,718	289,457
2007	81,735	1,023,033	1,104,768
2008	86,619	828,835	915,454
2009	832,461	616,429	1,448,890
Total 2006-09	1,082,554	2,676,015	3,758,569
2010	113,252	0	113,252
2011	103,801	0	103,801

Source: *Sustainability Action Plan*, APP, February, 2004.

Table 25. Deficit summary for IKPP (Alternative scenario) and LPPPI (Base case)

Year	IKPP	LPPPI	TOTAL
	(m ³ ob/year)	(m ³ ob/year)	(m ³ ob/year)
2006	81,739	207,718	289,457
2007	81,733	1,023,033	1,104,766
2008	86,620	828,835	915,455
2009	3,872,827	616,429	4,489,256
Total 2006-09	4,122,919	2,676,015	6,798,934
2010	123,372	0	123,372
2011	103,801	0	103,801

Source: Sustainability Action Plan, APP, February, 2004.

The target set by APP in the *Sustainability Action Plan* was that APP/SMG's Sumatran plantations would be able to support the entire demand of IKPP and LPPPI by 2012 and onward (APP 2004). In reality, some two years after publication of the *Sustainability Action Plan*, projections of wood demand for the coming years seem to have shifted substantially, towards greater needs.

The wood supply scenarios presented in the *Sustainability Action Plan* assumed that, between 2006 and 2022, IKPP pulp production would stabilize at a level of 1.85 million ADT yr⁻¹ (APP 2004). However, according to a confidential source made available to the authors during this study, APP estimated during 2005 that, subject to ongoing de-bottlenecking, fiber availability and Government approvals, IKPP could be capable of progressively increasing its yearly pulp output from 1.95 million ADT in 2005 to 2.5 million ADT in 2009/2010 with a projected total pulp output that could reach 11.6 million ADT during the period 2006-2010 (APP confidential document, Jakarta, 2005). In 2004-05, when this study was conducted, IKPP's operating license reportedly was for 1,790,600 ADT of pulp per year. Indonesian regulations tolerate overproduction within a limit of 30 percent of the licensed capacity. This implies that the production could be raised up to 2.3 million ADT per year without any further governmental approval.

Calculation by APP of wood demand at mill gate is based on the following: (i) a conversion factor from GMT wood to ADT pulp of 4.3; (ii) a conversion factor from wood weight (in GMT) to wood volume (in m³) of 1.142 for acacias. Therefore, in the event that IKPP were to produce 11.6 million ADT pulp during the period 2006-2010, this would require the supply of 56.9 million m³ of wood instead of the estimate of 43.3 million m³ contained in the *Sustainability Action Plan* (APP 2004; APP confidential document, Jakarta, 2005).

This represents an increase of 31.5 percent above the estimate provided by APP in its 2004 *Sustainability Action Plan*. Approximately 5 percent of this increase is due to the fact that the expected improvements in wood use efficiency during mill operations – improvements that the *Sustainability Action Plan* was anticipating – have only been partially realized. The remaining additional wood demand is due to the projected increase in pulp production.

In doing these projections, APP has apparently taken the position that a total plantation area larger than the 408,000 ha anticipated in the *Sustainability Action Plan* will be required if IKPP is to become fully reliant on plantation-grown wood (APP confidential document, Jakarta, 2005). Since future pulp outputs at IKPP are now expected to stand in between the current level of about 2.0 million ADT yr⁻¹ and 2.5 million ADT yr⁻¹, the corresponding requirements in plantation area will range between approximately 510,000 and 640,000 ha. This is being calculated by APP as follows (APP confidential document, Jakarta, 2005):

- A yearly pulp output of 2.0 million ADT requires a volume of acacia wood at mill gate of: 2 million x 4.3 x 1.142 = 9.82 million m³;
- Allowance for losses in fire, harvest, transport and chipping = 25%;
- Therefore standing wood demand is 9.82 million m³/year x 1.25 = 12.28 million m³/year;
- Average expected harvest volume at end of 6 year rotation is 144 m³/ha;
- Yearly plantation harvest area to supply demand of 12.28 million m³ is 85,277 ha (12.8 million ÷ 144);
- Total plantation area on 6 year rotation is 85,277 ha yr⁻¹ x 6 years = 511,662 ha.

A similar calculation shows that a yearly pulp output of 2.5 million ADT pulp would require a total plantation area on 6 year rotation of 639,400 ha

This means that additional areas of natural forests, which we estimate to range between 150,000 and 300,000 ha³⁹, will be clear-felled and parts of this land will be subsequently converted into acacia plantations. In 2004-05 APP reportedly had applied to the Indonesian Government for additional concession rights.

Current and future wood demand of PT Riau Andalan Pulp & Paper (RAPP)

In 1995, APRIL launched commercial production of pulp at Kerinci in Riau Province through Riau Andalan Pulp & Paper (RAPP), its subsidiary company. From 1995 to 2000 the mill production was entirely from mixed tropical hardwood (Canecio Munoz, pers. com. March 2005). In 2001, APRIL's pulp mill started using acacia wood, as their oldest acacia plantations had reached maturity (Virta 2006b: Table 5 'Wood Supply to Kerinci Mill 2000-2005 & 2006 Plan'). APRIL's first acacia plantations in the lowlands of Sumatra were established in 1993. However, it is only in 1995 that APRIL's plantation development programme started to be implemented at a faster pace following large-scale forest clearing.

APRIL's official data for 2005 show that the Kerinci mill consumed a total of 8,016,781 tonnes of round wood, including 4,820,995 tonnes of mixed tropical hardwood with bark and 3,195,786 tonnes of debarked acacia wood (Virta 2006b: Table 5 'Wood Supply to Kerinci Mill 2000-2005 & 2006 Plan'). The total pulp output during the same year was 1,930,270 ADT. The same source indicates that from 2000 to 2005, mixed tropical hardwood has accounted for 74.5 percent of the overall timber tonnage supplied to the mill. In the course of 2006, APRIL estimated that the relative share between mixed tropical hardwood and plantation wood, for the year, would be respectively 63.4 percent and 36.6 percent (Virta 2006b: Table 5 'Wood Supply to Kerinci Mill 2000-2005 & 2006 Plan').

