Tropical Rainforests

How Can We Save The Rainforests?

Rainforests are being threatened all around the world, and Singapore is no exception. Singapore is located in the area where lush tropical rainforests grow. Unfortunately, the only areas of tropical rainforests left in Singapore are in the central parts of the country.

In this chapter, we will learn how to preserve tropical rainforests and prevent them from being wiped out.

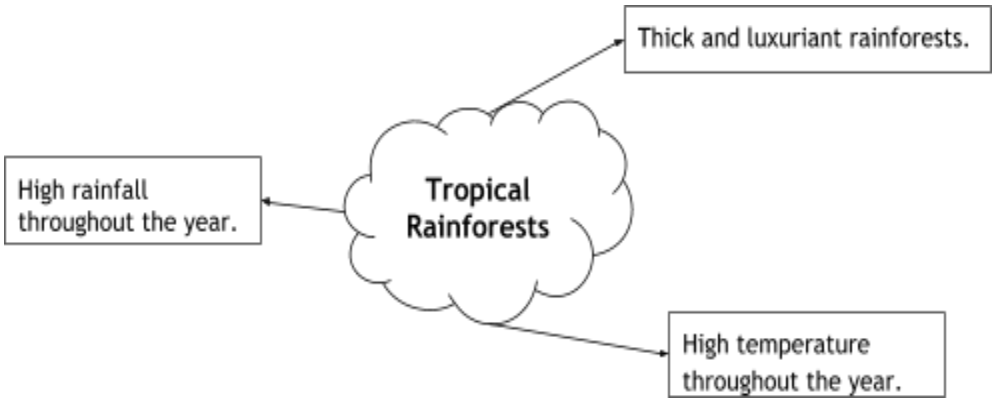
Questions that can help us learn more about saving tropical rainforests:

- What are tropical rainforests?
- What is deforestation?
- Where are tropical rainforests found and which areas have been deforested?
- Why does deforestation occur?
- How does deforestation impact people and the environment?
- How should we manage deforestation?

What Are Tropical Rainforests?

In this chapter, we will learn more about tropical rainforests. Let's first take a look at their characteristics and uses.

Characteristics of tropical rainforests



Let's take a closer look at the characteristics of tropical rainforests, namely the:

- Diversity of plant species
- Structure of the tropical rainforest
- Adaptation of plants

Diversity of plant species

Tropical rainforests are found in hot and wet environments. These allow a huge variety of animals and plants to flourish throughout the year, giving rise to rich biodiversity. Biodiversity refers to the range of plant and animal species found in a certain area.

Many different types of food that we eat can be found in tropical rainforests, which include:

- Fruits such as bananas and mangoes;
- Spices such as pepper and cinnamon;
- Vegetables such as corn and pandan; and
- Nuts such as Brazil nuts and walnuts.

Structure of the tropical rainforest

In a tropical rainforest, plants grow to various heights. This gives rise to the three-layered structure which is often associated with tropical rainforests.

Emergent layer 50m

Characteristics

Some trees in tropical rainforests can grow up to 50m, and some even up to 80m. These trees are known as emergent trees as they rise through the canopy below and tower above the other trees. The **emergent layer** is formed by the crowns of these trees.

Canopy layer 30m

In the **canopy layer**, many trees grow to heights of 20 - 30m to reach for sunlight. These trees block up to 90% of the sun's rays from reaching the forest floor. The dense unbroken canopy also catches much of the rain when it falls.

Lianas and epiphytes grow in this layer. Lianas are thick, woody vines that grow on the ground and twine up trees to reach for sunlight. Epiphytes are plants which grow on trees to receive sunlight, and this increases their chances of dispersing their seeds or spores by wind.

Undergrowth layer 20m

The **undergrowth layer** is dark as most of the sun's rays are blocked by the canopy above. These plants have larger leaves than plants in other layers to capture sunlight. Plants in this layer are small, thin and widely spaced due to the lack of sunlight.

