



INTRODUCTION TO TREE

*"Take care of the environment the same as you
take care of your life."*

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TENGKU NUR SYARAH BARIAH RAJA MOHD YAZIT
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POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

Wood Anatomy and Physical Properties

INTRODUCTION TO TREE



WRITERS

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POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH
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“Move forward. Good things are up ahead.”





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Preface

Introduction to tree is one of the topics in the course DCW10033 Wood Anatomy and Physical Properties in Wood Based Technology Programme. This e-book are covered several sub topics such as definition of tree and forest, identify structure of tree, explanation the characteristic of tree, distinguish of softwood and hardwood, strength and week point of wood, define the forest and wood classification and the commercial and non commercial wood in Malaysia.

This e-book is expected to provide guidance and information on the topic of introduction to tree and subsequently can help students to better understand this topic effectively.

Acknowledgements

First and foremost, we would like to thankful to Almighty Allah for giving we the strength, knowledge, ability and opportunity to involved in the publication of this e-book.

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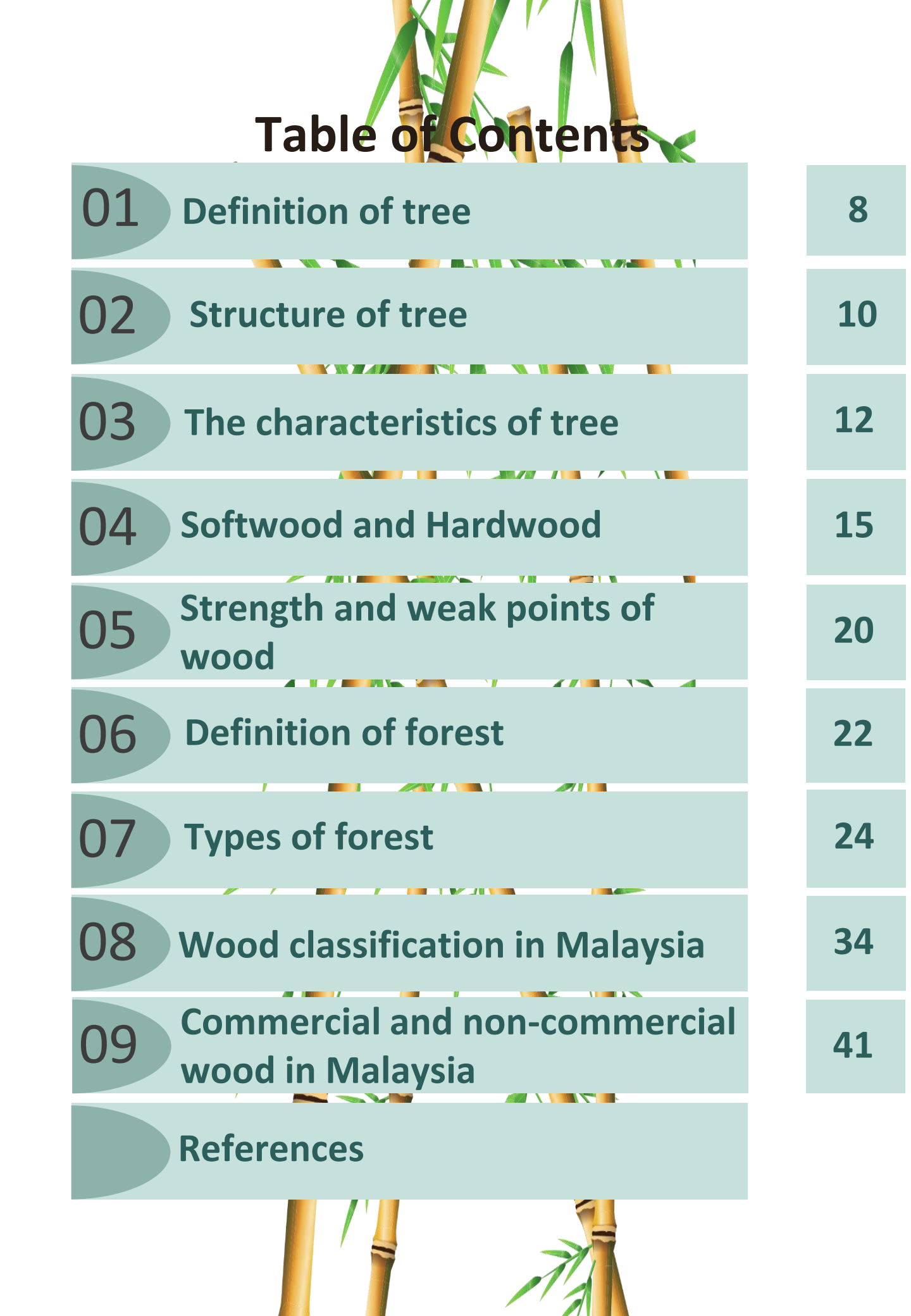


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01

DEFINITION OF TREE



"Trees exhale for us so that we can inhale them to stay alive. Can we ever forget that? Let us love trees with every breath we take until we perish."

— Munia Khan

TREE - /tri:/

SIMPLE DEFINITION

A tree is a tall plant that can live for a very long time. It has a single stem or trunk and branches that support leaves. Beneath the ground, a tree has a root system that acts as an anchor and stores the water and nutrients the plant needs to grow.

