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NON-FOREST TREE PLANTATIONS

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CONTENTS

1 INTRODUCTION

Some “non-forestry” tree plantations established by the agricultural rather the forestry sector, are of increasing importance for the supply of industrial fibres. The three main species of potential interest are rubber, coconut and oil palm. A number of other tree crops, sometimes used in agroforestry systems, are usually of greater importance to local people for the supply of domestic roundwood or woodfuel than for industrial use – these are not covered in this report.

The reported area of these three species is about one-third of forest plantation area in the tropics and subtropics. In the case of rubber and coconut the planted areas of each of these species rival the area of eucalypt plantations.

2 THE RUBBER TREE

2.1 The rubber plantation resource

The rubber tree, *Hevea brasiliensis* Muell. Arg is indigenous to the Amazon basin. During the nineteenth century, Brazil was the main supplier of hevea latex, which was collected through tapping of trees in the natural forest.

Rubber seedlings smuggled out of Brazil became the parent planting stock for all rubber plantations developed in present-day Malaysia and other Southeast Asian countries at the turn of the twentieth century. Rubber has since been planted in a number of tropical countries as a plantation crop. The most important rubber producers today are in Southeast Asia. Today Brazil plays an insignificant role in international markets (Table 1).

Tapping of rubber trees starts in the fifth to seventh year after planting and then continues for 25 to 30 years. A special knife is used to incise the bark so as to wound the resin canals without damaging the cambium.

After 30 years a decline in latex production makes further tapping of the trees uneconomic. The trees are then removed and replaced with new seedlings. In the past, felled rubber trees were either burnt on the spot or used as fuel for locomotive engines, brick burning or latex curing.

A 30-year old cultivated rubber tree is about 30 m tall with an average branch-free bole of 3 m. The diameter at breast height (dbh) may reach about 30 cm. The stem tends to taper. Young rubber trees have a smooth brown-green bark. The constantly tapped portions of the stem may develop, with age, a latex-smeared cortex.

Available log volume for diameters above 15 cm ranges from 52 m^3 ha^{-1} to 162 m^3 ha^{-1} (assessed for nine cultivars by Gan *et al.* 1985); in assessments a figure of 100 m^3 ha^{-1} is normally used. The utilizable wood volume per hectare depends upon numerous factors such as clone, site and management. Sawn timber recovery lies between 25 and 45 percent.

Rubberwood's favourable woodworking and timber properties make this medium-dense timber (air-dry density 560–650 kg m^{-3} - Lee 1982) suitable for a wide scope of applications. It can be easily steam-bent, or stained to resemble any other timber, depending on consumer demand. Its favourable qualities and light colour make it a good substitute for ramin (*Gonystylus bancanus* Baill.), a timber known for its quality in furniture making and other applications. The natural colour of rubberwood is one of the principal reasons for its popularity in Japan, where it is increasingly used to replace more traditional timbers, e.g. *Fagus* spp. and *Quercus* spp., in a wide variety of applications.

Table 1. Plantation area of Hevea brasiliensis and available wood volume

Country	1975 (1000 ha)	1990 (1000 ha)	1997 (1000 ha)	%	1990* mature	Rubberwood volume (million m^3)
Indonesia	2 296	3 040/3 155[1]	3 516[1]	36	1 863	186.0
Thailand	1 496	1 860/1 844[1]	1 966[1]	20	1 500	150.0
Malaysia	1 694	1 837[1]	1 635[1]	17	1 614	161.4
China	120	603	592[1]			
India	224	451[1]	533[1]		306	3.0
Vietnam	n.a.	200	275[1]			
Sri Lanka	228	199[1]	163[1]		146	1.5
Philippines	n.a.	86	88[1]			
Myanmar	n.a.	76	90[1]			
Cambodia	n.a.	52	52[1]			
Asia total	**6 058**	**8 503**	**8 910**	**92**	**5 429**	**543.0**
Nigeria		247[1]	247[2]			
Liberia		110[1]	110[2]			
Côte d'Ivoire		67	67[2]			
Cameroon		41	41[1]			
D.R. Congo		40[1]	40[2]			
Ghana		12	17[1]			
Others		11[1]	11[2]			
Africa total		**528**	**533**	**5.5**		
Brazil		197	180[1]			
Guatemala		26	38[1]			
Mexico		8	14[1]			
L. Amer. total		**231**	**232**	**2.4**		
World		**9 262**	**9 675**	**1 00**		**968.0**