At the end of June 2006, APRIL had legal HTI development rights and relevant management licenses for 326,340 ha of the company's own concessions and 328,392 ha of joint venture concessions, forming a core permanent production forest estate of 654,732 ha (APRIL 2006b). In addition, APRIL had HTR (*Hutan Tanaman Rakyat*) development agreements with local communities for 51,695 ha (Ibid).

Of the core permanent production forest estate, 325,083 ha (i.e. 49.6 percent of the area) has been identified to be suitable for plantation development. Of the 51,695 ha of

land to be developed with local communities, 34,974 ha (i.e. 67.6 percent) are suitable for acacia plantation.

At the end of 2005, APRIL had a total net plantation area of 228,305 ha (Virta 2006b: Table 2 'APRIL Plantation Programme'). Of this area, 17.8 percent were plantations in their second rotation and 98 percent of these second rotation plantations were established on APRIL's licensed concession. Of the total plantation estate (228,305 ha), 65 percent were established on APRIL's licensed concession, 26 percent were joint venture plantations established on licensed concessions of affiliated companies, and the remaining 9 percent were community plantations established under APRIL's community development programme.

Plans for 2006 included 18,397 ha of second-rotation plantations and 46,638 ha of new plantations following conversion of natural forests for supply of mixed tropical hardwood to the mill. Approximately 96 percent of the first-rotation plantation programme (new plantations following conversion of natural ecosystems) were planned for joint venture concessions, while approximately 94 percent of the second rotation plantations were to take place in APRIL own concessions. At mid 2006, approximately 55 percent of the 2006-planting programme had been completed (Virta 2006b: Table 3 'RAPP Existing Plantation', APRIL 2006b).

As per mid 2006, APRIL still had more plantations on dry land (57 percent of the total estate) than in peat swamp sites. The latter type of site is where most of the plantation development in the future years will take place. Acacia plantations on peat swamp sites require higher investments for establishment and management, and they grow at a slower rate; in addition, there are also more risks particularly vis-a-vis fire, occurrence of pests and diseases, and micronutrient deficiency.

APRIL's '2009 sustainability commitment', as far as wood procurement is concerned, consists of 'having sufficient fiber to support 2 million tonne production capacity by 2009' (APRIL 2006b).

It should be noted that in doing its wood supply projections APRIL uses high to very high productivity figures. This is illustrated by Table 26.

At the end of June 2006 APRIL had a total of 265,407 ha of plantation in place (APRIL 2006b). Using APRIL's comparatively high productivity ratios, we have estimated that, beyond June 2006, APRIL's plantation would have to be expanded by 102,000 ha, bringing the total plantation area close to 368,000 ha, should the commitment of a 2.0 million

Table 26. Key variables used by APRIL and APP to project their wood needs and plantation yield

Mid 2006 Situation	APRIL	APP
Share of plantation area planted with:		
* Acacia mangium (dry land)	57 percent (1)	Approx. 50 percent (4)
* Acacia crassicarpa (peat land)	43 percent (1)	Approx. 50 percent (4)
Length of rotation	6 to 7 years (2)	6 years (4)
Mean Annual Increment for A. mangium	6-7years: potential 35 m ³ ha ⁻¹ y ⁻¹ (2) 8 years: 28 m ³ ha ⁻¹ y ⁻¹ (2)	Average: 24 m ³ ha ⁻¹ y ⁻¹ at 6 years for the entire plantation estate (4)
Mean Annual Increment for A. crassicarpa	6 years: 25 m ³ ha ⁻¹ y ⁻¹ (2)	
Allowance for losses in fire, harvest, transport and chipping	25 percent	25 percent (4)
Conversion factor from wood weight (in GMT) to wood volume (in m ³) for acacias	1.142	1.142 (4)
Volume of acacia wood at mill gate required to produce 2 million ADT of pulp (BHKP)	9.0 million m ³ (3) This implies a conversion factor of 3.94 green metric tonnes (GMT) of wood for 1 ADT of pulp}	9.82 million m ³ (4) APP currently uses a ratio of 4.3 after aiming for a conversion ratio of 4.1 in its Sustainability Action
Total plantation area required to support, in continuity, a 2 million ADT capacity BHKP mill	$9,000,000 \times 1.25 / 30.6^{a/} = 367,650$ ha a/ Weighted MAI at age 6.5 for a mix 57 percent A. mangium (35 m ³ ha ⁻¹ y ⁻¹) and 43 percent A. crassicarpa (25 m ³ ha ⁻¹ y ⁻¹)	$9,820,000 \times 1.25 / 24 = 511,460$ ha

Sources:

(1) Virta (2006b): Table 3 'RAPP Existing Plantation',

(2) APRIL (2006b)

(3) Jouko Virta, pers. com. 2006

(4) APP internal documents

ADT pulp capacity entirely supported from plantation wood be met. This is a challenge since, as per June 2006, the land available for additional plantations in APRIL's concessions and partners' concessions (Joint Ventures and Community Fiber Farms) amounted to 94,650 ha (APRIL 2006b). The land resource situation will be more acute if APRIL's optimistic productivity targets can only be partially achieved.

Obtaining legal access to additional land for plantation establishment was and still is an important element of APRIL's plantation development strategy. In the context of Riau province, obtaining land for plantation establishment means almost certainly converting natural forests.

APRIL pulpwood plantations are managed on a six to seven year rotation period. Consequently, a six to seven year lag time after hypothetical completion of the 368,000 ha estate will be required before the yearly

wood flow stabilizes at the level required to support a 2.0 million ADT pulp capacity. In the meantime, APRIL will either need to use more MTH wood or to obtain plantation wood from other sources to feed the Kerinci mill.

Since APRIL's commitment to sustainability does not include a commitment to stop using mixed tropical hardwood altogether, APRIL will almost certainly continue to convert natural forests into plantations beyond the need of the company's '2009 sustainability commitment'. This is consistent with on-going efforts to increase pulp capacity at the Kerinci mill through debottlenecking and fine-tuning⁴⁰ (PR Newswire 2003). This is also consistent with statements of a number of local stakeholders and company officials indicating that APRIL's management has plans to bring the total annual pulp production at Kerinci to at least 3.0 million ADT yr⁻¹.

