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GLOBAL DEVELOPMENT OF THE RUBBERWOOD INDUSTRY

DU/INT/92/012

Technical report: The potential role of rubberwood in the forest economy of rubber-producing developing countries*

Prepared for member countries
by the United Nations Industrial Development Organization,
associated agency of the International Trade Center,
which acted as executing agency for the
United Nations Development Programme

Based on the work of Horatio P. Brion,
consultant in production of sawn rubberwood

Backstopping officer: Antoine V. Bassili
Agro-based Industries Branch

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* This document has not been edited.

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EXPLANATORY NOTES

The monetary units of the countries and their offical exchange rates at the time of the mission were:

Indian Rupee	:	IR	28.10 = US$1.00
Indonesian Rupiah	:	IRp	2,040 = US$1.00
Malaysian Ringgit	:	M$	2.55 = US$1.00
Philippine Peso	:	PhP	25.00 = US$1.00
Sri Lankan Rupee	:	SLR	43.02 = US$1.00
Thai Baht	:	ThB	25.06 = US$1.00
Viet Namese Dhong	:	VND	10,750 = US$1.00

The following acronyms are used in this Report:

CIRAD-Forêt	-	the new name of Centre Technique Forestier Tropical (CTFT), Nogent-sur-Marne, France
ESCAP	-	Economic and Social Commission for Asia and the Pacific
FELDA	-	Malaysian Government agency for government-owned and managed rubber tree plantations
FRIM	-	Forest Research Institute Malaysia, Kepong, Selangor, Malaysia
GATT	-	General Agreement on Tariffs and Trade, Geneva, Switzerland
ITC	-	International Trade Centre, Geneva, Switzerland
MIDA	-	Malaysian Industrial Development Authority, Kuala Lumpur, Malaysia
MTIB	-	Malaysian Timber Industry Board, Kuala Lumpur, Malaysia
RRII	-	Rubber Research Institute of India, Kottayam, Kerala, India
RISDA	-	Malaysian Government agency for rubber plantation small holders
RRIM	-	Rubber Research Institute of Malaysia, Kuala Lumpur, Malaysia
UNCTAD	-	United Nations Conference on Trade and Development
UNIDO	-	United Nations Industrial Development Organization
WB	-	The World Bank, Washington, D.C.

A hyphen between numbers (e.g., 1-5) indicates the full range involved, including the beginning and end points.

A full stop (.) is used to indicate decimals.

A comma (,) is used to indicate thousands, millions, billions.

The following symbols, and/or abbreviations as used in this Report:

IR	-	Indian Rupee, currency unit of India
IRp	-	Indonesian Rupiah, currency unit of the Republic of Indonesia
MDF	-	Medium Density Fibreboard
M$	-	Malaysian Dollar, Ringgit, currency unit of Malaysia
PhP	-	Philippine Peso, currency unit of the Republic of the Philippines
SLR	-	Sri Lalnkan Rupee, currency unit of Sri Lanka
ThB	-	Thai Baht, currency unit of the Kingdom of Thailand
US$	-	U.S. Dollar, currency unit of the United States of America
VND	-	Viet Namese Dhong, currency unit of Viet Nam
bd. ft.	-	Board Foot or Board Feet
cm.	-	Centimetre; 1/100th of a meter
dia. or D	-	diameter
etc.	-	"et cetera", and so forth
ft.	-	foot (12 inches); feet
ha.	-	hectare (10,000 m^2); hectares
hrs.	-	hours
hrs./day	-	hours per day
K. D.	-	kiln-dried; kiln-drying
m^3	-	cubic meter(s)
mc or MC	-	Moisture Content
mm	-	millimetre; 1/1000th of a meter
mm^2	-	square millimetre
m/min	-	meters per minute
m^3/yr.	-	cubic meters per year
N/mm^2	-	Newton per square millimetre, unit of pressure; or of unit force
n.a.	-	Not available
%	-	percent
S4S	-	surfaced (planed smooth) on all four faces of the lumber board
vs.	-	"versus"; compared with; against

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EXECUTIVE SUMMARY

Among the hundreds of latex bearing plants which exist in the world, *Hevea brasiliensis* is the most extensively cultivated as a plantation specie, and is estimated to supply more than 90 percent of the total natural rubber requirements of the world. On the basis of adequate and effective maintenance practices for rubber tree plantations, studies have shown that after 25 to 30 years the latex producing properties of the rubber tree decline and the cost of latex production exceeds the gross earnings from the sale of latex products. Thus, it has become a practice that the rubber tree is felled after 25-30 years and replaced with new plantings. The term "rubberwood" refers to the ligno-cellulosic portions of the rubber tree and commonly refers to the stems, of the tree's branches and twigs. The size and length of the stems, branches and twigs vary according to the age, clone type and soil and climate of the tree's habitat. *Hevea brasiliensis* thrives well in tropical areas with: (a) more or less even rainfall throughout the year; (b) the absence of strong wind and heavy rainfall brought about by typhoons and cyclones; and (c) fertile soil in well-drained areas.

Rubberwood was mainly used as fuelwood during the early part of this century: to smoke latex sheets and as fuel for household cooking purposes. Suggestions to exploit timber from rubber trees were proposed as early as the 1950's. Records indicate that as early as the late 60's and early 70's the Sri Lankans were already using rubberwood in the manufacture of school desks and school room furnishings. Forced by serious timber shortage during the same period, the Thai furniture producers cast their attention on rubberwood as an input material for the industry. Similarly, massive development activities to further enhance the industrial use of rubberwood was launched by the Malaysian government during the mid 70's and early 80's. This period may be called the "industrial modernization of the rubberwood processing industry". In 1984 the Forest Research Institute of Malaysia published a list of products which were successfully manufactured using rubberwood in Malaysia: household furniture and furnishings, handicraft and novelty items, sawn rubberwood timber, plywood, hardboard, building and construction components (which included doors, parquet floorings, mouldings, moulded hardboards, toilet seeds, panelling etc.).

More recently, Malaysia and Thailand have met success in the manufacture of particle board and medium density fibreboard (MDF) using exclusively rubberwood as the input. This development has tremendously increased the utilization of the ligno-cellulosic components of the rubber tree with diameters below 15 cm. However, the use of rubberwood in the construction and home building industries is still limited to non-load bearing components (or components bearing only light-load). The leading producers of rubberwood on an industrial scale include the following Asian countries: India, Indonesia, Malaysia, Sri Lanka and Thailand. Rubberwood plantations also exist in Cambodia, Myanmar, Papua-New Guinea, the Philippines and Viet Nam. Similarly, extensive rubber tree plantations are maintained in

Cameroon, Côte d'Ivoire, Liberia, Nigeria, Zaire, as well as, to a lesser extent, other West African countries. Rubber tree plantations have also been reported to exist in tropical areas of some Latin American countries like Brazil, Colombia, Guatemala and Mexico. However, rubberwood processing on an industrial scale is only found in the south and southeast Asian regions.

The rubber tree, being a renewable resource of timber, provides a major solution, to the terrible pressure laid upon the world's natural forests by the land and timber needs of an ever-increasing population. Recent studies indicate that the rubberwood log harvest potential for the period 1992 to 1997 is estimated at about 10 million m^3 per year, which is roughly 0.3 percent of the world's timber needs. Thus, more research and development work aimed at producing rubber tree clones with greater timber yields is indicated.

The physical and mechanical properties of Rubberwood (*Hevea brasiliensis*) compare favorably with those of traditional hardwood species such as White Meranti (*shorea-anthohypochra*), Ramin (*Gonystylus spp.*), Tanguile (*Shorea-rubropolysperma*) and others. Thus, rubberwood has become acceptable in the international market as a substitute material for furniture and joinery products. The material has also attained some degree of acceptance in the production of joinery products such as windows, doors and mouldings. The use of a computer software developed by CIRAD-Forêt (Nogent sur Marne, France), entitled "Tropical Wood Species (TWS) Data Base Software", has indicated more substitution possibilities for rubberwood on the basis of similarity or affinity of some of the characteristics or properties to those of some timber species which are currently popular and high-valued in the international market.

More extensive processing of rubberwood into marketable end products will lead to: (a) potential increase in new jobs; (b) the increase of foreign currency earnings, which is greatly needed by the economic development programmes of the rubber-producing developing countries; and (c) enhancement of the degree of its relevance to the current concern of environmentalist movements over the depletion of the earth's natural forests. However, further progress in this direction may be attained only if two major problems in rubberwood processing are addressed immediately and handled properly. These problems are: (a) the use of toxic or carcinogenic preservatives in the industry's efforts to minimize, if not prevent, biodegradation of the material when in use; and (b) the techno-legal acceptance of rubberwood as a material for the buildings and construction industries as provided in the building codes of potential user countries.

THE POTENTIAL ROLE OF RUBBERWOOD IN THE FOREST ECONOMY OF RUBBER PRODUCING DEVELOPING COUNTRIES

I. INTRODUCTION

A. What is Rubberwood

Rubberwood is the term given to the ligno-cellulose portions of the rubber tree, *Hevea brasiliensis* being the most common species in Asia's tropical regions. The term rubberwood commonly refers to the stem, branches and twigs of the rubber tree. The size and length of stems, branches and twigs vary according to the age, clone type, and soil and climate of the tree's habitat. The diameter of stems of mature rubber trees (25 to 30 years old) vary from 30 to 45 cm. at breast height. In isolated cases, however, rubber tree stems with diameters of 1 meter or more (at breast height) were found, like the 40-50 year old rubber trees in Dong Nai province, Viet Nam, and the 35-40 year old rubber trees in Zamboanga and Basilan provinces of southern Philippines. These old rubber trees, however, exhibited very marked tapers, 30° or more, from ground to breast height.

Rubberwood is generally a light coloured wood, with varying grain configurations, fine to medium coarse, depending on which part of the tree the sawn timber came from and the age of the tree when cut. Sawn timber cut from the lower part of the stem near the stump tend to be coarser than sawn timber cut from higher portions of the stem below the first branch. Younger stems give finer grained sawn timber than stems over 30 years old. Coarser and wilder grain patterns are exhibited by sawn timber cut from stem areas near the branches of rubber trees which were not properly trimmed/pruned during the early growing stage of the tree.

The rubber trees which are currently grown in Asian tropical areas came from the Para region of Brazil in south America, as early as the latter part of the nineteenth century, where the trees could not be raised as plantation trees, owing to their propensity to attacks by fungi and insects which dwell in the forests of the Para region. Fortunately, this handicap was not manifested when the rubber trees were transplanted to Asian tropical regions, where they now thrive successfully as plantation trees. Rubberwood is popularly known as "Parawood" in Thailand, probably a reference to or recollection of its original habitat in Brazil. It appears that the Asian version of *Hevea brasiliensis* thrive well in humid tropical areas with: a) more or less even rainfall throughout the year; b) absence of strong winds and heavy rainfall brought about by typhoons or cyclones; and c) fertile soil in well-drained areas.

There are hundreds of other latex bearing plants. However, only a few among these are commercially exploited for the production of natural rubber due to problems in extracting latex and unacceptable quality of the product. A. C. Sekhar lists some of these species for purposes of general information, as follows:

i. *Parthenium argentatum*: Generally found in North Central Mexico and Southern Texas; locally known as "guayule"; a desert adapted plant;

ii. *Castilla elastica*: A tall (20 m) and stout tree, found in Mexico, Bolivia and Brazil. The tree has a relatively smooth bark and is the main source of *castilla* Panama rubber;

iii. *Manihot glaziovii*: Native of South America, the tree is of medium height (9 m), with a thin, scaly and glossy bark. It thrives well in dry rocky areas. This tree is the source of "ceara" rubber;

iv. *Ficus elastica*: A large tree spreading with numerous large buttress roots; a native of Asia. It is also known as India or Assam or Rambong rubber tree;

v. *Cryptostegia grandiflora and C. madagascariensis*: Native to Madagascar, the tree is an ornamental wood climber; found in subtropic and tropical areas;

vi. *Taraxacum koksaghyz*: A perennial herb found at elevations of 1800-1900 meters above sea level; the plant is a native of Asia and withstands severe winter and drought; also known as dandelion rubber;

vii. *Funtumia elastica*: A tall and slender tree with a thin bark, found in tropical Africa; the tree is the source of Lagos silk rubber;

viii. *Hevea Brasiliensis*: A sturdy, quick growing, tall tree, the *Hevea* is a native of Brazil; and is grown in plantations in Asia, Africa and America; this tree is the most important commercial source of natural rubber. Several clones of the species have been developed in various rubber producing countries with a view to increasing the yield of latex; and lately, increasing the timber yield also. The most important *Hevea* species is the *Hevea brasiliensis Muell. Arg* from which almost all of the world's supply of natural rubber is currently obtained.

B. <u>Rubberwood Utilization - Brief History of its Development</u>

In the early part of this century, rubberwood was mainly used as fuelwood to smoke latex sheets and for household cooking purposes. Yet, the volume of rubberwood, stems and branches, was still much more than what could be consumed for fuelwood purposes; so that a huge volume of rubberwood still had to be burned in the fields, preparatory to replanting activities. A. C. Sekhar recalls that it was in the early part of 1950's that suggestions to exploit timber from the rubber trees were proposed by D. F. Grant. This was followed by a manual prepared by A. T. Edgar in 1958 showing the advantages of mechanization in felling, clearing and maintenance of roads and drainage systems in the rubber plantations.

Pressed by the acute shortage of timber in the country, Sri Lanka started to fabricate simple designs of school desks and schoolroom furnishings in the late '60s and early '70s. These efforts led to the realization that proper sawing, preservation and seasoning of sawn rubberwood are the keys to better quality end product, which formed the basis for studies on rubberwood utilization done by the Forest Department of Sri Lanka in 1971. Similarly, during the late '60s and early '70s, Thai furniture manufacturers have cast their eyes toward the use of rubberwood by the industry, seeking the help of the Thai Furniture Development Centre, Industrial Service Institute, to solve the problem of blue staining, and provide some indications of possible ways to overcome the instability of rubberwood.

Realizing the economic potentials of rubberwood, the Malaysian government, through the Forest Research Institute, Kepong, in cooperation with the Rubber Research Institute of Malaysia, Kuala Lumpur, and supported by other government agencies involved in the rubber industry (MTIB, FELDA, RISDA, etc.), launched massive development activities during the mid '70s and early '80s aimed at intensified industrial utilization of rubberwood. Parallel activities were also conducted by the Thai rubber industry during the period. This period may be called that of the "Industrial Modernization of the Rubberwood Processing Industry".

Salleh Mohd. Nor, in 1984, drew up a list of products successfully manufactured out of rubberwood in Malaysia as follows:

Household furniture & furnishings: Apron sets; bedroom sets; benches; cabinets; chests; dining sets; doors; drawer components; folding chairs and tables; garden sets; kitchen cabinets; living room sets; magazine racks; picture frames; plant stands; rocking chairs; screen partitions; shelves; tables; tea trolleys; television cabinets; etc.

Handicraft and Novelty Items: Bread boards; carving boards; chopping boards; fruit boards; gift boxes; ice buckets; jewelry boxes; knife blocks; pepper and salt sets; salad bowls; steak plates; toys; wine racks; etc.

Primary Products: Sawn rubberwood timber; plywood; hardboard; etc.

Building and Construction Components: Doors; parquet flooring; mouldings; moulded hardboards; toilet seats; panelling; etc.

Lately, Malaysia and Thailand have met with success in the manufacture of particle board and medium density fibreboard using 100 percent rubberwood material inputs. This development leads to the utilization of all the ligno cellulosic components of the rubber tree with diameters below 15 cm. Furthermore, the recent advances in finger-jointing and edge-gluing (lamination) techniques have opened a wide range of new end products for rubberwood. The use of rubberwood in the construction and home building industries, however, is still only limited to non-load up to light-load bearing components pending results of studies on its use in frame-construction methods similar to those developed by New Zealand for pine wood.

