ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY II

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THE SITUATION AND PROSPECTS FOR THE UTILIZATION OF COCONUT WOOD IN ASIA AND THE PACIFIC

by

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Contents

INFORMATION NOTE ON THE ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY

The Asia-Pacific Forestry Sector Outlook Study (APFSOS) is a wide-ranging initiative to gather information on, and examine, the evolution of key forestry issues as well as to review important trends in forests and forestry. The main purpose of the study is to provide a better understanding of the changing relationships between society and forests and thus to facilitate timely policy reviews and reforms in national forest sectors. The specific objectives are to:

1. Identify emerging socio-economic changes impacting on forest and forestry
2. Analyze probable scenarios for forestry developments to 2020
3. Identify priorities and strategies to address emerging opportunities and challenges

The first APFSOS was completed in 1998, with an outlook horizon to 2010. During its twenty-first session, held in Dehradun, India, in April 2006, the Asia-Pacific Forestry Commission (APFC) resolved to update the outlook extending the horizon to 2020. The study commenced in October 2006 and is expected to be completed by September 2009.

The study has been coordinated by the Food and Agriculture Organization of the United Nations (FAO), through its regional office in Bangkok and its headquarters in Rome, and implemented in close partnership with APFC member countries with support from a number of international and regional agencies. The Asian Development Bank (ADB), the International Tropical Timber Organization (ITTO), and the United Kingdom's Department for International Development (DFID) provided substantial financial support to implement the study. Partnerships with the Asia-Pacific Association of Forest Research Institutes (APAFRI) and the Secretariat of the Pacific Community (SPC) supported the organizing and implementing of national focal points' workshops and other activities, which have been crucial to the success of this initiative. The contributions of many other individuals and institutions are gratefully acknowledged in the main APFSOS report.

Working papers have been contributed or commissioned on a wide range of topics. These fall under the following categories: country profiles, sub-regional studies and thematic studies. Working papers have been prepared by individual authors or groups of authors and represent their personal views and perspectives; therefore, opinions expressed do not necessarily reflect the views of their employers, the governments of the APFC member countries or of FAO. Material from these working papers has been extracted and combined with information from a wide range of additional sources to produce the main regional outlook report.

Working papers are moderately edited for style and clarity and are formatted to provide a measure of uniformity, but otherwise remain the work of the authors. Copies of these working papers, as well as more information on the Asia-Pacific Forestry Sector Study, can be obtained from:

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1. INTRODUCTION

Background, description and importance of the study

When a country decides to establish a coconut wood industry, it must be assured of an adequate supply of disposable over-mature palms of known volume which should be attractive to prospective industrial investors.

- The actual and potential demand for coconut wood can be based on several factors:
- Actual and projected needs for housing
- Construction of large high-rise buildings
- Electrical and telecommunication poles
- Poultry and other livestock buildings
- Pre-fabricated housing components for modular homes, overlay flooring, architectural beams, decorative/structural columns
- Demand for house/office furniture, novelty items for both the domestic and export markets

Coconut wood has been proven to be a good substitute for many conventional woods. Like conventional wood, the coconut stem is durable, sturdy and versatile and can often be used at a considerably lower cost. The cost of coconut wood is only about half – or a little more than half – the price of conventional wood traditionally used for structural purposes (APCC 2000).

This fact is especially attractive to countries with limited budgets for housing for their growing populations. There is, therefore, a need to study the situation and prospects for coconut wood utilization in a country, if it wishes to develop that industry. A vast resource of coconut wood is available throughout the tropical countries of the world. This resource could be derived from millions of over-mature or senescent coconut palms.

Objectives of the study

This study aims to achieve the following specific objectives:

- Undertake a detailed review of information on changing areas and of coconut resources in coconut-growing Asia-Pacific countries with a particular focus on Pacific Island countries
- Identify and assess current and likely changes in various key driving forces that determine the volumes of coconut wood available for processing including copra (and other coconut-derived products) market conditions and the implications for coconut wood production
- Assess coconut wood processing capacities and applications in Asia-Pacific countries (including, especially, Pacific Island countries) and likely prospects for change, including potential and prospects for small-scale processing
- Provide an overview of demand conditions and prospects for major coconut products including sawn timber, composite board products, furniture and fittings, and handicrafts
- Assess changes and trends in coconut development policies and legislation which may impact on the availability of coconut wood resources to 2020, with a particular focus on Pacific Island countries
- Analyze the impacts of overall changing market conditions to identify most likely scenarios that describe how the coconut wood situation will evolve to

2020, including resource availability, processing capacities and demand for coconut wood products

2. COCONUT WOOD AND ITS USES

The coconut palm has a smooth, slender stem that grows to a height of about 25 metres with an average diameter of 300 mm. The hardest, densest part of the wood is found on the outer perimeter of the trunk, which gives the palm its strength, while the wood's high silica content gives the palm elasticity. Towards the centre of the trunk, the wood gets relatively softer.

The palm bears fruit until approximately 60-70 years of age, at which age it is considered to have reached the end of its economic life and is felled to make way for new coconut replants. Each year, several million palms are felled throughout the tropics.

Coco wood contains three degrees of density that dictate its uses:

- ***High-density wood*** (dermal or at the periphery of the trunk) – hard: basic density of 600-900 kg/m³
- ***Medium-density wood*** (sub-dermal or next to the high-density portion) – medium/hard: basic density of 400-600 kg/m³
- ***Low-density wood*** (found at the core of the trunk) – soft/medium: basic density of 2000-400 kg/m³

A coconut lumber user faces several important problems when using coco wood:

- It is difficult to nail and splits are common in high density wood finishes
- Only limited sizes of sawn lumber are available because of the small diameter of the coconut trunk. The optimum width and thickness of boards that can be usually recovered are 25 mm and 50 mm, respectively. For structures requiring larger sizes of lumber, *glued lamination* of the wood – to the desired dimensions – is done
- Untreated freshly-cut lumber can be easily attacked by moulds and staining fungi, especially if the material is not properly stacked and is exposed to humid environments during the air drying process. Further degradation during air-drying can also be caused by decay fungi and pinhole borers. Hence, prophylactic treatment is necessary, if coco wood is used for the production of high value products for export
- If coconut wood is not properly dried, checks and cracks develop on the surface in response to variations in relative humidity. Hence, drying of the wood should be done to bring its moisture content to a level appropriate for equilibrium in its location in service

It is estimated that about 30 to 50 percent of coconut palms in Asia Pacific countries, or about 359 million palms, are already senile and are due for replanting, These palms are already unproductive, but still have the potential to provide income for their owners and wood processors.

Only in very recent years have people begun to explore the potential commercial uses for this vast, alternative supply of wood.

House and building construction material

A hectare of replanted coconut palm can produce about 100-150 m^3 of coconut wood. At 100 palms/hectare, this translates to a minimum of 1 million m^3 for every 10,000 hectares replanted. This wood resource is sufficient to meet many wood requirements and boost housing and school-building programs in countries, thereby opening employment opportunities for many people.

Figure 1. A coconut house in the Philippines

Farmers can also earn cash by selling their coconut palms to processors for housing purposes.
In the Philippines for example, one coconut palm may be sold to coco wood timber processors
for P1,000 (US$21) or more.

Studies show that in terms of durability, sturdiness and versatility, coconut wood is comparable to conventional wood. When properly sawn, seasoned/dried, treated, and machined, high density coconut wood is suitable for all construction components that require strength properties like window frames, doors, trusses, floor tiles (parquet), girds, floor joists, purlins, balustrades, railings, window frames, jalousies and other load bearing structures.

Medium density wood can also be used for framing, horizontal studs, ceiling joists and door/window frames while low density coco wood materials are usually used only in non-load structures like wallboards and panels and temporary simple structures where safety of the users must be considered.

Table 1 shows the densities and portions of a coconut log recommended for different uses as coconut lumber for building construction.

Table 1. Uses of coconut lumber as construction materials by portion of log

Use	Portion of coconut log	Use	Portion of coconut log
Flooring	Hard	Window jambs	Hard
Trusses	Hard	Sidings	Hard with soft
Floor joists	Hard	Ceiling	Hard with soft
Stairs and railings	Hard	Jalousies	Hard with soft
Door panels	Hard	Studs	Medium
Rafters	Hard	Purlins	Medium
Exterior walls	Medium	Roof shingles	Medium
Panels	Soft	Interior walls	Soft

As a rule, experts suggest that coconut wood with density below 400 kg/m^3 should not be used as structural framing material but only in the internal parts of a building such as ceilings and wall linings in the form of boards and wall shingles.

Pre-fabricated housing components for modular homes, overlay flooring, architectural beams, and decorative/structural columns

South Pacific countries like Fiji and Tonga are heavily investing in and have managed to commercially process their senile coconut palms into high quality coco wood housing components. These countries are now producing and exporting TG flooring, parquet flooring,

architectural beams and decorative/structural columns to Australian and New Zealand markets.

Electrical and telecommunication posts and poles

Figure 2. Coconut trunks as electric poles

High-density coco wood can provide excellent material for electrical and telecommunication posts and poles. Sulc (1983) recommended using coconut for transmission poles, in pole-type buildings like sawmill structures, wood drying open-side sheds, woodworking shops and agricultural auxiliary buildings, marine piles and general wharf structures, fencing (corner or gate posts) and round wood split into halves and quarters.

The experience of the Manila Electric Company using high-density coco wood poles treated with chromated copper arsenate "tanalith" and "creosote" has shown that coco poles are good substitutes for non-conventional wood poles. The felled coconut trunks to be used as round timber are immediately debarked, brushed with recommended chemical for protection during drying and dried for about 4-5 months.