In this context, it should be noted that the more the plantation estate will expand beyond the limit of 368,000 ha, the lower the average productivity figure over the entire estate will be, in view of the fact that future plantations in Riau will, almost exclusively, be established on peat swamp sites.

According to discussions with company officials, APRIL does not view itself as an enterprise that has driven the conversion of natural forest ecosystems of Riau province for more than ten years and continues to do so (Canecio Munoz, pers. com. 2005). The image that APRIL is promoting is that of an enterprise managing natural resources through its mosaic plantation concept. This, according to APRIL's media material, involves 'creating diversified landscapes' and 'conserving biodiversity and providing opportunities for social development while ensuring a steady supply of renewable, high-quality and low-cost fiber' (Virta 2006b).

APRIL states that the share of the conservation areas in its future plantations, within Riau province and elsewhere, is likely to approach 30 percent of the gross area allocated for its HTI development. APRIL states that none of its wood supply comes from illegal clearance and that its plantations in the neighbourhood of protection areas serve as protective belts, particularly in peat swamp areas, where drainage structures are designed to block illegal loggers from access (APRIL 2006a, and Virta 2006a). Furthermore, APRIL is cooperating with a number of partner organizations towards identifying and protecting areas designated to be High Conservation Value Forest. In conclusion, APRIL estimates that its mosaic plantation concept offers a solution to the current issue of continuous forest degradation by illegal loggers.

Pacific Fiber, a company whose ownership is reportedly very similar to that of APRIL, has been set up to conduct a series of forest company acquisitions in Kalimantan. So far, Pacific Fiber has purchased two plantation

companies, namely PT ITCI and Adindo, possibly with the intention to supply fiber to APRIL's Rizhao mill in Shandong Province on the east coast of China.

In conclusion, APRIL apparently has no firm commitment to fully stop using mixed tropical hardwood at its Kerinci mill, since the company considers that it has an overall positive impact on the environment and on the well being of local populations by creating new diversified landscapes which include tracks of natural forests protected from illegal loggers. In the best-case scenario, which assumes a pulp production capacity stabilizing at 2.1 million ADT y⁻¹ and full achievement of high productivity targets on the plantation side, the shortfall of plantation wood at the Kerinci mill will amount to 2.88 million m³ in 2009. According to the same scenario the plantation wood shortfall from 2006 to 2010 will reach 23.1 million m³.

Summary of wood demand by PT Indah Kiat Pulp & Paper (IKPP), PT Lontar Papyrus Pulp & Paper Industries (LPPPI) and PT Riau Andalan Pulp & Paper (RAPP) under different scenarios

Our estimates of the respective wood demand of the three large-scale APP and APRIL pulp mills of the Riau-Jambi region, for the period 2006-2010, have been summarized in Tables 27 and 28. It should be emphasized that demand figures shown in Tables 27 and 28 are projections only, based on the information available when this study was conducted, and not the inevitable or certain future activities of these companies. The value of our projections lies in their representation of overall trends.

Table 27 has been composed with the following assumptions:

- The deficit summary for IKPP and LPPPI displayed in Table 24 ('Base case' wood supply scenario for the two mills) was recalculated on the basis of a constant and total pulp

Table 27. Projected shortfall of plantation-grown wood at IKPP, LPPPI and RAPP ('Low Wood Demand' Scenario) during 2006-2010

	APP IKPP and LPPPI (million m ³)	APRIL RAPP (million m ³)	Total (million m ³)
2006	1.025	7.252	8.277
2007	1.840	3.809	5.649
2008	1.650	7.167	8.817
2009	2.185	2.880	5.065
2010	0.850	2.018	2.868
Total	7.550	23.126	30.676

output of 2.75 million ADT yr⁻¹, during the 2006-2010 period, for the two mills (2.0 million ADT yr⁻¹ for IKPP and 0.75 million ADT yr⁻¹ for LPPPI).

- In recalculating the wood shortfall that APP anticipated in its *Sustainability Action Plan*, we have used the ratios and productivity figures that APP is now currently using in its own estimate. These involve: (i) a factor of 4.3 for processing round wood into pulp (i.e. 4.3 green metric tonnes (GMT) of wood for 1 ADT of pulp) instead of the expected 4.1 ratio; (ii) an average growth rate over the entire plantation estate revised down to 24 m³ ha⁻¹ y⁻¹; and (iii) 25 percent losses in wood volume from standing timber to volume of wood processed into pulp.
- The deficit of plantation-grown wood at RAPP was calculated for a pulp output of 2.05 million ADT in 2006, and 2.1 million ADT per year from 2007 to 2010.
- In assessing what the wood shortfall at RAPP would be, from 2006 to 2010, in a 'Low Wood Demand' scenario, we have assumed substantial advances in technology and logistics in RAPP operations in comparison to APP as shown by the productivity figures used in this assessment. These involve: (i) a factor of 3.94 for processing round wood into pulp (i.e. 3.94 green metric tonnes (GMT) of wood for 1 ADT of pulp); (ii) an average growth rate over the entire plantation estate of 30.6 m³ ha⁻¹ y⁻¹; and (iii) 25 percent losses in wood volume from standing timber to usable volume of wood for transformation into pulp.

Table 28 has been composed with the following assumptions:

- The deficit summary for IKPP and LPPPI displayed in Table 25 ('Alternative' wood supply scenario for IKPP and 'Base case' wood supply scenario for LPPPI) was recalculated to take into account a steady increase in pulp output of 50,000 ADT yr⁻¹ at IKPP, bringing the total yearly production in this mill from 2.05

million ADT in 2006, to 2.25 million ADT in 2010. We assumed that the yearly pulp output at LPPPI would remain at its current level of 0.75 million ADT during the same period.

