

### Key Terms

Biome  
 Ecosystem  
 Diurnal temperature range  
 Inter-tropical convergence zone  
 Photosynthesis  
 Permeable  
 Impermeable  
 Weathering  
 Regulate  
 Intercept  
 Surface runoff  
 Transpiration  
 Abiotic  
 Biotic

### Exam questions

1. State two local factors affecting biomes (2)
2. Describe the distribution of the tropical rainforest biome. (3)
3. Compare the characteristics of tropical rainforest and desert biomes. (4)
4. Explain the difference between bio-physical and bio-chemical weathering (4)
5. Define the term 'biotic' (1)

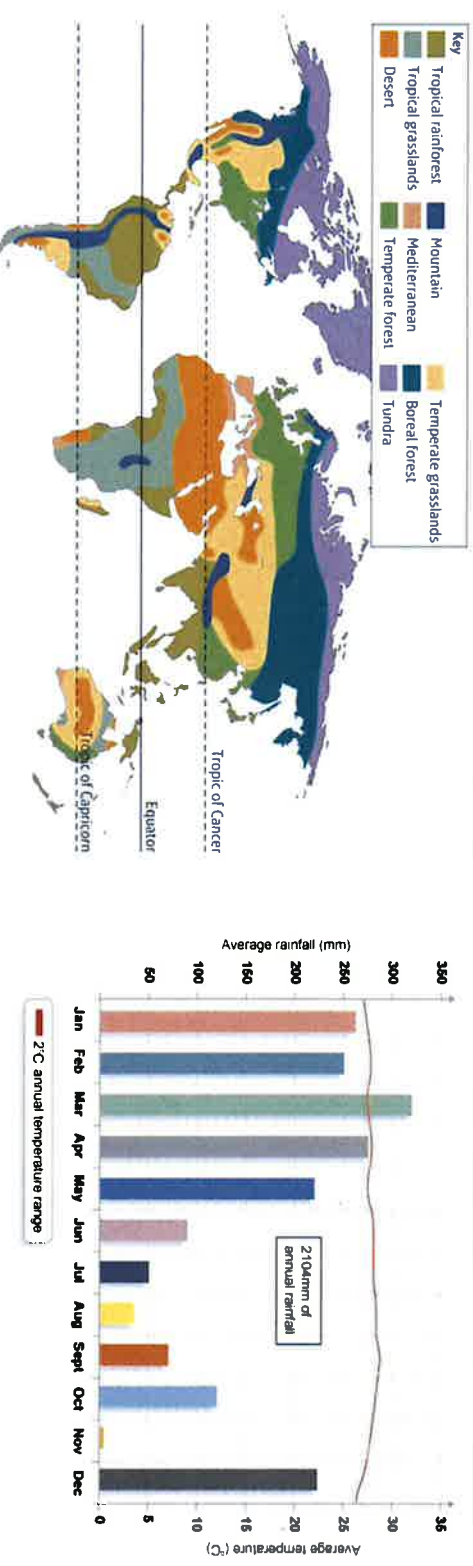
## Topic 7: People and the Biosphere

The Earth is home to many ecosystems and their distribution is affected by many factors

Biomes are large scale ecosystems like the tropical rainforest. Distribution is a key concept that describe the location of something—To describe the location of a biome, you can state what the biome is located between, you can add more detail by stating the latitudes it is generally found between and use place location such as the continents. A good description would state any anomalies in the distribution of a biome.