Furniture and high-value products

Coconut wood has properties that make it ideal for furniture and handicrafts:

1. *Density* – the wood's high density is ideal for products like furniture, but chairs and tables are quite heavy
2. *Durability* – coconut has adequate resistance to insect borers. High density wood appears to withstand the test of time in interior application
3. *Good working properties* – the wood has fair to good machining properties
4. *Finishing* – the wood can be finished fairly well with transparent finishes

Figure 3. Coconut wood furniture

Many furniture and novelty makers find coconut wood comparable to the traditional wood species commonly used in the furniture industry. With effective promotion of coconut as a new "exotic" material for furniture, novelty and other high value products can potentially have a high share of domestic and world markets.

Table 2 shows various products that can be derived from the different portions and densities of coconut timber.

Table 2. Coconut products by portion of log

Product	Portion of coconut timber	Product	Portion of coconut timber
Boxes		**Household implements**	
Cigar boxes	Hard portion	Plates	Hard with soft portion
Chest and jewelry boxes	Hard portion	Bowls	Hard with soft portion
Crating and packing boxes	Hard with soft portion	Cups	Hard with soft portion
Canes and sticks	Hard portion		
Novelties			
Gavels	Hard portion	Paper weight	Hard with soft portion
Handles	Hard portion	Ink stand	Hard with soft portion
Glass holder	Hard with soft portion	Pencil holder	Hard with soft portion
Candle holder	Hard with soft portion	Ash tray	Hard with soft portion
Lampshade stand	Hard with soft portion	Flower vases	Hard with soft portion
Name plate	Hard with soft portion	Clothes hangers	Soft portion
Laminated baseball bat	Hard with soft portion		
Fixtures			
Show case	Hard portion	Parquet flooring	Hard portion
Moulding	Hard portion	Balusters	Hard with soft portion
Shelves	Hard with soft portion	Headboards	Hard with soft portion
Cabinet divider	Hard with soft portion	Drafting boards	Hard with soft portion
Radio and television cabinets	Hard with soft portion	Street sign posts	Hard portion
Boat side planking	Hard portion	Road guard rails	Round and half round forms

Charcoal

Coconut wood is comparable to other woods as a fuel. Medium to good quality charcoal can be produced from coco wood using any of the conventional methods of making charcoal. However, several studies reveal that with varying densities within the coconut stem, energy potential and charcoal quality also vary.

The high density portions of the trunk yield higher charcoal recovery and better quality compared to that from the low density portions. Experience has also shown that good quality charcoal can be obtained from logging and sawmilling residues like coconut trunk slabs and timber off-cuts and from the butt part of the trunk. The upper portion of the trunk, consisting of low density wood, gives charcoal of inferior quality.

Studies by the Philippines' Forest Products and Research Development Institute show that compared to coconut shell charcoal, coco wood charcoal has lower fixed carbon and volatile matter contents and higher ash contents.

Coco wood charcoal is more or less similar to the charcoal obtained from giant ipil-ipil (*Leucaena leucocepala*). Corcuera (1983) arrived at values for the fixed carbon contents for low and high density coconut wood as 70.23 and 77.80 percent, respectively.

Studies also show that coco wood charcoal and charcoal briquettes have *high heating value*, can be easily handled and produce less smoke compared to that from conventional wood. Hence, for fuel purposes coconut trunk charcoal can be better converted into briquettes to increase their strength and density and improve their heating properties.

A briquette plant in the Philippines produces ovoid type briquettes of 1.5 oz size at 500 lb/hr. The briquettes have good crushing strength and burning properties. *Sorghum grain* has been found to be an effective binder for charcoal briquettes made from coconut trunks.

Chemicals

Activated carbon can also be made from coconut trunk charcoal. The product can be used to manufacture various chemicals such as carbon disulphide, calcium carbide, silicon carbide, carbon monoxide, paint pigments, pharmaceuticals, molding resins, black powder, electrodes, catalyst reactors, brake linings, and gas cylinder absorbent. Ethanol can also be produced from coconut waste products.

3. FOREST AREAS IN ASIA AND THE PACIFIC

According to FAO, the total natural forest area in the Asia-Pacific region is estimated at 734 million hectares (APFC, 2008). But like many forests elsewhere in the world, Asia-Pacific's forests are declining due to widespread deforestation and overall loss of forest quality.

This declining trend was already seen several years ago.

Brown and Durst (2003) noted that in 1990, *excluding the advanced industrialized countries of Japan, Australia and New Zealand*, the total forest area in Asia Pacific, reached more than 511 million hectares.

Within 10 years, however, from 1990 to 2000, the forest areas in Asia-Pacific decreased by about 0.02 percent or more than 8,055,000 hectares so that by 2000 the forest areas amounted to just a little more than 503 million hectares.

This is a decrease of almost 806,000 hectares a year for the same period.

Table 3. Extent of forest and other wooded land in the Asia-Pacific region

Country/ area	Land area					Inland water	Total area
	Forest		Other wooded land	Other land			
				Total	With tree cover		
	1000 ha	% of land area	1000 ha	1000 ha	1000 ha	1000 ha	1000 ha
North Asia	213,729	19.4	90,003	797,701	0	27,076	1,128,509
South Asia	79,239	19.2	8,065	325,612	1,158	35,828	448,745
Insular SEA	117,623	47.8	3,771	124,449	9,648	9,653	255,496
Continental SEA	86,262	45.4	18,006	85,857	0	3,798	193,923
Pacific Islands	33,944	63.6	5,760	13,688	139	1,123	54,513
AIEs	196,855	23.7	424,147	210,477	0	7,476	838,955
NIEs	6,267	63.0	0	3,673	0	54	9,994
Total Asia	**733,919**	**25.8**	**549,752**	**1,561,457**	**10,945**	**85,008**	**2,930,135**

Source: FRA, 2005.

While the total area of forest in Asia and the Pacific has declined since 1990, in perhaps the most positive trend for Asia-Pacific forests for several decades – since 2000, the total area of forests in the region has increased by more than 3 million hectares. This trend has not been reflected in areas of other wooded land, which have declined by almost 10 million hectares since 2000.

However, more detailed analysis of the statistics shows wide disparities in forest area change among countries. Overall, only a very small group of countries have increasing forest areas, with the net regional gain in forests mainly accruing from China's plantation program, with Fiji, India, New Zealand, Samoa, and Viet Nam also reporting net forest gains. Chronic forest loss is still experienced in a number of countries, with the greatest net deforestation since 2000 occurring in Indonesia, Myanmar, Australia, Cambodia and Papua New Guinea. The net forest area increase also disguises a change in the overall composition of forests in the region, with more than 9.5 million hectares of plantations established in Asia and the Pacific, since 2000, implying a net decrease in natural forests of at least 6 million hectares, and much

greater areas of natural forests being cleared in some places and offset by regeneration elsewhere. For example, if the small subset of countries that report increased forest areas for 2000-2005 is excluded, the remaining countries in Asia lost a total net area of 18.5 million hectares of forests during the five-year period, amounting to 6.4 percent of total forest area in other Asian countries, and 1 percent of forests in Pacific countries. The forest area of Indonesia, alone, declined by 9.3 million hectares (9.6 percent) during this 5-year period, while Cambodia (9.5 percent), DPR Korea (9.3 percent), Myanmar (6.8 percent), Pakistan (10.1 percent), Philippines (9.9 percent) and Sri Lanka (7.2 percent) lost disquieting proportions of their forest cover.

FAO reports that widespread deforestation, forest fires, an overall loss of forest quality and establishment of oil palm plantations have caused the loss of forest cover in the region (FAO 2005).

This situation of dwindling forest cover in the Asia-Pacific region is opening up opportunities to utilize senile coconuts as a substitute for conventional woods. Instead of wasting and allowing the senile coconuts to pose a hazard to the environment, they can be processed into construction, furniture and other materials of high value. Such a move shall reduce the pressure exerted on natural forests by demands for housing, building construction and other uses.

4. MAGNITUDE OF THE COCONUT INDUSTRY GLOBALLY AND IN ASIA-PACIFIC COUNTRIES

The world's coconut area in 2002 was reported to be 12.122 million hectares. This area increased to 12.159 million in 2005 but decreased later by 3 percent to 11.794 million in 2006 (Table 4).

From 2002 to 2006, coconut areas in the region remained constant at almost 10.5 million hectares with little variation at about 86 percent of the world's total coconut area.

This means that almost nine hectares out of every ten hectares of coconut areas in the world are located in the Asia-Pacific region.

Coconut areas in Asia and the Pacific

In 2006, the total coconut area in the region was estimated at **10.298** million hectares. Of this total, three countries had coconut areas of more than 1 million hectares each:

- Indonesia 3.818 million hectares (37.07 percent of total)
- Philippines 3.243 million hectares (31.49 percent) and
- India 1.935 million hectares (18.79 percent)

Of coconut-growing countries, the three countries with the smallest coconut areas were:

- Bangladesh (South Asia) 31,000 hectares (0.3 percent of total)
- China (North Asia) 27,000 hectares (0.26 percent) and
- Kiribati (Pacific Islands) 25,000 hectares (0.24 percent)

From 2002 to 2006, coconut areas in the region followed a pattern of variable increases and decreases. The year with the highest total area was 2005 with 10.503 million hectares of coconut lands.

Just one year later, however, in 2006, this area declined to 10.298 million hectares, a decrease of almost 2 percent or 205,000 hectares. The greatest decrease occurred in Thailand where the coconut area declined by 34 percent. Malaysia followed with a decline of 11.5 percent while Indonesia lost 1.9 percent of its coconut. Other Asia-Pacific countries were reported as retaining their 2005 levels.

Coconut areas in the rest of the world

A long-term trend of growth in coconut areas outside the Asia-Pacific region also followed a variable pattern during the period 2002-2006. Coconut areas in the "Rest of the world" countries totaled 1.656 million hectares in 2004. By 2006, however, following the same trend as in Asia and the Pacific, coconut areas declined to 1.496 million hectares representing a decrease of almost 10 percent within just two years and a loss of 161,000 hectares.