- In recalculating the wood shortfall that APP anticipated in its *Sustainability Action Plan*, we have used the ratios and productivity figures that APP is now currently using in its own estimates. These involve: (i) a factor of 4.3 for processing round wood into pulp (i.e. 4.3 GMT of wood for 1 ADT of pulp), instead of the expected 4.1 ratio; (ii) an average growth rate over the entire plantation estate revised down to 24 m³ ha⁻¹ y⁻¹; and (iii) 25 percent losses in wood volume from standing timber to volume of wood processed into pulp.
- In assessing what the wood shortfall at RAPP would be from 2006 to 2010 in a 'High Wood Demand' scenario we have assumed a pulp output of 2.05 million ADT in 2006, 2.5 million ADT yr⁻¹ in 2007 and 2008, and 3.0 million ADT yr⁻¹ in 2009 and 2010. We have also used less optimistic productivity ratios both at the mill and at the plantation. The revised ratios are as follows: (i) a factor of 4.1 for processing round wood into pulp (i.e. 4.1 GMT of wood for 1 ADT of pulp), instead of the expected 3.94 ratio; (ii) an average growth rate over the entire plantation estate revised down to 27 m³ ha⁻¹ y⁻¹ instead of the expected 30.6 m³ ha⁻¹ y⁻¹.

Volume of wood from key Kalimantan plantations potentially available to outside markets from 2006 to 2010

The plantation and mill profiles described earlier in this report have allowed us to assess the current and future production capacity of seven key Kalimantan plantations. The purpose of this section is to assess the capacity of these Kalimantan plantations to supply markets outside Kalimantan. In this assessment, we have considered two scenarios based on whether or not the two pulp mills planned for Kalimantan will be built.

Table 28. Projected shortfall of plantation-grown wood at IKPP, LPPPI and RAPP ('High Wood Demand' scenario) during 2006-2010

	APP IKPP and LPPP (million m ³)	APRIL RAPP (million m ³)	Total (million m ³)
2006	1.270	7.719	8.989
2007	2.330	7.570	9.900
2008	2.385	10.533	12.918
2009	6.205	9.676	15.881
2010	2.085	8.916	11.001
Total	14.275	44.414	58.689

Table 29. Volume of pulpwood potentially available to outside markets ('High Supply Capacity' scenario) during 2006-2010 (m³)

	2006	2007	2008	2009	2010	Total
ITCI	2,745,237 (+ 398,000)	751,899	337,389	18,327	219,309	4,470,161
Surya Hutani Jaya	888,960 (+ 343,200)	380,760	103,140	180,480	686,400	2,582,940
Finnantara Intiga	250,800 (+ 923,900)	426,200	595,400	814,900	181,400	3,192,600
Korintiga Hutani	229,320 (+ 31,836)	665,448	879,480	691,320	976,080	3,473,484
Hutan Rindang Banua	7,000,000	0	0	0	0	7,000,000
Total	12,811,253	2,224,307	1,915,409	1,705,027	2,063,189	20,719,185

Note: (+ xxx,xxx) refers to pulpwood volumes presumably not harvested in 2005 and therefore available for harvest in 2006.

'High Supply Capacity' scenario

This scenario is based on the following assumptions:

- Tanjung Redeb Hutani will sell all its wood production to Kiani Kertas pulp mill.
- Production at Adindo Hutani Lestari will remain insignificant through 2010.
- The Korindo and UFS pulp mill projects will not go ahead and therefore wood production from Korintiga Hutani and Hutan Rindang Banua, their associated plantations, would become available to outside markets.
- The other Kalimantan plantations that will sell their wood to markets outside Kalimantan include: Finnantara Intiga, ITCI Hutani Manunggal and Surya Hutani Jaya.

The production capacity of each of the above-mentioned plantations has been discussed earlier in this paper.

We found that, between 2006 and 2010, an excess of 20.7 million m³ of pulpwood should be available to markets outside Kalimantan. Approximately 62 percent of this volume would be ready for harvest as early as 2006.

In assessing the forthcoming production capacity of the five Kalimantan plantations mentioned in Table 29, we have assumed that half the volume reaching maturity in 2005 was harvested during this specific year, with the other half being available for harvest in 2006. The reason for this assumption is that the

restructuring of these plantation companies is recent or still in process, which constitutes an obstacle to full production and marketing. The entire plantation area of Hutan Rindang Banua was mature as early as 2004 and reportedly not harvested at the time of this study. Therefore we consider its pulpwood production capacity to be available for the 2006 harvest.

'Low Supply Capacity' scenario

This scenario is based on the following assumptions:

- Tanjung Redeb Hutani will sell all its wood production to Kiani Kertas pulp mill.
- Production at Adindo Hutani Lestari will remain insignificant throughout 2010.
- The Korindo and UFS pulp mill projects will go ahead and therefore wood production from Korintiga Hutani and Hutan Rindang Banua, their associated plantations, will not be available to outside markets.
- The only Kalimantan plantations which will sell their wood to markets outside Kalimantan will be those affiliated to APP and APRIL: Finnantara Intiga, ITCI Hutani Manunggal and Surya Hutani Jaya.

The production capacity of each of the above-mentioned plantations has been discussed earlier in this paper.

We found that, between 2006 and 2010, an excess of approximately 10 million m³

Table 30. Volume of pulpwood potentially available to outside markets ('Low Supply Capacity' scenario) during 2006-2010 (m³)

	2006	2007	2008	2009	2010	Total
ITCI	2,745,237 (+ 398,000)	751,899	337,389	18,327	219,309	4,470,161
Surya Hutani Jaya	888,960 (+ 343,200)	380,760	103,140	180,480	686,400	2,582,940
Finnantara Intiga	250,800 (+ 923,900)	426,200	595,400	814,900	181,400	3,192,600
Total	5,550,097	1,558,859	1,035,929	1,013,707	1,087,109	10,245,701

Note: (+ xxx,xxx) refers to pulpwood volumes presumably not harvested in 2005 and therefore available for harvest in 2006.

of pulpwood should be available to markets outside Kalimantan. Approximately 53 percent of this volume would be ready for harvest as early as 2006.

In assessing the forthcoming production capacity of the three Kalimantan plantations mentioned in Table 30, we have assumed that half the volume reaching maturity in 2005 was harvested during this specific year, with the other half being available for harvest in 2006. The reason for this assumption is that the restructuring of these plantation companies is recent or still in process, which constitutes an obstacle to full production and marketing.