Characteristics—The specific features that allow us to identify how one place/thing differs from another. Differences between the climate and vegetation of biomes—

- Tropical rainforest—Hot all year (25-30°C), wet all year (annual precipitation 200-3000mm). There is dense forest with several layers of trees.
- Tropical grasslands (Savannah) - Hot all year (25-25°C). 500-1000mm rainfall in a year with a distinct dry season. Tall grasses and drought adapted shrubs and trees.
- Deserts—Very hot all year (+30°C), with cool nights (large diurnal temperature range). Low precipitation (>250mm a year). Scarce plants that have water storage features and extensive routes.
- Temperate grassland—Hot in summer (25°C), very cold in winter (as low as -40°C). 500-900mm rainfall a year mainly in spring and summer. Short grasses with very few trees and bushes.
- Temperate forest—Warm summers (18°C), cool winters (5°C). Precipitation all year round with an average 1000mm year. Deciduous trees such as oak.
- Boreal (Coniferous) forest—Mild summers (10-20°C), very cold winters (Below 0°C). Low precipitation (less than 500mm) mainly in the summer.
- Tundra—Temperatures below 0°C for most of the year and only reaching around 10°C in the summer. >250mm precipitation. Mainly lichens and mosses as plants can't survive.



### Climatic factors affecting the distribution of biomes:

- Tropical rainforest—Generally occur near the equator due to high solar radiation and rainfall. The sun is generally directly overhead all year and the heat causes the air to rise (warm air is less dense), as it rises it cools, causing the water vapour in the air to condense, forming clouds and precipitation. The low pressure system created is called the inter-tropical convergence zone.
- Tropical grassland—Occur further away from the Equator. They are located where temperatures are still high and there is a distinct dry season that prevents tree growth.
- Hot deserts—Occur along the Tropic of Cancer and the Tropic of Capricorn. A high pressure system is present meaning the air is sinking. As the air sinks it is warmed and can hold more moisture so there is little condensation and cloud formation. This leads to high temperatures during the day. At night it is cooler as the ground does not retain heat very well and there are few clouds to act as a blanket. With little clouds there is little rainfall.
- Temperate forests—Generally located in high latitudes. The atmosphere consists of low pressure systems; the rising air helps create year round rainfall. In winter there is less sunlight so less photosynthesis occurs therefore trees lose their leaves to conserve energy.
- Temperate grasslands—Occur at similar latitudes to temperate forests, but are generally on the interior of continents (away from coasts/large bodies of water). Seasons are more pronounced. They have mild summers and very old winters which limits plant growth.
- Boreal forests—These occur further north than temperate forests, and are generally only located in the Northern hemisphere as there is little land at the same latitude in the Southern hemisphere. The temperatures are colder as there is a high pressure system so the air is sinking. There is also low precipitation. The conifer trees have adapted to the conditions having a waxy coat to prevent freezing and allow quick photosynthesis.
- Tundra biome—Occurs closest to the poles. Plant growth is limited by low precipitation and few sunlight hours. There is a consistent high pressure system here meaning evaporation is slow. Generally, mosses and lichen are the only things that can grow. There are also very high winds as there are few plants to slow it down.

### Local factors affecting biomes

- Altitude—The temperature falls by 0.5-1°C for every 100m climb in height. Mountains are also exposed to higher winds making it hard for plants to grow. As slopes are steep they have thin soils preventing plant growth.
- Rock type—Some rocks are hard and prevent growth of plant life and others are soft so roots can easily break through them. Some rocks are permeable allowing water to go through them (Chalk) others are impermeable (Slate). Permeable rocks can encourage plant growth.
- Soils—These are a mixture of rock, dead plants and animals, air and water. Different plants grow in different soil. Sandy soil is extremely permeable and cannot hold water well, plants have to be drought tolerant to grow in sandy soil. Clay soil is slightly impermeable due to small pores; this generally creates puddles that last a long time collecting nutrients. Plants like Wheat grow well in this soil. Chalky soil is permeable and water drains quickly so only plants like barley and grass grow well. Peat doesn't contain rock, it's made from dead plants and animals. It is rich in nutrients and is acidic. It supports rough grazing and forestry.
- Drainage—If there are impermeable rocks, the surface can become waterlogged creating peat bogs and marshland. There would be very few trees here.

The biosphere is a vital life support system for people due to its goods and services.

The biosphere provides vital resources—Many people depend on the biosphere for basic goods such as food, medicine, building materials and fuel. Especially indigenous people. All food comes from the biosphere (except salt), but developed cultures tend to farm food rather than forage.