In total, in 2006, the whole world lost 365,000 hectares of coconut lands with Asia-Pacific countries losing 205,000 hectares and the rest of the world, 161,000 hectares. Of the 365,000 hectares lost to *other uses*, more than half are in Asia and the Pacific, though proportionately, losses in the "Rest of the world" are higher.

Table 4. World coconut area, 2002-2006 ('000 ha)

Country	2002	2003	2004	2005	2006
South Asia	**2,365**	**2,372**	**2,325**	**2,361**	**2,361**
India	1,892	1,919	1,899	1,935	1,935
Sri Lanka	442	422	395	395	395
Bangladesh	31	31	31	31	31
Nepal	NA	NA	NA	NA	NA
Pakistan	NA	NA	NA	NA	NA
Maldives	NA	NA	NA	NA	NA
Bhutan	NA	NA	NA	NA	NA
Insular Southeast Asia	**7,226**	**7,259**	**7,260**	**7,267**	**7,176**
Indonesia	3,885	3,911	3,870	3,894	3,818
Philippines	3,182	3,217	3,259	3,243	3,243
Malaysia	159	131	131	130	115
East Timor	NA	NA	NA	NA	NA
Continental Southeast Asia	**529**	**505**	**517**	**517**	**401**
Thailand	327	328	343	343	226
Viet Nam	165	136	133	133	133
Myanmar	37	41	41	41	42
Cambodia	NA	NA	NA	NA	NA
Lao PDR	NA	NA	NA	NA	NA
North Asia	**25**	**27**	**24**	**25**	**27**
China	25	27	24	25	27
Korea, Republic of	NA	NA	NA	NA	NA
Mongolia	NA	NA	NA	NA	NA
Pacific Islands	**341**	**333**	**337**	**333**	**333**
Kiribati	25	25	25	25	25
Samoa	96	93	96	93	93
Vanuatu	96	96	96	96	96
Solomon Islands	59	59	59	59	59
Fiji	65	60	61	60	60
Tonga	NA	NA	NA	NA	NA
Asia-Pacific countries	**10,486**	**10,496**	**10,463**	**10,503**	**10,298**
Other countries	**1,636**	**1,627**	**1,657**	**1,656**	**1,496**
World	**12,122**	**12,123**	**12,120**	**12,159**	**11,794**

Source: Adapted from compiled materials provided by APCC member countries and FAO. Countries are members of the FAO-Asia-Pacific Forestry Commission. Australia, Japan and New Zealand are excluded since they have no coconut palms.

Why coconut areas decreased

Various observations, reports and studies reveal that decreases in coconut areas in Asia-Pacific countries can be traced to the following factors:

a. *Natural calamities* such as strong hurricanes, floods and even volcanic eruptions that usually fell thousands if not millions of coconut palms every year. In January 2003, for instance, Cyclone Ami so ravaged Fiji's coconut areas that the overall copra supply dropped by an estimated 50 percent (APCC's The Community Newsletter, March 2003).

b. *Destruction by pests*. In an APCC 2008 Survey, Papua New Guinea reported that all hybrid coconuts planted in the New Guinea Islands were wiped out by beetles, specifically, scapanes beetle (*Scapanes australis*), rhinocerous beetle (*Oryctes rhinoceros*) and black palm weevil (*Rhynchophorus bilineatus*).

c. *Urbanization* where coconut plantations are transformed into residential areas especially where coconut areas are reclassified by the government as no longer agricultural.

d. *Planting of new crops* e.g. oil palm, banana, fruit trees and other high-value, early-bearing crops which often required massive clearing of coconut areas. Malaysia projects a continuous decline in its coconut areas at a rate of 2.5-3.5 percent per year not only because of conversion to oil palm but also due to labor shortages and decreasing productivity of the coconut palms. Papua New Guinea also reported that approximately 15 percent of its coconut areas had been planted with oil palm since the mid-1980s in New Ireland and Milne Bay Provinces (APCC Survey, 2008).

e. *Growing awareness* among the rural and urban people of the income they can get from selling their coconut which is gaining popularity as a good substitute for conventional wood as construction material. Based on the Philippine experience, this awareness increased the demand for coconut wood which later led to rising prices for coconut palms. This phenomenon has even encouraged smallholder coconut farmers to cut even *productive* palms. To conserve its coconut resources, the Philippine government issued a law in 1995 banning the indiscriminate cutting of coconuts throughout the country except in cases where the palms are already senile, diseased or typhoon-damaged.

f. *Low and fluctuating prices for copra and coconut oil* in Samoa and Cook Islands have led families to abandon their plantations except to harvest coconuts for their own consumption. This has drastically affected the earning potential of many rural people (APCC Survey, 2008).

Given these factors, it is possible that coco wood and related industries in the Asia-Pacific region could have utilized a sizeable amount of coconut wood in 2006.

5. DEMAND FOR COCONUT WOOD AND ITS PRODUCTS

Housing

Senile coconut palms in Asia and the Pacific and their prospects for housing

How many senile palms are currently available in Asia and the Pacific? In 1997, a working paper published by FAO entitled *Asia Pacific Forestry Sector Outlook: Focus on Coconut Wood*, gave estimates on the percentage of senile palms by country. Using those same proportionate estimates, the whole of Asia and the Pacific would have had a total estimated number of coconut palms of around 1.03 billion in 2006 (Table 5). Out of this total, almost **360 million** palms can be expected to be senile.

In that same paper, the author (Arancon, Jr.) noted that "In the Philippines, where coconut wood is becoming widely used in house construction, a coco wood resource of 95 million senile trees would give 28.5 million cubic meters of sawn wood for economic utilization, or a potential of 1.89 million housing units."

Based on this estimate, 50 coconut palms are sufficient to build one (1) housing unit. Hence, with 360 million senile coconut palms, a total of about 7.2 million housing units could be built.

Table 5. Estimated number of coconut palms in Asia and the Pacific, 2006

Country	Coconut area ('000 ha) 2006	Est. number of coconut palms ('000)[1]	% senile (ave.)	Total number of senile palms ('000 palms)
South Asia	**2,361**	**236,100**		**45,555**
India	1,935	193,500	20	38,700
Sri Lanka	395	39,500	15	5,925
Bangladesh	31	3,100	30[2]	930
Nepal	NA	NA	NA	NA
Pakistan	NA	NA	NA	NA
Maldives	NA	NA	NA	NA
Bhutan	NA	NA	NA	NA
Insular Southeast Asia	**7,176**	**717,600**		**291,870**
Indonesia	3,818	381,800	50	190,900
Philippines	3,243	324,300	30[2]	97,290
Malaysia	115	11,500	32	3,680
East Timor	NA	NA	NA	NA
Continental Southeast Asia	**401**	**40,100**		**9,370**
Thailand	226	22,600	30[2]	6,780
Viet Nam	133	13,300	10	1,330
Myanmar	42	4,200	30[2]	1,260
Cambodia	NA	NA	NA	NA
Lao PDR	NA	NA	NA	NA
North Asia	**27**	**2,700**		**870**
China	27	2,700	30[2]	870
Korea, Republic of	NA	NA	NA	NA
Mongolia	NA	NA	NA	NA
Pacific Islands	**333**	**33,300**		**11,818**
Kiribati	25	2,500	30[2]	750
Samoa	93	9,300	16	1,488
Vanuatu	96	9,600	50	4,800
Solomon Islands	59	5,900	20	1,180
Fiji	60	6,000	60	3,600
Tonga	NA	NA	NA	NA
Asia Pacific, Total	**10,298**	**1,029,800**		**359,483**

[1] at 100 palms/hectare. Figures based on 2006 data of the FAO study.
[2]Average for Asia-Pacific.

Asia-Pacific population in 2006

In 2006, the Asian and Pacific region was home to almost 3.5 billion people (Table 6). Studies indicate that this population level constitutes about 54 percent of the global population during that year. China and India were the most populated countries in the world, with populations of 1.3 billion and 1.15 billion, respectively. Half of the region's population lives in these two countries.

Indonesia, the third most populated country in Asia Pacific, was home to more than 228 million people. Between 1990 and 2006, the population of Asia and the Pacific grew at half the rate of Africa – the region with the fastest growth.

Table 6. Asia-Pacific population and number of senile palms 2006 (in '000)

Country	Population ('000)	Est. no. of senile palms ('000)
South Asia	**1,519,530**	**45,555**
India	1,151,751	38,700
Sri Lanka	19,207	5,925
Bangladesh	158,665	930
Nepal	28,000	NA
Pakistan	160,943	NA
Maldives	306	NA
Bhutan	658	NA
Insular Southeast Asia	**342,357**	**291,870**
Indonesia	228,864	190,900
Philippines	86,264	97,290
Malaysia	26,114	3,680
East Timor	1,115	NA
Continental Southeast Asia	**218,290**	**9,370**
Thailand	63,444	6,780
Viet Nam	86,206	1,330
Myanmar	48,798	1,260
Cambodia	14,242	NA
Lao PDR	5,600	NA
North Asia	**1,402,595**	**870**
China	1,329,000	870
Korea, Republic of	71,000	NA
Mongolia	2,595	NA
Pacific Islands	**1,917**	**11,818**
Kiribati	94	750
Samoa	185	1,488
Vanuatu	221	4,800
Solomon Islands	484	1,180
Fiji	833	3,600
Tonga	100	NA
Asia Pacific, total	**3,484,689**	**359,483**

Sources of population data: Wikipedia Encyclopedia, UN World Population Prospects: The 2006 Revision and other sources.

Box 1. A Hypothetical Housing Calculation

If it is assumed that there are five members per family, the Asia-Pacific region would have had a total of 697 million families in 2006. Assuming further that out of this total, 20 percent are in need of new or improved shelter, then there would be about 139 million families needing improved shelter in the Asia-Pacific region.