C. The Rubber Tree as a Renewable Resource of Timber

1. Worldwide availability

Recent estimates of current plantation area, growing stock and annual log harvest potential for the next five years (1992-1997) in the world's major rubber producing regions are shown in Table I.

Table I. World Rubberwood Supply, 1991

Region	Rubber Planted Area, 1000 Ha.	Growing Stock D>5cm, 1000m^3	Rubberwood Log Harvest potential 1000m^3/yr,1992-97
Latin America	251.8	19,637	149
Africa	489.8	54,432	835
Asia	8,241.3	791,558	9,675
Total	8,982.9	865,627	10,659

Source: INDUFOR, Helsinki, Finland

The foregoing figures indicate that on the basis of the reported 3.45 billion cubic meters of round logs production in 1991, the rubber tree, properly and adequately maintained, will provide an appreciable volume of about 0.3 percent, vis-a-vis the traditional timber species, of the world's timber needs during the last decade of this century, hopefully continuing into the early decades of the next century.

The potential harvest of rubberwood logs in selected rubber producing countries of Asia, compared with their respective production of traditional timber species is shown in Table II.

Table II. Estimated total Logs Harvest of Rubberwood and Traditional Species in Selected Asian Countries, 1990 (x 1000 m^3)

Country	Rubberwood*	Traditional Species**	% Ratio, Rubberwood to Traditional Species
India	666	25,254	2.64
Indonesia	270	29,552	0.91
Malaysia	1,350	21,818	6.19
Sri Lanka	170	736	23.10
Thailand	1,638	5,280	31.02

Sources:
* Data is for Sawlogs of Veneer logs
** FAO Yearbook of Forest Products, 1979-1990, Rome, 1992

It will be noted from Table II that rubberwood has become a significant contributor (from 0.9 and 2.6 percent for Indonesia and India, and attaining 23.1 percent and 31.0 percent in the cases of Sri Lanka and Thailand respectively. Malaysia's figure is mid way between the two, it is bound to rise with the reduction of log extraction in Sabah and Sarawak) in the total timber production of Malaysia, Sri Lanka and Thailand. With the current trend among timber producing developing countries in Asia to limit, if not totally ban, logging operations in their natural forests, the importance of rubberwood in solving these countries' timber supply problems should be expected to increase. Except for Indonesia, most other rubber producing countries in the region have plans to develop further their rubber industry, this time giving more attention to the rubberwood processing industry. The outlook may be expected to brighten, now that rubber planters are being made to realize that there is value added to the rubber tree when the stems and branches are converted into marketable wood products, so that rubber tree replanting activities will not be postponed due to one reason or another.

It must be realized, however, that rubber growers will most likely only plant rubber if there is money in it. In Malaysia, rubber tree farmers are switching to palm oil, while in Kerala (India), they are replacing rubber trees by cash crops like cassava, corn, bananas etc. In the Philippines rubber trees are being replaced by fruit trees.

On-going research and development work to produce clones of rubber species which will give greater yields of both latex and timber will also enhance the future of the rubberwood processing industry. Latest reports from the Forest Research Institute of Malaysia, Kepong, indicated that such a clone has already been developed and identified. However, more work has to be done to raise the clone on a commercial basis. Hence, any benefits expected from the commercial exploitation of this clone may be attained only during the second decade of the 21st century, at the earliest.

2. Cutting Cycles and Replanting Periods

Common acceptance in the rubber industry identifies the replanting period as the time elapsed from planting to cutting. Based on economic studies, the desirable replanting period is from 25 to 30 years. However, actual cutting practices, influenced heavily by local environmental conditions and the cash position of the rubber plantation owner, range from 20 to 40 years, and in some isolated cases, even longer.

The length of the replanting period has a bearing on the total economic value of the rubber tree. It is held that when the amount spent for the maintenance and upkeep of the rubber tree becomes higher than the value of latex produced by the same tree, it is justified to cut down the rubber tree for replanting purposes. This guideline, however, is hardly applicable to plantations where the maintenance and upkeeping activities are very minimal, more often than not, only occasional efforts to cut the undergrowth, and none of the accepted silvicultural practices (use of fertilizer, thinning, etc.) designed to attain maximum latex yield. This situation is often encountered among smallholders who do not have the financial capability to support such practices. This situation results in lower latex yields. On the other hand, the timber yield is increased as the tree stem and branches grow bigger with age. This situation becomes very significant in countries where a big majority of the rubber plantation area is owned by smallholders. Thus, estimates of rubberwood availability based on the 25-30 year cutting cycle may have to be reviewed to consider the effects of the actual practices of smallholders.

Studies at the Rubber Research Institutes in Kuala Lumpur, Malaysia and Kottayam, Kerala (India) indicate that different clones do not have the same cutting cycles and replanting periods. Furthermore, the type of soil and local climatic conditions also influence the length of replanting period. However, in the absence of actual studies determining the length of rotation period replanting periods in their own country's rubber industry, some Asian countries (Indonesia, the Philippines, Viet Nam, for example) use or are guided by the 25-30 year cycle used by the Malaysian rubber industry. Even the other major rubber producing countries of Asia (Thailand, India, Sri Lanka, for example) recommend cutting cycles and replanting periods very similar to, if not the same as, those practised by the Malaysian rubber industry.

Another factor which may delay replanting activities for a few months in the year is the heavy rainfall season. There are areas in the Asian rubber producing region which are regularly subject to heavy rainfall (the monsoons) during 3 to 6 months in the year. The rainfall makes the soil so sodden (mud as deep as 24 cm.) that it is impossible to do any tree felling and yarding work at all (as in some areas of southern Viet Nam, Sri Lanka, southern India, and Mindanao in the Philippines).

II. CURRENT AND POTENTIAL USES OF RUBBERWOOD

A. Physical Properties of Rubberwood and Potential End Uses

Selected physical and mechanical properties of rubberwood (*Hevea brasiliensis)* are presented in Table III.

Table III. Selected Physical and Mechanical Properties of Hevea brasiliensis

Properties	Rubberwood (*Hevea brasiliensis*)
Density (kg/m³ at 16 percent MC)	560-640kg/m³
Tangential Shrinkage Coefficient (percent)	1.2
Radial Shrinkage Coefficient (percent)	0.8
Hardness (N)	4,350
Static Bending, N/mm2, @ 12 percent MC	66
Modulus of Elasticity, N/mm2, @ 12percent MC	9,700

Source: FRIM, Kepong, Malaysia

Annex 1 lists more details on the characteristics, habitat, drying requirements, machining properties, end-uses, etc. of *Hevea brasiliensis*, courtesy of CIRAD-Forêt.

Comparison with other latex bearing tree species, mentioned earlier in this report, is not possible because the corresponding data on physical and mechanical properties are not available at this writing.

A comparison of the physical and mechanical properties of rubberwood (*Hevea brasiliensis*) vis-a-vis other tropical timber species is facilitated with the use of the Tropical Wood Species (TWS) Data Base Software, developed by the CIRAD-Forêt. Using the properties of rubberwood (*Hevea brasiliensis*) as the basic yardstick, a step-wise selection was made to identify other timber species which possess similar or not too different properties as the basis. Three levels of selection were applied to a list of 200 tropical wood species.

The first selection level used parameters involving purely physical characteristics, such as colour, texture, interlocked grain, and density. A total of 62 species were identified to have the same colour range (white to yellow), the same texture range (medium to coarse) and within the density range (550 to 750 kg/m³, at 12 percent MC). The more commercially known among those species are:

Almon (*Shorea-rubro almon*)[1]
Bintangor (*Calophyllum spp.*)[1]
Gerutu (*Parashorea spp.*)[1]
Imbuia (*Ocotea Porosa*)[2]
Iroko (*Melicia excelsa-regia*)[3]
Kapur (*Dryobalanops spp.*)[1]
Kosipo (*Entandrophragma c.*)[3]
Meranti White (*Shorea-antho hypochra*)[1]
Merpau (*Swintonia floribunda-spicifera-spp.*)[1]
Mersawa (*Anisoptera spp.*)[1]
Pinus kesiya[1]
Pinus merkusii[1]
Ramin (*Gonystylus spp.*)[1]
Sapelli (*Entandrophragma cylindricum*)[3]
Seraya White/Bagtikan (*Parashorea Malaanonan*)[1]
Seringueira (*Hevea spp.*)[2]
Tangile (*Shorea-rubro polysperma*)[1]
Teak (*Tectona grandis*)[1/3]

This emphasizes the potentials of rubberwood to be readily used as substitute for the above-listed popular tropical wood species, except in applications where specific mechanical properties beyond those exhibited by rubberwood are dominant in the product's design. Because of the ease of staining rubberwood, it is also of interest to note that rubberwood can be used as a substitute (principally for appearance aspects) for such high-priced tropical African wood species as Iroko and Sapelli, and the southeast Asian Ramin, Meranti, Mersawa, Seraya, Merpau, Kapur, Tangile and Teak which make up more than 75 percent of the volume in Asian timber trade.

In the second selection level, only the fairly hard of the 62 species were accepted. This reduced the number of possible equivalents of rubberwood (*Hevea brasiliensis*) to 48, the more commonly known among which are:

Bitangor[1/3]	Kapur[1]	Merpau[1]	Ramin[1]
Gerutu[1]	Kosipo[2]	Mersawa[1]	Sapelli[3]
Iroko[3]	Meranti White[1]	Pinus Kesiya[1]	Teak[1/3]

This points out that, adding hardness characteristics to the aesthetic physical properties used in the first selection level, rubberwood can be used as a substitute for timber species which compose more than 50 percent of the timber trade movement in southeast Asia, tropical Africa and Latin America.

The third selection level involved the addition of two mechanical properties of *Hevea brasiliensis*: a) modulus of elasticity of 7,000 to 10,000 N/mm^2 and b) static bending characteristic of 75 to 100 N/mm^2, to the properties used in the first and second selection levels. Only two wood species were left after the third selection level: Kosipo (*Entandrophragma candollei*) and Imbuia (*Ocotea Porosa*), which have comparable modulus of elasticity and static bending properties as *Hevea*

[1] Commonly found in Asia

[2] Commonly found in Latin America

[3] Commonly found in Africa

brasiliensis, but none of which is much known in the international timber market. Kosipo's main habitat is tropical west Africa and equatorial Africa; *Hevea spp.* is found in tropical regions of south America, southeast Asia, Equatorial Africa, tropical west Africa and India; while Imbuia is principally found in southern Brazil.

A separate selection done by using only mechanical properties of *Hevea brasiliensis* as the identification parameters for equivalent tropical wood species gave the following results:

The first selection level, which collected all tropical wood species with crushing strength of 25 to 45 N/mm², identified 41 species, the more commonly known among which are:

Agathis (*Agathis alba-lanceolata-moorei-obtusa*)[3]
Almon (*Shorea-rubro almon*)[1]
Ayous (*Triplochiton scleroxylon*)[3]
Açacu (*Hura crepitans*)[2]
Cedro (*Cedrela spp.*)[2]
Ilomba (*Pycnanthus angolensis*)[3]
Jelutong (*Dyera Costulata*)[1]
Lauan Yellow (*Shorea-richeia kalunti-Shorea-antho assamica & polita*)[1]
Mayapis (*Shorea-rubro palosapis*)[1]
Meranti Light Red/LRM (*Shorea-rubro spp.*)[1]
Okoume (*Aucomea klaineana*)[3]
Pinus Patula[2/3]
Virola (*Virola spp.*)[2]
Yemane/Gmelina (*Gmelina arborea*)[1/2/3]

The second selection level identified, among the species from the first selection level, all those which have a modulus of elasticity of 7,000 to 10,000 N/mm². A total of 35 species were selected. Except for Virola, all the more commonly known species chosen in the first selection level, as listed above, have the desired modulus of elasticity.

On the third selection level, a static bending property of 50 to 75 N/mm², in addition to the parameters used in the first and second selection levels, was applied to the list of species chosen at the second selection level. The species with crushing strength, modulus of elasticity and static bending properties equivalent to those of rubberwood was reduced to only 21. These are:

Aiele (*Canarium velutinum*)[3]
Ako (*Antiaris toxicaria*)[3]
Açacu[2]
Cedro[2]
Copaiba (*Copaira multijuga*)[2]
Couroupita/Macacarecuia (*Couroupita spp.*)[2]
Duabanga (*Duabanga moluccana*)[2]
Faro (*Daniellia spp.*)[2]
Faveira (*Parkia spp.*)[2]
Geronggang (*Cratoxylon spp.*)[1]
Ilomba (*Pycanathus angolensis*)[3]
Kondroti (*Rhodognaphalon brevicuspe*)[3]
Lauan Yellow[1]
Marupa (*Quassia simarouba*)[2]
Muiratinga (*Maquira coriacea*)[2]
Okoume[3]
Ovoga (*Pola oleosa*)[3]
Para-para (*Jacaranda copaia*)[2]
Sesendok (*Endospermum malaccense-medullosum-peltatum*)[1]
Tamboril (*Enterelobium contor-tisiliquum-cyclocarpum-maximum*)[2]
Yemane/Gmelina[1/2/3]

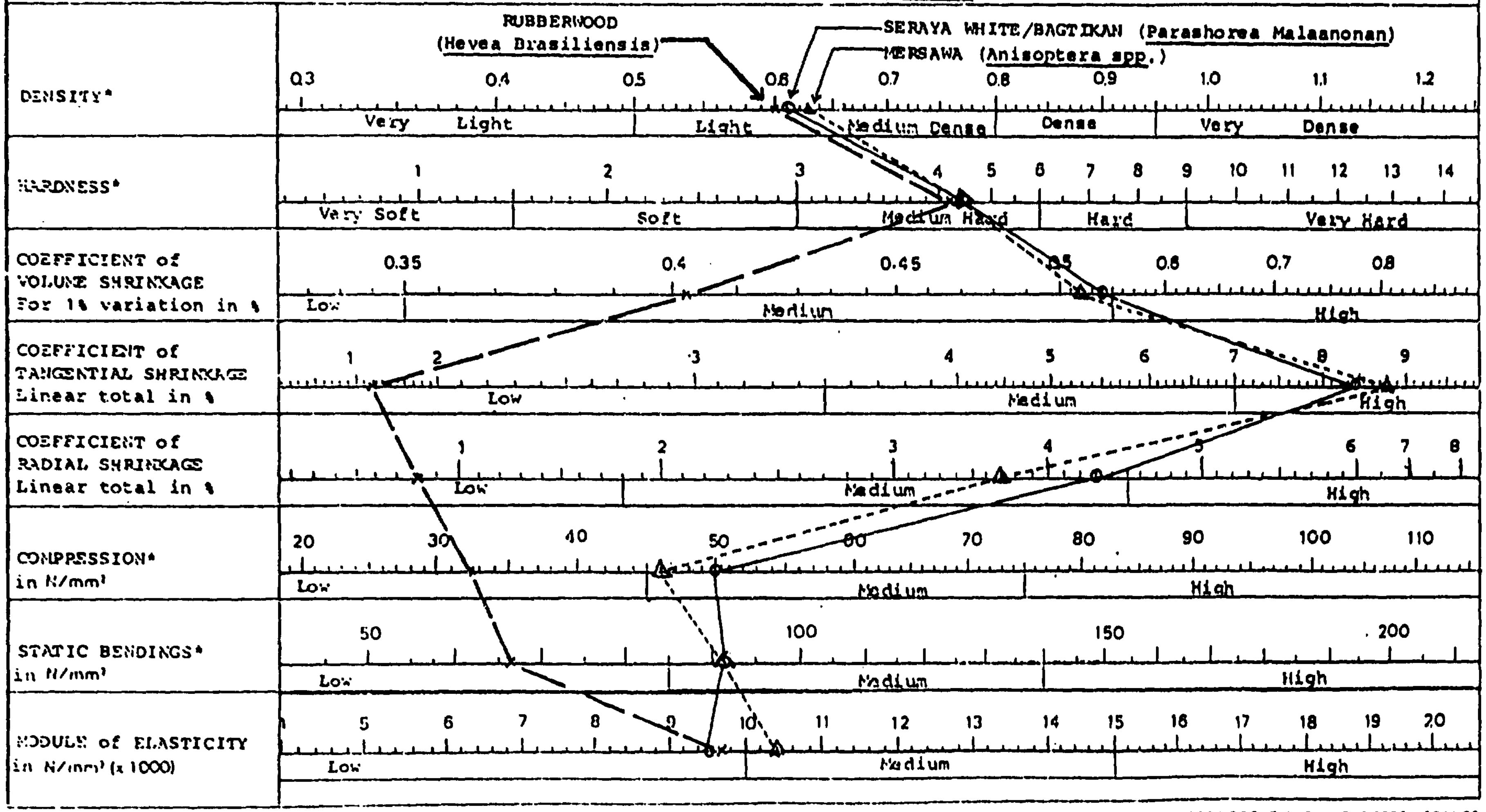
Graphical representations of the comparative physical and mechanical properties of rubberwood and other selected traditional timber species of Africa, Southeast Asia and Latin America are shown in Figures 1 to 5.