Supply and demand balance, 2006-2010

The basic assumption behind the supply and demand scenarios presented in this section is that APP and APRIL pulp mills in Riau and Jambi provinces would be the sole destination of any future pulpwood surplus available from Kalimantan plantations. These scenarios allow us to measure to what extent Kalimantan plantations could contribute to fill in the fiber shortfall of the three largest Sumatran pulp mills. At this stage, and without any clear Indonesian policy for optimizing the use of Indonesian plantation resources for the sole benefit of domestic industries, these scenarios have to be regarded as hypothetical scenarios.

Indeed the most likely scenario is that any pulpwood surplus from Kalimantan plantations will be traded to China. In March 2005, APP started producing wood pulp in its new Hainan mill of 1.1 million ADT yr⁻¹ capacity, in spite of a chronic wood shortfall from local sources (Barr and Cossalter 2004). During the same year, APRIL concluded a joint venture with Shandong Rizhao SSYMB Pulp & Paper Co. Ltd., a state-owned enterprise, for the construction of a 1.0 million ADT yr⁻¹ new pulp line (Cossalter and Barr 2006). APRIL is holding 90 percent of the shares. On the same industrial site, Shandong Rizhao SSYMB Pulp & Paper Co. Ltd. has been operating, since June 2002, a pulp line of 0.22 million ADT capacity producing hardwood kraft pulp. The Rizhao mill is outsourcing 100 percent of its wood needs in the form of wood chips shipped from Guangdong and Guangxi provinces, Australia, Thailand, Indonesia and South Africa. The new 1.0 million tonne pulp line will function in the same mode, with most of its wood fiber supplied in the form of chips from Kalimantan plantations.

What follows refers to the two supply and demand scenarios for 2006 - 2010 which would apply in the two most extreme situations. These scenarios assume that new policy decisions would give priority to Kalimantan plantation wood over Sumatran mixed tropical hardwood in the wood procurements of APP and APRIL's pulp mills in Riau and Jambi provinces.

Table 31. Supply and demand balance, 2006-2010 ('Minimum Gap' scenario)

	'Low Wood Demand' scenario for APP & APRIL mills of Riau & Jambi (million m ³)	'High Supply Capacity' scenario for Kalimantan plantations (million m ³)	Gap (millions m ³)
2006	8.277	12.811	+ 4.534
2007	5.649	2.224	-3.425
2008	8.817	1.915	-6.902
2009	5.065	1.705	-3.360
2010	2.868	2.063	-0.805
Total	30.676	20.718	-9.958

Note: + means that supply is higher than demand
- means that supply is lower than demand

Table 32. Supply and demand balance, 2006-2010 ('Maximum Gap' scenario)

	'High Wood Demand' scenario for APP & APRIL mills of Riau & Jambi (millions of m ³)	'Low Supply Capacity' scenario for Kalimantan plantations (millions of m ³)	Gap (millions of m ³)
2006	8.989	5.550	-3.439
2007	9.900	1.559	-8.341
2008	12.918	1.036	-11.882
2009	15.881	1.014	-14.867
2010	11.001	1.087	-9.914
Total	58.689	10.246	-48.443

Note: - means that supply is lower than demand

The 'Minimum Gap' scenario (Table 31) compares the 'Low Wood Demand' scenario of the Riau and Jambi pulp mills (see Table 27) with the 'High Supply Capacity' scenario of Kalimantan plantations (see Table 29). Our analysis shows that with the 'Minimum Gap' scenario, the cumulative gap over the next five years is expected to be on the order of 10 million m³.

The 'Maximum Gap' scenario (Table 32) compares the 'High Wood Demand' scenario of the Riau and Jambi pulp mills (see Table 28) with the 'Low Supply Capacity' scenario of Kalimantan plantations (see Table 30). Our analysis shows that with the 'Maximum Gap' scenario, the cumulative gap over the next five years is expected to be on the order of 48 million m³.

Our study shows that in all scenarios the wood production of Kalimantan plantations will not be sufficient to compensate for the projected shortfall of plantation-grown wood over the next five years at APP and APRIL pulp mills in Sumatra. However, using the wood surplus of Kalimantan plantations for processing at the three largest Sumatran pulp mills would presumably ease pressure on the natural forests in Sumatra. Supposing that Indonesian authorities will make policy decisions in this respect, some 10.0 to 20.7 million m³ of Kalimantan plantation-grown wood could substitute for an approximately equal volume of mixed tropical hardwood from Sumatran lowland forests. We estimate that such a move would contribute to saving 100,000 to 200,000 hectares of natural forests from deforestation from 2006 to 2010.

Because APP and APRIL have pulp mills both in Sumatra and on the Chinese coasts, deciding on the priority market for Kalimantan plantation wood is primarily an economic issue. The approach of both groups is to work out a global wood supply strategy at the lowest possible cost.