Noting that Asia-Pacific countries have 359 million senile coconut palms with capacity to provide 7.2 million housing units, coconut wood housing would be sufficient only to meet 5.2 percent of this estimate of demand.

Comparing the population and number of senile coconut palms in Asia and separately in the Pacific reveals another dimension to the picture. The Pacific countries have many senile palms in excess of housing needs of their people.

At 50 palms per housing unit, the Pacific countries' almost 12 million senile coconut palms can produce a total of 236,360 shelters. Using the same hypothetical estimate above, Table 7 shows comparative supply and demand for coconut housing in Pacific Island countries.

Table 7. Number of shelters needed, Pacific, 2006

Pacific country	Hypothetical estimate of shelters needed	Number of potential shelters*
Kiribati	3,760	15,000
Samoa	7,400	29,760
Vanuatu	8,840	96,000
Solomon Islands	19,360	23,600
Fiji	33,320	72,000
Tonga	4,000	NA

* at 50 palms = 1 shelter= 1 family.

The Pacific countries are clearly in a strong position to develop other construction, charcoal, furniture, chemical and other high-value product industries based on coconut. Or alternatively, Pacific countries may be able to develop an export trade in coconut wood to Asia to help meet demands for cheap wood.

Of course, it would be naïve to think that all the senile coco palms will be used for housing projects alone in the Asia-Pacific region. Coconut wood can also be used to build schools, furniture, furnishings, novelty and other items, among others.

These and other coco wood products are now attracting domestic and foreign buyers and investors looking for exotic and unique products that can be manufactured and sold at reasonable prices and income.

Furniture, novelty and other items

With demands from government and private housing and school building projects and furniture industries, coconut farmers have a ready market for their senile coconut palms. In the Philippines, timber processors buy one palm at about P1,000 (US$21) or more.

The world trade in furniture has been steadily increasing over the years. Furniture and novelty items made of coconut command premium prices in the export markets. Exporters are willing to buy high-quality and very attractive coconut wood products that include furniture, decorative interior walls, parquet floors, novelties and curio items like walking sticks, ash trays, hammer handles, egg cups, plates, bowls, vases and other items.

Figure 4. Coco chairs (Philippines)

There are also products called composed panels produced from small-diameter coconut logs for use as inner cores for blockboards and for small furniture items like small cabinets, chests, trays and plant hangers. According to a local Philippine manufacturer, there is a demand for composed panels especially in Japan.

The furniture sector as a whole is one of the most basic industries, if the industrialized countries are considered. This sector generally represents between 2-4 percent of the total production value of the manufacturing industries. The global furniture industry showed a growth rate of 85 percent in 2005.

Figure 5. Coco lamp shade (Thailand)

The industry was valued at around US$76 billion in 2005, up from US$70 billion in 2004. Italy's exports amounted to US$10.5 billion narrowly beating China's US$10.3 billion.

In the same year, Germany, Poland and Canada were the top five furniture exporting countries while the US, Germany, UK, France and Japan, the only Asian nation, were the top five importers.

What is emerging today is the fact that the manufacturing hub of furniture is quietly shifting to Asia, particularly to China. This change of world furniture manufacture to Asia and China first started in the 1980s. In 2004, China’s furniture industry recorded a total output valued at about US$33.7 billion with exports touching US$10.353 billion – nearly 31 percent of the total output. From 1994 to 2001 the Chinese furniture industry increased its exports by a phenomenal 335 percent.

In 2001, China exported furniture to the US was valued at US$2.8 billion. Exports to the US have shown an annual growth rate of more than 35 percent. The Asian countries are now the second largest furniture exporting region, with China taking the lead.

Will coconut furniture fare well in the world market?

A number of coconut wood processing companies in Fiji, Indonesia, Philippines, Thailand and Viet Nam have successfully demonstrated the commercial production of high-quality wood furniture, coco wood flooring and handicrafts for export.

The Pacific Green Furniture Company in Fiji, for instance, has made great strides in processing and producing high-quality coco wood furniture for export.

The company has an annual turnover of around F$15 million and predicts a future increase of F$60 million (Yabaki, 2004).

Coco wood handicrafts from Indonesia, Thailand and the Philippines are also now getting favorable nods from local and foreign buyers. The Philippines' Davao Ethnocrafts Design company, for instance, has reported that producing coconut handicrafts and novelty items is an economically and technically feasible venture.

The continued patronage of local buyers and the ingress of foreign orders have assured a stable business for the company. Production capacity is still insufficient to meet existing demands. Hence, the company now plans to expand its operation by buying modern machines, improving product quality and increasing volume capacity to accommodate rising demands from the export market (PCARRD, 1997).

Figure 6. Dried coco lumber (PCA-ZRC, Phil.)

In the central Philippines, the Cebu' furniture industry is now the forerunner of the province's thrust toward global competitiveness. Due to its rich tradition in furniture-making and its impressive track record both as a major export earner and net exporter, the Cebu furniture industry is considered as having one of the greatest potentials in the world market.

Already noted for excellent designs and craftsmanship, the industry strives to come out with new products to further keep its edge over its Asian neighbors. Raw materials are scarce but this has not discouraged the very talented Cebuano furniture designers. They now have beautiful furniture made from combinations of traditional and indigenous materials such as sea grass, abaca (Manila hemp), arorog, and butay (coconut twig) mixed with wood, bamboo, rattan, stone and wrought iron.

A great majority (82 percent) of the establishments export their products. Thirteen percent has anywhere from 10-90 percent of their outputs bound for abroad, while only 5 percent produces solely for the local market. Most of the Cebu products go to the Americas (44 percent), with 40 percent to the US. Europe is a far second (21 percent), followed by the Asian market (12 percent). Other markets including the local market constitute 23 percent of all outputs.

The prospects then of coconut wood as furniture are good especially now that many of the following problems related to coco wood use are already resolved:

a. It is *difficult to nail the high density wood* and splitting at the edges is common. But this is remedied by pre-drilling before nailing.
b. Furniture made of purely high density material is unusually *heavy* which is undesirable for domestic use. But this problem can now be minimized by using medium and low density material for the internal parts of furniture.

c. The hard portion can be machined satisfactorily to obtain a smooth surface. But machining the medium and soft materials may result in *chipped grains.* But extra sanding effort or using wood fillers resolves this problem.
d. During staining, the *soft portion absorbs more stain* and tends to become darker than the other portions of the wood. But this can be controlled now by applying a very thin coat of sanding sealer and lacquer thinner mixed at a ratio of 1:6 before staining.
e. Glossy finishes applied over the *softer portion tend to lose their luster*. But this can be corrected now by applying more coating materials to the softer portion than to the harder portions. There is about 10-30 percent change in finish consumption per 0.1 change in the density of the wood.
f. The *small size of the stem diameter limits the size of sawn timber*. Normal logs provide sawn lumber with maximum width and thickness of 125 mm and 50 mm, respectively. But to achieve pieces having wide surfaces, side laminating the narrow pieces of wood together solves this dilemma.
g. Coconut wood is difficult to machine. It *dulls blades of woodworking machines* because of its silica content. But this can now be corrected by using stellite (Ste) or Tungsten Carbide (TCT) in the saw.

As indicated earlier, a coconut palm can provide wood not only for housing but also for furniture, novelty products, charcoal and other products. All these uses, if promoted well, can result in greater demand for coconut wood.

With strong designs, mixed media and product innovation, furniture manufacturers can price their products higher than those in other furniture producing countries. Catering to the medium and high end buyers still remains highly competitive.

The value added chain can be completed when manufacturers start their own product development and design, manufacturing, assembly, and final furnishing. The secret lies in the hands of their multi-skilled, fine craftsmen who can readily adapt to the changing needs of the customers, offering variety in designs, function, color, texture, material and most of all excellent workmanship.

TG flooring, overlay, pre-fabricated components for modular homes, architectural beams and decorative/structural columns

As cited earlier, coco wood can also be processed to produce materials for overlay, flooring, pre-fabricated components for modular homes, architectural beams and decorative/structural columns.

High density coco wood taken from the base log of the trunk (first log) is ideal for the “Tongue and Groove” (TG) flooring and parquet flooring manufacture. The small and short pieces recovered from the off-cuts and slabs can also be used as materials for parquet flooring.

Manufacturing TG flooring starts with kiln drying the coco lumber to reduce the moisture content to about 10-12 percent. Drying time is about 4-5 days using the recommended kiln drying schedule.

The dried boards are then planed at two wide surfaces and grooved at the two opposite edges using a four-sided surface planer. The ends of the planed materials are trimmed using the radial cross-cut saw and finally end matched with the use of an end matcher. The finished TG boards are tightly bundled by batches for shipment and marketing.

Fiji and Tonga are now exporting TG flooring, parquet flooring, architectural beams and decorative/structural columns to Australia and New Zealand markets and aim to capture the world export market for wood flooring worth over US$5billion worldwide.

The Fiji government believes that it can gain a substantial share of hardwood products export market by opening up new coconut wood product factories with American large companies as partners.

In fact, to complement the current and future trends in the coco wood processing industry, Fiji is employing the apple coring, smoking and waxing technologies to produce high quality coconut decorative/structural columns acceptable to international standards.

Fiji plans to expand the business within the next five years to include commercial production of pre-fabricated components for modular coconut timber resort and kit homes.

Globally, the demand for alternative flooring materials is expected to rise due to the rapid decline in the availability of conventional hardwoods. The American National Wood Flooring Association (Floor Covering Weekly, July 19, 2003), divides the hardwood flooring sales worldwide amounting to US$5.4 billion, into three segments:

a. Americas US$2 billion and rising at 6 percent per year
b. Europe US$2 billion stable
c. Asia US$1.4 billion

Figure 7. Coco wood chair on a coconut parquet flooring, Philippines

In the US, demand for wood flooring remains high as remodeling and home improvements drive the market to over US$2 billion per year.