Figure 1 compares graphically selected physical and mechanical properties of rubberwood (*Hevea brasiliensis*) and two well known Southeast Asian timber species: Seraya white/Bagtikan (*Parashorea maalanonan*) and Mersawa (*Anisoptera spp.*). While the densities and hardnesses of the three timber species are about the same, rubberwood exhibits significantly lower volumetric, tangential and radial shrinkage coefficients. This indicates that the joints in rubberwood furniture or joinery items are comparatively more stable than those in products made of the other two timber species. The moduli of elasticity of the three timber species are about the same magnitude, but the compression and static bending characteristics of rubberwood are definitely lower than those of the other two species, which makes rubberwood a better material for product components which are subjected to compression and static bending, such as chair legs and seat frames. Annexes 2 and 3 give more details on the properties, habitat, and other pertinent data on Seraya White/Bagtikan and Mersawa, respectively, courtesy of CIRAD-Forêt.

Figure 1

COMPARATIVE PHYSICAL AND MECHANICAL CHARACTERISTICS
OF RUBBERWOOD AND SELECTED TROPICAL TIMBER SPECIES

RUBBERWOOD (Hevea Brasiliensis) vs. {SERAYA WHITE/BAGTIKAN (Parashorea Malaanonan) / MERSAWA (Anisoptera spp.)



* = Value at 12% MC

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Similarly, Figure 2 compares graphically selected physical and mechanical properties of rubberwood to two well-known, highly-valued African timber species: Sapelli (*Entandrophragma cylindricum*) and Iroko (*Milicia excelsa-regia*), on the other hand. The densities and hardness characteristics of the three timber species do not differ greatly. However, as in the case of Seraya White/Bagtikan and Mersawa, rubberwood has lower shrinkage coefficients and compression and bending properties than the two African hardwood species. The moduli of elasticity of the three timber species being compared do not differ greatly. It was indicated above that it is readily possible (through the use of modern machining and finishing techniques) to make rubberwood look like Sapelli and Iroko for their appearance characteristics (colour, grain configuration, texture, and density) are not very far apart. Annexes 4 and 5 give more details on the respective characteristics and properties of Sapelli and Iroko.

Rubberwood is again compared, in Figure 3, with two well-known Southeast Asian timber species: Ramin (*Gonystylus spp.*) and Tangile (*Shorea-rubro polysperma*). While, in general, the similarities and differences between rubberwood, on one hand, and Ramin and Tangile, on the other hand, follow the same pattern as those exhibited in the previous comparative cases (Figures 2 and 3), the difference in the volumetric, tangential and radial coefficients of shrinkage is much greater in this case. Although rubberwood has about the same modulus of elasticity as tangile, Ramin has a significantly higher modulus of elasticity than the other two species. Thus, when substituting rubberwood for Ramin, product design requirements of material elasticity should be thoroughly considered. More details on the properties of the two southeast Asian species are given in Annexes 6 and 7, respectively.

Two other wood species were found to possess properties and characteristics very similar to rubberwood (by the CIRAD-Forêt method): an African species called Kosipo (*Entandrophragma candollei*) and a South American (South Brazil) wood species named Imbuia (*Ocotea porosa*). Figure 5 shows the comparative properties and characteristics of rubberwood, as against these other two wood species. Again, in spite of all the similarities indicated by the CIRAD-Forêt method (see Annexes 8 and 9 for more detailed properties and characteristics of Kosipo and Imbuia) rubberwood has very definitely lower coefficients of volumetric, tangential and radial shrinkage, which would indicate that more stable joints could be made of rubberwood than these other two species.

Another comparative illustration is given in Figure 5 where rubberwood is compared with two other well-known timber species of southeast Asia: *Pinus Kesiya* and Meranti white (*Shorea-antho hypochra*). Density and hardness characteristics are very similar for the three wood species. Again, rubberwood exhibits significantly lower shrinkage coefficients than the two southeast Asian species. In the same manner but to a lesser degree of difference, rubberwood possesses lower compression, static bending and modulus of elasticity than *Pinus kesiya* and Meranti White. It is thus indicated that moves to substitute rubberwood for the two southeast Asian wood species should be done only after due consideration of the product design aspects involving shrinkage, compression, bending and elasticity. Annexes 10 and 11, respectively, give more details on the properties and characteristics of *Pinus kesiya* and Meranti White.

B. Machining Properties of Rubberwood

The machining properties of rubberwood do not differ greatly from those of the timber species discussed in the preceding paragraphs. Previous studies and experiments emphasized that the following machining properties must be considered when planning or expanding rubberwood processing operations:

There is normal blunting effect during sawing and machining operations. Ordinary or high speed steel may be used for saw teeth. However, due to possible existence of internal stresses, it is advisable to keep saw teeth always with sharp edges, for latex tends to clog the saw teeth.

It slices or peels well for conversion into veneer.

Standard cutterheads and profiled knives may be used to work on rubberwood. However, a better and smoother moulded surface is obtained when the cutting angle is reduced from the standard 27° to 15°, with a corresponding increase of the clamping jaw length from 22mm to 25mm. Similarly, an increase in cutterhead diameter from the standard 125mm to 180mm is indicated to reduce the depth of the cutter marks, thus giving a better finish. Lower feed speeds (8-12 meters per minute, at cutterhead speeds of 5,500-6,000 RPM) are also recommended.

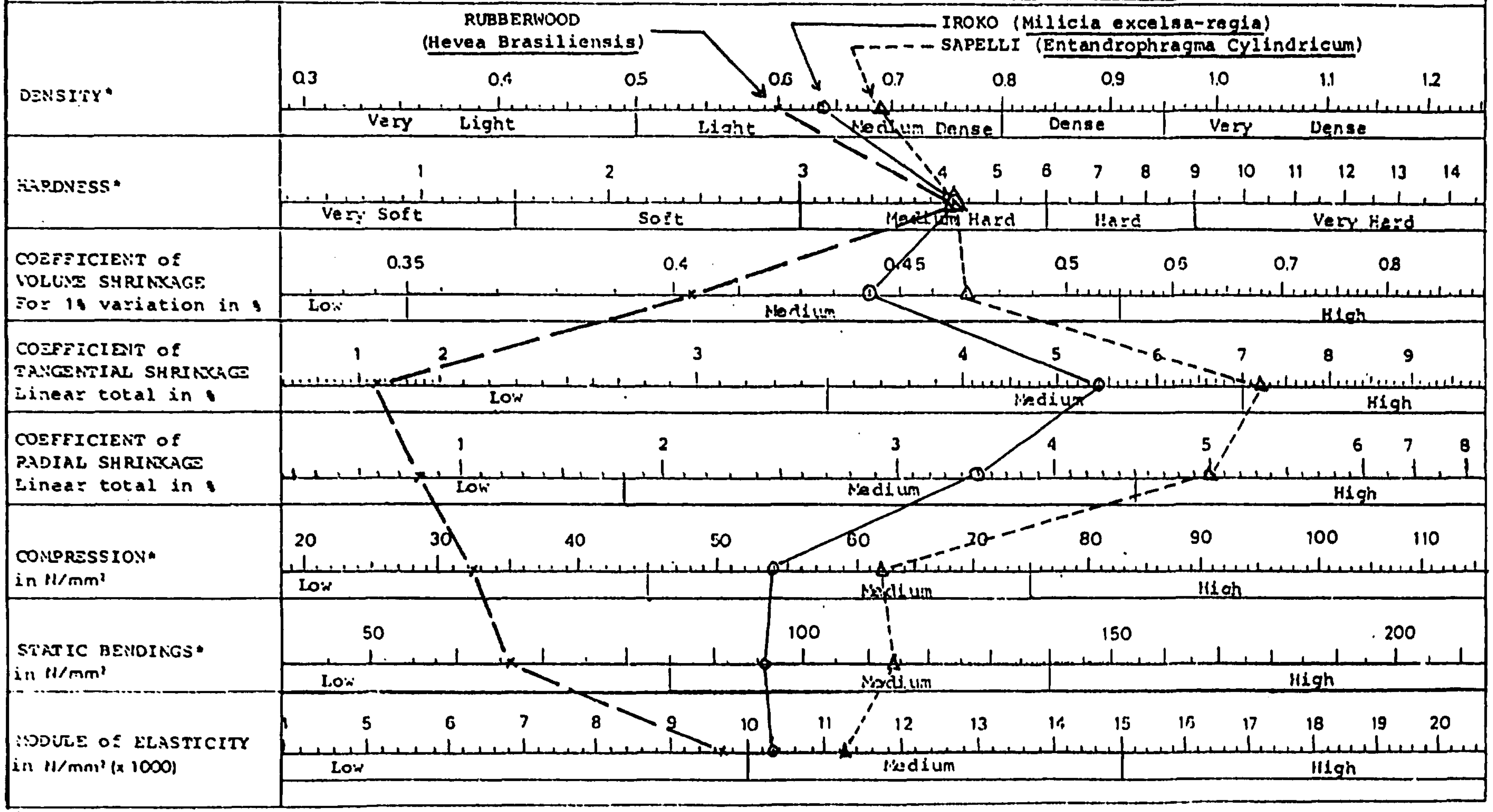
The presence of latex in rubberwood tends to clog the router bit groove with fine routing dust or chips. This may be avoided, or its effects diminished, by using router bits with larger clearance angles than standard.

Rubberwood can be turned without burn marks or tear-outs on standard lathes. Similarly, the wood is easy to tenon, drill or bore. Good profiles and smooth edges may be obtained on a vertical spindle moulder by observing the same recommendations given above for multi-cutterhead operations.

Figure 2

COMPARATIVE PHYSICAL AND MECHANICAL CHARACTERISTICS OF RUBBERWOOD AND SELECTED TROPICAL TIMBER SPECIES

RUBBERWOOD (Hevea Brasiliensis) vs. { IROKO (Milicia excelsa-regia)
SAPELLI (Entandrophragma cylindricum)



* = Value at 12% MC

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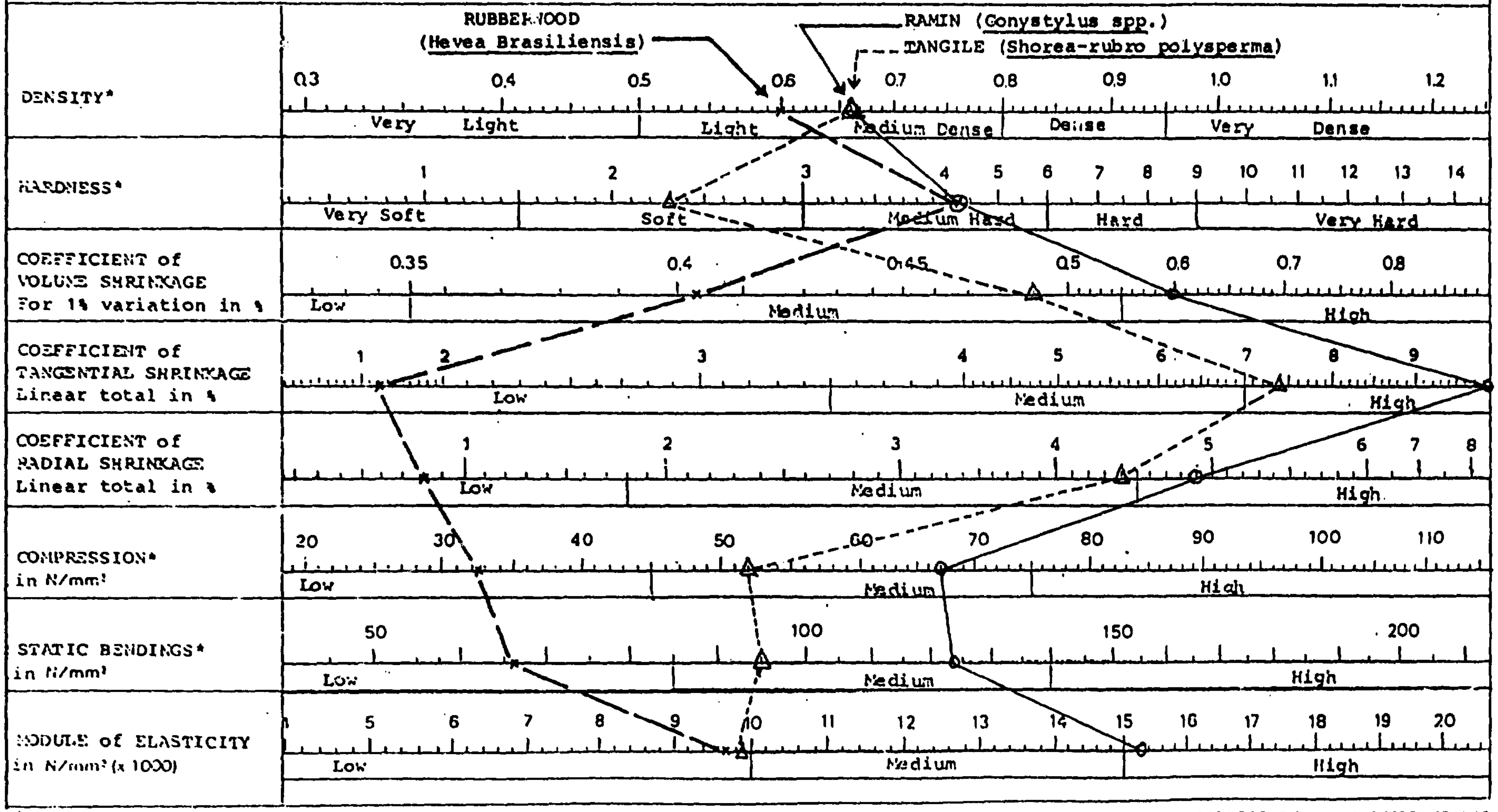
Figure 3

COMPARATIVE PHYSICAL AND MECHANICAL CHARACTERISTICS OF RUBBERWOOD AND SELECTED TROPICAL TIMBER SPECIES

RUBBERWOOD (Hevea Brasiliensis) vs. { RAMIN (Gonystylus spp.) / TANGILE (Shorea-rubro polysperma)