Vegetation near the forest floor is sparse except for openings created by fallen canopy trees. The hot and wet environment causes rapid decomposition, leaving a thin layer of leaf litter.

Some plants found in:

Emergent layer:

- Kapok tree
- Tualang tree

Canopy layer:

- Staghorn ferns
- Bird’s nest fern

Undergrowth layer:

- Monkey ladder vines
- Fungi
- Mosses

Adaptation of plants

Parts of plants	Adaptive features
Bark and branches	Most of the trees have tall, straight trunks with branches spread out near the top of the trees. This helps the trees to obtain the maximum amount of sunlight. The smooth bark allows rain to flow easily from the crown to the roots of the trees.
Leaves	The leaves are broad in order to capture sunlight for photosynthesis. The leaves have waxy, leathery or hairy surfaces. These minimise the loss of moisture through transpiration due to the high temperatures Some of the leaves have **drip tips** to allow water to run off easily, which prevents fungi and bacteria from growing in the leaves.
Fruit and flowers	Air is usually still in tropical rainforests. This makes it hard for seed dispersal and pollination to occur by wind. Hence, fruits and flowers are colourful and strong-smelling to attract insects and other animals for dispersal or pollination
Roots	**Buttress roots** are large roots which grow from 1 - 5 metres above the ground. The trees in the rainforest have buttress roots to support their heavy weight, as the rainforest has favourable climate conditions for plant growth. The roots are shallow as the nutrients, which consist of decomposed fallen leaves and branches, are mostly found in the top layer of the soil. Trees do not to develop deep roots to search for underground water as water is available throughout the year.

Uses of tropical rainforests

Although tropical rainforests grow only in certain parts of the world, they have many uses and are important to people all over the world. The following are some uses of tropical rainforests.

Water catchment

Water catchment refers to an area drained by a river and the smaller rivers that flow into it. When rain falls in tropical rainforests, the trees stop it from reaching the ground directly. As water slowly drips from the trees, it seeps into the ground and is stored as groundwater. In this way, tropical rainforests are large water catchment areas.

Green lungs of the earth

Tropical rainforests help the earth to ‘breathe’, hence are called the **green lungs of the earth**. Tropical rainforests absorb carbon dioxide from the atmosphere and release oxygen through photosynthesis. More than 20% of the earth’s oxygen is estimated to be produced by the Amazon rainforest alone.

Habitat to flora and fauna

Tropical rainforests are home to more than 2 million species, which represents over half of the world’s species of plants, animals, insects and a huge variety of fungi.
The abundance and diversity of **flora** and **fauna** could be due to two main reasons:

- The ample sunlight is converted into energy and food through photosynthesis, and this allows the plants to thrive. These plants are then eaten by animals for survival.

- The continuous canopy is a habitat where other plants can grow and animals can live in.

Habitat to indigenious people

Many indigenious people have been living in tropical rainforests for thousands of years. They are the original inhabitants of a country. The rainforests provide these people with daily necessities such as food, clothing and medicine.

The indigenious people obtain food either by hunting and gathering, or agriculture, which is the growing of crops for human use, mainly for food. The food that the indigenious people produce is just sufficient to feed themselves. This type of agriculture is known as subsistence cultivation. Indigenious people are either hunter-gatherers, or shifting cultivators.

- Hunter-gatherers hunt, fish and gather wild fruits and nuts.

- Shifting cultivators grow their own plants for food and medicine. They first clear the land by burning the vegetation, then rely on the burnt vegetation to provide the nutrients to fertilise the plants. When the nutrients in the soil have been used up, and the soil cannot support any more plants, the shifting cultivators would move to another plot of land in the forest and leave original plot to regain it’s fertility naturally.

Source of timber

Tropical rainforests provide wood fuel in countries where people depend on fire to cook.