Source: IRSG, 1997
[1] Source: IRSG, 1999
[2] No data available for 1997.

2.2 Present status of the rubber plantation resource

About 80 percent of the 9.7 million ha of rubber plantations established worldwide for latex production in 1999, are in Southeast Asia; 72 percent of the total (or 5.2 million ha) are in Indonesia, Malaysia and Thailand (IRSG 1999). With an overall area of more than 3.5 million ha, Indonesia is now the world's largest producer of natural rubber.

In 1990, 64 percent of the total area planted with rubber in Southeast Asia was overmature (Table 1). In Malaysia alone the figure was over 85 percent of the plantations, with a total available timber volume of 543 million m^3, thus indicating a decrease in replanting over time (Table 2). The total annual available volume of rubberwood in the area of the Association of Southeast Asian Nations (ASEAN) was estimated at about 17 million m^3 (Ser 1990). However, only a small portion of this calculated volume was actually converted. From 1982 to 1992 rubberwood production figures for Malaysia increased from 30 000 m^3 to 1 872 000 m^3 (Malaysian Ministry of Primary Industries 1993).

Table 2. Area replanted with rubber trees in Malaysia (ha)

Year	Rubber	Other crops	Total	% rubber
1991	31 500	7 700	39 200	80
1992	33 000	8 400	41 400	80
1993	31 100	10 400	41 500	75
1994	26 100	12 800	38 900	67
1995	22.900	14 000	36 900	62
1996	21 600	13 000	34 600	61
1997	11 300	13 000	24 300	47
1998	9 100	11 000	20 100	46

Source: FDM Asia, 1999.

2.3 Economic and social importance of rubberwood

Rubberwood has traditionally been used as a cheap source of woodfuel in most of the countries where rubber plantations are abundant, such as for industrial brick burning, tobacco curing, or for fuelling of locomotive engines. Due to lack of durability, rubberwood was rarely used as utility timber except in timber-scarce countries. After a number of problems had been overcome with the help of applied research, particularly in connection with wood seasoning and preservation but also related to the small size of logs, rubberwood developed as one of the most successful export timbers of Southeast Asia.

Salleh (1984) reported 61 different products made from rubberwood. The most important uses are: furniture and furniture parts, parquet, panelling, wood-based panels (particleboard, cement and gypsum-bonded panels, medium-density fibreboard (MDF), kitchen and novelty items, sawn timber for general utility and fuel.

Rubberwood has certain advantages over conventional timbers from the natural forest. Because it is a plantation by-product, it is available at a relatively low cost. Thus in spite of its comparatively low recovery rate, the production cost per cubic meter of rubberwood is only about 30 percent of the production cost of meranti (*Shorea* spp) (Kollert and Zana 1994).

The most developed rubberwood sawing and downstream processing industries are located in Peninsular Malaysia. In 1993, 116 stationary and 26 mobile sawmills – i.e. 20 percent of total Malaysian sawmills – cut only rubberwood (MPI 1993). The production of rubberwood sawn timber in Malaysia increased from 88 000 m^3 in 1990 to 137 000 m^3 in 1997. In addition, rubberwood has been supplying a growing panel industry. At present, four particleboard mills, four moulded particleboard mills and one wood cement board mill are in operation (Forestry Department, Peninsular Malaysia 1998). Branches and sawmill offcuts have become an important raw material particularly in the manufacture of MDF. In 1999, Malaysia had nine MDF mills with 13 production lines using primarily rubberwood, with an overall production capacity of 1.16 million m^3 per annum (MTC 1999).