* = Value at 12% MC

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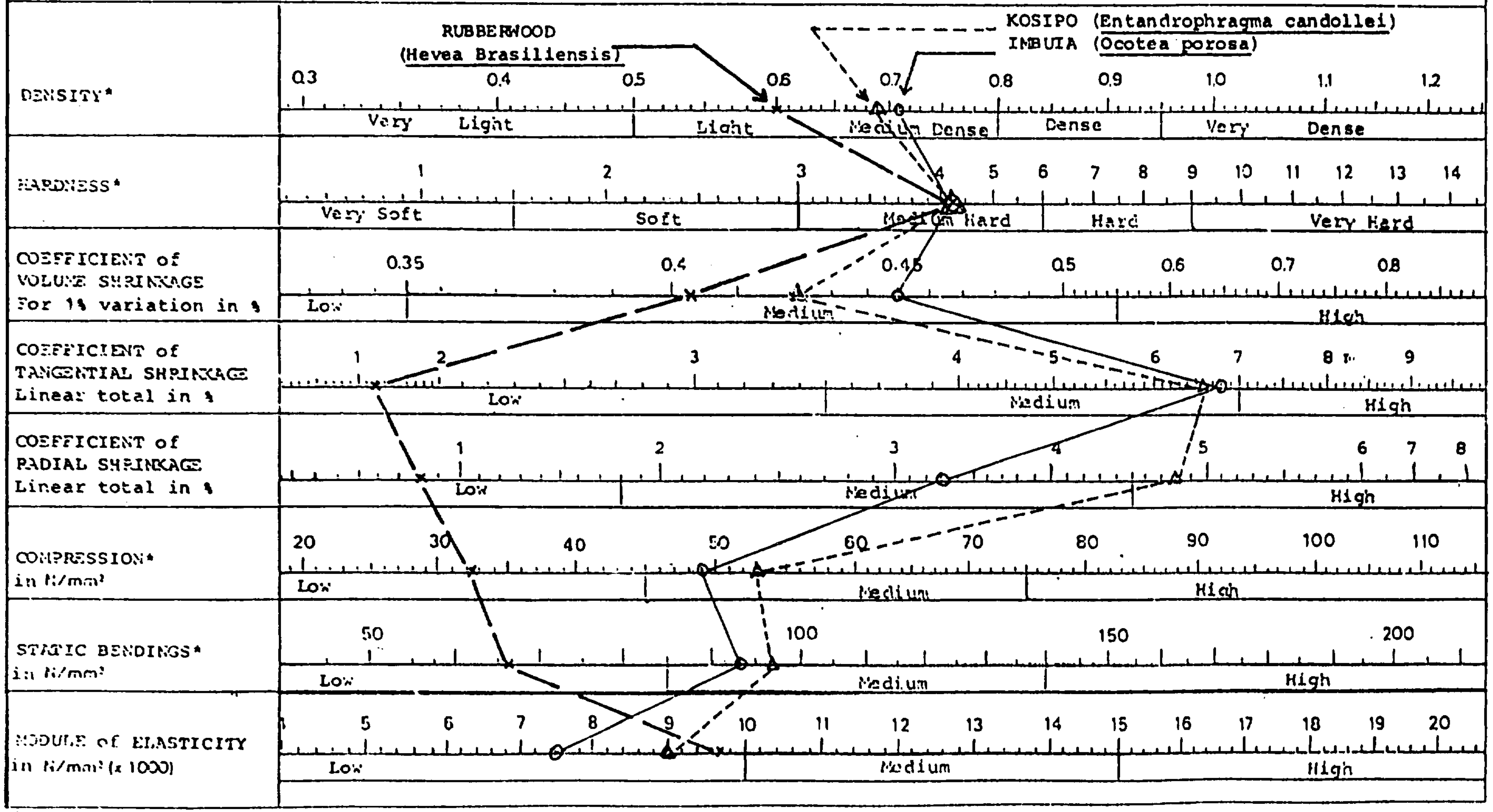
Figure 4

COMPARATIVE PHYSICAL AND MECHANICAL CHARACTERISTICS OF RUBBERWOOD AND SELECTED TROPICAL TIMBER SPECIES

RUBBERWOOD (Hevea Brasiliensis) vs. {KOSIPO (Entandrophragma candollei) / IMBUIA (Ocotea porosa)}



* = Value at 12% MC

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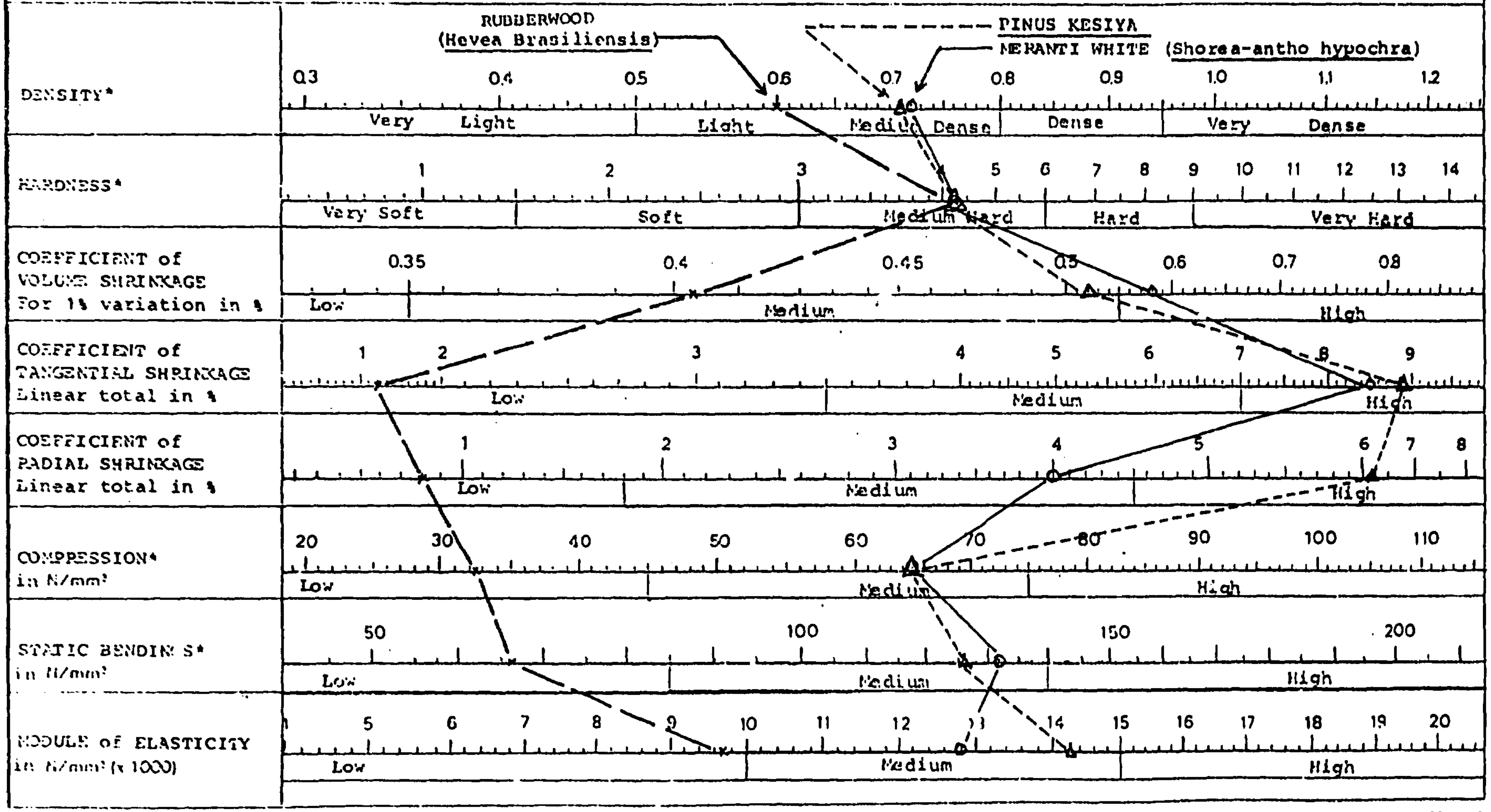
Figure 5

COMPARATIVE PHYSICAL AND MECHANICAL CHARACTERISTICS OF RUBBERWOOD AND SELECTED TROPICAL TIMBER SPECIES

RUBBERWOOD (Hevea Brasiliensis) vs. { PINUS KESIYA / MERANTI WHITE (Shorea-antho hypochra)



* = Value at 12% MC

C. Drying and Sanding Properties of Rubberwood

Kiln-drying schedules for rubberwood (using conventional hot air convection type of kilns) compares well with that for Light Red Meranti, although it is faster than that for Dark Red Meranti, according to the findings of K.S. Ho and K.T. Choo. However, the transition from pre-drying to drying dry-bulb temperature levels (at about 65°-66°C) is done at a much more gradual rate. Drying time (from 60 percent down to 10 percent MC) is about 6 days for 25mm boards and 10 days for 50mm boards. Incidence of warping and splitting degrades were found to be directly related to the presence of "core wood"[4] mixed with heartwood resulting from the sawmilling pattern used.

More recently, the vacuum technique of drying was applied to dry rubberwood and was found to be effective in cutting short the drying time to a matter of hours, instead of days when drying with the use of conventional hot-air kiln-driers.

It was found that adequate drying (10 percent-12 percent MC) is a prerequisite for effective sanding of rubberwood boards. Furthermore, the use of open-coat aluminum oxide sanding sheets/ belts is preferred to other types of industrial abrasive, due to the heating effect of the latex content of rubberwood.

D. Gluing and Assembling Properties of Rubberwood

Most types of industrial adhesive material currently available can be effectively used to join or laminate rubberwood furniture or joinery product components, using conventional pressing jigs and fixtures. However, urea melamine formaldehyde glue is recommended for applications which require water resistant adhesive.

E. Finishing (and Painting) Characteristics of Rubberwood

Manufacturers' experience show that most finishing material systems (coatings) now available in the market can be used on rubberwood products. Special attention, however, is required to prevent grain raising and to fill open grains, particularly on the edges of laminated rubberwood boards. This is done by "sealer-sizing" and the use of high viscosity/high solid contents sealer material. Applying wood filler on rubberwood surfaces helps eliminate open grains. Using 240 grit sandpaper on final sanding helps attain good adhesion between rubberwood surfaces and coatings.

F. Durability aspects of the use of rubberwood

Rubberwood, being easily subject to attack by fungus and wood borers, requires preservative treatment. A number of preservative formulations have been used in the rubberwood processing industry, among which are mixtures based on

---

[4] Less dense central part of the heartwood

Pentachlorophenolic (PCP) compounds, Copper-Chrome-Arsenate solutions; and the Borate/Boric Acid system. The carcinogenic properties of PCP has led to discontinuance of its use for preserving rubberwood products. The toxic properties of CCA has limited its use to applications that present minimum exposure of human beings to the CCA-treated wood products. Thus, the Borate/Boric Acid system has become the most popularly used rubberwood preservative today.

G. Indicated End Uses for Rubberwood

Discussions of the properties and characteristics of rubberwood in the preceding paragraphs indicated a wide range of end uses for the wood species, based on the physical mechanical properties of the traditional wood species it will replace.

Rubberwood can be used for the manufacture of plywood. However, the size of the end product is ordinarily limited to a maximum of 900mm (3 ft.) x 1800mm (6 ft.), as 2400mm (8 ft.) logs are seldom cut in sufficient quantities out of existing rubber tree stems.

At the moment, the use of rubberwood in the building and construction industries is limited to non-load bearing components, such as mouldings and wall panelling, which is dictated by the smaller sizes of rubberwood boards that can be cut from rubber tree stems. However, the current knowledge on laminating techniques may be developed and applied to allow the composition of rubberwood beams for construction use on a commercial scale.

The use of rubberwood for floor parquet tiles is currently well known and developing into a good sized industry even in small rubber producing countries like the Philippines. In fact, blue staining is no longer considered a problem; rather, blue stained parquet tiles laid in aesthetically sound patterns have become acceptable to both building architects and owners for both flooring and wall panelling purposes. Bleached blue-stained parquet tiles may even find use in ceilings and wall appliques.

There is no question that rubberwood can be used in the furniture and joinery industries, not only as a substitute for traditional species like Ramin, Meranti, Lauan etc., but on its own merits due to its uniform grain configurations, physical and mechanical characteristics and machining, assembling and finishing properties. Currently, Malaysia and Thailand enjoy the lead in the processing of rubberwood into furniture and joinery products among south and southeast Asian rubber producing countries. The more popular rubberwood products are furniture items for the living and dining rooms.

A more intensive utilization of rubberwood in woodworking plants is attained by the conversion of wood wastes generated during secondary processing operations into marketable products such as toys, novelty items (such as ashtrays, pen holders, decorative appliques, etc.), instead of using the wood wastes as fuelwood for the generation of steam for industrial heating purposes. Such a tertiary rubberwood processing plant is found in Kerala, India.

As an ultimate end-use for rubberwood wastes generated during the secondary and tertiary rubberwood processing industries, the rubberwood charcoal briquette provides a smokeless source of heat for home cooking purposes. The development work for the manufacture of rubberwood charcoal briquettes has recently been successfully completed in Davao City, southern Philippines, using locally fabricated machinery and production fixtures. Plans for the commercial production of the briquettes and the corresponding cooking stove are now being finalized.

H. Technical Requirements for Rubberwood to Replace Traditional Wood Species

There are certain technical guidelines and conditions by which rubberwood can successfully replace some of the better known and well accepted traditional wood species. Most of these are already being followed and still being improved in the more advanced rubberwood producing countries of Asia: Malaysia and Thailand. However, the existing rubberwood processing industries in other Asian countries still have to adapt these guidelines and conditions to their respective country's industrial development levels.

Foremost of these conditions are proper preservative treatment and adequate seasoning. It is necessary that rubberwood be treated with chemicals that will prevent attack by fungi and wood borers. The choice of the preservative chemical and the method of its application, however, is subject to government regulations (both of the supplier and buyer countries) covering the use of such chemicals. A 100 percent penetration, i.e. the whole cross-section and length of the wooden piece is sufficiently penetrated by the chemical, is, of course, the ideal condition which will help lengthen the service life of the product made of rubberwood. Also of prime importance, during the industrial processing of the material, is that rubberwood should be dried down to a maximum of 12 percent MC to attain the desirable moisture content level necessary for good machining. However, it may be necessary to further dry rubberwood, to the 8-10 percent level, if the end product is to be exported to and used in areas where the existing equilibrium moisture content (EMC) is within these lower MC levels.

Rubberwood users must recognize the fact that owing to the relatively smaller size of rubber tree stems, commercial size boards with cross-sections larger than 25mm x 100mm (1 in. x 4 in.) or 50mm x 75mm (2 in. x 3 in.) are not readily available in quantity. Furthermore, again because the rubber tree does not grow tall enough to produce long stems, the most commonly available rubberwood board lengths seldom exceed 1800mm (6 ft). However, current finger-jointing and wood laminating techniques are able to produce wider and longer rubberwood components.

Product design and manufacturing techniques, using rubberwood as the primary material, therefore, should take into consideration these size limitations of rubberwood boards.

Except for desirable adjustments in cutting angle and knife-set backing on moulder and planer cutterheads; wider grooves on router bits and slower feed speeds for optimum machining efficiency, rubberwood can be worked on using conventional woodworking machines.

Adequately seasoned rubberwood allows the effective application of existing adhesive and finishing material systems on the material, using available conventional gluing and finishing equipment and jigs and fixtures. No specific adjustments are needed to make up for whatever effects the presence of latex does in gluing and finishing operations using rubberwood as the substrate material.

The basic supply requirement for rubberwood logs is a round-the-year availability of desired volumes of the material. Observations in some rubber producing countries in Asia indicate that the least developed link in the chain of activities that convert the rubber tree stem and branches into marketable wood products is that portion which include felling, yarding and transport of the material from the rubber plantations to the wood processing plants. The problem is more serious in areas where continuous rain periods exist, thus preventing year round rubberwood logging operations. Localized solutions to this problem has proven ineffective, leading to problems in assuring a year round supply of rubberwood logs.