Timber refers to the wood used to build or make things. Tropical hardwoods such as teak, ebony, mahogany and meranti are valued for their strength, durability, texture and beauty.

Medical application

Tropical rainforests are also known as ‘the world’s largest pharmacy’ as they have been a huge source of medicine. Many of the foods from tropical rainforests, such as Brazil nuts, have cancer-fighting properties.

Examples of some rainforest plants and their medical uses:

- **Cinchona tree:** Used to treat malaria (a disease characterised by chills and fever at regular intervals)
- **Madagascar periwinkle plant:** Used to treat childhood leukaemia (a form of cancer)
- **Clavillia plant:** Used to treat eczema and itchiness

What is deforestation?

In 1980, tropical rainforests covered an area of 19.1 million square kilometres of the earth’s land surface. In just 10 years, this area decreased to 17.9 million square kilometres due to deforestation, according to the Food and Agriculture Organization of the United Nations (FAO).

Deforestation is the cutting down and removal of all or most of the trees in a forested area. If not managed properly, deforestation can lead to the permanent destruction and eventually disappearance of a once renewable resource: trees.

Trees are considered a renewable resource because they can be replanted after they have been cut down. However, if the rate of

deforestation is faster than the rate of replanting, it is possible to lose the trees forever.

Where are tropical rainforests found and which areas have been deforested?

Global distribution of tropical rainforests

Tropical rainforests are found on **less than 5 percent of the earth's land surface.** The growth and distribution of tropical rainforests are influenced by climate conditions, which are the average weather conditions of a place over a long period of time.

Tropical rainforests require abundant sunlight, high temperatures and heavy rainfall throughout the year. Thus, they are found in areas which experience the **equatorial climate**. These areas are near the Equator, between 10N and 10S.

Distribution of tropical rainforests in Singapore

Many parts of Singapore were originally covered with rainforests. After Singapore was colonised in 1819, its rainforests were rapidly cleared to grow crops and build infrastructure. By 1882, only 7 percent of the original rainforests were left. The remaining tropical rainforests occupy an area of around 20 square kilometres. This is about 3 percent of Singapore's total land area.

Global distribution of deforested areas of tropical rainforests

Rainforests are disappearing around the world because of human activities such as agriculture, mining, logging and land clearance for housing and industries. Meanwhile, the remaining forests are not only smaller, but they are also broken up into fragments. Hence, there is less biodiversity in the rainforest.

Why does deforestation occur?

Some of the human activities that cause deforestation are:

Agricultural activities

Agriculture refers to the growing of crops and raising of animals to provide food.

Cattle ranching

Cattle ranching involves operating large farms to raise cattle. Large areas of rainforest are cleared to create land for cattle to graze.

Logging

Logging refers to the cutting down of trees for timber. Commercial logging of tropical hardwoods is a major cause of deforestation in Southeast Asia and Africa. Logging not only reduces the number of trees but damages the rainforest as a whole.

Mining

Precious metals and gemstones such as gold, copper and diamonds are found beneath many tropical rainforests. Forests are cleared to establish the mines and construct roads to transport the mined minerals.

How does deforestation impact people and the environment?

Environmental impact

Tropical rainforests are crucial and beneficial to people and the environment. Hence, losing rainforests would result in the loss of these benefits.

Loss of biodiversity

Deforestation destroys the habitats of plants and animals, resulting in **loss of biodiversity.** This refers to the loss of the variety of plants and animals. With the loss of biodiversity, the variety of resources that we can obtain from the rainforest, such as food, medicine and timber, will also be gone.

Loss of water catchment areas

Forests play an important role in maintaining our water supply. Forests enable water to be collected and stored within a water catchment area.

Clearing trees disrupt the water cycle. Trees absorb water through their roots and release it into the atmosphere through transpiration. The water in the atmosphere eventually falls again as rain. When trees are removed, the water cycle is affected, leading to a drier climate and drier soils. Hence, the ground no longer contains and receives as much water.