Developed cultures also process food, transport it and store it, whereas indigenous people tend to eat fresh foliage and game they have collected.

Commercial exploitation—Modern technology has reduced our dependence on the biosphere from day-to-day. However, it has also led to increased exploitation of resources. Rapid population growth, modernisation of agriculture, industrialisation and urbanisation has led to a dramatic increase in demand for water. This means that parts of the biosphere is deprived of water. E.g. Hamoun Wetlands in Iran, drought, dam building, irrigation and population growth have caused the wetlands to dry up. Biofuels are also commercially exploited as they are an alternative to fossil fuels. Therefore, huge areas of land are being cleared to grow biofuel crops. This means local's food and fuel prices increase and any indigenous people living in the vicinity could struggle to collect the resources they need for survival. As well as this many habitats are destroyed. For example, the rainforest in Borneo is being cleared to grow palm oil. This is destroying the orang-utans habitat. Even though minerals are not part of the biosphere, the demand for them affects the biosphere. For example, mountain top removal mining, to collect coal developed in the Appalachian Mountains USA, has destroyed many habitats, created mass air pollution and has polluted water supplies.

Biospheres play a globally important role:

Regulating the atmosphere— The main way is through the regulation of carbon dioxide and oxygen in the atmosphere through respiration and photosynthesis. As an equilibrium has been created it prevents the earth plunging into a glacial period as the carbon dioxide keeps the earth warm.

Soil health—Most soils would be infertile if it wasn't for leaf litter decomposing in damp/wet conditions to produce humus. This is aided by earthworms which churn the humus and other dead organic matter to break it down chemically. Soils are vital for human existence to grow crops and the biosphere helps keep them healthy.

Managing water—The hydrological cycle helps prevent flooding and stores water. Mangroves can prevent flooding in coastal locations. Deforestation can reduce interception and absorption leading to increased flooding such as the flooding in Pakistan in 2010.

Questions

- Explain how the biosphere provides resources for people. (4)
- Explain the importance of the biosphere on a global scale. (4)
- Explain how increasing resource demand can lead to exploitation of the biosphere. (4)
- Explain the difference between Malthus' and Boserup's theories. (4)

Key Terms

- Indigenous
- Biofuels
- Humus
- Affluence
- GDP per capita
- Consumerism
- Urbanisation
- Industrialisation
- Deforestation
- Open cast mining
- Epidemics
- Green revolution
- Carrying capacity



Over exploitation—global trends -

The demand for resources (food, water, energy and others) has constantly increased over time. Today we extract 50% more natural resources than 30 years ago (approximately 60 billion tonnes of raw materials a year). The main reason for this is the increasing world population. The natural environment provides us with the resources we need to survive. People in developed countries consume 10x more resources than those in developing or emerging countries.

As significant as the rising numbers of people is the rising affluence of people. Global GDP (gross domestic product) per capita has risen steadily from US\$6800 in 1993 to US\$13,100 in 2013. This has led to people buying more resources and consuming more than is needed.

Regional trends—Some developing countries are now becoming emerging economies such as Brazil, Russia, India and China (BRIC countries). These countries have grown rapidly. Collectively their GDP surpassed the USA's in 2006, although Russia and Brazil have declined slightly. The newest group of countries that are expected to develop quickly are Mexico, Indonesia, Nigeria and Turkey (MINT countries). As the people in these countries gain more wealth they spend more (consumerism), this means they can access more resources, which in turn means more resources are needed.

Urbanisation and Industrialisation—In the last 50 years' urbanisation and industrialisation have increased, leading to an extra demand on resources. This has directly impacted biomes. A city requires a lot of resources to support its population such as food, water, energy and shelter, however these resources are not always collected locally, they are collected nationally and even globally. This increases pollution, mining, dam building etc. Emerging countries such as China and India have been the major uses of more resources. Again this is due to affluence (a 6-10% annual increase in GDP since 1990). These countries also have large populations and have rapidly industrialised and urbanised. In the next 35 years it is predicted that energy consumption would increase by 56%.

