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ALTERNATIVE TIMBER SPECIES - A REVIEW OF THEIR PROPERTIES AND USES

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ABSTRACT

As the timber species originating from natural forests have become limited in Sri Lanka, there is a growing concern of using timber species that originate from sources other than natural forests (sustainable sources) for construction and furniture. Popularization of a timber species depends on its technical properties as well as on its commercial properties such as availability. Timber property studies carried out on the species grown in Sri Lanka have been limited. This limited data, along with some primary data gathered in the present study on technical and commercial properties of these species, are presented. Key technical properties such as specific gravity, surface texture, shrinkage, workability and durability, and key commercial properties such as availability and price levels are presented along with the end uses.

The following timber species are suggested as alternative species, which have good prospects for construction, joinery and/or furniture in future: Albizia (*Paraserianthes falcataria*), Lunumidella (*Melia dubia*), Kadju (*Anacardium occidentale*), Toona (*Cedrella toona*), Cypress (*Cupressus macrocarpa*), Rubber (*Hevea brasiliensis*), Pinus species (*Pinus caribaea, Pinus pilularis and Pinus insularis*), Mango (*Mangifera indica*), Ginisapu (*Michelia champaca*), Sabukku (*Gravillea robusta*), Havarinuga (*Alstonia macrophylla*), Gansooriya (*Thespesia populnea*) and Eucalyptus species (*Eucalyptus grandis, Eucalyptus pilularis, Eucalyptus robusta, Eucalyptus microcorys, Eucalyptus citradora, Eucalyptus globulus*. Properties of three high rated popular alternative species, Teak (*Tectona grandis*), Mahogany (*Swietenia macrophylla*) and Jak (*Artocarpus heterophyllus*), are also presented for comparison.

Most of these species are fast growing, and have rotations of about 20-30 years, hence selection of suitable species from this list in establishing future forest plantations and agroforestry systems to meet the timber demand is recommended.

1 INTRODUCTION

The natural forest cover of Sri Lanka has been depleted and timber supplies from these sources are becoming limited. Nevertheless, sawnwood demand is projected to grow from 0.544 million m^3 in 1993 to 0.885 million m^3 in 2020, i.e. by about

12,600 m^3/year. This corresponds to an average annual growth rate of 2% (FSMP, 1995). As the timber species originating from natural forests have become limited in Sri Lanka, there is a growing interest in using timber species that originate from sources other than natural forests (sustainable sources) such as forest plantations and agroforestry lands.

Recent statistics show that more than 70% of the local commercially acceptable timbers are now potentially available from sources other than natural forests such as forest plantations, home gardens, Rubber and Coconut lands (FSMP, 1995). Major plantation species available in forest department plantations are Teak, Pine, Eucalyptus and Mahogany. These timbers, originating from sources other than natural forests, can be produced in a sustainable manner by planting more trees. These species can be used as alternatives to the natural timber species, and it is essential to identify such species and popularize them in this country to meet the national timber demand. Those timbers which originate from sources other than natural forests are termed "ALTERNATIVE SPECIES" (Amarasekera, 1993). If future timber requirements can be met by these species, then the remaining natural forests can be conserved for protection of soil, water and bio-diversity. The properties of some of these alternative species are presented in this paper (Table 1).

Table 1: Some alternative timber species used in Sri Lanka

Common Name	Botanical Name
Relatively lesser known alternative species	
Albizia	*Paraserianthes falcataria*
Lunumidella	*Melia dubia*
Kadju	*Anacardium occidentale*
Toona	*Cedrella toona*
Cypress	*Cupressus macrocarpa*
Rubber	*Hevea brasiliensis*
Pinus species	*Pinus caribaea, Pinus pilularis* and *Pinus insularis*
Mango	*Mangifera indica*
Ginisapu	*Michelia champaca*
Sabukku	*Grevillea robusta*
Havarinuga	*Alstonia macrophylla*
Gansooriya	*Thespesia populnea*
Eucalyptus species	*Eucaluptus grandis, Eucalyptus pilularis, Eucalyptus robusta, Eucalyptus microcorys, Eucalyptus citradora, Eucalyptus globulus*
High rated popular alternative species	
Teak	*Tectona grandis*
Mahogany	*Swietenia macrophylla*
Jak	*Artocarpus heterophyllus*

With the rapid growth and expansion of wood products and construction sector in Sri Lanka, it is essential to utilize these alternative species in place of natural rare species to satisfy the market demand on the one hand and to protect natural ecosystems on the other.