Increased risk of flooding, soil erosion and sedimentation

The clearing of tropical rainforests also increases the **risk of flooding**. Soil in the forests absorb rainwater and releases it slowly into the rivers. When rain falls, forests intercept the rain and allow the rainwater to seep into the ground. **Infiltration** is the process where rainwater seeps into the ground. When trees are cleared, the ground is left bare. Rainwater falls directly on the ground and flows over the surface more rapidly as surface runoff. This causes flooding in the surrounding areas.

Soil erosion is another impact of deforestation. It refers to the removal of the top layers of soil by rainwater, wind and destructive human activities such as logging. Tree roots hold the soil to the ground and keep the ground stable. When the trees are removed, land becomes exposed. Therefore, the water washes the soil away when it rains.

Eroded soil is often washed into rivers, increasing the amount of sediments in the rivers. This affects water quality and, hence, aquatic life. **Water quality** is a measure of the condition of water in terms of whether it is suitable for a specified purpose.

Enhanced greenhouse effect

A greenhouse is a building made of glass, where you grow plants that need protection from cold weather. The glass allows sunlight to pass through, warming the plants. At night, the heat is trapped by the glass, thus it cannot escape. Therefore, the greenhouse stays warm even in cold weather.

Like the greenhouse, the earth's atmosphere keeps the earth warm enough for us to live in.

The amount of greenhouse gases (e.g carbon dioxide, methane, water vapour and some other gases) in the atmosphere has increased because of human activities such as the setting up of industries, transport network and power stations. Many scientists think that this has led to a rise in the earth's average temperature as more heat is trapped in the atmosphere. This is called the **enhanced greenhouse effect**.

Deforestation is one of the human activities contributing to the enhanced greenhouse effect. Deforestation increases the amount of carbon dioxide in the atmosphere. This is because trees absorb carbon dioxide from the atmosphere and store it as carbon. The stored carbon is released into the

atmosphere when trees are cut down. Less trees means that less carbon dioxide is absorbed and more of it remains in the atmosphere.

The burning of rainforests also releases carbon dioxide into the atmosphere. Branches and logs that are left behind become fuel for forest fires.

Economic impact

Depletion of natural resources

Tropical rainforests provide important natural resources that contribute greatly to the economic growth of many countries. Tropical rainforests provide natural resources such as timber, food and water, which are essential for many industries.

Rapid deforestation often destroys the rainforest faster than it can replenish itself. As a result, many natural resources provided by rainforests are being depleted. This affects the earnings of industries that rely on rainforest resources.

Social impact

Effects on indigenious people

Cutting down rainforests to create land affects the lives of indigenious people.

Besides losing their homes, indigenious people are forced to adapt to a new way of living. The loss of rainforests means they have to find other ways to survive. This displacement from their homes also often causes indigenious tribes to disperse and cultures to disappear.

How should we manage deforestation?

Managing deforestation in the Amazon

Protection of forested areas

Protection of forested areas refers to the setting of laws to protect an area from unfavourable activities. Such activities might endanger the biodiversity and natural resources found in the area.

Reforestation

Reforestation is the planting of trees in areas where the original forest has been cleared. It often involves non-profit organisations, companies and local communities.

Controlled logging

Controlled logging refers to the careful management of forests that are being logged. Controlled logging allows logging only in certain areas and in a sustainable manner (e.g only selected plant species can be logged)

Public education

To manage deforestation, people's attitude and practices towards rainforests needs to be changed. This begins with education. People need to be told of the importance of rainforests and ways to contribute to conserving rainforests.

Conserving tropical rainforests in Singapore

Protection of forested area

The main areas where tropical rainforests are found today are protected as nature reserves by the Parks and Trees Act 2005. They are not to be developed for other uses. The Parks and Trees Act 2005 contains guidelines for visitors to the nature reserves to minimise disturbance to the rainforest.