Exploitation -

The demand for resources has continued to increase leading to a lot of damage to the biosphere. Demand for beef (and soya to feed cattle) has led to mass deforestation in the Amazon rainforest. Destroying habitats and indigenous people's homes. The demand for palm oil has encouraged deforestation in Cameroon. Palm oil is used in pizza dough, shampoo, soap, noodles and ice cream. Water is a vital resource to all species therefore dams have been created to store huge volumes of water as well as create electricity with HEP. However, this causes flooding displacing people and habitats such as the Santo Antonio Dam in Brazil which destroyed 400km<sup>2</sup> or tropical rainforest. Open case mining is also widespread due to demand for fuels and minerals. This has caused a lot of environmental problems in Alberta tar sands in Canada to extract oil.

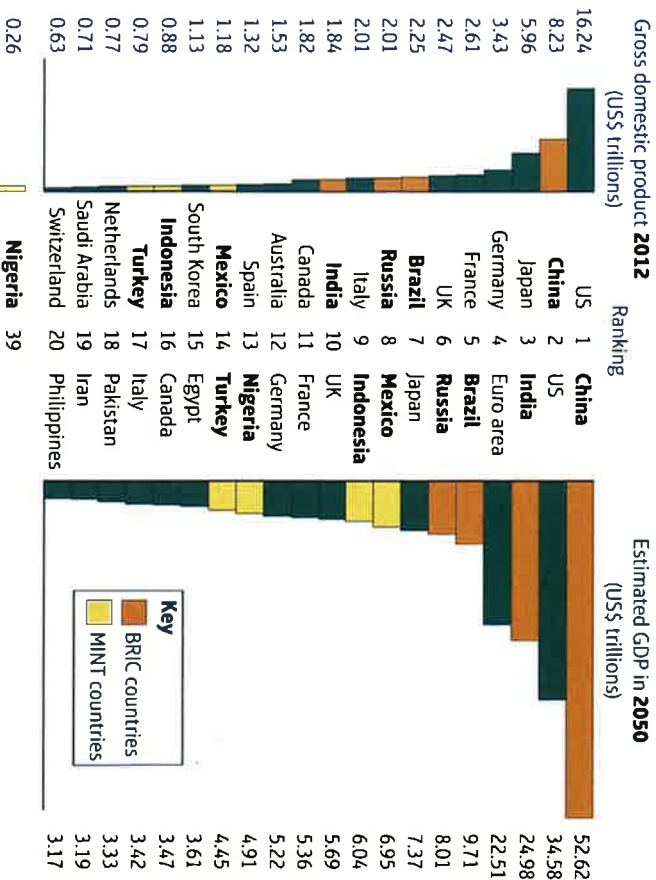


Figure 15 GDP levels in 2012 and projected to 2050

- Key Terms**
- Tropical rainforest
  - Equatorial climate
  - Abiotic
  - Ecosystem
  - Biotic
  - Nutrients
  - Nutrient cycle
  - Soil
  - Litter
  - Biomass
  - Leaching
  - Biodiversity
  - Emergents
  - Canopy
  - Prehensile

**The structure, functioning and adaptations of the tropical rainforest reflect the equatorial climate (biotic and abiotic components, biotic adaptations, nutrient cycles)**