Rubberwood is also still used for charcoal manufacturing and woodfuel.

The demand for, and popularity of, this timber and its products in traditional timber-importing countries such as Japan and the United States stimulated the growth of the downstream processing industry in Malaysia (Hong 1995). This growth in turn encouraged the development of similar rubberwood processing industries in neighbouring countries, particularly in Indonesia and Thailand. In Malaysia, rubberwood has outperformed some of the traditional furniture timbers in export earnings. In 1994, exports of rubberwood furniture brought in US$297 million, accounting for 70 percent of Malaysia's furniture exports. In 1998, the country exported rubberwood furniture for a value of about US$683 million (Table 3).

Table 3. Exports of rubberwood furniture from Malaysia (million US$)

YEAR	VALUE
1991	74.2
1992	106.0
1993	197.1
1994	297.4
1995	352.4
1996	439.8
1997	532.7
1998	683.3

Source: Malaysian Timber Industry Board statistics cited in FDM Asia, 1999.

Smallholders own most of the area planted in Southeast Asia (81 percent in Malaysia, 83 percent in Indonesia, and 95 percent in Thailand). These plantings are geographically dispersed and accessibility is often poor.

Smallholders provide logs of lower quality than large estates as they devote less attention to management and proper tapping practices. For example, in Johore, Malaysia, only 18 percent of the rubberwood logs harvested in smallholder areas were found suitable for sawn timber. As a result, only 5 percent of the rubber tree wood volume available was converted into wood products, the remainder being left behind in the plantations or burnt.

Transport costs of the logs are usually borne by the supplier. Because the prices of rubberwood logs, particularly those of poor quality, are low, financial gains for smallholders from log sales are negligible (Kollert and Zana 1994). Therefore smallholders often prefer to burn the logs or let them rot in the plantation after felling. Hence a major portion of industrially used rubberwood comes from large-scale plantations, where logs are of much better quality, and, due to higher volume, better infrastructure and better organization, felling and transport are less costly.

2.4 Outlook for rubberwood

Timber availability, extensive research and aggressive marketing have contributed towards making rubberwood one of the most important export timbers in Southeast Asia, a substitute for light tropical hardwoods and one of the major timbers for the production of furniture and indoor building components.

The main reasons for success are its favourable timber and woodworking properties and the relatively low cost of the raw material since rubberwood is an agricultural by-product. This factor makes the timber highly competitive in comparison with timber from forest species that have comparatively high raw material costs. An additional asset is its “green” aspect: rubber trees have to be removed and the areas replanted once the latex yield has declined to uneconomic levels. The acceptance of rubberwood as a sustainable, plantation-grown, “environmentally friendly” timber has contributed to its universal appeal.

It can be safely assumed that market prospects for rubberwood will continue to be favourable. This is also reflected by the increased overseas investments in the Southeast Asian rubberwood industry. Rubberwood now has a position no other single tropical hardwood species can match in terms of available volume. If we assumed that all plantations would be available for wood production and that there was a ‘normal’ distribution of age classes, then the potential annual production could be up to 30 million m^3 of rubberwood logs.

With the increase in plantation area and research in improved hevea clones, which may yield both high-quality latex and timber, prospects for a continuous supply of rubberwood seem to be good.

However, it remains to be seen if the increased plantation area in Southeast Asia will be sufficient to meet the industrial processing capacities built up regionally and nationally, and to meet the market’s growing demand for rubberwood products.

3 THE COCONUT PALM

3.1 The coconut resource

Cocos nucifera L., the coconut palm, is an agricultural crop widely spread through the tropics. The species has been cultivated for 4000 years.