I. Traditional Timber Species and Rubberwood Log Production of Selected Asian Countries, 1985-1990

The following paragraphs compare the traditional timber species and rubberwood log (industrial roundwood) production of selected countries in tropical Asia during the period 1985-1990. Table IV shows the comparative data for India; Table V, for Indonesia; Table VI, for Malaysia; Table VII, for Sri Lanka; and Table VIII, for Thailand. Corresponding data for China and Viet Nam are not available. There was hardly any rubberwood logging in the Philippines during the period, an effect of the country's agrarian reform laws. Thus, it was deemed pointless to make the corresponding comparison for the Philippines.

Table IV shows that there has been an appreciable growth (3.5 fold) in rubberwood production during the period 1985-1990. Correspondingly, the participation of rubberwood in the total industrial log production of India rose from 0.505 percent in 1985 to 1.796 percent (in 1990) of the sawlog and veneer from traditional timber species.

Table IV. Sawlog and Veneer log Production in India, 1985 and 1990, (x 1,000m^3)

Year	Traditional Species*	Rubberwood**	Ratio of Rubberwood to Traditional Species (percent)
1985	18,350 (est.)	92.67**	0.505
1990	18,350 (est.)	329.61***	1.796

Sources:
* FAO Yearbook of Forest Products, 1979-1990, Food and Agriculture Organization of the United Nations, Rome, 1992
** "A Study of Rubber Wood Market", by V. Haridasan, Rubber Board Bulletin, Vol. 22, No. 1, Kcttayam, 1987
*** Data furnished by the United Planters Association of Southern India, 7 July 1992

Table V indicates that rubberwood industrial log production in Malaysia doubled during the period 1985-1989, while industrial log production of traditional species showed an increase of roughly 43 percent. However, the outlook for the following five-year period appears brighter since more rubber plantations are expected to reach the mature age for replanting. Nonetheless, it may be realistically summarized that rubberwood's share in the Malaysian timber industry will grow to attain 3 to 5 percent of the volume of traditional timber species produced.

Table V. Sawlog and Veneer log Production in Malaysia, 1985-1990, (x 1000 m^3)

Year	Traditional Species*	Rubberwood**	Ratio of Rubberwood to Traditional Species (percent)
1985	28,652	595	2.07
1986	29,879	696	2.32
1987	35,111	898	2.55
1988	38,980	1,241	3.18
1989	41,011	1,103	2.68
1990	41,011 (est.)	971	2.36

Sources:
* FAO Yearbook of Forest Products, 1979-1990, Food and Agriculture Organization of the United Nations, Rome, 1992

Among the Asian countries which were the subject of this study[5], it appears that rubberwood's share in the total supply of industrial logs in Thailand is the largest, amounting, in 1990, to as much as 695 percent of the log production from traditional species. This could be partly due to the fact that Thailand was among the first Asian countries to ban logging activities in its natural forests and also realized the potential benefits to be derived from the development of its rubberwood processing industries. Table VI shows how rubberwood grew in importance in the country's total industrial log supply during the period 1985-1990.

Table VI. Sawlog and Veneer log Production in Thailand, 1985-1990, x 1,000 m^3)

Year	Traditional Species*	Rubberwood**	Ratio of Rubberwood to Traditional Species (percent)
1985	1,875	2,047 est.	109.17
1986	2,015	2,047 est.	101.58
1987	2,149	3,050	141.92
1988	2,048	3,050 est.	148.92
1989	919	3,050 est.	331.88
1990	492	3,418	694.71

Sources:
* FAO Yearbook of Forest Products, 1979-1990, Food and Agriculture Organization of the United Nations, Rome, 1992
** Planning Department and ORAFF (Office of Economic Statistics), Ministry of Agriculture and Cooperatives, Royal Government of Thailand

J. End uses of Rubberwood Log Production in Selected Asian Countries, 1985-1990

During the period 1985-1990, rubberwood industrial logs were processed into marketable products according to the breakdown given in the tables below. Table VII refers to the distribution by end use in India; Table VIII, in Malaysia; and Table IX, in Thailand. Unfortunately, corresponding usage distribution schedules could not be drawn up for Indonesia, Sri Lanka, Viet Nam and the Philippines either because there was no relevant data available or that the data available was not sufficient to allow a realistic and reliable representation of the rubberwood logs usage distribution.

Table VII shows that about 46 percent of the rubberwood harvest of India during the period 1985-1990 was used for producing match veneers and match-stick splints, for which softwood is the traditional principal material; i.e., rubberwood, a medium hardwood, was used to replace softwood. Furthermore,

[5] India, Indonesia, Malaysia, Philippines, Sri Lanka, Thailand and Viet Nam

rubberwood was used as a major material input for the tea chest manufacturing industry, in support of one of the principal export industries of the country - tea. Only a small portion of the rubberwood industrial log production was converted into furniture and joinery items (and their components) - reflecting human nature: it is used for flooring other essentials first before less essential items such as furniture and joinery products.

Table VII. Average End Use Distribution of Rubberwood Industrial Log Production in India, 1985-1990* (expressed as a percentage of total rubberwood log production)

End Product	% of Total Rubberwood Log Production**
Furniture & Joinery items (& Components)	4.8
Plywood	7.8
Other Products	
Packing cases	27.7
Veneers & Splints (Matches)	46.5
Tea Chest Panels	13.2
Total	100.0

Note:
* The average values for the period 1985-1989 were assumed also to prevail in 1990.

Source:
** "Rubberwood Consuming Units in Kerala - Technical Facilities and Problems" by Vijuipe C., et. al., RRII, Rubber Board Bulletin, 23, No.1, Kottayam, 1989

At the time of writing, no data was available on the end use distribution of rubberwood industrial log production in Indonesia, Sri Lanka and Viet Nam for the period 1985-1990.

The average end use distribution of rubberwood industrial log production in Malaysia for the period 1985-1990 (see Table VIII) reflects two important points:

i. The Malaysian government policy to encourage and support export-oriented processing of rubberwood; and

ii. The "timber surplus" status of Malaysia, and its small domestic market present barriers to the development of the rubberwood processing industries for domestic consumption purposes.

It will be noted that during the period 1985-1990 sawn rubberwood was the predominant export product of the rubberwood processing industry. Correspondingly, it is indicated that the manufacture and export of rubberwood furniture items has started to gain ground during the period. Thus, the decision of the

Malaysian government to impose a levy (discouragingly high) on exports of sawn rubberwood in 1990 must have been adopted to encourage further the processing of rubberwood into higher value-added products such a furniture and joinery items.

Table VIII. Average Usage Distribution of Rubberwood Industrial Log Production in Malaysia, 1985-1990 (expressed as a percentage of total rubberwood log production)

End Product	% of Total Rubberwood Log Production*
Sawn Timber, Treated & Kiln-Dried	65.29
Furniture and Components	10.72
Others (Sold in Domestic Market)	23.99
Total	100.00

Source:
* Calculated values using:
  i. Export data of rubberwood products furnished by MTIB, Kuala Lumpur;
  ii. "Availability of rubberwood in Peninsular Malaysia", Nor'ini Hj.Haron, et.al., Proceedings of the International Rubberwood Seminar, May 21-22,1990, Kuala Lumpur; and
  iii. "Prospects of further processing of rubberwood", by Chew Lye Teng and Rozehan Mohd. Idrus, Proceedings of the International Rubberwood Seminar, May 21-22, 1990, Kuala Lumpur

Table IX shows a different product mix for the rubberwood processing industry in Thailand. An intensive utilization of its rubberwood resources is reflected by the range of uses on which data is carefully collected: even data on the simplest and basic use of the material, such as fuelwood and charcoal.

Table IX. Average End Use Distribution of Rubberwood Industrial Log Production in Thailand, 1985-1990 (expressed as a percentage of total rubberwood log production)

End Product	% of Total Rubberwood Log Production*
Fuelwood (for Industry)	30.5
Charcoal	11.0
Particle Board	16.7
Poles and Piles	1.8
Furniture and Components	20.4
Toys, Boxes, Ice Cream Sticks, Tooth Picks, Clogs, Brush Handles, Picture Frames, etc.	19.6
Total	100.0

Source:
"Production and utilization of para-rubber wood in Thailand", by Chavalit Urapecpattanapong, presented at the Workshop in the Expansion of Trade In Rattan and Rubberwood Furniture, ESCAP, Bangkok, 1991

III. IMPACT OF THE RUBBERWOOD PROCESSING INDUSTRY DEVELOPMENT ON THE FOREST ECONOMY OF TROPICAL COUNTRIES GROWING RUBBER

The major effects of the development of the rubberwood processing industry on the forest economy of rubber growing tropical countries is readily measured or indicated by:

i. the potential increase in the number of new jobs needed by the various phases of the developing industry;

ii. the foreign currency to be generated by the export of end products of the rubberwood processing industry; and,

iii. the degree of its relevance to the current concern of environmentalist movements over the depletion of the earth's natural forests; providing some relief of the pressure on the world's existing timber resources as a result of the replacement of traditional timber species by rubberwood as the prime material input for certain types of wood processing activities.

Although the potential benefits to be derived from the full development of the rubberwood processing industries may not be readily quantified if considered on a global basis, the preceding paragraphs have shown that, on a country-by-country basis, the processing of rubberwood into marketable products can provide a very important and much needed boost to the forest economy of the rubber growing tropical countries of the world.

A. Creation of Jobs

Based on each 1,000 hectares of mature rubber tree plantation, the schedule given in Table X lists the estimated number of jobs and the corresponding levels of skills that will be needed to support the labour requirements of a fully developed rubberwood processing industry, excluding personnel requirements for top management and marketing operations. The job listings include logging operations, and the basic manufacturing operations for three types of end products, namely: blanks and components for knock-down furniture (without finishing/coating), plywood and particle board[6]. The general idea is to determine

[6] In order to log 1000 ha annually on a perpetual basis the mill must have access to some 25 to 30000 ha of rubber wood plantations.

the labour requirements if the log yield from the 1,000 hectares is to be used as the material input for any one of the three types of factories.

The sawlogs (100mm diameter and larger) may be used as input either for the sawmill or plywood manufacturing operations. Hence, the personnel line-up of the logging operations, together with the transport and distribution operations will be one and the same either for log inputs to sawmilling or plywood manufacturing. On the other hand, a separate group of workers are required for the preparation and handling of the logs having a diameter of less than 10 cm, which are the inputs used in the manufacture of particle board. This raw material is obtained from the rubberwood left-overs after the logging operations for the sawmill's (or plywood plant's) log requirement has been served. Similarly, the log transport and distribution personnel requirement will be the same for the sawmill and plywood plant's inputs. However, in view of the fact that the smaller size logs for the particle board plant input require more handling, its log transport and distribution crew is a little bigger than that for the corresponding sawmill or plywood plant crew.

Without ignoring the benefits to be derived from economies of scale, the following presentations are purely for purposes of deriving indications on jobs to be created by the full utilization of the log yield per 1,000 hectares of rubber tree plantation. It must be noted that the calculations do not refer to optimum economic plant size for each of the three types of factories used in the illustrations.

1. Furniture/Joinery Products Factory

Table X shows the estimated potential number of jobs created in the furniture/joinery manufacturing industry by the full utilization of rubberwood logs from each 1,000 hectares of rubber tree plantation, using the following basic considerations and assumptions:

i. The 1,000 hectares will be fully logged during one year, so that the size of the wood processing factory used as the basis of calculating the labour generating potential is based on the volume of rubberwood logs harvested from the 1,000 hectares;

ii. Each hectare will yield 180 m^3 of logs with average diameters 50mm or larger (either for the sawmill's or the plywood plant's input), of which only 15 percent is good for lumber (or veneer) production;

iii. The lumber yield rate is 25 percent; while the plywood conversion rate is 35 percent; and

iv. The maximum hauling distance from logging site to factory is 50 kms.

Other specific considerations and assumptions for particular aspects of the logging, transport and manufacturing operations will be listed as their respective labour requirements are discussed.

A total of about 300 jobs in the furniture and joinery manufacturing industry may be expected upon full utilization of the rubberwood log harvest of each 1,000 hectares of rubber tree plantation. This number may increase further if the industry expands into assembling, finishing operations and/or manufacture more sophisticated types of end products than the blanks and components for knock-down furniture (without finishing/coating) referred to above. The composition of the expected new labour force is 61.2 percent semi-skilled and unskilled; 22.2 percent skilled; 11.1 percent highly skilled and 5.5 percent technicians.

Table X. Estimated Potential Number of Jobs for the Furniture/Joinery Manufacturing Industries per 1,000 Hectares of Mature Rubber Tree Plantation received for the Full Development of the Rubberwood Processing Industry

Industry Phase	Technician Level	Highly Skilled	Skilled	Semi-Skilled & skilled	Totals
Logging & Log Transport--------	1	6	19	49	75
Log Yard-----------	1	1	2	10	14
Sawmilling---------	1	12	13	13	39
Treatment & Seasoning--------	3	0	6	24	33
Lumber Transport & Distribution--	0	0	3	6	9
Furniture/Joinery Manufacturing:					
Surfacing/Shaping-	0	1	2	2	5
Final Sizing------	0	1	2	2	5
Other Machining---	0	2	4	8	14
Sanding-----------	0	0	4	16	20
Packing/Crating---	0	0	0	32	32
Materials & Finished Goods Warehousing------	1	0	2	8	11
Plant, Machinery, Equipment and Cutting Tools Maintenance------	3	4	8	12	27
Administration:					
Plant Supervision	3	3	0	0	6
Finance/Budget---	2	2	0	0	4
Personnel--------	1	2	2	4	9
Purchasing-------	1	0	1	2	4
Totals-----	17	34	68	188	307
Percentage of Total-------	5.5	11.1	22.2	61.2	100

Note: The end products are furniture/joinery components, sanded, unassembled and unfinished (unpainted).

2. Plywood Manufacturing Plant

The results of calculations done for plywood as the end product, using the same set of basic considerations and assumptions of the log supply as in the case of the furniture/ joinery plant module, are shown in Table XI. The following basic considerations and assumptions were used in this case:

i. The plywood sheets are either 900mm x 900mm (3 ft. x 3 ft.) or 900mm x 1800mm (3 ft. x 6 ft.), 3-ply or 5-ply, to be sold totally on the domestic market;

ii. Preservative treatment of the green veneer is done by the dip diffusion or spraying method; the treated veneer is then dried to its desired moisture content levels, using a conventional type of veneer drier;

iii. Since the plywood plant is medium-sized (log input of 90 m^3 per day), only the basic plywood manufacturing machinery and equipment with a minimum of central-control or automatic-control electronic devices will be used; and transport of materials-in-process will be principally done using hand-operated lifting and moving equipment;

iv. The dryers in the plywood factory will operate 24-hours per day and 6 days per week; and while the other departments will operate only 2 shifts;

v. The total production output will be sold in the domestic market.

A total of about 460 jobs may be expected in the plywood manufacturing industry upon full utilization of the rubberwood log harvest from each 1,000 hectare rubber tree plantation logged per year. The new labour force is composed of 68.8 percent semi-skilled and unskilled; 16.9 percent skilled; 8.5 percent highly skilled and 5.8 percent technicians.

The decision to go into plywood production, rather than furniture/joinery products manufacturing, will, of course, be greatly dependent upon the results of an overall comparative study on both the profitability and the economic cost-benefit analysis of the two options.