- <https://ecotree.green/>



IMPORTANCE OF TREE

Trees are vital. As the biggest plants on the planet, they give us oxygen, store carbon, stabilise the soil and give life to the world's wildlife. They also provide us with the materials for tools and shelter.

<https://www.royalparks.org.uk>



Methuselah Tree

FUN FACTS

Trees are the longest living organisms on Earth, and never die of old age.

California holds the record for the oldest living trees. Some of the state's bristlecone pines and giant sequoias are 4,000-5,000 years old. Methuselah, an estimated 4,852-year-old ancient Bristlecone Pine, is one of the oldest living trees in the world.



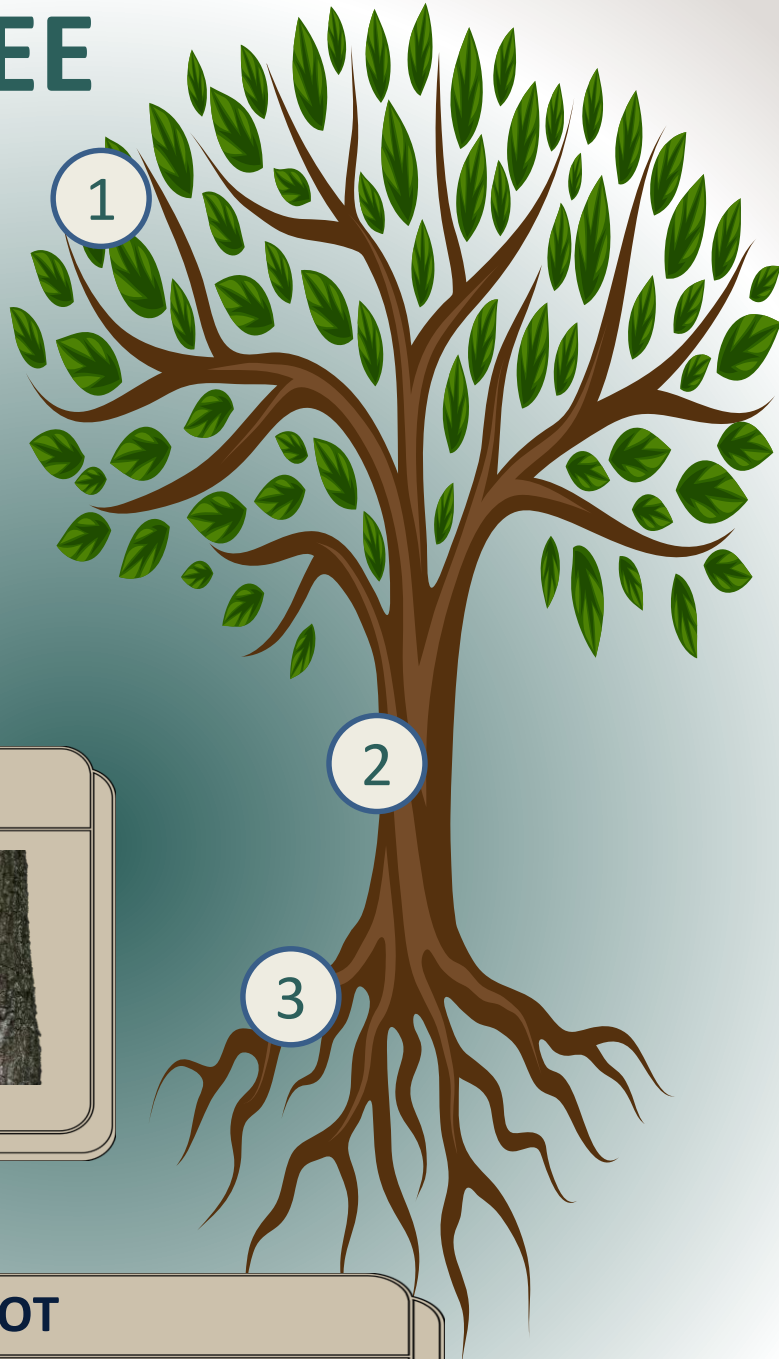
“No matter how beautiful architecture men can make, they will never create such a wonderful thing as a tree.”

- Pier Luigi Nervi

PART OF TREE

1. LEAVES

plant that are flat, thin,
and usually green



2. TRUNK

the thick main stem of
a tree, from which its
branches grow



3. ROOT

the part of a plant which attaches it to
the ground or to a support, typically
underground, conveying water and
nourishment to the rest of the plant via
numerous branches and fibres.



03 | THE CHARACTERISTICS OF TREE



I love the woods: they calm my storms, leaving peace in my eyes

— Fabrizio Caramagna

THE FUNCTION

LEAVES



1. Is an above-ground plant organ specialized for photosynthesis
2. Also can store food (sugars) & water
3. make the oxygen in the air that we breathe

TRUNK



1. Support the branches & leaves
2. convey food from leaf to root or otherwise
3. Transports water & dissolved nutrients from the roots to the leaves
4. As storage place

ROOT



1. absorption of water and inorganic nutrients
2. anchoring of the plant body to the ground.
- .

ACTIVITY 1

Sustainable environmental is very important to life. Discuss how structure of tree can influence the sustainable environmental .