Traditionally found around hamlets in smaller stands to provide villagers with basic products, coconut palms were planted at the end of the last century in larger plantations, especially in the Pacific, Indonesia, the Philippines, South Asia, East Africa and the Caribbean for large-scale copra production (Table 4). Based on their stem height, tall and dwarf varieties are distinguished. Presently over 100 varieties are known, about half of them talls. All plantations older than 40 years were planted with tall varieties. Once these tall palms, which can reach stem heights above 20 m, are 50–60 years old, their copra yield declines rapidly, and the question of replacement arises. Removal of felled palms from the plantation site is necessary to avoid the rhinoceros beetle (*Oryctes rhinoceros)* breeding in the decaying biomass and from there attacking the young seedlings. When large-scale coconut replanting started in the 1960s, old palm stems had to be removed and destroyed at a cost. Acknowledging this necessity, various coconut growing countries in the Asia-Pacific and Caribbean regions began to investigate the economic disposal and use of the stems, and research on converting palm stems commercially (e.g. into lumber) began. Although inappropriate because the resource is a monocotyledonous plant, the term "coconut wood" has been established for the material from the stem.

The anatomical properties of palm stems in general result in a rather inhomogeneous raw material. Density and all related mechanical properties decrease considerably towards the stem centre and over stem height (Killmann 1983). Other characteristics like high contents of fine parenchymatous material and silica as well as high moisture content. Non durability does not pose a problem for conversion of palm stems into lumber, but pose a problem for putting the lumber into use. Due to its properties, coconut wood is difficult to process with conventional tools (Killmann and Fink 1996). Since the material is also very inhomogeneous, the sawn timber has to be graded according to its position in the stem, which reflects properties and, subsequently, end-use. The lack of natural durability makes its use in untreated form problematic, when exposed to weather conditions.

However, most of these problems have been overcome, partially with the assistance of FAO and bilateral co-operation.

3.2 Present status of the coconut resource

In 1997 the total world area planted with coconut palms was about 12 million ha, more than 90 percent of which was in Asia (Table 4). Major coconut producers were Indonesia, the Philippines and India. The data in Table 4 only include plantations, but not palm trees growing in smaller stands around hamlets ("trees outside forest").

On average, in 1993, about 30 percent of the plantations in the Asian countries were over-aged while in the Pacific it was over 45 percent. There is considerable variability between countries (Table 4).

The average stem volume is about 90 m^3 ha^{-1} - 92 m^3 ha^{-1} for the cultivar San Ramon Tall in the Philippines, according to Jensen and Killmann (1981) and 88 m^3 ha^{-1} for Fiji Tall according to Alston (1981). In 1993 four Asian countries had over 65 million m^3 of available coconut wood (Table 4).

3.3 Economic and social importance of coconut wood

In the Asia-Pacific region, most of the plantations are smallholdings (50–70% on the Solomon Islands, Fiji and the Philippines; and over 90% in India, Indonesia, Malaysia and Thailand). An exception is Papua New Guinea where under 40 percent of the palms are grown by smallholders.