Table XI. Estimated Potential Number of Jobs for the Plywood Manufacturing Industry per 1,000 Hectares of Mature Rubber Tree Plantation Created by the Full Development of the Rubberwood Processing Industry

Industry Phase	Technician Level	Highly Skilled	Skilled	Semi-Skilled & skilled	Totals
Logging & Log Transport-------	1	6	19	49	75
Log Pond/Yard-----	1	1	2	10	14
Veneer Production-	6	9	12	96	123
Veneer Repair, Sorting/Grading--	0	0	6	21	27
Veneer Splicing & Sizing----------	3	3	6	12	24
Assembling & Pressing---------	3	0	12	30	45
Sizing, Sanding & Panel Grading----	0	6	9	54	69
Packing/Crating---	0	0	4	26	30
Materials/Supplies, & Finished Goods Warehousing------	0	1	2	9	12
Plant, Machinery, Equipment and Cutting Tools Maintenance------	6	6	9	4	25
Administration:					
Plant Supervision-	3	3	0	0	6
Finance/Budget---	2	2	0	0	4
Personnel--------	1	2	2	4	9
Purchasing-------	1	0	1	2	4
Totals----	27	39	84	317	467

3. Particle board Manufacturing Plant

All stems and branches less than 100mm, but larger than 50mm in diameter, which were left over from the logging operations to supply the furniture/joinery factory or the plywood plant, will then be cut to desired lengths and transported to the particle board plant. The following basic considerations and assumptions are adopted in this particular case:

i. The expected yield of small-diameter rubberwood logs is about 153 m^3 per hectare, or a total of approximately 153,000 m^3 in one year;

ii. The particle board plant will operate on a continuous basis, 6 days/week;

iii. The end products are 12mm x 1200mm x 2400mm and 19mm x 1200mm x 2400mm particle board panels; and

iv. The particle board plant is located not more then 50 kilometres from the logging area.

The available raw material can support one particle board factory of the latest European design with a rated output capacity of about 300 m^3/day or ten small particle board mills each with a rated output capacity of 30 m^3/day of the design widely used in the People's Republic of China. Obviously, the small Chinese particle board mills will require more workers than the large European model, making the former more suitable in countries with high density populations and widely dispersed sources of raw material (e.g., China, India, and Indonesia). The quality of the board would probably also be lower. The estimated number of workers needed to operate each type of particle board plant is given in Table XII.

Table XII. Estimated Potential Number of Jobs for the Particle board Manufacturing Industry per 1,000 Hectares of Mature Rubber Tree Plantation Created by Full Development of Rubberwood Processing Industry

Industry Aspect	300 m^3/day Plant* (1 Factory)	30 m^3/day Plant** (Total for 10 Plants)
Logging & Log Transport----	204	460***
Production Workers------	80	350
Supporting Activities---	120	190
Administrative Personnel---	20	60
Totals------	424	1,060

Sources:

* Data gathered during a visit to the particle board factory and supporting logging operations in Hat Yai, southern Thailand

** "The Manufacture of Flat-Pressed Particle board in the Beijing Woodworking Plant" by Ba Ru-You, UNIDO ID/WG.335/5, Vienna, 1981

*** Based on logging operations data obtained during a visit to rubber tree plantations in Dong Nai, southern Viet Nam , in Sept. 1992.

B. Additional Source of Foreign Currency

Rubberwood end products (furniture and components, joinery items, mouldings, etc.) have become acceptable on the international market. This provides an additional potential source of foreign currency which is always in great d[illegible] in developing countries with plans to develop their econom[illegible]

Based on the current domestic price of rubberwood logs at M$195 (US$78) per cubic meter and using export prices of rubberwood sawn timber (before export levy) and selected rubberwood products furnished by MTIB and some private loggers and processors of export rubberwood products in Malaysia and Thailand, a schedule of value-added multipliers for each stage of rubberwood processing was calculated. Table XIII shows that the manufacture and export of knock-down furniture has the highest value-added multiplier (above 25) among the products derived from sawn rubberwood, and parquet floor tiles (with a value-added multiplier of about 19) next.

Table XIII. Value-added Multipliers for Rubberwood Products

Product Type	Price (Per m^3)	Value-added Multiplier per m^3 of saw logs
Price of logs ex-mill gate..	US$ 78.00	1
Sawn Timber; Treated and Kiln-dried, Rough.........	US$ 250.00	3.2
Dressed Sawn Timber; treated/kiln-dried, S4S blanks cut to specified thickness/width/length....	450.00	5.8
Components, machined and sanded to specifications without finish............	975.00	12.5
Furniture, knock-down, finished..................	2,000.00	25.6
Toys; Novelty Products......	725.00*	9.3*
Parquet Floor Tiles, Sanded, Not Finished/ Not varnished............	1,490.00*	19.1*

* These values were calculated using rubberwood lumber (treated and kiln-dried) as the input material; and are significantly higher if the input used were wood wastes from sawmilling and/or secondary wood processing activities. In the above calculation, the rubberwood raw material input was given a 0-value, but handling and transport costs were charged. This amounts to about 6 to 8 percent of the original cost of treated/kiln dried rubberwood boards.

Although a successful breakthrough has recently been attained in the manufacture of particle board, plywood and MDF boards, for commercial purposes, and using rubberwood as the principal material, marketing of these products have still been limited to the domestic market. However, this may be taken as substitution for imported goods, and thus help conserve the outflow of foreign currency from the developing country. No figures are yet available to allow calculation of value-added multipliers (for export purposes) for these products.

C. Relief of Pressure on Existing Timber Resources

The fast-growing world population leads to the corresponding rapid depletion of the timber resources as natural forests are converted to agricultural land in order to provide food for more mouths to feed. Population increase also adds to the depletion of the world's timber resources, as more and more people need shelter, fuel, furniture and other necessities of life which are made of wood.

The success in the development of techniques to process rubberwood into marketable end products (furniture/joinery items, plywood, particle board, MDF board, etc.) which were chiefly made from traditional timber species 10 or more years ago, helps to ease the mounting pressure on the world's natural forests. Considering that the rubber tree is a self-sustainable and renewable timber source, aside from having a much shorter cutting cycle than existing traditional timber species, there is no doubt that development of the world's rubberwood processing industry will contribute significantly to current efforts to maintain a viable ecological balance.

To summarize the indications in Chapter I, Section C-1, of this report, it is not unrealistic to state that rubberwood can be made to replace the use of no less than 3.5 percent to 5 percent of the industrial logs consumption in the major rubber tree-growing tropical countries of south and southeast Asia, a situation which can also be made to apply to the rubber growing countries of Africa and Latin America.

D. Barriers to the use of Rubberwood

The general indications on the increased use of rubberwood as a major input material in wood processing plants and in the building and construction industries are positive on the over-all. And, if managed reasonably well, it could become a significant factor in the national economy of rubber producing nations. The importance of rubberwood processing becomes more significant, particularly to the economy of "timber deficit" countries like India and Thailand.

However, there are two major factors (among others) which, if not handled properly and addressed immediately may delay or even curtail the benefits to be derived from rubberwood processing.

The use of toxic or carcinogenic preservatives is one of these factors. The only non-toxic nor carcinogenic system of preservatives which has found extensive use and acceptance in the rubberwood processing industry now-a-days is the borate/boric acid system. Yet, it must not be forgotten that this system is purely anti-fungus and has a limited protective period. Thus, users of the system have to adjust their processing operations (between sawmilling and seasoning) and incur additional expenses to make-up for the limited protective period of the borate/boric acid preservative system. It appears that the quest for a more viable and less expensive preservative system for use in the rubberwood processing industry is not yet ended.

Another factor which must be immediately addressed is the techno-legal acceptance of rubberwood in the buildings and construction industries. Many countries allow architects and civil engineers to use only timber species listed in their respective building codes for the design and construction of buildings and structures. However, rubberwood, being a relatively new construction material, may not yet be included in the list of acceptable materials in the building codes of many countries. Thus, it is indicated that professional and trade associations will have to address this problem within their respective country's procedural set-up to include rubberwood in the list of materials acceptable under their respective building codes. Also, the acceptance of rubberwood as a species usable in construction would have to go hand-in-hand with the acceptance of finger-jointed and/or glued laminated components, since the log dimensions would otherwise preclude its widespread use.

Realistic and effective solutions of the two major problems discussed in the preceding paragraphs will help pave the way for a faster development of the rubberwood processing industry in rubber producing countries of the world.

CTFT-ITTO 08-07-1992 **Annex 1** species n°103

RUBBERWOOD (Hevea spp.)

OTHER NAMES : SERINGA,HATTI,MAPALAPA,HEVEA,SHIRINGA,JEVE,ARBOL DE CAUCHO,RUBBER WOOD,HEVEA WOOD,PARA RUBBER TREE

GEOGRAPHIC DISTRIBUTION

. South America - Brazil - South East Asia - Equatorial Africa - Tropical West Africa - India

LOG DESCRIPTION

. Diameter : 30 to 60 cm
. Thickness of sapwood : n.d
. Durability in forest : low (must be treated)
. Floatable
. Availability in forest : high

WOOD DESCRIPTION

. Sapwood : not distinct
. Colour : creamy white
. Texture : coarse
. Grain : straight or interlocked (slight)

PRODUCTION
important

EXPORT
important

. Note : logs must be treated,extracted as soon as after felling and converted rapidly-heartwood becomes beige on exposure

PHYSICAL AND MECHANICAL PROPERTIES (CTFT-6)

Density (kg/m^3 at 16 percent MC)	560-640kg/m^3
Tangential Shrinkage Coefficient (percent)	1.2
Radial Shrinkage Coefficient (percent)	0.8
Hardness (N)	4,350
Static Bending, N/mm2, @ 12 percent MC	66
Modulus of Elasticity, N/mm2, @ 12percent MC	9,700

NATURAL DURABILITY AND AMENABILITY TO PRESERVATIVE TREATMENT

. Sapwood not or slightly demarcated : risk of dry wood insect attacks in all the wood (see also termites)
. Not or poorly resistant to termites
. Not or poorly resistant to decay
. Good amenability to preservative treatment

SAWING AND MACHINING

. Normal blunting effect
. Teething recommended for sawing : ordinary or high speed steel . Tools recommended for machining : ordinary tools
. Good aptitude for peeling . Good aptitude for slicing
. Note : presence of internal stresses-sharp edges are recommended to avoid woolly surface-latex tends to clog the sawteeth

DRYING

. Drying rate : rapid
. High risk of distortion . Slight risk of checking
. Note : a careful piling and top weighting of the stacks are recommended to avoid distortion as is end coating to avoid checking

ASSEMBLING

. Nailing and screwing : easy . Gluing : correct
. Note : tends to split in nailing

REQUIREMENT OF A PRESERVATIVE TREATMENT

. In case of insect attacks : the species requires a preservative treatment
. In case of risks of temporary humidification : the species requires a preservative treatment
. In case of risks of permanent humidification : the species requires a preservative treatment
. Note : liable to blue stain

END-USES

. Current furniture or furniture components - Interior joinery - Interior panelling - Moulding - Flooring - Pulpwood - Stairs - Boxes and crates - Particle and fiber board - Veneer for interior of plywood - Blockboard - Light carpentry - Glued laminated
. Note : stains well

TFT-ITTO 13-04-1992 **Annex 2** species n°158

SERAYA WHITE/BAGTIKAN (Parashorea malaanonan)

OTHER NAMES : URAT MATA, WHITE LAUAN, PENDAN, LAUAN MALAANONAN, MINDANAO WHITE LAUAN, PHILIPPINE MAHOGANY

GEOGRAPHIC DISTRIBUTION

. South East Asia - Sabah-Sarawak - Indonesia - Philippines

LOG DESCRIPTION

. Diameter : 30 to 130 cm
. Thickness of sapwood : 2 to 7 cm
. Durability in forest : moderate (treatment recommended)
. Floatable
. Availability in forest : high

WOOD DESCRIPTION

. Sapwood : not clearly distinct
. Colour : pinkish white
. Texture : coarse
. Grain : straight or interlocked

PRODUCTION
moderate

EXPORT
moderate

. Note : wood pink white to straw coloured becomes pale brown with age-frequent ringshakes and brittle heart (large trees)

PHYSICAL PROPERTIES (CTFT-5)

		mean	stand.deviat.
. Density at 12% M.C	:	0.61	0.10
. Volumetric shrinkage (%)	:	0.54	0.06
. Total tangential shrinkage (%)	:	8.4	0.9
. Total radial shrinkage (%)	:	4.3	0.9
. Hardness	:	soft	

MECHANICAL PROPERTIES (CTFT-5)

		mean	stand.deviat.
. Crushing strength at 12% M.C (N/mm2)	:	50	7
. Static bending at 12% M.C (N/mm2)	:	92	18
. MOE (longitudinal) at 12% M.C (N/mm2)	:	9,686	1,773
. Strength class	:	n.d	

. Note : vertical canals more or less frequent are filled with white resin-numerous regular rays are medium sized

NATURAL DURABILITY AND AMENABILITY TO PRESERVATIVE TREATMENT

. Sapwood not or slightly demarcated : risk of dry wood insect attacks in all the wood (see also termites)
. Not or poorly resistant to termites
. Resistance variable to decay (see note "requirement of a preservative treatment")
. Moderate amenability to preservative treatment

SAWING AND MACHINING

. Normal blunting effect
. Teething recommended for sawing : ordinary or high speed steel
. Tools recommended for machining : ordinary tools
. Good aptitude for peeling
. Aptitude for slicing not determined
. Note : risks of tearing-tendency to woolliness during edging-necessity to keep the sharp edges-interlocked grain produce a broad stripe figure

DRYING

. Drying rate : normal
. Slight risk of distortion
. Slight risk of checking
. Tested kiln schedule :
The following schedule can be used for thickness less than 38 mm. For thickness between 38 mm and 75 mm, the relative humidity must be increased of 5% for each step (to avoid high gradient of humidity in wood). For thickness up to 75 mm, increase of 10%.

Moisture content of wood (%)	Temperature °C Dry bulb	Temperature °C Wet bulb	Relative humidity % (approx.)
green	50.0	47.0	85.0
40	50.0	45.0	75.0
30	55.0	47.0	65.0
20	70.0	55.0	45.0
15	75.0	58.0	40.0

. Note : some risks of cupping-must be properly stacked to avoid distortion

ASSEMBLING

. Nailing and screwing : easy
. Gluing : correct
. Note : a filling is recommended to obtain a good finish

REQUIREMENT OF A PRESERVATIVE TREATMENT

. In case of insect attacks : the species requires a preservative treatment
. In case of risks of temporary humidification : the species requires a preservative treatment
. In case of risks of permanent humidification : the use of this species is not recommended
. Note : durability and permeability often variable-liable to dark coloured "pin holes" borers

END-USES

Veneer for interior of plywood - Veneer for back or face of plywood - Interior joinery - Interior panelling - Exterior joinery - Current furniture or furniture components - Particle and fiber board - Formwork - Moulding - Ship building (planking and deck) - Boxes and crates

Note : WHITE SERAYA is used for timber from Malaysia and BAGTIKAN for timber from the Philippines

CTFT-ITTO 23-07-1992 | Annex 3 | species n°98

MERSAWA (Anisoptera spp.)