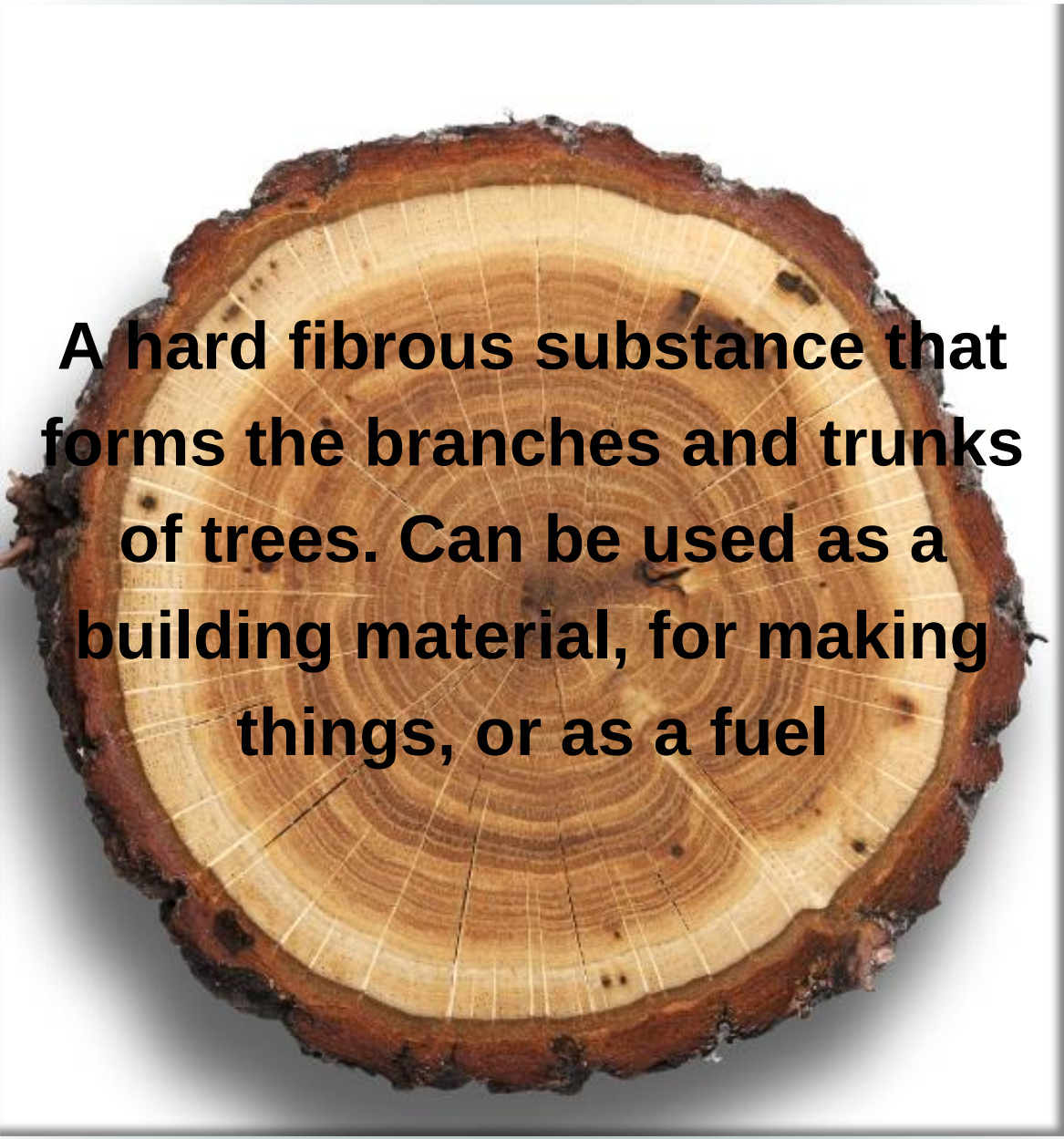
04 | WOOD : SOFTWOOD & HARDWOOD



"What we are doing to the forests of the world is but a mirror reflection of what we are doing to ourselves and to one another."

— Chris Maser

DEFINITION OF WOOD



A hard fibrous substance that forms the branches and trunks of trees. Can be used as a building material, for making things, or as a fuel

Source: <https://en.wikipedia.org/wiki/Wood>

INTRODUCTION OF HARDWOOD & SOFTWOOD



- Classifying wood as either **hardwood** or **softwood** comes down to its physical structure and makeup, and so it is overly simple to think of hardwoods as being hard and durable compared to soft and workable softwoods.
 - This happens to be *generally* true, but there are exceptions, such as in the cases of wood from yew trees, a softwood that is relatively hard and wood from balsa trees, a hardwood that is softer than softwoods.
 - The definition and classification of whether a tree is considered a hardwood or softwood comes down to the seed they produce, not the density of the timber.
-

Anatomical structure of hardwood and softwood

Characteristics	Hardwood	Softwood
Botanical Classification	Angiosperm	Gymnosperm
Tree shape	Shady canopy	Long slender cone
Leaves Type	Porous broad leaves, evergreen	non porous, leaves are long, thin, triangular scale-like, needle-like
Fruit and seed	Seeds are inside the containers (fruits)	Seeds are in the open space of cones
Density	Higher density	Lower density
Mechanical Support	fibers (wood cells)	tracheid
Area	tropical & semi tropical regions	mainly in temperate zone
Example	Oak, Ash	Pine, Spruce, Hemlock



ACTIVITY 2

Differentiate at least three physical characteristics of hardwood and softwood trees



05 | STRENGTH AND WEAK POINTS OF WOOD



"When trees burn, they leave the smell of heartbreak in the air."