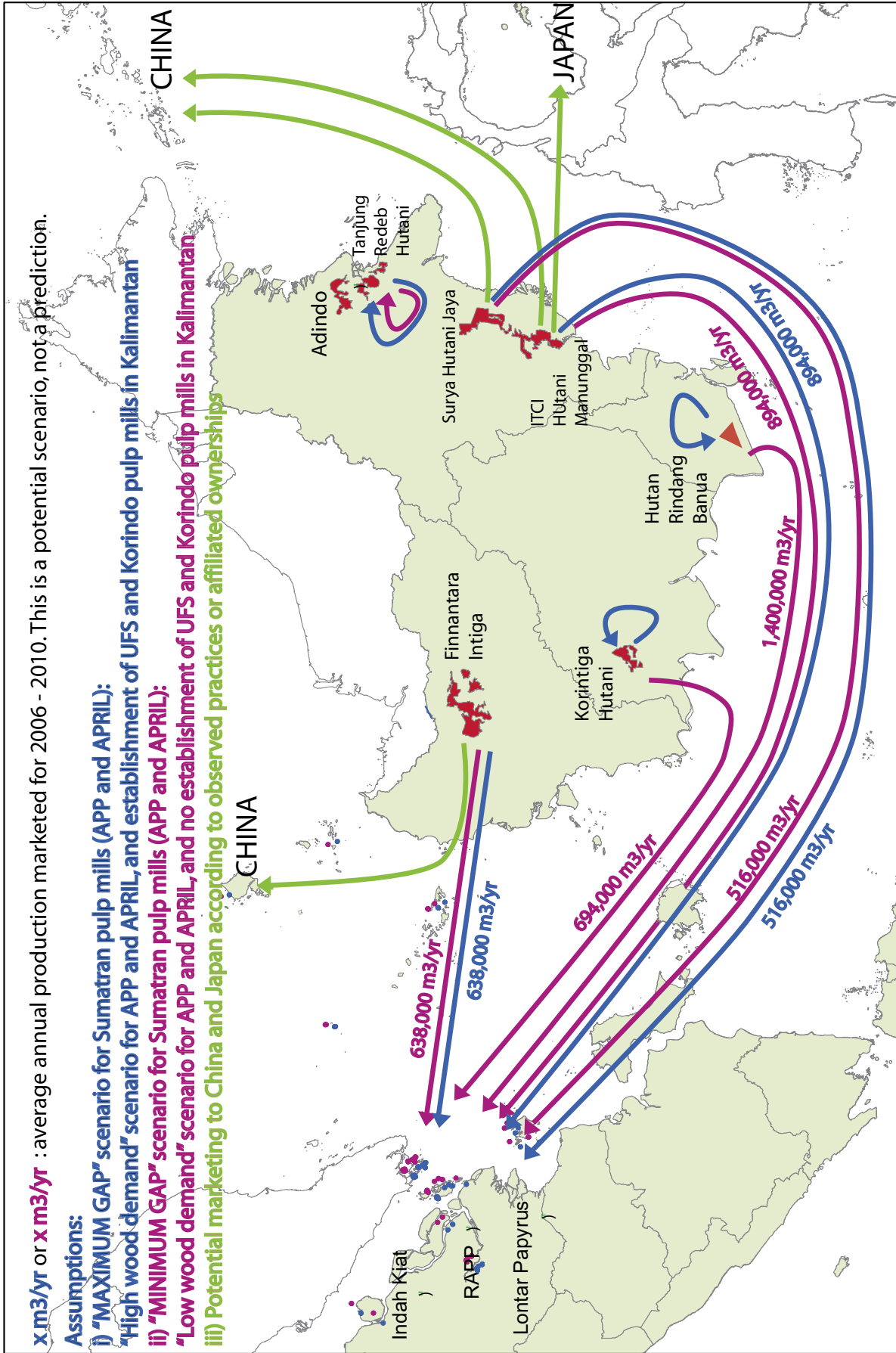
Adding \$10 to \$15 m⁻³ to Kalimantan FOB costs for transporting logs or wood chips by barges to Riau Province would set the final price in Riau somewhere between 35 and 50 percent above the local Sumatran market

price. We have estimated that the extra costs that APP and APRIL would have to pay over the next five years to process in their Sumatran mills all acacia wood available from Kalimantan, rather than the equivalent volume from Sumatran natural forests, would range somewhere between \$100 million and \$300 million. Instead, APP and APRIL are applying to Indonesian authorities for access to additional areas of Sumatran natural forests as relatively instant new sources of cheap wood fiber.

The cost of growing wood fiber along the coastal regions of China is substantially higher than in Indonesia, and this commodity is in relative short supply (Barr and Cossalter 2004, Cossalter 2006b). Newly built, high-capacity, Chinese pulp mills have depended on and will continue to depend on overseas supplies for part of their fiber requirement. The dependence on fiber from overseas exerts strong upward pressure on local log and wood chip prices. At the end of 2005, the southern China market price for pulpwood logs delivered at the gates of pulp mills ranged from \$42 to \$44 m⁻³ while imported wood chips reached prices ranging from \$110 to \$140 per bone dry ton (Cossalter 2006a, Cossalter and Barr 2006). In this context, APP and APRIL can supply plantation logs and wood chips from Kalimantan to their mills in China at competitive costs relative to other sources, in spite of relatively high handling and transport costs to China (from \$15 to \$20 per ton for transport and handling with conventional equipment). The new, high-capacity Chinese pulp mills have their own port facilities where important investments have been made in loading and unloading equipment and conveyor belts. At the Rizhao mill, company officials claim that they are able to reduce port handling expenses by US\$8 per tonne as compared to handling costs in ports using conventional equipment.

In view of the above, it becomes clear that APP and APRIL's global fiber supply strategy will largely be shaped by short-term economic factors, as opposed to any long-term commitment to social or environmental sustainability.

Scenarios for pulpwood flows from Kalimantan plantations: 2006 - 2010



Map 7. Scenarios for Pulpwood Flows from Kalimantan Plantations: 2006-2010

CONCLUSION

Our study arose from our concern that large-scale natural forest conversion of Sumatran forests will continue in order to feed APP and APRIL pulp mills in Riau and Jambi Provinces. The paradox is that Indonesia has an aggregate area of close to 250,000 ha of medium-sized pulpwood plantations which are currently under-utilized and, in some cases, under low-intensity management, in part because they are not linked to stable markets.

Our survey of key pulpwood plantations in Kalimantan has allowed us to document a wide range of situations. Most of the plantations we visited were established between 1990 and 1995, when the Ministry of Forestry and a number of investors were investigating the feasibility of wood pulp production in several Kalimantan locations. Since these plantations were usually established through joint ventures between private groups, on the one hand, and the Inhutani state-owned forestry companies, on the other hand, they had access to the Reforestation Fund as a strong incentive. In most cases, however, the financial support provided by the Reforestation Fund did not guarantee the long-term success of the operations.

Nineteen ninety-eight was the turning point for several reasons: (i) the Indonesian Government decided to suspend allocations from the Reforestation Fund, making a principal source of finance unavailable to many plantation companies; (ii) several pulp mill projects were not realized due to the Asian economic crisis; and finally (iii) large-scale fires (linked to El Niño) destroyed large planted areas in HTI concessions.