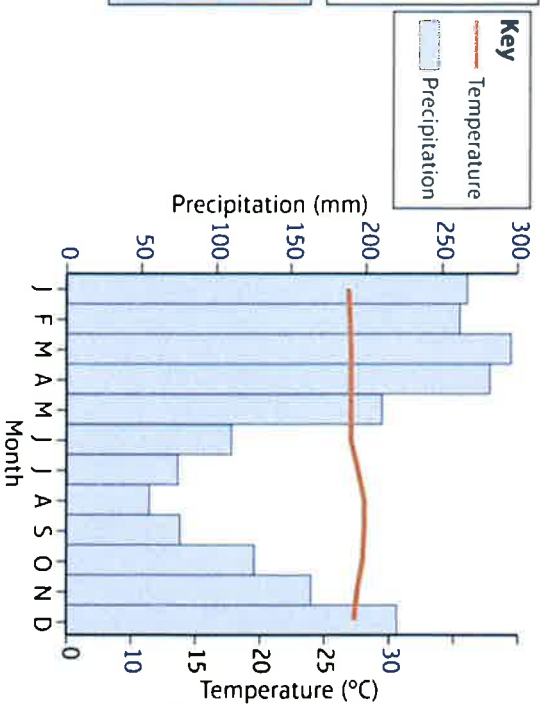
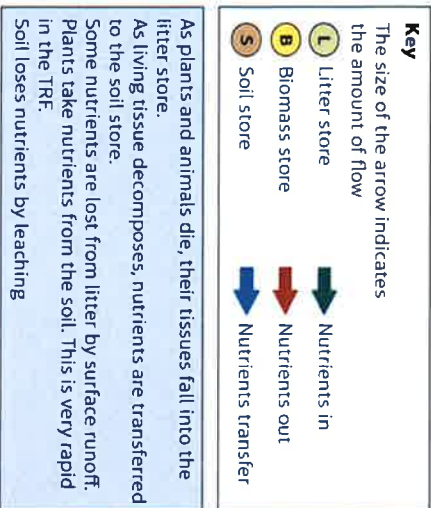
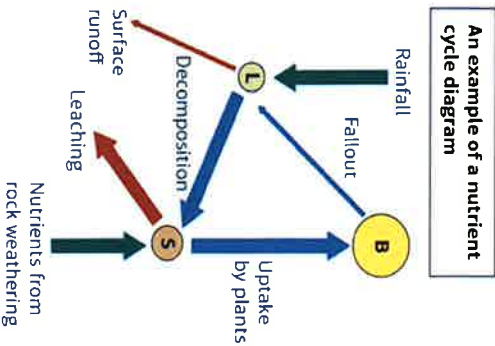
Most tropical rainforests are located between 20° north and south of the Equator. This zone has an equatorial climate. This means it is hot all year round with average temperatures of 27-20°C and never falls below 20°C. There is precipitation all year round with annual precipitation rates of 2000-3000mm a year. These conditions are ideal for plant growth.

The non-living components of the tropical rainforest ecosystem such as soil, climate and rocks are the abiotic components. The living things such as plants and animals are the biotic components.

The nutrient cycle describes how nutrients are transferred around an ecosystem. It has 3 stores: litter, soil and biomass. Nutrients are transferred between these stores. The biggest store is the biomass which is made up of all the biotic components. When the leaves fall and enter the litter store they decompose quickly so the nutrients are transferred into the soil. The plants then absorb these nutrients.

Due to the constant precipitation a lot of water travels through the soils, as it does this it takes nutrients and minerals with it. This is called leaching. This makes the soils low in nutrients.

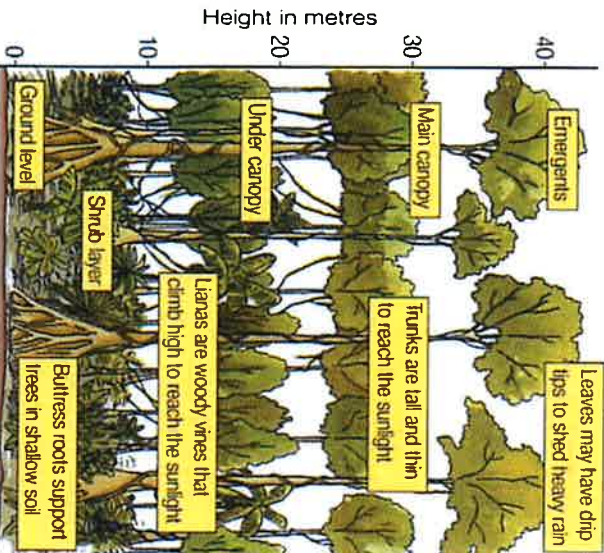
The tropical rainforest has a very high biodiversity. This is because the conditions for plant growth are so good allowing the ecosystem to support thousands of species. As well as this, the ecosystems have developed and evolved over thousands of years.