OTHER NAMES : PALOSAPIS,KABAK,KRABAK,PIK,AFU,BAGANG,KARAB,KAUNGHMU,VEN-VEN,PHDIEK,PENGIRAN,BAC,VEN VEN XANH

GEOGRAPHIC DISTRIBUTION

. South East Asia - Oceania - Malaysia (peninsular) - Thailand - Viet-Nam - Laos - Cambodia - India - Indonesia - Burma - Philippines - Sabah-Sarawak - Brunei - Papua-New-Guinea

LOG DESCRIPTION

. Diameter : 60 to 150 cm
. Thickness of sapwood : 5 to 8 cm
. Durability in forest : moderate (treatment recommended)
. Floatable
. Availability in forest : high

WOOD DESCRIPTION

. Sapwood : not clearly distinct
. Colour : orange-yellow
. Texture : coarse
. Grain : straight or interlocked (slight)

PRODUCTION

negligible or low

EXPORT

negligible or low

. Note : heartwood orange yellow darkening to golden brown-resin veins filled with white deposits

PHYSICAL PROPERTIES (CTFT-6)

	mean	stand.deviat.
. Density at 12% M.C	0.63	0.06
. Volumetric shrinkage (%)	0.52	0.10
. Total tangential shrinkage (%)	8.8	1.2
. Total radial shrinkage (%)	3.7	0.8
. Hardness	fairly hard	

. Note : hardness varies from soft to fairly hard

MECHANICAL PROPERTIES (CTFT-6)

	mean	stand.deviat.
. Crushing strength at 12% M.C (N/mm2)	46	8
. Static bending at 12% M.C (N/mm2)	92	18
. MOE (longitudinal) at 12% M.C (N/mm2)	10,400	1,215
. Strength class	SD6	

NATURAL DURABILITY AND AMENABILITY TO PRESERVATIVE TREATMENT

. Sapwood not or slightly demarcated : risk of dry wood insect attacks in all the wood (see also termites)
. Moderately resistant to termites
. Resistance variable to decay (see note "requirement of a preservative treatment")
. Poor amenability to preservative treatment

SAWING AND MACHINING

. Fairly high blunting effect
. Teething recommended for sawing : stellite-tipped
. Tools recommended for machining : tools with tungsten carbide
. Good aptitude for peeling
. Good aptitude for slicing
. Note : during steaming resin exudations-quartersawn material tends to tear

DRYING

. Drying rate : slow
. Slight risk of distortion
. Slight risk of checking

. Tested kiln schedule :
The following schedule can be used for thickness less than 38 mm. For thickness between 38 mm and 75 mm, the relative humidity must be increased of 5% for each step (to avoid high gradient of humidity in wood). For thickness up to 75 mm, increase of 10%.

Moisture content of wood (%)	Temperature °C Dry bulb	Temperature °C Wet bulb	Relative humidity % (approx.)
green	50.0	47.0	85.0
40	50.0	45.0	75.0
30	55.0	47.0	65.0
20	70.0	55.0	45.0
15	75.0	58.0	40.0

. Note : drying requires care to avoid the risks of wet patches

ASSEMBLING

. Nailing and screwing : easy
. Gluing : correct

REQUIREMENT OF A PRESERVATIVE TREATMENT

. In case of insect attacks : the species requires a preservative treatment
. In case of risks of temporary humidification : the species requires a preservative treatment
. In case of risks of permanent humidification : the use of this species is not recommended
. Note : poorly to moderateky resistant to decay

END-USES

. Light carpentry - Glued laminated - Flooring - Veneer for interior of plywood - Veneer for back or face of plywood - Boxes and crates - Formwork - Exterior joinery - Interior joinery - Ship building (planking and deck) - Current furniture or furniture components - Moulding - Interior panelling - Turned goods
. Note : filling is recommended to obtain a good finish

Annex 4

CTFT-ITTO 06-04-1992 species n°143

IROKO (Milicia excelsa-regia)

OTHER NAMES : SIMME,SEMLI,ODOUM,ROKKO,OROKO,ABANG,MANDJI,KAMBALA,MOLOONDOU,LUSANGA,MOKONGO,MOREIRA,MOFULA,MVULE,M'GUNDA,TULE MOFALA

GEOGRAPHIC DISTRIBUTION

. Tropical West Africa - Tropical East Africa - Equatorial Africa

LOG DESCRIPTION

. Diameter : 80 to 100 cm
. Thickness of sapwood : 5 to 10 cm
. Durability in forest : good
. Not floatable
. Availability in forest : high but in places

WOOD DESCRIPTION

. Sapwood : clearly distinct
. Colour : yellow brown
. Texture : coarse
. Grain : straight or interlocked (slight)

PRODUCTION

moderate

EXPORT

moderate

. Note : yellow brown to brown more or less dark with golden tinge-ribbon figure on quartersawn-lighter veins on backsawn

PHYSICAL PROPERTIES (CTFT-20)

	mean	stand.deviat.
. Density at 12% M.C	0.64	0.06
. Volumetric shrinkage (%)	0.44	0.07
. Total tangential shrinkage (%)	5.4	0.7
. Total radial shrinkage (%)	3.5	0.4
. Hardness	fairly hard	

. Moderately stable in service
. Note : possible presence of deposits of calcium carbonate often hidden sometimes a darker colour surrounds them

MECHANICAL PROPERTIES (CTFT-20)

	mean	stand.deviat.
. Crushing strength at 12% M.C (N/mm2)	54	6
. Static bending at 12% M.C (N/mm2)	96	17
. MOE (longitudinal) at 12% M.C (N/mm2)	10,346	2,013
. Strength class	n.d	

NATURAL DURABILITY AND AMENABILITY TO PRESERVATIVE TREATMENT

. Sapwood distinct : risk of dry wood insect attacks limited to sapwood (see also termites)
. Resistant to termites
. Resistant to decay
. Poor amenability to preservative treatment

SAWING AND MACHINING

. Normal blunting effect
. Teething recommended for sawing : ordinary or high speed steel . Tools recommended for machining : ordinary tools
. Good aptitude for peeling . Good aptitude for slicing
. Note : deposits of calcium carbonate present in some logs severely damage cutting edges-sawdust very irritating-risks of tearing due to irregular grain

DRYING

. Drying rate : normal
. No risk of distortion . No risk of checking

. Tested kiln schedule :
The following schedule can be used for thickness less than 38 mm. For thickness between 38 mm and 75 mm, the relative humidity must be increased of 5% for each step (to avoid high gradient of humidity in wood). For thickness up to 75 mm, increase of 10%.

Moisture content of wood (%)	Temperature °C Dry bulb	Temperature °C Wet bulb	Relative humidity % (approx.)
green	50.0	47.0	85.0
40	50.0	45.0	75.0
30	55.0	47.0	65.0
20	70.0	55.0	45.0
15	75.0	58.0	40.0

. Note : the sticks often leave marks-the boards must be vertically air dried before stacking-risk of checking in thick stock

ASSEMBLING

. Nailing and screwing : easy . Gluing : correct

REQUIREMENT OF A PRESERVATIVE TREATMENT

. In case of insect attacks : the species does not require any preservative treatment
. In case of risks of temporary humidification : the species does not require any preservative treatment
. In case of risks of permanent humidification : the use of this species is not recommended
. Note : for export as logs the sapwood is usually removed because of its low durability

END-USES

. Exterior joinery - Interior joinery - Flooring - Sliced veneer - Ship building (planking and deck) - Interior panelling - Cabinetwork (high class furniture) - Turned goods - Current furniture or furniture components - Light carpentry - Cooperage - Glued laminated - Stairs - Veneer for interior of plywood - Veneer for back or face of plywood - Vehicle or container flooring - Bridges (parts not in contact with water or ground)
. Note : filling recommended-some stocks may give troublesome with paints and varnishes but a priming coat with a vinyl paint ensures a good surface

CTFT-ITTO 06-04-1992 **Annex 5** species n°152

SAPELLI (Entandrophragma cylindricum)

OTHER NAMES : ABOUDIKRO, PENKWA, SAPELE, ASSIE, ASI, BILOLO, M'BOYO, LIKAFI, LIBUYU, MOYOVO, LIFUTI, UNDIANUNO

GEOGRAPHIC DISTRIBUTION

. Tropical West Africa - Equatorial Africa - Tropical East Africa - Cote d'Ivoire - Ghana - Nigeria - Cameroon - Gabon - Republic of Central Africa - Congo - Zaire - Uganda - Liberia - Angola

LOG DESCRIPTION

. Diameter : 70 to 120 cm
. Thickness of sapwood : 4 to 8 cm
. Durability in forest : good
. Floatable
. Availability in forest : high

WOOD DESCRIPTION

. Sapwood : clearly distinct
. Colour : red brown
. Texture : fine
. Grain : interlocked (high)

PRODUCTION

important

EXPORT

important

. Note : possible presence of wrinkly grain and ringshakes-wood pink brown darkens to copper red brown-cedar like scent

PHYSICAL PROPERTIES (CTFT-20)

		mean	stand.deviat.
. Density at 12% M.C	:	0.69	0.04
. Volumetric shrinkage (%)	:	0.47	0.06
. Total tangentiel shrinkage (%)	:	7.2	0.9
. Total radial shrinkage (%)	:	5.0	0.6
. Hardness	:	fairly hard	

MECHANICAL PROPERTIES (CTFT-20)

		mean	stand.deviat.
. Crushing strength at 12% M.C (N/mm2)	:	62	7
. Static bending at 12% M.C (N/mm2)	:	114	12
. MOE (longitudinal) at 12% M.C (N/mm2)	:	11,254	1,938
. Strength class	:	n.d	

NATURAL DURABILITY AND AMENABILITY TO PRESERVATIVE TREATMENT

. Sapwood distinct : risk of dry wood insect attacks limited to sapwood (see also termites)
. Moderately resistant to termites
. Moderately resistant to decay
. Poor amenability to preservative treatment

SAWING AND MACHINING

. Normal blunting effect
. Teething recommended for sawing : ordinary or high speed steel . Tools recommended for machining : ordinary tools
. Good aptitude for peeling . Good aptitude for slicing
. Note : sawing in the round recommended (internal stresses)-tendency to tearing during planing (interlocked grain)-ribbon figure on quartersawn

DRYING

. Drying rate : normal
. High risk of distortion . Slight risk of checking

. Tested kiln schedule :
The following schedule can be used for thickness less than 38 mm. For thickness between 38 mm and 75 mm, the relative humudity must be increased of 5% for each step (to avoid high gradient of humidity in wood). For thickness up to 75 mm, increase of 10%.

Moisture content of wood (%)	Temperature °C Dry bulb	Wet bulb	Relative humidity % (approx.)
green	40.0	37.0	80.0
40	44.0	38.0	70.0
30	44.0	36.0	60.0
20	46.0	36.0	50.0
15	49.0	37.0	45.0

. Note : drying of quartered pieces is much slower

ASSEMBLING

. Nailing and screwing : easy . Gluing : correct

REQUIREMENT OF A PRESERVATIVE TREATMENT

. In case of insect attacks : the species requires a preservative treatment against termites
. In case of risks of temporary humidification : the species requires a preservative treatment
. In case of risks of permanent humidification : the use of this species is not recommended

END-USES

. Sliced veneer - Cabinetwork (high class furniture) - Current furniture or furniture components - Exterior joinery - Interior joinery - Interior panelling - Veneer for interior of plywood - Veneer for back or face of plywood - Flooring - Stairs Ship building
. Note : sanding requires care in the presence of highly interlocked grain to obtain a good finish

Annex 6

CTFT-ITTO 23-07-1992 species n°185

RAMIN (Gonystylus spp.)

OTHER NAMES : MELAWIS,LANUTAN BAGIO,GARU BUAJA,LAPIS KULIT,MEDANG KAMUAN,PANGGATUTUP,PINANG BACK,GERIMA,MEDANG KELADI,MERANG

GEOGRAPHIC DISTRIBUTION

. South East Asia - Oceania - Sabah-Sarawak Malaysia (peninsular) - Indonesia - Philippines - Papua-New-Guinea - Fidji - Salomon (islands)

LOG DESCRIPTION

. Diameter : 50 to 70 cm
Thickness of sapwood : n.d
Durability in forest : low (must be treated)
Floatable
Availability in forest : high but in places
Note : heart shakes may occur in the logs-unpleasant odour when green-presence of tension wood

WOOD DESCRIPTION

. Sapwood : not distinct
. Colour : creamy white
. Texture : fine
. Grain : straight or interlocked (slight)

PRODUCTION

moderate

EXPORT

negligible or low

PHYSICAL PROPERTIES (CTFT-3)

	mean	stand.deviat.
Density at 12% M.C	0.66	n.d
Volumetric shrinkage (%)	0.60	n.d
Total tangentiel shrinkage (%)	10.1	n.d
Total radial shrinkage (%)	4.9	n.d
Hardness	fairly hard	

Poorly stable in service

MECHANICAL PROPERTIES (CTFT-3)

	mean	stand.deviat.
. Crushing strength at 12% M.C (N/mm2)	67	n.d
. Static bending at 12% M.C (N/mm2)	124	n.d
. MOE (longitudinal) at 12% M.C (N/mm2)	15,300	n.d
. Strength class	SD3	

NATURAL DURABILITY AND AMENABILITY TO PRESERVATIVE TREATMENT

Sapwood not or slightly demarcated : risk of dry wood insect attacks in all the wood (see also termites)
Not or poorly resistant to termites
Not or poorly resistant to decay
Good amenability to preservative treatment

SAWING AND MACHINING

Normal blunting effect
Teething recommended for sawing : ordinary or high speed steel . Tools recommended for machining : ordinary tools
Good aptitude for peeling . Good aptitude for slicing
Note : risk of splinters in cross-cutting

DRYING

Drying rate : rapid to normal
Slight risk of distortion . High risk of checking
Note : risk of surface checking, end splitting and blue staining in thicker sizes-(cf.kiln schedule available at the CTFT to avoid these defects)

ASSEMBLING

Nailing and screwing : easy . Gluing : correct
Note : tends to split in nailing pre-boring recommended

REQUIREMENT OF A PRESERVATIVE TREATMENT

In case of insect attacks : the species requires a preservative treatment
In case of risks of temporary humidification : the species requires a preservative treatment
In case of risks of permanent humidification : the species requires a preservative treatment
Note : very prone to blue stain

END-USES

Moulding - Cabinetwork (high class furniture) - Current furniture or furniture components - Veneer for interior of plywood - Veneer for back or face of plywood - Sliced veneer - Flooring - Interior joinery - Exterior panelling - Turned goods - Rolling shutters

Annex 7

CTFT-ITTO 23-07-1992 species n°157

TANGILE (Shorea-rubro polysperma)

OTHER NAMES : RED LAUAN,TANGUILE

GEOGRAPHIC DISTRIBUTION
. South East Asia - Philippines

LOG DESCRIPTION
. Diameter : 70 to 150 cm
. Thickness of sapwood : 5 to 6 cm
. Durability in forest : good
. Floatable.
. Availability in forest : high

WOOD DESCRIPTION
. Sapwood : clearly distinct
. Colour : dark red
. Texture : medium
. Grain : interlocked (slight)

PRODUCTION
important

EXPORT
important

. Note : wood red to dark brownish red slightly lustrous-moiré or ribbon figure on quartersawn-frequent brittle heart

PHYSICAL PROPERTIES (CTFT-6)

		mean	stand.deviat.
. Density at 12% M.C	:	0.66	0.04
. Volumetric shrinkage (%)	:	0.49	0.04
. Total tangential shrinkage (%)	:	7.4	0.9
. Total radial shrinkage (%)	:	4.4	0.8
. Hardness	:	soft	

. Note : hardness varies from soft to fairly hard

MECHANICAL PROPERTIES (CTFT-6)

		mean	stand.deviat.
. Crushing strength at 12% M.C (N/mm2)	:	52	5
. Static bending at 12% M.C (N/mm2)	:	95	14
. MOE (longitudinal) at 12% M.C (N/mm2)	:	9,967	1,875
. Strength class	:	n.d	

NATURAL DURABILITY AND AMENABILITY TO PRESERVATIVE TREATMENT
. Sapwood distinct : risk of dry wood insect attacks limited to sapwood (see also termites)
. Moderately resistant to termites
. Moderately resistant to decay
. Poor amenability to preservative treatment

SAWING AND MACHINING
. Normal blunting effect
. Teething recommended for sawing : ordinary or high speed steel . Tools recommended for machining : ordinary tools
. Good aptitude for peeling . Good aptitude for slicing
. Note : sometimes irregular grain-during planing tendency to grain tearing-necessity to keep the sharp edges

DRYING
. Drying rate : normal to slow
. Slight risk of distortion . Slight risk of checking
. Risks of casehardening
. Tested kiln schedule :
The following schedule can be used for thickness less than 38 mm. For thickness between 38 mm and 75 mm, the relative humidity must be increased of 5% for each step (to avoid high gradient of humidity in wood). For thickness up to 75 mm, increase of 10%.