— Jodi Thomas



WOOD

Advantages

VS

Disadvantages

- Structural expression
- Natural beauty
- Easy to work
- Good insulation
- Healthy
- Safe, light, strong and durable
- Wide range of engineered solutions
- Readily available
- Easy to cut and shape
- Relatively inexpensive
- Aesthetically pleasing
- Feels good - is tactile

- Wood-Destroying Pests (knots - wood is hard and condensed)
- Durability - Stronger in some places than others
- Moisture
- Burning
- Irregular properties : no two trees are the same
- Grain varies
- Hygroscopic - absorbs and releases water (makes it shrink swell and warp)
- Wood worm can occur



06 | DEFINITION OF FOREST



"Trees are poems that the earth writes upon the sky."

— Kahlil Gebran

FOREST - /'forist/

SIMPLE DEFINITION

A forest is an area of land dominated by trees that combine factors such as tree density, tree height, legal standing, land use and ecological function.

<https://en.wikipedia.org/wiki/Forest>



Forests are natural areas and priceless treasures. Forests have covered almost fifty percent of the earth's surface. Forests provide a variety of interests, including the forest providing raw material resources to humans for industrial development and housing. Indirectly, the forest can provide many job opportunities for the people in the furniture industry in addition to generating the national economy. In addition, the forest is also a habitat for various species of flora and fauna that are very valuable to the country.

The government should take the first step to gazette forest reserves and national parks as an effort to conserve forests. This initiative will attract the attention of the people and non-governmental organizations to provide close cooperation to preserve forests in Malaysia. Next, be able to produce people who love the environment and have an awareness of personal responsibility to contribute energy in solving nature and forest problems. All parties should play their respective roles in the preservation and conservation of the national forest.

Source:

<http://kpkkt.com.my/index.php/introduction>

07 | TYPES OF FOREST



"In a forest of a hundred thousand trees, no two leaves are alike. And no two journeys along the same path are alike."

— Paulo Coelho

FOREST TYPES IN PENINSULAR MALAYSIA

Montane-Ericaceous

Ericaceae family, bamboos, ferns and bryophytes

>1500m

Montane-Oak

Mempening, Berangan and Medang

1200m

Upper Dipterocarp

Meranti bukit, Damar minyak, Bintangor, Keruing,
Balau gunung, Balau gajah and Meranti sarang punai

750m

Hill Dipterocarp

Meranti seraya, Keruing and other Meranti

300m

Lowland Dipterocarp

Meranti, Balau and Kapur

Peat Swamp

Kempas, Bintangor, Meranti paya,
Ramin, Nyatoh, Geronggang and Resak

Mangrove

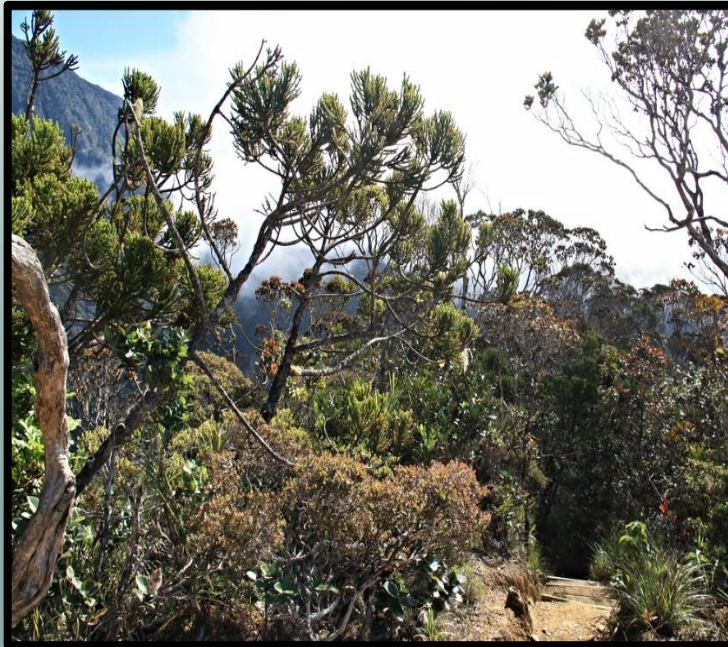
Rhizophora spp. (bakau)

Sources:
www.forestry.gov.my



TYPES OF FORESTS IN MALAYSIA

MONTANE- ERICACEOUS FOREST



Forest located at an altitude above 1,500 meters is known as Montane-Ericaceous Forest. Trees found at this forest type are small in size, gnarled and stunted. Forest floor mostly dominated by species from Ericaceous family such as *Rhododendron spp.* and *Vaccinium spp.* Besides that, bamboos, ferns and mosses also can be found here.