Table 4. Area of coconut palm plantations and availability of coconut wood

Country	1993 (1000 ha)	1997 (1000 ha)	1993 overmature (%)[2]	1993 overmature (1000 ha)	Coconut wood[3] (1000 m^3)
Indonesia	3 636	3 760	20	727	65 400
Philippines	3 075	3 314	30	923	83 000
India	1 538	1 886	5	77	69 300
Sri Lanka	419	442	20	84	75 600
Thailand	336	377	35	118	10 600
Malaysia	310	270	60	186	16 700
Vietnam	215	200	n.a.	n.a.	n.a.
Rest Asia	64	65[1]	n.a.	n.a.	n.a.
Asia Total	**9 593**	**10 314**	**n.a.**	**2115**	**320 600**
Papua New Guinea	260	260	30	78	7 000
Vanuatu	96	96	58	56	5 000
Fiji	65	54	43	28	2 500
Solomon Islands	59	59	50	30	2 700
Samoa	50	75	54	27	2 400
Rest Pacific	151	152[1]	average 45	68	6 100
Pacific Total	**681**	**696**	**n.a**	**287**	**25 700**
Tanzania	305	310[1]	40	122	10 900
Rest Africa	141	350[1]	n.a	n.a	n.a.
Africa Total	**446**	**460[1]**	**n.a**	**n.a.**	**n.a.**
Brazil	228	258[1]	n.a.	n.a.	n.a.
Mexico	141	135[1]	n.a	n.a.	n.a.
Rest America	79	83[1]	n.a.	n.a.	n.a.
America Total	**448**	**476[1]**	**n.a.**	**n.a.**	**n.a.**
World	**11 168**	**11 974**		**2 524**	**375 200**

Source: APCC, 1998. Compiled from information provided by APCC and FAO member countries.

[1] 1996 data, in APCC 1998.
[2] Killmann, 1993.
[3] Jensen and Killmann, 1981.

There are a number of products traditionally provided by the coconut palm, like roofing material (from leaves), ropes and strings (coir from husk), beverages (coconut juice, toddy from inflorescences), food (coconut, palm heart), fuel (from husks, nuts and dried leaves), and wood (from the stem). The main produce, however, is oil pressed out of copra, the dried kernel of the nut.

In the early 1900s copra was a major plantation product, and coconut palmoil a major export product for many countries. The introduction of hybrids, particularly the dwarf varieties during the 1960s and 1970s, helped to increase considerably the copra yield per hectare. The importance of coconut palmoil subsequently decreased due to competition from other vegetable oils, particularly palm oil from *Elaeis guineensis*. Copra prices went down and plantations were neglected or under-planted with other crops. While the importance of coconut palms as a plantation crop has decreased, its relevance as provider of products for daily needs remains, particularly on remote islands.

Initially coconut palm stems generally became available for conversion into timber once hurricanes or diseases (e.g., cadang-cadang in Guam and the Philippines, lethal yellowing in the Caribbean) had struck. The stems were converted into wood products at cottage level – often in very rough form – and used as a substitute for conventional timber in building and bridge construction, but also for tools, toys and other items of daily necessity. In the Maldives, coconut wood has been traditionally used for building fishing boats.

With entire plantations becoming over-aged and being felled, and processing problems having been solved, commercial use of coconut wood started during the 1970s. Depending on its original position in the stem, the main potential end-uses for coconut wood are for wooden construction, panelling, stairs, window and door jambs, flooring and power poles.

As is the case in other plantation by-products like rubberwood or oil palm stems, coconut palm stems have no costs except those for harvesting and transport. Theoretically, plantation companies should even pay for the palm stem removal, or at least give them away for free, since the disposal of old stems also removes a threat of insect attack to the young seedlings. Thus, low raw material prices more than balance additional processing costs and make coconut wood an interesting timber substitute for certain end-uses.

Also, being a by-product from agricultural plantations established long before the environmental discussion started, the use of coconut wood is not marred by any accusations of contributing towards degradation or destruction of tropical forests. It thus stands a good chance as a substitute for some tropical timbers on the markets in Europe and North America.

There have been a number of attempts to market coconut wood internationally, however with little success up to now. The main problem is that the suppliers could rarely guarantee a continuous supply of certain wood volumes of standard quality.

Since in the Philippines coconut wood is available at half the price of white Lauan (*Parashorea spp., Shorea spp. Pentacme contorta*), it could become the construction material for the poor.

3.4. Outlook for coconut wood

During the period 1993–1997, in spite of the strong competition by other vegetable oils, major producers like Indonesia and the Philippines increased their coconut palm plantation area by 5 percent and 8 percent, respectively. In India the coconut estate grew 22 percent. It can be safely assumed that in any planting high copra yielding hybrids will have been used. There is also a trend to grow the palms for the production of coconut water. These hybrids are of little interest as a timber substitute as the stems cannot be sawn. In the long run they could become of interest as raw material for reconstituted wood products.