- Questions**
1. Explain one way how the plants are adapted to the equatorial climate (2)
  2. Identify two ways in which the chameleon is adapted to the challenges of the tropical rainforest environment. (2)
  3. Explain why Madagascar's rainforests have high levels of biodiversity. (4)

### Plant adaptations

The main challenge for plants in the rainforest is competing for light. Some trees have adapted to grow extremely tall (50m+) called emergents. Trees below this form the canopy layer and are between 30-40m high. If a tree falls and dies, a light patch will appear and tree saplings will race upwards to the light and the gap is filled by the winner which spreads its branches and leaves out to collect as much sunlight as possible. A second adaptation is drip-tip leaves which means water can run off them quickly. If this did not happen moss and algae would grow quickly over the leaf surface blocking its ability to absorb sunlight. Another adaptation is buttress roots. As the soil in rainforests is very thin and the nutrients are concentrated at the top of the soil, the roots of the trees have evolved to be tall, slender and shallow to collect what they need to grow.



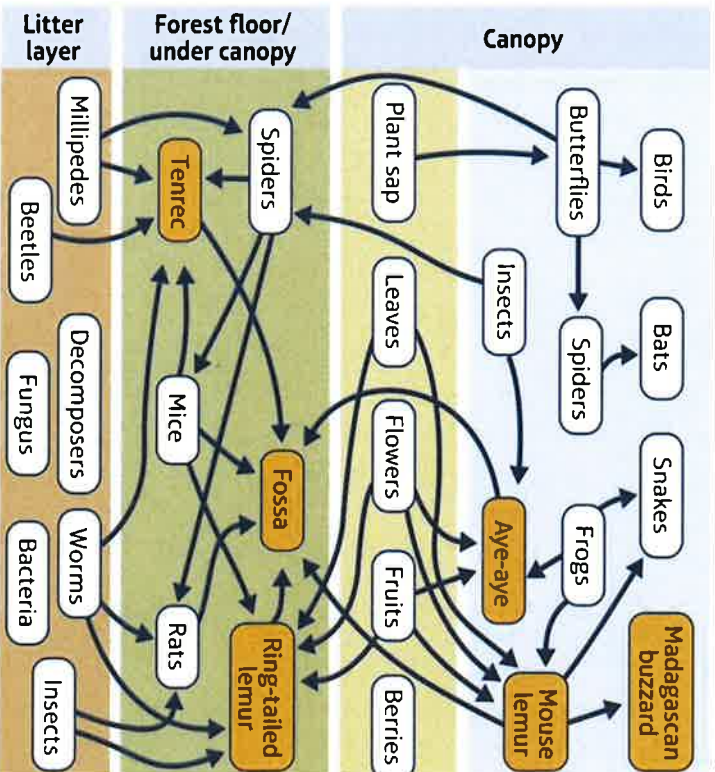
Food webs are a type of diagram used to show who eats what in an ecosystem. These are highly complex in tropical rainforests due to high biodiversity and due to the different layers in the rainforests there are mini-ecosystems with their own food webs.



### Animal adaptations

Due to the abundance of plant life in rainforests, animal life thrives. In the Madagascar rainforest it is estimated that 14,000 plant species support 250,000 known animal species, of which 75% are not found anywhere else in the world. The animals have adapted in many ways:

- As plants flower and produce fruits at different times of year, animals (specifically monkeys) have adapted to travel through the canopy. They have gripping hands and feet, long prehensile tails for balance and coloured vision to identify if fruits are ripe.
- Birds have also evolved such as eagles, these have powerful legs and clawed talons that can grab monkeys from the canopy.
- Some animals like chameleons' camouflage to avoid being eaten.