2. KEY TIMBER PROPERTIES

Utilization of these alternative timber species is a challenge to the construction and furniture industries, because some of them are relatively new to the market and knowledge on their properties and service qualities is limited. To assess the potential utilization of these species it is essential to acquire sound knowledge on their properties before the timber can be marketed. Timber property studies carried out on the species grown in Sri Lanka have been limited (Amarasekera and Denuwara, 1995a; Denuwara, 1992; Navaranjan 1985; Chandrakeerthi, 1985; Senevirathe, 1981; Soyza, 1973; Tisseverasinghe, 1971). These limited data, along with some primary data gathered in the present study on technical and commercial properties of these species, are presented.

In general terms, the use of a particular species and quality of timber in an end use is a function of the technical and commercial properties of that timber. The technical properties include tree form, sawing and machining properties, colour, durability, shrinkage and movement, figure and texture, density and strength. The key commercial properties include availability of sizes and quality required, regularity of deliveries, and price competitiveness. In Sri Lanka, as timber usage is heavily controlled, legal and procedural difficulties in obtaining stocks are also important commercial factors.

2. 1 SPECIFIC GRAVITY

The widely used Timber classification system in Sri Lanka is adopted from the timber category system of the State Timber Corporation (STC, 1994). This system is based largely on demand and supply and not on strength or durability of timbers. Most authors have classified timbers according to their specific gravity (Bhat, 1985; Keating, 1980), because this can be used as a major determinant of the timber quality especially concerning most of the strength properties (Elliott, 1970). Hence, in order to obtain knowledge on the quality of alternative timbers in Sri Lanka, these are classified according to specific gravity and are presented in Table 2. The specific gravity data (based on green volume and oven dry weight) were obtained from two previous studies (Denuwara, 1992 and Navaranjan, 1985).

Based on specific gravity values it was possible to classify timbers into three specific gravity ranges: Light (less than 0.500), moderately heavy (0.500-0.650) and heavy (more than 0.650). All *Eucalyptus* species except *E. grandis*, alstonia, teak and gansooriya fall in the category of Heavy, indicating their suitability for medium to heavy construction. Most of the timbers that fall into the Moderately Heavy

category (grandis, rubber, mahogany, jak, mango, ginisapu and sabukku) are used for construction. Timbers such as albizia, lunumidella, pine, toona and cypress which fall into the category of Light can be used as furniture and panelling timber.

Table 2: Classification of timbers according to specific gravity

Species	Common Name	Specific gravity	
		Denuwara 1992	Nawaranjan 1985
Light (< 0.500)			
Paraserianthes falcataria	Albizia	0.189	
Melia dubia	Lunumidella	0.305	
Pinus caribaea	Pine, Rata amba		0.413
Anacardium occidentale	Kadju	0.421	
Cedrella toona	Toona	0.424	
Cupressus macrocarpa	Cypress	0.441	
Pinus patula	Pine		0.495
Moderately Heavy (0.500- 0.650)			
Hevea brasiliensis	Rubber	0.513	
Pinus insularis	Pine		0.513
Swietenia macrophylla	Mahogany	0.559	
Eucaluptus grandis	Grandis	0.506	0.645
Artocarpus heterophyllus	Jak	0.591	
Mangifera indica	Mango, Amba	0.598	
Michelia champaca	Ginisapu	0.613	
Gravillea robusta	Sabukku, Gravillea Silky oak	0.622	
Heavy (> 0.650)			
Alstonia macrophylla	Alstonia Ginikuru	0.659	
Thespesia populnea	Gansooriya	0.684	
Tectona grandis	Teak	0.745	
Eucalyptus robusta	Red gum	0.764	0.747
Eucalyptus microcorys	Tallow wood	0.802	0.759
Eucalyptus globulus	Blue gum		0.809
Eucalyptus pilularis	Black butt		0.849
Eucalyptus citradora	Lemon-scented	0.866	0.871

2.3 SHRINKAGE

Shrinkage of wood on drying is an important property as it affects the target sizes for green sawn timber and influences the behaviour of the timber during seasoning. The extent of shrinkage is often used as a guide to the anticipated stability in service. Green to oven dry shrinkage of the timber species are presented in Table 3.

Table 3: Shrinkage (green to oven dry) of alternative timbers

Species	Common name	Tangential (%)	Radial (%)	Source
Thespesia populnea	Gansooriya	2.1	2.9	1
Eucalyptus citradora	Lemon-scented gum	3.4	3.1	2
Paraserianthes falcataria	Albizia	3.4	0.9	1
Eucalyptus globulus	Blue gum	3.7	3.2	2
Eucalyptus microcorys	Tallow wood	3.7	3.2	2
Artocarpus heterophyllus	Jak	4.0	1.4	1
Eucaluptus grandis	Grandis	4.1	3.2	2
Mangifera indica	Mango, Amba	4.5	2.5	1
Swietenia macrophylla	Mahogany	4.5	3.4	1
Eucalyptus robusta	Red gum	4.6	3.8	2
Eucalyptus pilularis	Black butt	4.6	3.6	2
Hevea brasiliensis	Rubber	4.6	2.9	1
Pinus insularis	Pine	5.2	4.3	2
Tectona grandis	Teak	5.4	3.6	1
Melia dubia	Lunumidella	5.9	0.9	1
Pinus patula	Pine	6.0	4.8	2
Michelia champaca	Ginisapu	6.1	2.5	1
Gravillea robusta	Sabukku, Gravillea Silky oak	6.3	4.3	1
Alstonia macrophylla	Alstonia, Ginikuru	6.9	4.7	1
Pinus caribaea	Pine, Rata amba	7.3	5.6	1