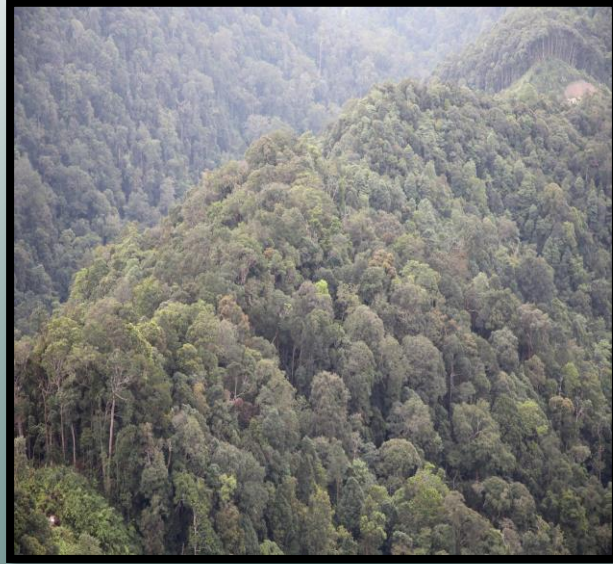
FACTS

In Sabah, Montane-Ericaceous forest type occurs at elevation between 2,500 to 3,500 meters above sea level. The elevation above sea level where this forest changes to montane forest differs from one mountain to another. The recognizable altitudinal zonation in Peninsular Malaysia is obscured in Sabah and Sarawak.

Source: <http://ms1759.mygeoportal.gov.my>

TYPES OF FORESTS IN MALAYSIA

MONTANE OAK FOREST



This forest type can be found between 1,200 to 1,500 meters altitude. The main species found in this forest are *Lithocarpus spp.* (Mempening), *Fagaceae sp.* (Berangan) and *Cinnamomum sp.* (Medang). Dipterocarp species are rare and only a few species can be found here such *Dipterocarpus retusus* (Keruing gunung) and *Vatic spp.* (Resak).

FACTS

Note : In Peninsular Malaysia, montane oak forest is most developed and distinct on the main granitic mountain ranges, such as the Titiwangsa, Bintang, and East Coast mountain ranges. Montane oak forest can be classified into two kinds, the oak-laurel type, and the upper (hill) dipterocarp type. The upper hill dipterocarp/lower montane forest type is basically an extension of the hill dipterocarp forest, but with the absence of the common hill dipterocarp, *Shorea curtisii*. Instead, the dipterocarps that predominate include montane dipterocarps like *Shorea platyclados*, *Shorea ciliata*, *Dipterocarpus retusus*, and *Shorea ovata*, which are all capable of large size.

Source:

[https://www.rainforestjournal.com/lower-montane rainforest/](https://www.rainforestjournal.com/lower-montane-rainforest/)

TYPES OF FORESTS IN MALAYSIA

UPPER DIPTEROCARP FOREST



Forest located at 750 to 1,200 meters a.s.l. Among the species found in this forest are *Shorea platyclados* (Meranti bukit), *Agathis borneensis* (Damar minyak), *Calophyllum* sp. (Bintangor), *Dipterocarpus* sp. (Keruing), *Shorea astylosa* (Balau gunong), *Shorea submontana* (Balau gajah) and *Shorea parvifolia* (Meranti sarang punai) .

FACTS

Shorea platyclados can grow to enormous dimensions. One of the biggest trees in Malaysia is in fact, a *Shorea platyclados* (Meranti bukit in Malay) somewhere in south Kelantan, with a diameter of around 4 m! In valleys/depressions on the granitic mountains where the soil is deep, these mountain dipterocarp trees are a spectacular sight, with their branches and trunks always cloaked in a dense, thick layer of epiphytes and orchids, and their crowns poking high up from the gullies below, sometimes 50-60 meters tall.

Source:

<https://www.rainforestjournal.com/upper-dipterocarp-forest/>

TYPES OF FORESTS IN MALAYSIA

HILL DIPTEROCARP FOREST



Hill dipterocarp forest is the most extensive forest type in Peninsular Malaysia and exists at 300 to 800 meters a.s.l. The main species found are *Shorea curtisii* (Meranti seraya), *Dipterocarpus* (Keruing) and other Meranti's.

FACTS

The hill dipterocarp forest in Peninsular Malaysia is quite unique to it, in the sense that you don't have such a similar formation elsewhere, on the island of Borneo for example, even though both are the centers for mixed dipterocarp biodiversity. Hill dipterocarp forests share plenty of similarities with lowland dipterocarp forest, and some foresters do not recognize any strict demarcation between them, apart from the seraya stands themselves. The balau group of heavy hardwood meranti (mostly the *Shorea* group), is also more common in hill dipterocarp forest. These are much valued timber due to their durability and weight.

Source :<https://www.rainforestjournal.com/hill-dipterocarp-forest/>

TYPES OF FORESTS IN MALAYSIA

LOWLAND DIPTEROCARP FOREST



Forest located below 300 meters a.s.l and consists of a vast variety of tree species. The main species found in this forest type are *Shorea sp.*(Meranti), Balau and *Dryobalanops* (Kapur).

Dipterocarps can grow very tall and large, and they form a very large proportion of the rainforest canopy here in Peninsular Malaysia. An extensive study showed that up to 57% of the emergent layer of the lowland forest in Peninsular Malaysia is composed of dipterocarps. In Sarawak, dipterocarps comprise even more of the emergent and canopy layer, at 75%, while in Sabah, it can be as high as 90%. Little wonder then, that Sabah has the tallest dipterocarps ever found to date; in fact Sabah has the tallest tropical trees in the world.

FACTS

The current tallest tropical tree in the world is a *Shorea faguettiana* in Danum Valley, Sabah, which was taped drop measured at 100.8 meters tall. This astounding find surpasses all the previous records and dispels previous notions scientists had of tropical tree height. In fact this tree which has been named as “Menara” (Malay for “Tower”) is the second tallest tree (so far found) in the entire world.