The strategy that Bob Hasan, a prominent figure in Indonesia's timber sector during the Suharto regime, pursued in East Kalimantan may have also affected the healthy management of several plantations. In the 1990s, Bob Hasan had control over three Kalimantan plantation companies: Tanjung Redeb Hutani (through the Kalimanis group), Surya Hutani Jaya (through the Astra group), and ITCI Hutani Manunggal (through Nusamba). Originally, each of these plantation companies had been assigned to a distinct pulp mill project. With Bob Hasan taking control over the three plantation companies, it turned out that Kiani Kertas was the only pulp mill built in Kalimantan before the 1997-98 financial crisis. The effect on Surya Hutani Jaya and ITCI Hutani Manunggal was that both companies entered into a period of hard times marked by difficulty in marketing their wood production and resulting in a lack of cash flow. These two plantation companies were not

able to secure contracts for an adequate fiber supply to Kiani Kertas either, due to irregular payments. For many years their sources of income have been the sale of wood chips to local MDF mills and to Japan and the sale of logs to plywood plants and sawmills from selected stands managed on a longer rotation. However, only a portion of the wood production could be sold, and today these companies still have significant volumes of mature and over-mature wood standing in plantations of generally poor condition.

With the exception of Korintiga Hutani in Central Kalimantan, all the plantations we visited had rather poor general conditions mainly due to the lack of maintenance. Difficult topography and soils of poor quality were also a problem in several locations with obvious effects on productivity and conditions of transport. Indeed, Korintiga Hutani was the only company which apparently enjoyed sufficient financial support and the only company to support a significant research and development program.

In 2004, changes started to occur with the purchase of several Kalimantan plantations by Asia Pulp & Paper and by the APRIL affiliate, Pacific Fiber. The changes in ownership have brought in a more intensive management. We were able to witness these changes at various plantation sites visited during the course of this study. We believe that the newly purchased companies will expand their plantation estates and will improve the quality of their future plantations, especially through better genetic material and proper maintenance.

In the second part of this document, we have assessed to what extent wood fiber procurement from Kalimantan plantations could become a viable alternative to forest conversion in Sumatra. Indeed, APP and APRIL are planning further expansions at their pulp mills in Sumatra, and future wood production from Kalimantan plantations could theoretically help in reducing the expected substantial shortages of wood that we detailed in this report. However, one should be aware that the risk remains of future wood production from Kalimantan plantations partially flowing to APP and APRIL's expanding pulp mills in China, due to the specific economic logic of these groups (see Pirard and Rokhim 2006 for a discussion of this logic in the case of APP).

To assess the potential of Kalimantan plantations as a substitute to natural forest conversion in Sumatra, we have projected the wood fiber demand of Indah Kiat, RAPP and Lontar Papyrus during the period 2006-2010. Using the latest available information on the

mill and plantation operations of the two groups, our study presents a 'low demand' scenario and a 'high demand' scenario. Similarly, we have proposed a 'high supply capacity' scenario and a 'low supply capacity' scenario for the Kalimantan plantations. We compare the 'low demand' scenario with the 'high supply capacity' scenario to discuss a 'minimum gap' scenario. Similarly, we compare the 'high demand' scenario with the 'low supply capacity' scenario to propose a 'maximum gap' scenario.

We conclude that in all scenarios the wood production of Kalimantan plantations will not be sufficient to compensate for the shortfall of plantation-grown wood over the next five years at APP and APRIL pulp mills in Sumatra. However, using the wood surplus of Kalimantan plantations for processing at the three largest Sumatran pulp mills would likely ease pressure on natural forests in Sumatra.

If Indonesian authorities make policy decisions supporting the use of domestic fiber supplies, some 10.0 to 20.7 million m³ of Kalimantan plantation-grown wood could substitute for an approximately equal volume of mixed tropical hardwood from Sumatran lowland forests. We estimate that such a move would contribute to save some 100,000 ha to 200,000 ha of natural forests from deforestation from 2006 to 2010. We have estimated that the extra costs that APP and APRIL would have to pay over the next five years to process in their Sumatran mill all acacia wood available from Kalimantan, rather than the equivalent volume from Sumatran natural forests, would range from \$100 million to \$300 million. However, this may not be an option that APP and APRIL will choose to pursue, since both groups are applying to Indonesian authorities

for authorization to access additional areas of Sumatran natural forests as new sources of cheap wood fiber.

Beyond issuing new policies aimed at optimizing the use of Indonesian plantation resources for the sole benefit of domestic industries, the Government of Indonesia could also freeze the Korindo and UFS pulp mill projects. Indeed, in a context of industrial overcapacities in pulp and paper production, taking steps to guarantee the wood supply and long-term fiber sustainability of existing mills would seem to be a wise option. Allowing the Korindo and UFS projects to go ahead would deprive APP and APRIL mills of nearly 11.0 million m³ of fiber over the next five years, and therefore would worsen the current gap between industrial processing capacities and sustainable wood resources.

Finally, our estimate of the wood demand for APP and APRIL over the next five years assumes that their acacia plantations on Sumatran peatlands established during the last ten years will produce the expected amount of wood. The possibility of additional wood shortfall due to lower-than-expected performances of peat swamp plantations should not be totally excluded, since large-scale pulpwood production on peatlands has to be regarded as a high-risk undertaking. The additional risks, compared to dry-land plantation development on mineral soils, include a higher susceptibility to fires, an increased susceptibility to pests and diseases, a higher susceptibility due to wind-throw and a decrease of yields in successive rotations. In this case, the wood production potential from Kalimantan plantations would become even more crucial for Sumatran pulp mills.

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Endnotes

- ¹ See last section « Supply and Demand Scenarios » for more details about conversion factors used in this report. Note that pulp mills in Indonesia have differing strategies regarding wood supply: wood procurement at PT Tanjung Enim Lestari and PT Toba Pulp is entirely from associated plantations; a large share of PT Kiani Kertas's pulp output is from imported plantation wood; Kertas Kraft Aceh uses both plantation wood and wood from natural forests. The three largest Indonesian pulp mills IKPP, RAPP and LPPPI still rely very heavily on wood harvested from natural forests.
- ² When not specified otherwise, the information about ITCI Hutani operations, production and ownership were collected during interviews with directors and field staff of the company, held during a one-year period ending in March 2005.
- ³ Beginning in 1970, the Ministry of Forestry issued HPH concession licenses to private and state-owned timber companies. The HPH contract required the concession-holder to practice selective harvesting of commercial timber on a 35-year rotation.
- ⁴ Since the late-1980s, the Ministry of Forestry has issued HTI licenses for industrial plantation development. The license-holder is allowed to clear most remaining stands of natural forest in the concession area and is required to replant this area with a commercial timber species. HTI licenses typically are granted for a period of 35 years plus the length of a single rotation.