Source: 1= Denuwara (1992) 2 = Navaranjan (1985)

2.4 OTHER TIMBER PROPERTIES

Other timber properties important in introducing a lesser known timber into the market include the following (Bhat, 1985; Keating, 1980)

- strength properties
- durability
- workability, which includes the suitability for sawing, planing, drilling, nailing, nail holding, screwing, gluing, moulding and other properties related to the cutting combining and shaping of wood.
- Finishing characteristics which refers to the surface quality and appearance after wood working.
- preservative permeability
- commercial properties such as availability, price levels and any procedural and legal requirements in obtaining these timbers

Some of these technical properties have not been collected systematically on Sri Lankan species. Existing data together with that gathered in the present study, on the characteristics and end uses of alternative timbers are presented in Table 4. For comparison, the characteristics of high rated popular species are also presented.

The following data are presented in Table 4.

Species - Common and botanical names are indicated.

Specific gravity - Specific gravity based on green volume and oven dry weight is presented (Denuwara, 1992; Navaranjan, 1985).

Texture - Surface texture is classified as fine, medium and coarse.

Tangential shrinkage - Tangential shrinkage from green to air dry condition measured according to Sri Lanka standards (SLS: 836, 1988) are presented (Amarasekera and Denuwara, 1995a).

Working quality - This refers to the case of working and is classified as good, medium or difficult.

Durability - Natural durability rating given in Tisseverasinghe (1970) is given as very durable (VD), moderately durable (MD), durable (D) and non durable (ND) when exposed in exterior conditions. Preservative treatment can be used when timber is not sufficiently naturally durable for the situation in which it is to be used.

Availability - Availability from producer to the timber user is described as regular, limited or variable.

Price - Average retail price per m^3 of sawnwood collected in early to mid 1995 are presented as Low, Medium, High and Very High.

Low	< Rs 10000
Medium	Rs 10000-20000
High	Rs 20000-30000
Very High	> Rs 30000

These prices are for guidance only and vary according to the prevailing market conditions.

Uses- Major end uses for construction and furniture are presented.

HC - Heavy construction
(such as roof trusses, beams)
MC - Meium construction
(such as door/window and frames)
LC - Light construction (temporary work etc)
WP - Wall Panelling
HQF - High quality furniture
CF - Common furniture

Most of the timbers can be used for more purposes than those listed. Uses of Sri Lankan species are recorded by Amarasekera and Denuwara, 1995b).

Table 4: Alternative timbers and their key technical and commercial properties

Species	Specific gravity	Texture	Tangential shrinkage	Working quality	Durability	Availability	Price of timber	Recommended end uses					
								HC	MC	LC	WP	HQF	CF
Albizia *Paraserianthes falcataria*	0.189	Coarse	3.4	Good	MD	Regular	Low			X	X		X
Alstonia, ginikuru *Alstonia macrophylla*	0.659	Mediumm	6.9	Good	ND	Variable	Medium		X		X		X
Cypress *Cupressus macrocarpa*	0.441	Fine		Good		Limited	Medium			X	X		
Eucalyptus grandis	0.506	Medium	4.1	Good	D	Regular	Medium		X				X
Eucalyptus microcorys	0.802	Medium	3.7	Good	VD	Variable	V High	X					
Eucalyptus pilularis	0.849	Medium	4.6	Good	D	Limited	Medium	X					X
Eucalyptus citriodora	0.866	Medium	3.4	Good	D	Limited	Medium	X					
Eucalyptus robusta	0.764	Medium	4.6	Good	D	Limited	Medium	X					X
Eucalyptus globulus	0.809	Medium	3.7	Good	D	Limited	Medium	X					
Gansooriya *Thespesia populnea*	0.684	Medium	2.1	Good		Limited	Medium	X	X			X	
Gitisapu *Michelia champaca*	0.613	Medium	6.1	Good	D	Variable	Medium		X		X	X	
Lumumdella *Melia dubia*	0.305	Coarse	5.9	Medium	ND	Regular	Medium				X		X