More than 300 million m^3 of coconut wood from the tall varieties are available in Asia alone, which at an assumed yield of 25 percent would produce about 75 million m^3 of sawn wood.

Coconut wood has two advantages that can make it an interesting timber substitute for certain end-uses. It has low raw material cost and a green image being a plantation by-product. Thus there has been an increasing interest in this resource on the European and North American markets. However, due to the lack of a sustainable raw material supply, coconut wood has not established itself, as yet, on the international markets.

However, despite its international acceptance, its use is expected to increase

- on remote islands and in areas with timber shortage (Pacific islands, Zanzibar);
- in developing countries that are net timber importers (Sri Lanka);
- in rural areas in the tropics;
- as export wood to meet demands in niche markets in industrialized countries.

4 THE AFRICAN OIL PALM

4.1 The oil palm resource

As its name *Elaeis guineensis* Jacqu. indicates, the oil palm's original habitat is in West Africa's tropical forests. Unlike *E. guineensis*, its closest relative, the American oil palm (*Elaeis oleifera* (Kunth.), has never gained economic importance.

The African oilpalm traditionally supplied the rural populations in West Africa with vegetable fat and oil, palm wine and some regionally important non-wood forest products. During the sixteenth century it found its way with the slave trade to Brazil, but was only introduced, as an ornamental plant, to Southeast Asia in the nineteenth century.

During the twentieth century oil palm became an important plantation crop, providing palmoil from its mesocarp, and palm kernel oil from its nuts. In 1999 total oil production reached nearly 19 million tons.

The by-products of palmoil production in the plantation are palm fronds (through pruning) and palm stems after replanting, while at the palmoil mill there are nutshells, empty fruit bunches, pressed mesocarp fibres, and palm oil mill effluents (POME). Palm fronds are used for mulching and the mill by-products are burnt to generate energy for the mill.

Oil palms are grown on a 25–30 year rotation before being removed and replanted. At felling the average palm has reached a height of 12–15 m with a stem diameter at breast height of 45 cm. An average 30-year old oil palm has a stem volume of about 1.6 m^3 (Khozirah *et al.* 1991).

After felling palm stems are mostly shredded on the spot, dried, and either left to decay or burnt. Disposal is a cost and decaying stems often leads to insect infestations, with added expenses.

In the 1980's Malaysia, which is the world's largest palmoil producer, started research on oil palm stem utilization. As with other palms, the physical and mechanical properties are distributed very unevenly over the stem. They are far inferior to those of the coconut palm stem. This may be partly due to their relatively young age when felled. Furthermore oil palm stems have a high moisture content (up to 500 percent), and high percentage of parenchymatic tissue, rich in free sugars and starch. Due to these characteristics, oil palm stems are even more prone to fast degradation than coconut palm stems.

4.2 Present status of the oil palm resource

The total world plantation area under oil palm covers about 6 million ha, of which nearly half is in Malaysia, and almost 80 percent in Asia (Table 1). Between 1996 and 1999 the area planted increased by 18 percent.

Table 5. Plantation area of oil palms

Country	1996 (1000 ha)	1999 (1000 ha)	%	Stem material (million tons)
Malaysia	2 692	3 313[1]	45	1 211
Indonesia	1 350	1 807	30	405
Thailand	140	155		36
Rest Asia	27	35		8
Total Asia	**3 818**	**4 692**	**78**	**1 660**
Pacific	**70**	**76**		**18**
Nigeria	352	358		84
Ivory Coast	160	159		37
Rest Africa	216	218		51
Total Africa	**728**	**735**	**12**	**173**
Colombia	118	128		30
Ecuador	87	100		24
Rest L. America	135	149		35
L. America total	**340**	**377**	**6**	**89**
Rest world	94	102		24
World	**5 050**	**5 982**		**1 940**

Sources: Oil World Annual, 1999
[1] Department of Statistics 2000

At felling and with a stocking of 128-165 palms per hectare, some 205–264 m^3 (average 235 m^3) of palm stem material becomes available for use. The average annual replanting programme in Malaysia alone is about 4 500 ha, with a potential production of about 1.1 million m^3 per year of stems.