Source: <https://www.rainforestjournal.com/dipterocarp-trees/>

TYPES OF FORESTS IN MALAYSIA

PEAT SWAMP FOREST



This forest is formed on peat soil with a depth of about 6 meters in aqueous and acidic. This forest is located behind the coastline. Among the species commonly found in the forest are *Koompassia malaccensis* (Kempas), *Calophyllum spp.* (Bintangor), *Shorea platycarpa* (Meranti paya), *Gonystylus spp.* (Ramin), *Sapotaceae sp.* (Nyatoh), *Cratoxylum spp.* (Geronggang) and *Vatica spp.* (Resak).

The peat is formed from the accumulated semi-decomposed leaves and other plant material deposited on sulphidic marine clay or riverine alluvium that creates anaerobic conditions and retards decomposition. The water is black because of the tannins and other alkaloids that leach from the leaves, and acidic, with a pH value of 2.9 to 4.5. Soil nutrients are low because the leaf litter accumulates but do not decompose to add nutrients to the soil.

The peat swamp forests are characterized by trees with adaptations such as stilt roots, buttresses, and pneumatophores, or roots that grow upwards and out of the water to allow the trees to breathe in anoxic conditions. The forest canopy can have emergent, middle and understory trees.

TYPES OF FORESTS IN MALAYSIA

PEAT SWAMP FOREST



FACTS

Malaysian peat swamp forests (PSF) are significantly available in term of size in states of Selangor, Pahang, Sabah and Sarawak. Based on statistic of 2017, there was about 1.14 million ha PSF in Sarawak and 0.12 million ha in Sabah. However, all PSF in Sabah are classified as conservation forests. As for Peninsular Malaysia, the PSF occur behind the coastal line along both the west and east coasts and estimated to be about 0.30 million ha.

Source: <https://info.peatblackwaterjewel.com>

TYPES OF FORESTS IN MALAYSIA

MANGROVE FOREST



Characterized by its location which is situated in the coastal areas and experience low and high tides. The main species found in this forest is *Rhizophora* spp (bakau). The vegetation in this ecosystem is characterized by the unique root system known as stilt roots and pneumatophores as well as thick leaf structures. Matang mangrove forest is managed under sustainable forest management system and is recognized as the best managed mangrove forest in the world.

FACTS

Mangrove trees have special adaptations to enable them to colonize their environment, such as leaves that can excrete salt, viviparous breeding (fruits that germinate while attached to the parent tree), stilt and buttress prop roots to support them in the muddy substrate, and pneumatophore roots (aerial roots that can breathe).

Source : <https://www.rainforestjournal.com/mangrove-forest/>

TYPES OF FORESTS IN MALAYSIA

FOREST PLANTATION



The development of large-scale commercial forest plantations (March 2005). Out of the nine selected species, two major species related are Rubberwood (Timber Latex Clone) and Acacia spp. (mangium /hybrid). Other additional fast growing timber species recommended are *Tectona grandis* (Teak); *Azadirachta excelsa* (Sentang); *Khaya* spp. (*Khaya ivorensis*/*Khaya senegalensis*), *Neolamarckia cadamba* (Kelempayan/Laran); *Paraserianthes falcata* (Batai), *Octomeles sumatrana* (Binuang) and Bamboo (five selected commercial bamboo species).

FACTS

Every 25,000 ha of mature forest plantation is expected to produce 5 million m³ of timber. Malaysia's climate and soil conditions are highly conducive for the fast growth of tree plantations. Up to September 2016, a total of 112,008.43 ha of forest plantations have been developed under the Forest Plantation Development Programme. A total of RM600.4 million (US\$145 million) of government loan has been disbursed to develop forest plantations. The first forest plantation projects are due to mature in 2021 and are located in Kelantan, Pahang and Selangor in Peninsular Malaysia and in Sarawak, with an expected yield of 3.78 million m³ of logs.

Source :<http://mtc.com.my/resources-ForestPlantationsinMalaysia.php>



“It takes a noble man to plant a seed for a tree that will someday give shade to people he may never meet.”

— D. Elton Trueblood

WOOD CLASSIFICATION



Heavy Hardwood (density : 800 -1120 kg/m³)



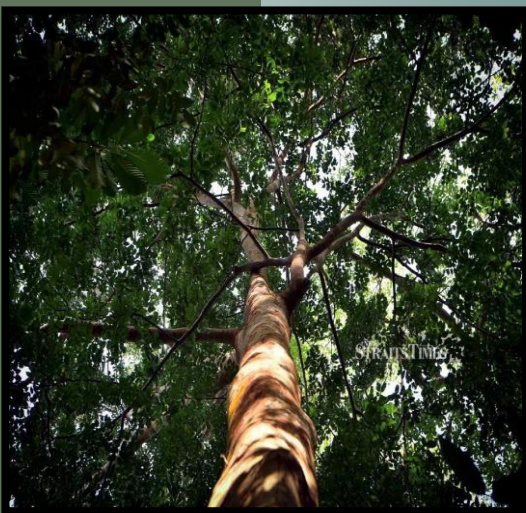
Medium Hardwood (density : 720 -880 kg/m³)



Light Hardwood (density : 400 -720 kg/m³)



Softwood (density < 400 kg/ m³)



Merbau Tree

FACTS

Merbau was officially announced as Malaysia's national tree by Prime Minister Tun Dr Mahathir Mohamad during his speech when he officiated the *Hutan Kita: Journey Through Our Rainforest* at the Kuala Lumpur Tower on 23 August 2019. The PM said that he believes that Malaysians can take the *merbau* as a symbol as national pride due to its hardy nature.