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Mango, Amba *Mangifera indica*	0.598	Coarse	4.5	Medium	ND	Variable	Low		X	X	X		X
Pine *Pinus caribaea*	0.413	Fine	7.3	Good	ND	Regular	Medium Treat-Hi		pulp ussa	X	X	X	
Rubber *Hevea brasiliensis*	0.513	Medium	4.6	Good	ND	Regular	Low			X		X	
Sabukku, Gravillea *Gravillea robusta*	0.622	Coarse	6.3	Good	ND	Limited	Medium		X		X	X	
Toona *Cedrella toona*	0.424	Coarse		Good	MD	Limited	Medium		X	X	X		X

HIGH RATED POPULAR ALTERNATIVE TIMBERS

Teak *Tectona grandis*	0.745	Coarse	5.4	Medium	VD	Regular	V High		X		X	X	
Mahogany *Swietenia macrophylla*	0.559	Medium	4.5	Good	MD	Regular	V High		X			X	
Jak *Artocarpus heterophyllus*	0.591	Coarse	4	Good	D	Regular	V High		X			X	

Key : **Durability** - VD - very durable (VD) MD - moderately durable D - durable ND- non durable

Price - Average retail price per m^3 of sawnwood (in early to mid 1995)

Low < Rs 10000 Medium Rs 10000-20000 High Rs 20000-30000 Very High > Rs 30000

Uses- Major end uses for construction and furniture are presented.

HC - Heavy construction MC - Meium construction LC - Light construction (temporary work etc)

WP - Wall Panelling HQF - High quality furniture CF - Common furniture

Navaranjan (1985), after investigation of strength properties of Sri Lankan Pine and Eucalyptus species, has recommended different end uses for these species (Table 5).

3. CONCLUSIONS AND RECOMMENDATIONS

Based on specific gravity, it was possible to classify timbers as Light, Moderately heavy and Heavy. With the wide range of specific gravity values, these species appear to have potential to meet the wood quality requirements for construction and furniture. Among the species listed in Table 3, some species such as Jak, Mahogany and Teak, have been extensively used for construction and/ or the furniture industry and there properties are well known. Rubber is also widely used in furniture and wooden crafts industries after being treated with boron compounds. However, some other species are lesser known or secondary species.

The most important secondary species for Sri Lanka at present appear to be *Eucalyptus* and *Pinus* because the Forest Department has planted substantial areas of these species. However these are still less known to the market due to marketing strategy as well as due to the lack of knowledge on the properties and uses of these species. Most *Eucalyptus* species can be used in both heavy and medium construction, especially *Eucalyptus microcorys* which is a good timber for heavy construction such as roof work and also has high durability. Commonly available *Eucalyptus grandis* can be recommended for medium construction but is not very durable. *Eucalyptus* species have another undesirable quality - they are prone to heavy splitting. This is more prominent in *Eucalyptus grandis*. Pinus species are not durable but after proper treatment they can be used in furniture, panelling and also in some construction applications.

Table 5: Recommended end uses for *Eucalyptus* and *Pinus* species

Species	Roof work	Beams	Floor -ing	Doors and windows	Furnit -ure	Panell -ing	Sleep -ers	Poles and Posts
E. citriodora	●●●	●●	●●●	●●●	●	●	●●●	●●●
E. microcorys	●●●	●●	●●●	●●●	●	●	●●●	●●●
E. pilularis	●●●	●	●	●●	●●	●●	●●	●●●
E. globulus	●●●	●	●●	●●	●	●	●●	●●●
E. robusta	●●●	●	●	●●	●●	●●	●●	●●●
E. grandis	●●	●	●●	●●	●●	●●	●●	●●
E. insularis	●	X	X	--	--	--	X	--
P. patula	●	X	X	--	--	--	X	--
P. caribaea	X	X	X	X	X	X	X	--

●●● = More suitable ●● = Suitable ● = Less suitable X = Unsuitable
---- = No conclusion on the usage (Adopted from Navaranjan 1985)

Ginisapu is another promising species for medium construction which is also durable. Alstonia and Sabukku are also other important secondary species which can

be used both in medium construction and in furniture. However, these two are not durable species. Lunumidella and Cypress are widely used alternative species for panelling purposes.

Most of these species are fast growing, and have rotations of about 20-30 years, hence it is recommended that suitable species from this list be selected in future afforestation and reforestation programmes (forest plantations, tree growing on private and other agro-forestry lands) to meet the timber demand.

Some of these alternative species may not possess precisely the desirable properties that the timber specifiers and contractors would like to have, such as high natural durability and strength. Hence, to popularize the use of these alternative timbers it is essential to establish scientific timber grading and standards for selecting timber species and sizes for the building industry. Timbers should be classified according to their mechanical properties and durability.

One of the major difficulties in popularizing these species is that transport and processing of these timbers are governed by excessive legislation and procedural requirements (permits). Hence it is essential to review the transport legislation of these sustainable alternative species to encourage their establishment and usage.

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