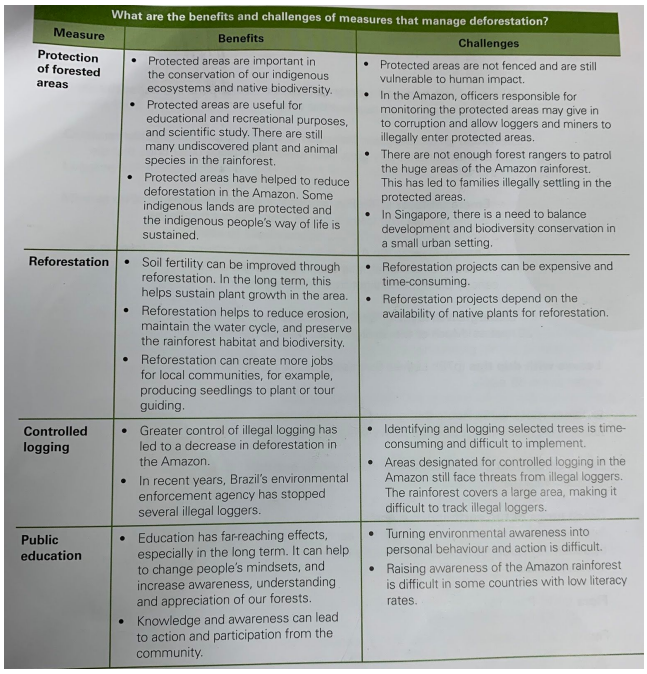
Reforestation

Reforestation projects were carried out to improve the condition of the forests. Some areas of the forest had poor soil and vegetation due to unsustainable agricultural practices.

Public education

The Singapore government aims to promote people's understanding of our forests by:

- **Increasing appreciation, awareness and understanding of nature through public seminars, road shows and events**
- **Promoting volunteerism through biodiversity interest groups**
- **Incorporating elements of biodiversity conservation into the school curriculum**



What are the benefits and challenges of measures that manage deforestation?

Measure	Benefits	Challenges
Protection of forested areas	• Protected areas are important in the conservation of our indigenous ecosystems and native biodiversity. • Protected areas are useful for educational and recreational purposes, and scientific study. There are still many undiscovered plant and animal species in the rainforest. • Protected areas have helped to reduce deforestation in the Amazon. Some indigenous lands are protected and the indigenous people's way of life is sustained.	• Protected areas are not fenced and are still vulnerable to human impact. • In the Amazon, officers responsible for monitoring the protected areas may give in to corruption and allow loggers and miners to illegally enter protected areas. • There are not enough forest rangers to patrol the huge areas of the Amazon rainforest. This has led to families illegally settling in the protected areas. • In Singapore, there is a need to balance development and biodiversity conservation in a small urban setting.
Reforestation	• Soil fertility can be improved through reforestation. In the long term, this helps sustain plant growth in the area. • Reforestation helps to reduce erosion, maintain the water cycle, and preserve the rainforest habitat and biodiversity. • Reforestation can create more jobs for local communities, for example, producing seedlings to plant or tour guiding.	• Reforestation projects can be expensive and time-consuming. • Reforestation projects depend on the availability of native plants for reforestation.
Controlled logging	• Greater control of illegal logging has led to a decrease in deforestation in the Amazon. • In recent years, Brazil's environmental enforcement agency has stopped several illegal loggers.	• Identifying and logging selected trees is time-consuming and difficult to implement. • Areas designated for controlled logging in the Amazon still face threats from illegal loggers. The rainforest covers a large area, making it difficult to track illegal loggers.
Public education	• Education has far-reaching effects, especially in the long term. It can help to change people's mindsets, and increase awareness, understanding and appreciation of our forests. • Knowledge and awareness can lead to action and participation from the community.	• Turning environmental awareness into personal behaviour and action is difficult. • Raising awareness of the Amazon rainforest is difficult in some countries with low literacy rates.