Source: :
<https://www.nst.com.my/news/nation/2019/08/515369/merbau-now-malaysias-national-tree>

HEAVY HARDWOOD

There are heavy or very heavy constructional timbers ranging in density from about 800kg/m³ to 1120 kg/m³ at 15 % moisture content. They are naturally durable as they contain within their tissue some toxic materials, e.g. alkaloids or other substances repellent to wood destroying agents and can therefore be safely used without preservative treatment even in positions exposed to fungus or termite activities the sapwood of these timbers however, is not durable.

Source : <https://www.yleminent.com.my>



Balau

Source: <http://www.kamwo.com.my>

MEDIUM HARDWOOD

There are moderately heavy to heavy constructional timbers ranging in density from about 720 to 880 kg. per cu. m . at 15 per cent moisture content. Some of these timbers are heavy and strong enough to be classified as “Heavy Hardwoods” but under tropical conditions they lack sufficient natural durability when exposed to the weather or in contact with the ground unless they are properly treated with preservatives before use. Most of them however, are naturally durable in temperate countries where climatic conditions are less conducive to the activity of the wood destroying agents.

Source : <https://www.yleminent.com.my>



Keruing

Source : <https://nzawoodsb.com>

LIGHT HARDWOOD

These include all the relatively light weight and soft timber which range in density from about 400 to 720 kg/m³ at 15 per cent moisture content. They are the 'general utility' timbers of Malaysia comparable with the general utility timbers in temperate climates; the latter however, are mainly softwoods (conifers).

In addition to general utility purpose many of these Light Hardwoods are excellent for high class joinery work, cabinet making, furniture, decorative panelling, etc. Although not naturally durable in tropical climate, some are quite durable in temperate regions. Provided that proper precautions are taken against attack by wood destroying agents, the Light Hardwoods as a whole make very satisfactory timbers for general construction even when used in tropical climates.

Source : <https://www.yleminent.com.my>



Red Meranti

Source : <https://my.all.biz/>

SOFTWOOD

Softwood is renowned for its versatility and strength. Sourced from all over the globe, with a large breadth of applications and a remarkably aesthetic appeal, softwood can be used across a broad range of internal and external projects - from furniture and flooring, to decking, landscaping, external joinery and structural applications. **Softwoods are more readily available and easily manipulated.** They also develop at a quicker pace, leading to lower cost levels. They are flexible, lighter in weight and less dense than most hardwoods. Softwoods are commonly used for interior mouldings, **the manufacturing of windows, construction framing and generating sheet goods such as plywood and fibreboard.** At Arnold Laver we have the broadest and most comprehensive range of softwood species and grades to cover all timber requirements.

Source : <https://www.yleminent.com.my>



Damar Minyak

Source : Smartwood Industries Official Facebook



"To really feel a forest canopy one must use different senses, and often the most useful one is the sense of imagination."

— Joan Maloof

COMMERCIAL & NON COMMERCIAL WOOD



Heavy Hardwood



Medium Hardwood



Light Hardwood



Softwood



HEAVY HARDWOOD

- **Balau**
- **Balau merah**
- **Belian**
- **Bitis**
- **Chengal**
- **Giam**
- **Kekatang**
- **KerANJI**
- **Malagangai**
- **Merbau**
- **Penaga**
- **Penyau**
- **Resak**
- **Tembusu**



Balau

Source:

<https://www.horizon-custom-homes.com/>

MEDIUM HARDWOOD

- ❖ Alan Batu
- ❖ Bekak
- ❖ Derum
- ❖ Entapuloh
- ❖ Geriting/ Teruntum
- ❖ Kandis
- ❖ Kapur
- ❖ Kasai
- ❖ Kayu malam
- ❖ Kedang belum /
Tulang daing
- ❖ Kelat
- ❖ Keledang
- ❖ Kempas

- ☐ Pauh kijang
- ☐ Perah
- ☐ Petaling
- ☐ Punah
- ☐ Rangu
- ☐ Rengas
- ☐ Semayur
- ☐ Senumpul
- ☐ Simpoh
- ☐ Tampoi
- ☐ Tualang

- ✂ Keruing
- ✂ Keruntum
- ✂ Kulim
- ✂ Mata Ulat
- ✂ Mempening
- ✂ Mengkulang
- ✂ Meransi
- ✂ Merawan / Gagil
- ✂ Merbatu
- ✂ Merpauh
- ✂ Mertas
- ✂ Nyalin