The trend is projected to continue at a compound rate of 7 percent from 2006 to 2010 raising the demand for wood flooring at the end of the decade to more than US$3 billion (Construction and Building News, Nov. 2006 issue, as cited by Tom Ehart. Market Research. com).

May (2007) reported that as housing continues to be a major factor in the Australian domestic economy, the Australian hardwood flooring market may also increase substantially from the present A$100 million per annum in the next few years. In fact, some big companies have already invested with help from the Australian Government (A$13.5 million) to establish factories that will produce overlay flooring, hardwood parquet flooring and engineered wood.

In Indonesia and Malaysia, some smaller companies have opened up similar factories directly targeting the huge American and European market demands (May, 2007, report to the Cabinet Sub-Committee on Agriculture, Fiji). A coconut wood flooring factory in Indonesia, the PT Minahsa, which is the only fully operational coconut wood flooring factory in the world, supplies more than 15 containers of engineered coco wood flooring per quarter and orders are picking up mostly from Germany, Holland and France (James May Report, 2007).

In an unpublished report, Peñamora (2007) estimated that for the production of 44 TG flooring per month, a net income of about US$500 per month or US$6,000 per year can be earned (US$1 = Php 49). Coconut wood utilization in the European processing industry, especially parquetry production (e.g. finished parquetry), has good prospects.

Coconut fiber-cement board (CFB)

The coconut fiber-cement board (CFB) is a relatively new product that makes use of coconut wastes and can be combined with coconut wood. It is manufactured from fibrous materials like coconut coir, fronds, spathes, coconut top logs, or even shredded wood from small-diameter fast-growing trees growing along the borders of coconut plantations.

Manufacturing CFBs can be a good investment area for construction material suppliers, building contractors and private agencies involved in building low-cost houses. Even governments will find CFBs useful in their socialized and low-cost shelter programs especially for the low and middle-income households dreaming of owning affordable houses.

Figure 8. CFB made at PCA-Zamboanga Research Center, Philippines

The government can also use CFBs in building schools, benches and furnishings. Studies by the Philippine Coconut Authority-Zamboanga Research Center recommend the use of CFBs as a good replacement for tiles, brick, plywood, asbestos and cement hollow blocks.

CFB is made by mixing coconut fiber and cement at a predetermined ratio of 70 percent cement and 30 percent fiber by weight. The cement-fiber mixture is formed into mats and pressed to the desired thickness.

The model coconut house inside the Center (shown below) demonstrates the use of CFB for internal and exterior wall systems, partitions and ceiling, base support for upper-level flooring, roofing systems and as a component of furniture, cabinets, chairs, tables, boxes and vases. The European processing industry may find good prospects in CFB, as it uses otherwise coconut and wood waste resources, which is good for the environment.

Figure 9. Model coconut house, Philippines

Peñamora et al.'s (2006) study on CFB reported its following basic properties:

- Board density 550-650 kg/m^3
- Water absorption 32 percent
- Thickness swelling 4.2 percent
- Bending strength 8.30 kg/cm^2
- Thermal conductivity 0.09 W/m-k

Figure 10. CFB as a ceiling partition and as a component of furniture/boxes, Philippines

Coconut handmade paper

The pulp and paper industry is largely dominated by the US, Canada, Sweden, Finland, Japan, Australasia, and Latin America. In addition to being one of the dominating forces in the industry, the US also consumes more paper than any other country in the world. In fact, from 1990 to 2002 alone, the consumption of paper within the US rose from 84.9 million tonnes to 97.3 million tonnes (www.paperindustry.com).

Forest reduction is one of the primary concerns facing the paper and pulp industry. This is why most paper and pulp factories plant new trees to replace the ones they cut down for their paper making business. Of course, it takes several years for these newly planted trees to reach the same size as the trees they are replacing.

Paper recycling has also helped reduce the number of trees needing to be harvested for paper, as a typical piece of paper made from wood pulp can be recycled four to seven times before the fibers become too short to reuse.

A recent study in the Philippines has found a new use for coconut top logs, logging wastes and sawmill off-cuts which are sawmilling wastes as **paper**.

Figure 11. Coconut paper bags

Like other paper products, coconut handmade paper can be used for gift wrapping, boxes, paper bags, folders, decor, collage and stationery, among others. In Japan, Republic of Korea, Thailand, the US and Europe, the demand for handmade paper and paperboard products remains high. Thus, this is an area with good prospects for processors of finished products.

Like most industries, there are environmental concerns associated with the paper making process. Production of handmade paper from coconut involves the use of different chemicals such as caustic soda which are thrown away with used water. These are hazardous to the environment and health if not handled properly.

Fortunately, paper mills are working hard to find ways to minimize harm to the environment. The opportunities for using coconut wood for a wide range of products are still relatively unknown.

Promoting it in a comparatively conservative market like the one for wood and for products manufactured from it (furniture, doors, parquet, etc.) is generally considered as a difficult move.

Killman and Fink (1996) cited three conditions for the use of coconut wood and marketing:

1. The manufacture and use of coconut wood products should not pose any problem
2. The products should meet the quality requirements of the different markets. Producing products of inadequate quality can bring the coconut wood into disrepute
3. The raw material (coconut palm) should be adequate and permanently available to assure a continuous supply of coco wood products to the outlet markets

The last condition cited above is critical. It would be pointless to go into the coco wood export business if the raw material, the coconut palm, is in limited supply.

6. ECONOMICS OF COCONUT WOOD UTILIZATION

The key to profitability in the use of coconut wood lies in the efficiency of converting the coconut logs into finished products, the machineries and equipment used and the skills of the people involved. Each log passes through several processes before it is ready for market as sawn timber or other products for sale to consumers. It is important that all the facilities necessary from primary conversion to end product development be available if the countries want to maximize returns from their coco wood industries. Coconut wood processing technologies, machineries and equipment are already available that can process coco wood efficiently and profitably.

Coconut utilization involves primary and secondary processing. Primary processing includes logging, sawmilling, anti-sapstain treatment, lumber grading, drying and preservation. Secondary processing includes machining, assembly and finishing of products (furniture, handicraft, etc.

Primary processing

Logging

Harvesting or logging of the coconut consists of: a) felling and bucking; b) skidding and loading and c) transporting to the sawmill.

Harvesting the mature coconut trunks involves the use of chainsaws for felling and bucking operations. The logging team, usually consisting of a chainsaw operator and two assistants, fells the palms, bucks and grades the logs at farm sites and transports the logs to the sawmill. For large scale operations, a forklift is used to load the logs for transport. However, manual loading can also be done for small scale operations.

To do away with transporting the logs to the sawmill area, a portable sawmill can be used to saw the logs right in the field. The sawn boards are then transported by truck to a factory for further processing into finished products.

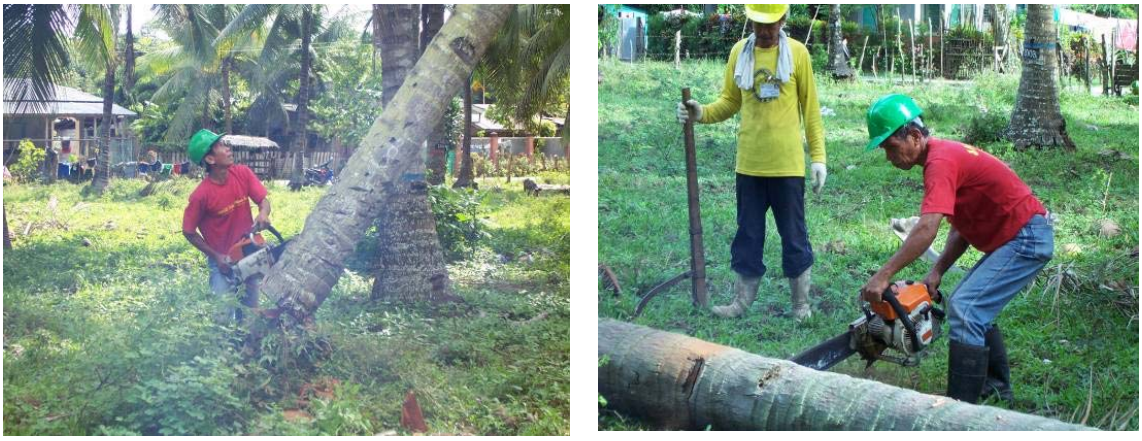

Figure 12. Felling and bucking

A modern portable mill, the *Lucas Portable Sawmill* with a 27 hp diesel engine has a capacity of sawing 30 logs per day.

This sawmill can be manually adjusted to conform to the shape of the log and is capable of sawing it in the round method of cutting to separately recover maximum quantity of hard and medium density portions of the trunk.

It is operated by three men. The sawmill has an output capacity of 22 m³ sawn timber per day. According to Peñamora (2007), operating a portable coconut sawmill would give an investor a total net income of about US$ 8,800 a month or US$106,000 per year as shown in the following cost and return analysis.

Figure 13. Lucas Circular sawmill, powered by diesel engine and electric motor (Fiji)

Table 8. Cost and return analysis, portable sawmill operation, 2007

Item	Value (rounded in US$)	
	Per month	**Per year**
Gross income		
▪ cash sales from sawn timber	19,800	237,600
Costs. variable (cash)	10,507	126,084
▪ Hired labor	5,428	65,136
▪ Coconut logs	1.080	12,960
▪ Tungsten carbide tips	2	24
▪ Anti sapstain chemicals	162	1,944
▪ Fuel, petrol	637	7,644
▪ Diesel	2,550	30,600
▪ Saw chain replacements	120	1,440
▪ Oil, grease, etc.	120	1,440
▪ Marketing & selling costs (1% sales)	198	2,376
▪ Interest on operating capital (4.5%)	210	2,520
▪ Total fixed costs	**480**	**5,760**
▪ Cash	140	1,680
▪ Interest on fixed capital investment	140	1,680
▪ Non-cash	340	4,080
▪ Depreciation	340	4,080
▪ Total costs (variable + fixed)	10,987	137,604
▪ Net cash income	9,153	109,836
▪ **Net income**	**8,813**	**105,756**

Source: Peñamora, L.J., Business Plan for the Coconut Wood Utilization Project Unpublished Report (2007).