⁵ According to an Ernst & Young audit on the Reforestation Fund (Ernst & Young 1999), cited in Barr (2001), ITCI Hutani Manunggal received Rp 116,900 billion in government grants and interest-free loans from the government prior to 1998.

⁶ See Table 2. Compared to plantation sites in Sumatran provinces, e.g., Riau and Jambi, the topography is much less favorable.

⁷ The conversion factor is 650 kg per m³. This value is based on a measurement by Alam Jaya Lestari chipping mill, several weeks after the logging.

⁸ For a more complete description of Kiani Kertas, see the profile of the affiliated plantation Tanjung Redeb Hutani.

⁹ Prices are in US dollars when not specified otherwise.

¹⁰ Information about Alam Jaya Lestari were collected during interviews with the director of the chipping mill in 2004.

¹¹ According to Alam Jaya Lestari, a distance of over 100 km would not be profitable unless the price paid for chips is increased.

¹² We remind the reader that the report was written in 2005.

¹³ It should be noted that this report was prepared in 2005, and that figures for 2005 and subsequent years are projections based on the assumptions detailed in this section. CIFOR has not been able to verify the extent to which actual figures for these years correspond to the projections reported here.

¹⁴ Information about the social aspects were collected from the company's Annual Work Plan (RKT 2005).

¹⁵ When not specified otherwise, the information about Tanjung Redeb Hutani operations, production and ownership were collected during interviews with directors and field staff of the company, held during a one-year period ending in March 2005.

¹⁶ According to an Ernst & Young audit on the Reforestation Fund (Ernst & Young 1999), cited in Barr (2001), Tanjung Redeb Hutani and Kiani Kertas have received Rp 83,200 billion in government grants, interest-free loans and commercial loans from the government.

¹⁷ Kiani Kertas management claims the maximum feasible production is 475,000 t yr⁻¹.

¹⁸ One official reason was the higher processing cost when using MTH compared to acacia logs or chips, because more chlorine was necessary for bleaching. However, this argument is not very convincing as MTH could be purchased at a price far lower than chip imports.

¹⁹ Kiani Kertas only accepts logs with diameters above 10 cm and more than 4 m long.

²⁰ It should be noted that this report was prepared in 2005, and that figures for 2005 and subsequent years are projections based on the assumptions detailed in this section. CIFOR has not been able to verify the extent to which actual figures for these years correspond to the projections reported here.

²¹ When not specified otherwise, the information about Surya Hutani Jaya, production and ownership were collected during interviews with directors and field staff of the company and of Sinar Mas group (the new owner), held during a one-year period ending in March 2005.

²² According to an Ernst & Young audit on RF (Ernst & Young 1999), cited in Barr (2001), Surya Hutani Jaya has received Rp 188,800 billion in government grants, interest-free loans and commercial loans from the government.

- ²³ With a one-week waiting period between harvest and delivery to the mill, 1 ADT of wood has a volume of 1.2 m³.
- ²⁴ It should be noted that this report was prepared in 2005, and that figures for 2005 and subsequent years are projections based on the assumptions detailed in this section. CIFOR has not been able to verify the extent to which actual figures for these years correspond to the projections reported here.
- ²⁵ When not specified otherwise, the information about Finnantara Intiga operations, production and ownership were collected during interviews with directors and field staff of the company, held during a one-year period ending in March 2005.
- ²⁶ Over 3,522 ha of clear-felling. The average output of commercial wood would then be 129 m³ ha⁻¹.
- ²⁷ It should be noted that this report was prepared in 2005, and that figures for 2005 and subsequent years are projections based on the assumptions detailed in this section. CIFOR has not been able to verify the extent to which actual figures for these years correspond to the projections reported here.
- ²⁸ When not specified otherwise, the information about Korintiga Hutani operations, production and ownership were collected during interviews with directors and field staff of the company, held during a one-year period ending in March 2005.
- ²⁹ We understand the company has applied for new boundaries, and these are expected to be official soon. The 56,000 ha of plantable area is based on the new boundaries.
- ³⁰ It should be noted that this report was prepared in 2005, and that figures for 2005 and subsequent years are projections based on the assumptions detailed in this section. CIFOR has not been able to verify the extent to which actual figures for these years correspond to the projections reported here.
- ³¹ According to an Ernst & Young audit of the Reforestation Fund (Ernst & Young 1999), cited in Barr (2001), Adindo Hutani Lestari has received Rp 41,200 billion in government grants, free interest loans and commercial loans from the government.
- ³² It should be noted that this report was prepared in 2005, and that figures for 2005 and subsequent years are projections based on the assumptions detailed in this section. CIFOR has not been able to verify the extent to which actual figures for these years correspond to the projections reported here.
- ³³ Hutan Rindang Banua was formerly known as Menara Hutan Buana.
- ³⁴ According to an Ernst & Young audit on RF (Ernst & Young 1999), cited in Barr (2001), the company secured Rp 144,000 billion from the Reforestation Fund.
- ³⁵ Thorolf Nyfors, interview in Jakarta, February 2005.
- ³⁶ A recent report by Global 2000 and Friends of the Earth Austria (Hausknot 2006) suggests a worst case of 25,000 ha planted areas still standing in 2005. This is based on confidential sources and could not be verified by the authors.
- ³⁷ It should be noted that this report was prepared in 2005, and that figures for 2005 and subsequent years are projections based on the assumptions detailed in this section. CIFOR has not been able to verify the extent to which actual figures for these years correspond to the projections reported here.
- ³⁸ SMG refers to the Sinar Mas Group, APP's parent conglomerate which controls the group's forestry assets.
- ³⁹ With 70-100 m³ pulpwood produced per hectare of clear-felled natural forest.
- ⁴⁰ Pulp production at the Kerinci mill was progressively raised from 1,739,184 ADT in 2002 to 2,050,000 ADT in 2006, a 17.9 percent increase in production in four years (Virta 2006 b: Table 4 'RAPP Pulp Production (ADT)').