4.3 Economic and social importance of oil palm fibres

The rapid increase in plantation area in Malaysia, e.g. between 1970 and 1999 from 300 000 ha to 3.3 million ha, indicates the economic importance of this plantation crop and the growing world demand for palmoil.

The site requirements of oil palm and rubber are similar but rubber production is more labour intensive than palmoil production. Many plantation companies in Southeast Asia, particularly in Malaysia, have shifted from growing rubber to oil palms due to the demand for vegetable oils, sinking prices for natural rubber and increasing labour costs.

In the main oil palm growing countries, Malaysia and Indonesia, most of the plantation area is owned and managed by large companies. For example, in 1999 in Malaysia, nearly 60 percent of plantations were on private estates, about 30 percent in co-operatively managed schemes, and only 10 percent were owned by smallholders. However, even with the private estates entire villages depend on the plantations, since the companies have often employed families for a generation.

4.4 Outlook for oil palm fibre products

Oil palm by-products such as kernel shells, pressed fibres and empty fruit bunches have established uses in heat generation. In Malaysia an MDF plant based on oil palm fruit bunches is in operation with a daily production capacity of 55 m^3. Palm fronds from the plantations are also burnt for heat generation, or used for mulching in the plantations. Palmoil mill effluents may have a future for biogas generation.

The palm stems available at replanting are the largest biomass by-product of palmoil production. In Southeast Asia alone, over 1.6 billion m^3 are expected to become available in the years to come. However, their economic utilization is still undetermined. The properties of the oil palm stem make it an unlikely substitute for conventional timber products like sawn timber. In spite of its availability at no raw material costs, costs of transportation, seasoning (high moisture content) and segregation of the stem material, combined with its low recovery rate and low durability, do not favour its economic utilization (Killmann and Woon 1990).

Therefore, particularly in the largest producer country, Malaysia, considerable research has begun on more unconventional uses for oil palm stems. Studies range from cattle food to ammonia plastification, from converting stems into particleboard, cement and gypsum-bonded panels to MDF (Killmann 1993). The latter is the first of the technical processes developed at the laboratory level to be implemented in an industrial scale. An MDF plant based on oil palm stem material is presently being built in Malaysia.

In the long run oil palm stems will find their way into industrial utilization even if just because of the sheer volume of biomass available. However, this will be mainly in the form of fibre-based panels or reconstituted fibre. Considering their poor properties and the fact that 75 percent of the world’s oil palm plantations grow in the two major Asian timber producing countries, where timber from forests is still abundant, it is unlikely that oil palm stem material will become an important substitute for solid timber.

5 CONCLUSIONS

Of all tree species originally grown for non-wood purposes, rubber, coconut and oil palm are planted most extensively. The area under coconut, rubber and oil palm is currently about 12.0, 9.7 and 6.0 million hectares, respectively. All grow in the humid tropics and have their biggest concentrations in Asia. All three are grown principally for other products rather than wood and so when mature and the stands need replacing the stems are available for other industries at minimal cost.

Only for rubberwood stems has a well established industry and a major international market developed. Rubberwood is extensively used for a variety of purposes ranging from furniture through to woodfuel. Coconut wood from the older taller varieties is sawn and the low-grade utility timber is used on a small scale. The newer small varieties have no potential as sawn timber. Oil palm is of even lower quality than coconut wood and currently unused.

However, because of the considerable volumes available, all three will probably be utilized more in the future. The best outlook is for rubberwood.

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