Sawmilling

This is the process of cutting or milling the coconut stem into lumber using either band sawmills or circular mills. The conventional sawmills are appropriate for large scale coconut timber milling. In many Pacific countries, modern mobile sawmills as already described above, are widely popular due to their efficiency and mobility. Compared to many hardwoods

coconut is more difficult to saw due to variation in density within the stem. Hence, hard-facing materials, like satellite and tungsten carbide are recommended on conventional saw blades to overcome the rapid dulling of saw teeth.

In backyard scale operations especially in rural areas, power chainsaws are used by skilled sawyers using the freehand lumbering method. In a case study in the Philippines, the cost of coconut lumber manufacturing per crew per day using a chainsaw *at material source* is distributed as follows:

1. Coconut trunk	54%
2. Hired labor	26% (1 chainsaw operator and 2 helpers)
3. Fuel/lubricant	12% (gasoline and oil)
4. Chainsaw depreciation	2%
5. Replacement/maintenance of chainsaw parts	6%

Assumptions (Arancon, 1997):

- No of trunks processed 5 logs/day
- Gross volume 4.5 m³
- Average diameter 22 cm
- Lumber recovery/log 30 m³
- Chainsaw is owned by operator
- Excludes transport cost as distance of plantation to lumber yard varies

Due to the hardness of the dermal portion of coconut trunks, sawing them in green condition is suggested. When the logs are sawn dry, the sawing rate is reduced and wearing of the saw teeth is increased.

In selecting the milling equipment, an investor must consider:

- Profitability (conversion efficiency and marketability)
- Ability to be relocated if required
- Simplicity of design to avoid breakdowns which are difficult to repair in isolated situations
- Ease of operation as skills of operators will often be limited
- Location of the equipment (most of the coconut areas are situated in poor and underdeveloped areas)

From good, healthy and straight palms, it is possible to recover high quality sawn wood up to 8 metres long with dimensions of 175 mm x 63 mm and graded as high density.

Using a stationary circular breakdown sawmill and breast bench re-saw at PCA-Zamboanga Research Center, Palomar and Peñamora (1992) obtained 40 percent sawn wood recovery from 60-80 year old mature coconut palms. The off-cuts and sawdust accounted for about 30 percent each.


Figure 14. Using chainsaws is popular in rural areas in small scale operations (left). But in large scale operations, bandsaws or circular mills, like the Varteg sawmill in Vaitele, Western Samoa (right), are used

The mean recovery of sawn wood by density groups is as follows:

- High density (Grade A) 53.36%
- Medium density (Grade B) 23.39%
- Low density (Grade C) 23.24% (including very low density material at approximately 2%)

Grading/sorting of sawn coconut timber

Grading or sorting can be done visually based on the physical defect and color of the newly sawn lumber. However, other grading methods such as determining the specific gravity of the stiffness of the lumber can also be used. The soft, low density core may not be sawn right away into the final dimension. It is squared first for air drying before re-sawing to the desired dimension.

The visual process is slow and conservative because visible defects can only be assessed approximately. Other factors that cannot be seen like the variability in strength and internal defects of the material are extremely difficult to evaluate.

Figure 15. Visual lumber grading, Philippines

A more accurate and direct method of sorting the coconut lumber for efficient use is by mechanical means. The sizes or frequency of defects are not limited here as in the visual grading method, because the machine checks that both the stiffness and bending strength of the wood meet specified limits.

Mechanical grading classifies the timber faster even when parcels of hard and soft pieces are mixed together. Mechanical grading may mean added cost, but if a greater value is added, then the system of classifying coconut lumber is warranted (Espiloy, 1999).

Anti-Sapstain treatment

Anti-sapstain treatment of freshly sawn wood is necessary for effective utilization. The freshly sawn or green lumbers are dipped in the anti-sapstain solution for 2-3 minutes before stacking for air drying to prevent attacks of stain and fungi.

Basilit PN and Pentabrite with the standard sodium pentachlorophenate as the active ingredient effectively control fungal infection on coco lumber. Alternative chemicals are Difolatan and Daconil, both agricultural fungicides, with active ingredients of tetrachloroethyl and tetrachloroisopthainitrite, respectively (Palomar, 1992).

Seasoning and drying

Seasoning and drying must be done before using the coconut lumber. The moisture contents must be reduced to appropriate levels depending on the intended purpose for the lumber. This process dictates the quality, utility, value and serviceability of the wood.

Drying in an open sided roofed shed is the most economical and easiest means of drying coconut lumber. When freshly sawn coconut boards are stacked for drying, it is necessary to protect them from mould and fungi attacks.

Various commercially available anti-sapstain chemicals can be used on the wood before air drying. For wood requiring good shapes and sizes, such as furniture, novelties and tool handles, drying timber in the kiln is recommended. For lumber, >50 mm thickness and air dry stock from green to 25-30 percent moisture content are necessary before kiln drying.

This practice reduces excessive degrades and lessens the high moisture content gradients that may develop in the stock. Improper drying results in defects called seasoning degrades.

Preservation

When exposed to weather, coco wood will degrade in a very short time. Decay fungi and termites destroy the hard portion of the trunk within 2-3 years, when used in ground contact. The soft portion will deteriorate within a few months.

Figure 16. Coconut wood preservation, Philippines

To extend the service life of coco wood, it must be treated with appropriate preservatives to protect it from attacks by insects and decay organisms.

The two types of wood preservatives are oil-borne and water-borne. Creosote and pentacholorophenol are examples of oil-borne preservatives. Various formations of copper-chrome-arsenate or CCA are water-borne preservatives. CCA preservatives are resistant to leaching when impregnated in the wood.

Their trade names are Tanalith C, Celcure A, or Boliden K33 and are much cheaper than creosote. Boron (trade name: Timbor) is also used in sawn coconut lumber. It is toxic to

wood-boring insects and wood-destroying fungi. It is safe for humans. The chemical is suitable in treating purlins, trusses, ceilings, joists, and other internal structural members when impregnated in the wood. It easily leaches out when exposed outdoors.

There are two methods of preserving coconut wood: the pressure and non-pressure methods. In the pressure method, the wood is impregnated in a closed cylinder under pressure. It requires high capital investment and skilled technicians to operate the plant.

The non-pressure method is suitable in rural areas. Simple to operate, it does not entail high capital outlay. However, this method provides inferior control over preservative retention and penetration in the wood compared to the pressure method.

Palomar (1979) developed treatment schedules for coconut wood intended for different service conditions using various types of preservatives.

Table 9 presents the treating processes and preservative concentration in green and dried coconut wood for end products.

Table 9. Treating process and preservative concentration of green and seasoned coconut wood for end products

Service conditions	Preservative and concentration	Process and treating schedule	Timber condition	Retention (kg/m³)
Ground contact (poles, posts, piles)	CCA 4-5%	Pressure, first vacuum, 45 min; pressure, 120 min; second vacuum, 10 min.	Dry	14-18 (dry-salt)
	Creosote-bunker oil @ 70-30 mixture	Pressure, first vacuum, 1-1½ hr.; pressure, 2-3 hr pressure. Dry temp., 160-180ºF; second vacuum, 1 hr.	Dry	160-192
Ground contact (poles, posts, piles)	Creosote-bunker oil @ 70-30 mixture	Hot and cold bath 8-10 hr. heating and overnight cooling	Dry	128-192
Outdoors, not in contact with ground (sign boards, benches, fence, nails, roof shingles, etc.)	CCA 2-3 %	Pressure-first vacuum, 30 min; pressure, 60 min; second vacuum, 10min.	Dry	7-12 (dry salt)
	Copper sulfate 35 arsenic pentoxide plus sodium dichromate, 3%	Double diffusion soaking in 3% copper sulfate for 2-3 days; arsenic pentoxide plus sodium dichromate for 3 days	Green	7-12 (dry salt)
Indoors, not in contact with ground (beams, rafters, jambs studs, etc.)	Boron (Timbor)-25%	Dip diffusion, soak for 2-3 min then block stock for 4-5 wks.	Green	5-8 (dry salt)

Secondary processing

Machining

This is the process of cutting the wood into various shapes and sizes using simple machine tools or more complex woodworking machines such as moulders, routers, lathes, and sanders.

The machining quality of coconut wood is influenced by the moisture content, density of specific gravity, and cellular structure of the wood itself or by the factors attributed to the machine used, such as knife angle, feed rate, depth of cut, number of knives, sharpness of knives, and others.

Machining coco wood with high moisture content may result in a rough surface due to raised grain. This happens in planing, shaping and turning operations. However, when coconut wood with low MC, below 12 percent, is subjected to machining operations such as planing, shaping, turning, mortising, and boring, breaking of wood surfaces into short particles or groups of fibers below the line of cut may develop. This also occurs in planing with deeper knife cut and higher feed rate.

Machining the soft portions of the coco wood, if not done properly, may result in defects in the form of shallow dents caused by shavings that cling to the tips of the knives. Suction apparatus should be installed in the wood shop to avoid chip marks.

Finishing

As in other furniture timber, coco wood requires the application of finishes to preserve and accentuate the grain, color, or figure and to enhance its natural beauty. Finishes also impart good protection against abrasive wear, warping, raising of the grain, cracking, and shrinkage.

Finishing starts with preparing the wood surface and is completed with the application of the desired type of top coat or final coat. Surface preparation includes sanding and filling. Sanding levels the wood surfaces and removes the tool and machine marks.