Keruing

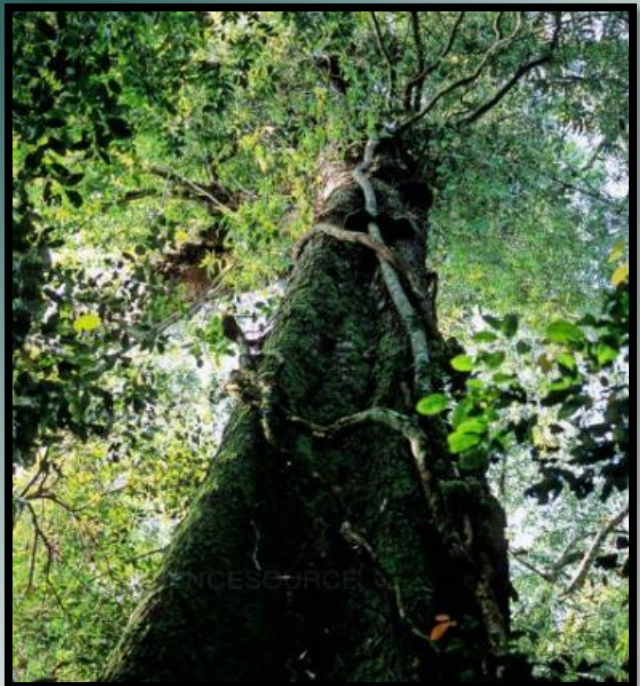
Source:

<https://rindangsekali.wordpress.com>

LIGHT HARDWOOD

- Alan bunga ✓ Kedondong ○ Ramin
- Ara ✓ Kelumpang ○ Sengkuang
- Babai ✓ Kembang Semangkok ○ Sentang
- Bayur ✓ Ketapang ○ Sepetir
- Berangan ✓ Kungkur ○ Seraya putih
- Bintagor ✓ Laran ○ Sesendok
- Binuang ✓ Macang ○ Terap
- Dedali ✓ Mahang ○ Terentang
- Durian ✓ Medang
- Geronggang ✓ Melantai
- Gerutu ✓ Melunak
- Jelutong ✓ Mempisang
- Jongkong ✓ Meranti Bakau
- Kayu getah

- Meranti kuning
- Meranti merah muda
- Meranti merah tua
- Meranti putih
- Merbulan
- Mersawa
- Nyatoh
- Pelajau
- Panarahan
- Perupok
- Petai
- Pulau



Meranti

Source:
<https://www.misarma.com/>

SOFTWOOD

🌳 Damar minyak

🌳 Podo

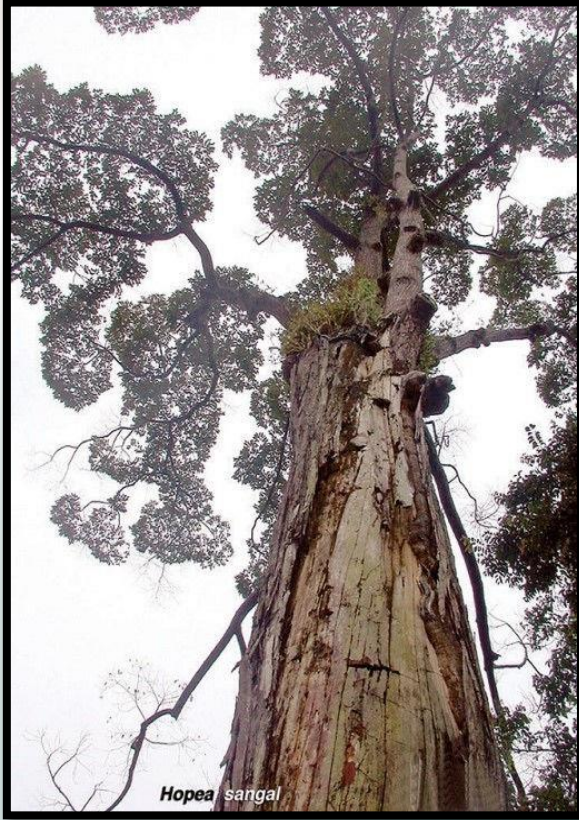
🌳 Sempilor



Damar minyak

Source : [https://www.flickr.com/photos Ahmad Fuad Morad](https://www.flickr.com/photos/AhmadFuadMorad)

MOST POPULAR SPECIES IN MALAYSIA (MTC,2019)



Chengal

Source:

<https://archimediaunit.wixsite.com/>

- Balau (*Shorea* spp.)
- Bintangor (*Calophyllum* spp.)
- Chengal (*Neobalanocarpus heimii*)
- Dark Red Meranti (*Shorea* spp.)
- Gerutu (*Parashorea* spp.)
- Kasai (*Pometia* spp.)
- Kelat (*Syzygium* spp.)
- Keledang (*Artocarpus* spp.)
- Keruing (*Dipterocarpus* spp.)
- Mengkulang (*Heritiera* spp.)

- Merbau (*Intsia* spp.)
 - Nyatoh (*Palaquium* spp.)
 - Kembang Semangkok (*Scaphium* spp.)
 - Kempas (*Koompassia malaccensis*)
 - Red Balau (*Shorea* spp.)
 - Yellow Meranti (*Shorea* spp.)
 - Sepetir (*Sindora* spp.)
 - Mersawa (*Anisoptera* spp.)
 - Merpauh (*Swintonia* spp.)
 - Rubberwood (*Hevea brasiliensis*)
-

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SAPWOOD OF YOUNG TEAK FROM THINNING AS POTENTIAL MATERIAL FOR MAKING PRODUCTS Case Study: Sapwood of Young Teak from Teak Plantation in Java, Indonesia Imam Damar DJATI*, Takatoshi TAUCHI**, Mitsunori KUBO**, Fumio TERAUCHI**THE SCIENCE OF DESIGN BULLETIN OF JSSD Vol. 61 No. 5 2015

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INTRODUCTION TO TREE

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