Moisture content of wood (%)	Temperature °C Dry bulb	Wet bulb	Relative humidity % (approx.)
green	50.0	47.0	85.0
40	50.0	45.0	75.0
30	55.0	47.0	65.0
20	70.0	55.0	45.0
15	75.0	58.0	40.0

. Note : careful piling and loading of the stacks are recommended to reduce the distortion

ASSEMBLING
. Nailing and screwing : easy . Gluing : correct

REQUIREMENT OF A PRESERVATIVE TREATMENT
. In case of insect attacks : the species requires a preservative treatment against termites
. In case of risks of temporary humidification : the species requires a preservative treatment
. In case of risks of permanent humidification : the use of this species is not recommended

END-USES
. Interior joinery - Interior panelling - Exterior joinery - Exterior panelling - Current furniture or furniture components - Sliced veneer - Veneer for interior of plywood - Veneer for back or face of plywood - Ship building (planking and deck) - Cigar boxes - Flooring - Cabinetwork (high class furniture) - Light carpentry - Boxes and crates - Cooperage - Rolling shutters Moulding - Particle and fiber board - Pulpwood

CTFT-ITTO 6-04-1992 **Annex 8** species n°144

KOSIPO (Entandrophragma candollei)

OTHER NAMES : PENEMA-AKOWAA, OMU, HEAVY SAPELE, ATON-ASSIE, BOBOMA, MBOYO-EANGA, KOUSSIE, NDIANCHI, ESAKA, LIBUYU, LIFAKI MPEMBE, IMPOPO, LIFUCO

GEOGRAPHIC DISTRIBUTION

. Tropical West Africa - Equatorial Africa - Cote d'Ivoire - Nigeria - Cameroon - Congo - Zaire - Guinea - Angola - Gabon - Ghana

LOG DESCRIPTION

. Diameter : 70 to 200 cm
. Thickness of sapwood : 4 to 8 cm
. Durability in forest : good
. Not floatable
. Availability in forest . medium

WOOD DESCRIPTION

. Sapwood : clearly distinct
. Colour : red brown
. Texture : coarse
. Grain : straight or interlocked (slight)

PRODUCTION

moderate

EXPORT

moderate

. Note : wood red brown with purple tinge darkens on light-black resin deposits in the pores-ribbon figure on quartersawn

PHYSICAL PROPERTIES (CTFT-4)

	mean	stand.deviat.
. Density at 12% M.C	0.69	n.d
. Volumetric shrinkage (%)	0.42	n.d
. Total tangential shrinkage (%)	6.6	n.d
. Total radial shrinkage (%)	4.8	n.d
. Hardness	fairly hard	

. Note : some logs may present a mottled figure

MECHANICAL PROPERTIES (CTFT-4)

	mean	stand.deviat.
. Crushing strength at 12% M.C (N/mm2)	53	n.d
. Static bending at 12% M.C (N/mm2)	97	n.d
. MOE (longitudinal) at 12% M.C (N/mm2)	9,000	n.d
. Strength class	n.d	

NATURAL DURABILITY AND AMENABILITY TO PRESERVATIVE TREATMENT

. Sapwood distinct : risk of dry wood insect attacks limited to sapwood (see also termites)
. Moderately resistant to termites
. Moderately resistant to decay
. Poor amenability to preservative treatment

SAWING AND MACHINING

. High blunting effect
. Teething recommended for sawing : stellite-tipped
. Tools recommended for machining : tools with tungsten carbide
. Good aptitude for peeling
. Good aptitude for slicing
. Note : power required-some difficulties due to irregular grain (tearing)-blunting effect varies from fairly high to high because of silica content

DRYING

. Drying rate : normal
. Slight risk of distortion
. No risk of checking

. Tested kiln schedule :
The following schedule can be used for thickness less than 38 mm. For thickness between 38 mm and 75 mm, the relative humidity must be increased of 5% for each step (to avoid high gradient of humidity in wood). For thickness up to 75 mm, increase of 10%.

Moisture content of wood (%)	Temperature °C Dry bulb	Wet bulb	Relative humidity % (approx.)
green	40.0	37.0	80.0
40	44.0	38.0	70.0
30	44.0	36.0	60.0
20	46.0	36.0	50.0
15	49.0	37.0	45.0

. Note : drying of backsawn is more difficult and slower with risks of distortion more marked-quartersawn stock well dry recommended for exterior uses

ASSEMBLING

. Nailing and screwing : easy
. Gluing : correct

REQUIREMENT OF A PRESERVATIVE TREATMENT

. In case of insect attacks : the species requires a preservative treatment against termites
. In case of risks of temporary humidification : the species does not require any preservative treatment
. In case of risks of permanent humidification : the use of this species is not recommended

END-USES

. Exterior joinery - Interior joinery - Sliced veneer - Cabinetwork (high class furniture) - Interior panelling - Current furniture or furniture components - Light carpentry - Glued laminated - Veneer for back or face of plywood - Flooring - Stairs - Exterior panelling - Shingles
. Note : sometimes presence of resin may give troublesome to adherence of finition products-sanding needs care-filling required to obtain a good finish

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Annex 9

species n°41

IMBUIA (Ocotea porosa)

OTHER NAMES : CANELA IMBUIA, BRAZILIAN WALNUT, AMBUIA

GEOGRAPHIC DISTRIBUTION
. South America - Brazil (South)

LOG DESCRIPTION
. Diameter : 80 to 120 cm
. Thickness of sapwood : 3 to 6 cm
. Durability in forest : good
. Floatable
. Availability in forest : high
. Note : pleasant odour-heartwood yellowish brown beige to dark brown with irregular dark fine veins

WOOD DESCRIPTION
. Sapwood : clearly distinct
. Colour : yellow brown
. Texture : fine
. Grain : straight or interlocked (slight)

PRODUCTION
negligible or low

EXPORT
negligible or low

PHYSICAL PROPERTIES (CTFT-20)

		mean	stand.deviat.
. Density at 12% M.C	:	0.71	0.08
. Volumetric shrinkage (%)	:	0.45	0.06
. Total tangential shrinkage (%)	:	6.8	0.9
. Total radial shrinkage (%)	:	3.3	0.6
. Hardness	:	fairly hard	

MECHANICAL PROPERTIES (CTFT-20)

		mean	stand.deviat.
. Crushing strength at 12% M.C (N/mm2)	:	49	5
. Static bending at 12% M.C (N/mm2)	:	93	12
. MOE (longitudinal) at 12% M.C (N/mm2)	:	7,500	117
. Strength class	:	n.d	

NATURAL DURABILITY AND AMENABILITY TO PRESERVATIVE TREATMENT
. Sapwood distinct : risk of dry wood insect attacks limited to sapwood (see also termites)
. Moderately resistant to termites
. Moderately resistant to decay
. Moderate amenability to preservative treatment

SAWING AND MACHINING
. Normal blunting effect
. Teething recommended for sawing : ordinary or high speed steel
. Tools recommended for machining : ordinary tools
. Good aptitude for peeling
. Good aptitude for slicing
. Note : dust may cause dermatosis

DRYING
. Drying rate : slow
. Slight risk of distortion
. Slight risk of checking
. Risks of collapse
. Note : slow drying is recommended

ASSEMBLING
. Nailing and screwing : easy
. Gluing : correct

REQUIREMENT OF A PRESERVATIVE TREATMENT
. In case of insect attacks : the species requires a preservative treatment against termites
. In case of risks of temporary humidification : the species does not require any preservative treatment
. In case of risks of permanent humidification : the use of this species is not recommended

END-USES
. Sliced veneer - Current furniture or furniture components - Cabinetwork (high class furniture) - Interior panelling - Flooring - Interior joinery - Veneer for back or face of plywood - Moulding - Light carpentry - Wood house frame - Turned goods - Stairs - Ship building - Exterior joinery - Exterior panelling

Note : used as substitute for european Walnut (Juglans regia)-recommended for high class use

T-ITTO 23-07-1992

Annex 10

species n°182

PINUS KESIYA

OTHER NAMES : PIN A 3 FEUILLES,NGO,SRAL,THONG,MAY PEK

GEOGRAPHIC DISTRIBUTION

South East Asia - Viet-Nam - Laos - Thailand - Burma - Philippines - Indonesia - India

LOG DESCRIPTION

Diameter : 50 to 60 cm
Thickness of sapwood : 4 to 5 cm
Durability in forest : moderate (treatment recommended)
Floatable
Availability in forest : high but in places
Note : wood salmon pink-resin ducts numerous-species occurs at altitude of 610-2700m

WOOD DESCRIPTION

. Sapwood : not clearly distinct
. Colour : orange-yellow
. Texture : medium
. Grain : straight

PRODUCTION
negligible or low

EXPORT
negligible or low

PHYSICAL PROPERTIES (CTFT-3)

		mean	stand.deviat.
Density at 12% M.C	:	0.71	n.d
Volumetric shrinkage (%)	:	0.52	n.d
Total tangentiel shrinkage (%)	:	8.9	n.d
Total radial shrinkage (%)	:	6.1	n.d
Hardness	:	fairly hard	

MECHANICAL PROPERTIES (CTFT-3)

		mean	stand.deviat.
. Crushing strength at 12% M.C (N/mm2)	:	65	n.d
. Static bending at 12% M.C (N/mm2)	:	126	n.d
. MOE (longitudinal) at 12% M.C (N/mm2)	:	14,120	n.d
. Strength class	:	n.d	

Note : physical and mechanical properties vary with age and site

NATURAL DURABILITY AND AMENABILITY TO PRESERVATIVE TREATMENT

Sapwood not or slightly demarcated : risk of dry wood insect attacks in all the wood (see also termites)
Not or poorly resistant to termites
Resistance variable to decay (see note "requirement of a preservative treatment")
Moderate amenability to preservative treatment

SAWING AND MACHINING

Normal blunting effect
Teething recommended for sawing : ordinary or high speed steel
Good aptitude for peeling
Note : resin may clog the tools
. Tools recommended for machining : ordinary tools
. Aptitude for slicing not determined

DRYING

Drying rate : rapid
No risk of distortion . Slight risk of checking
Note : risks of blue stain and resin exudation-wood must be rapidly sawn-for air drying: stacking under cover and piling in "V"

ASSEMBLING

Nailing and screwing : easy . Gluing : correct

REQUIREMENT OF A PRESERVATIVE TREATMENT

In case of insect attacks : the species requires a preservative treatment
In case of risks of temporary humidification : the species requires a preservative treatment
In case of risks of permanent humidification : the use of this species is not recommended
Note : durability variable : poorly to moderately resistant to decay

END-USES

Light carpentry - Glued laminated - Flooring - Interior joinery - Boxes and crates - Matches -
Current furniture or furniture components - Interior panelling - Formwork - Pulpwood - Veneer for interior of plywood -
Veneer for back or face of plywood - Exterior joinery
Note : can be used for wooden house construction

Annex 11

T-ITTO 08-07-1992 species n°164

MERANTI WHITE (Shorea-antho hypochra)

OTHER NAMES : MERANTI SERIT,M. LAPIS,M. PALANG,M. TEMAK,MELAPI,MELAPI LAUT,MERANTI PUTIH,PA HONG,SUAI,KABAK KHAO,KOKI PHNONG, KHEN-FAI,LUMBOR,VEN VEN VANG

GEOGRAPHIC DISTRIBUTION

South East Asia - Malaysia (peninsular) - Sabah-Sarawak - Indonesia - Brunei - Thailand - Cambodia - Laos - Viet-Nam

LOG DESCRIPTION

Diameter : 90 to 150 cm
Thickness of sapwood : 5 to 8 cm
Durability in forest : moderate (treatment recommended)
Float floatable
Availability in forest : high but in places
Note : logs are at the limit of floatability-sometimes brittle heart-occasionally deeply interlocked grain

WOOD DESCRIPTION

. Sapwood : not distinct
. Colour : creamy white
. Texture : medium
. Grain : straight or interlocked (slight)

PRODUCTION

moderate

EXPORT

moderate

PHYSICAL PROPERTIES (CTFT-3)

		mean	stand.deviat.
Density at 12% M.C	:	0.72	n.d
Volumetric shrinkage (%)	:	0.58	n.d
Total tangential shrinkage (%)	:	8.5	n.d
Total radial shrinkage (%)	:	4.0	n.d
Hardness	:	fairly hard	

MECHANICAL PROPERTIES (CTFT-3)

		mean	stand.deviat.
. Crushing strength at 12% M.C (N/mm2)	:	65	n.d
. Static bending at 12% M.C (N/mm2)	:	132	n.d
. MOE (longitudinal) at 12% M.C (N/mm2)	:	12,800	n.d
. Strength class	:	n.d	

Note : wood whitish when fresh becomes pale yellow brown on exposure-ribbon figure on quatersawn

NATURAL DURABILITY AND AMENABILITY TO PRESERVATIVE TREATMENT

- Sapwood not or slightly demarcated : risk of dry wood insect attacks in all the wood (see also termites)
- Not or poorly resistant to termites
- Moderately resistant to decay
- Moderate amenability to preservative treatment

SAWING AND MACHINING

. High blunting effect
. Teething recommended for sawing : stellite-tipped
. Tools recommended for machining : tools with tungsten carbide
. Good aptitude for peeling
. Good aptitude for slicing
. Note : high silica content-tendency to woolliness-filling is recommended to obtain a good finish

DRYING

Drying rate : rapid to normal
Slight risk of distortion
. No risk of checking

Tested kiln schedule :
The following schedule can be used for thickness less than 38 mm. For thickness between 38 mm and 75 mm, the relative humudity must be increased of 5% for each step (to avoid high gradient of humidity in wood). For thickness up to 75 mm, increase of 10%.

Moisture content of wood (%)	Temperature °C Dry bulb	Temperature °C Wet bulb	Relative humidity % (approx.)
green	42.0	39.0	82.0
50	48.0	43.0	74.0
40	48.0	43.0	74.0
30	48.0	43.0	74.0
15	54.0	46.0	65.0

ASSEMBLING

. Nailing and screwing : easy
. Gluing : correct
Note . sometimes risks of splitting in that case pre-boring necessary

REQUIREMENT OF A PRESERVATIVE TREATMENT

. In case of insect attacks : the species requires a preservative treatment
. In case of risks of temporary humidification : the species requires a preservative treatment
. In case of risks of permanent humidification : the use of this species is not recommended
Note : liable to dark coloured "pin hole" borers

END-USES

Interior joinery - Interior panelling - Flooring - Stairs - Veneer for interior of plywood - Veneer for back or face of plywood
Sliced veneer - Current furniture or furniture components - Exterior joinery - Vehicle or container flooring - Light carpentry - Glued laminated

Annex 12

Substantive Officer's Comments

This report has attempted to indicate the role rubberwood could play to replace species traditionally used in production of mouldings, furniture etc. in South East Asia. Unfortunately, it has been impossible to obtain historical price comparisons for these species and rubberwood.

Similarly, there is no doubt that conditions will arise when *Hevea brasiliensis* will be planted for its timber and not latex value. However, it must also be borne in mind that the farmers (especially the smallholders) are interested in the monetary yield per acre. Existing rubberwood plantations, may, in certain cases, be replaced by other crops (palm oil, fruit trees, or cash crops). Although clones for wood-oriented rubberwood tree grouping have been identified, these have not yet undergone testing in commercial scale plantations.

Finally, work remains to be done on developing other wood preservatives in case the Boron salts currently used are banned for ecological reasons.

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