As already discussed, one of the coco wood products with a growing demand is TG flooring. According to Peñamora (2007), to produce 44 m^3 of TG flooring (kiln dried, end matched), a manufacturer can earn a net income of US$25,515/month or about US$306, 180/year.

He would need to spend almost US$19,400 a month or about US$232,400 a year but he will earn a net income that is 1.32 times his expenses just to produce the 44 m^3 of TG flooring. Table 10 shows Peñamora's cost and return analysis for producing 44 m^3 of TG flooring.

Table 10. Cost and return analysis for TG flooring production, 2007

Item	Value (rounded in US$)	
	Per month	**Per year**
Gross income ▪ Cash sales from TG flooring	44,880	538,560
Variable costs, cash	18,941	227,292
▪ Hired labor	5,428	65,136
▪ Sawn timber	10,982	131,784
▪ Tungsten carbide tips	2	24
▪ Electricity	1,517	18,204
▪ Marketing & selling costs (1% sales)	449	5,388
▪ Interest on operating capital (4.5%p.a.)	563	6,756
▪ Fixed costs	**424**	**5,088**
▪ Cash, interest on fixed capital investment	124	1,488
▪ Non-cash	300	3,600
▪ Total costs	**19,365**	**232,380**
▪ Net cash income	25,815	309,780
▪ Net income	**25,515**	**306,180**

Source: Peñamora, L.J. Business Plan for the Coconut Wood Utilization Project, 2007.

The costs, of course, may vary from country to country in the region depending on the machines used, the amount of labor, power costs and other cost items and their current assumptions.

For commercial operations using different equipment and machineries in the harvesting, sawmilling and preservation of coconut wood, the data in Table 11 may provide a good indication of the current costs of the equipment and machines:

Table 11. Equipment/machinery for coco wood processing (2008)

Equipment/machinery	Indicative cost * (US$)
Harvesting	
Chainsaw (standard)	750/unit
20 tonne tip trucks(6x4) (flat-cock)	135,000-180,000/unit
Front-end loader (4x4) (2.5 tonne lift capacity	105,000-135,000/unit
Sawmilling	
Edwards Stationary Sawmills in two parts: (1) Headrig Saw(circular) with log carriage, by 75 hp motor and (2) Breast bench (circular) manually operated by 35 hp motor	255,000
Tractor loader (standard)	30,000
Varteg portable sawmill. Driven by tractor. P.T.O Single; circular saw output capacity : 1.6 m³/day; 3 operators	38,000
Varteg portable sawmill driven by stationary 47 hp engine, break down saw and breast bench (output capacity: 3-4³/day; 5 operators)	53,000
Break down resaw unit, for village use (prodn: 1-3 m³/day)	12,000
Break down resaw and breast bench, suitable for light contracting (prodn: 4-5 m³/day)	37,000
Contracting model breakdown and breast bench, and log loading forks fitted and driven by a 60-80 hp diesel engine, with all accessories, mounted in a trailer (prodn: up to 10 m³/day)	46,000
Preservative treatment	
Pressure Treatment Plant (charge capacity : 7 m³; cylinder : 37 ft. long)	375,000
Varteg portable sawmill driven by stationary 47 hp engine, break down saw and breast bench (output capacity : 3-4³/day; 5 operators)	53,000
Break down resaw unit, for village use (prodn: 1-3 m³/day)	12,000
Break down resaw and breast bench, suitable for light contracting (prodn: 4-5 m³/day)	37,000
Contracting model break down and breast bench, and log loading forks fitted and driven by a 60-80 hp diesel engine, with all accessories, mounted in a trailer (prodn: up to 10 m³/day)	46,000

* Based on data from Tonga and New Zealand Sawmill Manufacturers. Increased by 50 percent over the 1997 data.

7. RECOMMENDATIONS

While this paper has shown the good prospects for using coco wood in the Asia Pacific region, many things still need to be done to see the industry grow. Earlier in this paper, it has been stressed that for the industry to take off the ground, there has to be a sustainable supply of senile coconut palms in the long run.

The following recommendations are geared towards determining and ensuring the sustainability of the supply of coco wood in every Asia-Pacific country.

A sustainable and rationalized coconut replanting strategy

Whatever replanting strategy governments in the Asia Pacific adopt, the following should be considered:

a. *Proper disposal of the felled palms and residues*

Disposal should always be part of any coconut replanting program. Without it, coconut replanting is bound to create another problem which is deadly: the Rhinoceros beetle which is the most destructive pest of the coconut.

The spread of this pest may be prevented, minimized or controlled by the following methods: (a) destroying the breeding places like rotting or decaying coconut logs and residues which are just left on the ground; (b) using Green Muscardine fungus and baculovirus which are bio-control agents specific to the beetle; (c) using pheromones to trap the adult beetles (the adult stage is the most destructive stage of the life of the beetle) and d) simple sanitation.

b. *Replanting scheme*

Will replanting be done solely by the government or will it be done by concerted efforts of the government and the private sector?

If it will be by the government alone, perhaps it should consider strategies like *purposive, systematic cutting* where government-organized **mark** teams would go from one area to the next to mark the senile palms to cut. Then **cutting** teams start felling the marked palms, followed by the **disposal** teams which will cut and properly dispose of the logs and debris and finally, the **holing and planting** teams which will dig the planting holes and plant new coconut seedlings. Such a system can be effective but needs to be evaluated carefully. The resources and the equipment needed to implement the replanting program should also be determined, including the seedlings that will be planted with least delay.

If it will involve the participation of the private sector, it is necessary to determine at what stage of the replanting program the private sector will come in and what will its role and responsibilities will be.

c. *Replanting experiences*

Are there Asia-Pacific countries which have already implemented coconut replanting programs? Is it possible for these countries to meet or communicate with one another and share their experiences and successes?

d. *Other programs which may affect or relate to replanting program*

The coconut replanting program cannot be implemented alone without considering other programs like reforestation, housing, tourism development and furniture industry development schemes.

Definite housing programs for instance, will dictate when and where the coconut replanting program will be implemented and given priority. The government must see how the coco wood industry can be developed in conjunction with – in support to – and to benefit from, other industries.

e. *Incentives under the replanting program*

There may be a need to consider providing incentives to coconut farmers joining the replanting program. Felling the senile palms means loss of income for the farmers. Unless this loss is "returned" to them in some way through the replanting program, the farmer-participants may delay their participation.

Hence, the government must think of incentives for farmers joining the program. Small farm holders in the region will be willing to replace their senile palms when they see that doing so will provide income and employment especially for the whole family.

Entire families are often engaged in the manufacture of such products as brooms, baskets, lanterns, food products from coconut buds and various other products, which give additional income to the whole family. These are products from the other parts of the coconut which become available when the senile palms are felled.

Another incentive would involve provisions for free coconut seednuts or seedlings of high-yielding and early-maturing varieties and hybrids; or free intercrop seeds/seedlings given to those interested in planting other crops and earning income while the newly-planted coconuts are still unproductive.

f. *Coconut varieties for replanting*

To sustain the coco wood industries, the supply of the "right" coconut variety must be available to meet demand. For the coco wood industries the "right" variety is the **tall variety**.

Dwarf varieties cannot provide the amount and quality of coconut wood that processing industries require. Dwarf varieties may be attractive for young tender nut production for coconut water and other purposes, but definitely not for coco wood production.

Farmers and policy makers must decide which areas shall be planted in tall varieties to sustain the coco wood industries and which ones in dwarf varieties and other purposes.

Since tall varieties generally take longer to mature, seedlings of these materials may have to be planted now under senile palms, or planted immediately after cutting the senile palms. Another way is to adopt replanting systems that allow gradual cutting of senile palms by blocks which are immediately replanted with tall palms.

Governments also need to pursue active research programs geared towards searching for precocious tall populations that can be used in replanting programs. Perhaps, in this regard, the Asia-Pacific countries may agree on an exchange program involving precocious planting materials of tall coconut populations for replanting.

g. *Coconut replanting to meet demand for other uses*

Coconut replanting will not only meet demand for coco wood but also for other products like copra, virgin coconut oil and food products.

The Asia and Pacific Coconut Community or APCC has projected the demand for coconut oil in 2008 to increase by :

- 6.6% in Europe
- 4% in the US and
- 13% in Asia/Pacific (particularly for the China market)

It is also anticipated that the Philippines and Indonesia, the world's major coconut oil exporting countries will increase their domestic consumption by almost 10 percent.

Table 12. World's supply and demand balance, coconut oil, 2002-2006 (in 1000 MT)

	2002	2003	2004	2005	2006
Opening stocks	576.0	522.0	432.0	432.0	406.0
Production	3,106.8	3,287.0	3,063.0	3,257.0	3,101.0
Imports	1,870.1	1,957.0	1,843.0	2,124.0	2,039.0
Exports	1,732.5	2,061.0	1,836.0	2,273.0	1,909.0
Consumption	3,301.2	3,296.0	3,077.0	3,115.0	3,240.0
Ending stocks	519.2	409.0	425.0	416.0	397.0

Source: Oil World.

The above factors should encourage Asia-Pacific countries to plant more coconuts, i.e. to replant without delay when their senile palms are felled and used for the development of their coconut wood industries and rehabilitate their existing palms.

Simple and do-able farm practices like organic (compost) and inorganic fertilization (using common salt and urea or ammonium sulfate), intercropping or inter-row cultivation, mulching with husks, and proper harvesting and copra making will certainly contribute to increased coconut and oil production.

Promote the use of coconut wood

When farmers and investors know the benefits of using coconut wood, they will be more ready to participate in a replanting program. Hence, promotion on the use of coco wood is very important.

Promoting coco wood includes not only information about coco wood technologies from felling to processing but also market prospects, opportunities and challenges of the industry will make farmers, potential investors and entrepreneurs, and the public in general, appreciate the importance, value and the benefits of using coconut wood. Correct information will also avoid misconceptions and generate cooperation among groups involved in the development of the coco wood industry.

Some of the promotion activities that governments can do may include:

- Organizing and promoting annual local and international fairs (e.g. for coconut furniture or novelties as done in Cebu, Philippines)
- Publishing and distributing annual marketing and promotional materials – locally and internationally
- Commissioning technical and market development seminars/workshops to discuss issues affecting the coco wood industry, design and product development, even including maintenance of ethical practices within the coco wood industry, and others
- Providing available technical and management services
- Establishing an information center for coco wood that can provide library services, newsletters, an Internet homepage and other relevant information

The promotion activities, if done effectively, can hasten coconut replanting. This will mean a decrease in coconut population and therefore, a dwindling supply of copra which coconut oil millers need.

A real problem arises when farmers sell their still-productive palms to coco wood processors (e.g. small coco lumber dealers) who take advantage of the ignorance of the general public about the proper densities of coco wood to use.

Back in the mid-1990s, coconut farmers in the Philippines could earn as much as Php1,000 (US$25) or more per palm from coco wood timber processors. The high prices offered for coconut trunks so greatly influenced the smallholders to sell their senile palms that later on the cutting included even the still-productive palms.

This situation so alarmed the copra dealers, the oil milling sector and the government that in 1995, Republic Act No. 8048 known as the “Coconut Preservation Act of 1995” was crafted. This law provides for the regulation of the cutting of coconut palms, their replenishment and also establishing penalties for violators.

The law states that no coconut palm shall be cut except in the following cases and only after a permit has been issued by the country’s regulating body, the Philippine Coconut Authority (PCA):

- The coconut palm is 60 years old or more
- No longer economically productive
- Severely disease-infected and/or pest-infested
- Damaged by typhoons or lightning
- The coconut land shall have been approved for conversion into residential, commercial or industrial areas by the Department of Agrarian Reform
- The coconut land shall be converted into other agricultural uses or agriculture-related activities pursuant to conversion applied for by the owner and approved by proper authorities
- Hazard to life and property
- The applicant has already planted the equivalent number of coconut palms applied for

The country continued to implement the law until 2007 when the PCA issued a moratorium for the cutting of coconuts with a few exceptions. Though some reports were unconfirmed, they indicate that the indiscriminate cutting of coconut palms has somewhat abated.

Promoting the use of coco wood for economic reasons must be carefully weighed, however. In the case of the Philippines, economics is the reason why farmers sold their products. But in other countries, this may not be so. Favorable economic conditions alone are not a sufficient reason for the sale or use of coco palm.

A study on the industrial production of sawn coconut timber in Tanzania cited two conditions that could lead to an increased use of coco wood in that country:

a. Willingness of the farmer-owners to replace their over-aged coco palms under the present condition.
b. The use of coco wood should already be popular. Accordingly, the use of coco wood in Tanzania has "played a subordinate role…the possibilities of use, properties and qualities of the palm wood as well as the connection of these parameters to the age of the palm are widely unknown."

But are the above conditions, also true in the Asia-Pacific region? It should be necessary to look into this matter more closely as more than 80 percent of coconut landholdings in the region are owned by small farm holders (Arancon, 1997).

Provide support and incentives for the coconut wood industry

The government can encourage entrepreneurs and investors to put their money in either all or any one or two of the steps in coco wood utilization. For example, some people may invest in sawmills only, while others may opt for preservation equipment only. Considering that 30-50 percent of the coconut palms in Asia-Pacific are already senile and are due for replacement, commercializing coconut wood can be a good area for investment.

To further encourage prospective investors, the government can also consider providing incentives for those going into the coco wood export or domestic business. For prospective exporters, the government may consider providing fiscal and non-fiscal incentives such as:

Fiscal incentives

- Income tax holiday (e.g. 6 years for pioneer firms and 4 years for non-pioneer firms)
- Duty of 3 percent on imported capital equipment and its accompanying spare parts
- Tax credit on domestic capital equipment
- Additional deductions for labor expenses
- Tax credit for taxes and duties on raw materials
- Exemption from wharfage duties and any export tax, duty import fees
- Exemption from contractor's tax
- Tax duty exemption on imported spare parts

Non-fiscal incentives

- Simplification of customs procedures for the importation of equipment, spare parts, raw materials and supplies and exports of processed products
- Employment of foreign nationals in supervisory, technical or advisory positions for five years from registration. The president, general manager and treasurer of

foreign-owned registered enterprises or their equivalent shall not be subject to the foregoing limitations
- Access to a bonded manufacturing/trading warehouse system. Registered export-oriented enterprises may have access to bonded warehousing systems
- Other non-fiscal incentives

Craft development plans, policies and legislations to enhance the development of the coconut wood industry

Using coconut wood in the Asia-Pacific region will require proper planning in the short and long term. The scale of the industry is large, with 359 million or more senile palms currently available. Without proper planning that considers not only cutting but also replanting and proper disposal of the unusable portions of the coco trunks, it will be foolhardy to start any operation in the industry.

Though some countries have already drawn up policies or legislations that aim to develop their coco wood industries, it seems that various factors have limited their implementation. In a 2008 survey conducted by the APCC, Samoa, Papua New Guinea and the Philippines indicated the following policies and legislations:

Table 13. Policy/legislation affecting coco wood industry development in some Asia-Pacific Countries

Country	Policy/legislation description (year crafted)	Aim	Status of Implementation
SAMOA	Develop a practical plan for a coconut tree replacement and replanting program (2005). Reviving the coconut industry through value addition in the form of Organic Certification, Fair Trade Labeling and diversifying the processing of coconut products into forms suitable for export to niche organic markets.	Coconut planting and replanting. To enhance income earning ability for rural household livelihoods and overall national food security through organic farming, and further value added coconut products while contributing to the economy in the increased agricultural exports and the revival of the coconut industry.	People are leaving rural Samoa in search of paying jobs. There is a lack of interest in utilizing the coconut to generate income and a lack of many other viable income generating opportunities. The number of interested coconut farmers is increasing because the exports for organic virgin coconut oil which all come from WIBDI client farms are increasing again after a recent decline.
PHILIPPINES	Republic Act No. 8048 (*Coconut Preservation Act of 1995"* requires an applicant for a cutting permit to pay a fee of Php 25/palm and to have already planted palms replacing the palms applied for cutting (certified by a PCA technician.	To preserve productive coconut palms from unabated and indiscriminate cutting.	This Act is still being implemented following its Implementing Rules. In 2005 alone, more than 565,000 coconut palms were cut. The Philippine Coconut Authority collected fees amounting to more than PhP14 million that year. Illegal cutters were apprehended and court cases were filed.
PAPUA NEW GUINEA	**Kokonas Indastri Koporesen(KIK) Act 2002.** Coco wood known as coconut lumber in the Act is defined as a "coconut product."	To regulate the coconut industry in PNG	The KIK Board and Management operate under this Act. KIK issues licenses to buyers, processors and exporters of coconut products. KIK will issue licenses to committed investors to process coconut lumber. Interested investors are currently exploring economical ways of harvesting coconut palms and processing the hard wood. The government so far has not made any commitment to fund any proposed national coconut replanting program. KIK is doing everything to plant new areas with coconut in the provinces but it needs financial support from the national and provincial governments to undertake a sustainable coconut replanting and expansion program.

Based on some responses to APCC Survey 2008. Information from the Philippines was based on reports.

Samoa and PNG are interested in replanting their senile coconuts but implementation is hampered by:

- People are leaving the rural areas to look for paying jobs probably in the urban centers (Samoa). But why are they leaving? Is it because the rural people do not see how they can earn from cutting their old palms and replanting them? Perhaps, the people are not aware of coconut-based income generating opportunities. Or perhaps because if they cut their coconuts they will lose the opportunity to supply the export market for organic virgin coconut oil

- Whatever, the real reasons are in Samoa, the government must think of ways to let the replanting program take off the ground. As already seen, Samoa had about 1.5 million senile palms as of 2006. There is lack of logistical support from the government, especially funding. Papua New Guinea's response to the survey clearly shows this

The Philippines' case is different. The government wants to make sure that only the senile coconut palms are cut and not the young, still productive ones. The law also requires that before any cutting permit is granted, the applicant shall have planted new palms as replacements for the ones to be cut.

Regular monitoring of the implementation of the programs, policies and legislations affecting the coco wood industry needs to be done. Accomplishments must be evaluated vis-à-vis targets and corrective measures. Considering that 30-50 percent of the coconut palms in Asia-Pacific countries are already senile and are due for replacement, commercializing coconut wood can be a good incentive for replanting and a stimulant for the growth of related industries.

New furniture products using coco wood, alone or in combination with other non-coco wood materials, are being produced both for local and export markets. Coconut wood has been shown to be a good material for furniture, construction and other end uses. It is now no longer just any ordinary wood.

Rubber wood was considered ordinary too before the 1980s. During those years, people in Malaysia and Thailand used rubber wood almost exclusively as fuel wood and charcoal. In fact, an FAO report indicates that a significant share of rubber wood production was still used for these purposes – almost 20 percent during the early 1990s in Malaysia.

Since the 1980s, however, rubber wood has gradually established itself as a major wood product in several countries, particularly for the production of furniture, furniture components and wood panels.

Given the proper support, the coco wood industries in the Asia-Pacific region might just follow the path that rubber wood took. But each member country of the region needs to recognize that coconut wood processing industries can only be developed to levels that match sustainable supply.

As noted earlier, the total coconut resource in the Asia-Pacific region is 1.03 billion palms (359 million already senescent), which implies that approximately 11 million palms will reach senescence (age 60) each year. Taking into account the already senescent palms, over a 20-year planning horizon, a sustainable industry producing approximately 9 million m^3 of coconut lumber per year could be developed.

This scale of resource can open up big opportunities for the Asia-Pacific region to meet the demand for coco wood products and materials not only in the region but also in the rest of the world.

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