**Tropical rainforests are threatened directly by deforestation and indirectly by climate change** (Causes, Effects, Climate change)

Deforestation happens as the forest is converted into farmland. Trees are cut down either to sell as timber, provide space for open-cast mining and HEP schemes. Deforestation, logging and mining are direct threats to the rainforest. Deforestation causes

- Commercial agriculture—this is when crops are grown to sell at a profit. This is the main cause of deforestation in the tropical rainforest (75% deforestation in Brazil is for cattle farming). In recent years the rainforest has been cleared to grow sugarcane to export. Deforestation in the South East Asian countries is mainly to clear land for palm oil plantations. These crops are in high demand as they are biofuels.
- Subsistence agriculture—this is when people farm to feed their families. A small plot of trees is felled and burnt so crops can be planted. Leaching is a big problem because of this as the nutrients in the soils are washed away during any precipitation. Poorer farmers resort to ‘slash and burn’ as no money is needed to clear the land which creates a lot of pollution. In the past land would be left barren for a long period of time after being used for crops. However as the population is growing more and more land is being cleared for families and plots are having to be used straight away.
- Commercial hardwood logging—many countries are participating in commercial logging to earn money to pay off interest on international debts. A lot of countries have strict controls on logging however it still occurs illegally on a large scale due to demand. Chinese buyers will pay high prices for hardwood timber such as rosewood. Poverty is another reason why logging is high in tropical rainforests. Logging companies pay very well so locals take the jobs even though is illegal. The police and government are generally aware of illegal logging but allow it due to corruption
- Mining—valuable minerals can be found underneath the tropical rainforest so open-cast mines are created to extract the minerals. This means huge areas of forests are lost for the mines and roads created. The roads encourage farmers to settle in the rainforest and clear the land for crops (approx. 15% deforestation is linked to mining and road building).
- Fuelwood—The indigenous people of the rainforest use the trees as fuelwood.

**Climate change**

Climate change is an indirect threat to the rainforest meaning there is no direct cause between one thing and another. The Earth’s atmospheric temperature is increasing which is affecting the atmospheric circulation systems that bring wet seasons to the equatorial climate. The warmer temperatures mean that the rain belt moves polewards and the rainforest receives less rainfall. This means the rainforest may suffer with drought conditions and many areas will become seasonal tropical forests. Temperatures in the tropical rainforest are similar all year round and many species will not be able to adapt to any change in temperature or lack of rainfall. The flying fox bats have been dying due to heatwaves as their bodies cannot cope with the change in temperature. There is a higher risk of forest fires as plants and trees dry out in the heat. As large areas dry out, drought tolerant species would out-compete the rainforest species. This would lead to ecosystem stress in which the plants and animals would have a lower tolerance to pests and diseases.

**Key Terms**

Commercial agriculture  
Subsistence agriculture  
Logging  
Deforestation  
Mining  
Fuelwood  
Direct threats  
Indirect threats  
Ecosystem stress

**Questions**

Explain why rates of tropical rainforest deforestation are rising in some areas but falling in others. (4) Explain the difference between a direct threat and an indirect threat. (2)  
Assess the severity of threats to the tropical rainforest (8)  
Identify 3 ways the TR is being deforested (3)



## Conservation & sustainable management of tropical rainforests is vital if goods & services are not to be lost for future generations

(Advantages/disadvantages of CITES, REDD, sustainable forestry, ecotourism)

### Key Terms

CITES  
 REDD  
 Remote sensing  
 Sustainable rainforest management  
 Ecotourism

### Questions

1. Select the conservation strategy that you think would be best for the tropical rainforest biome. Justify your choice. (8)
2. Why do people in Japan, China, USA and the UK have a role in reducing deforestation? (3)
3. Several options exist for conserving the tropical rainforest in a sustainable way. Three possibilities are:
  - a.) Create a national park area
  - b.) Use remote sensing to monitor human activity
  - c.) Use CITES and REDD
 Select the best option you think would be best to manage the tropical rainforest (12+4)

### Global Actions

CITES (Convention on International Trade in Endangered Species of wild fauna and flora) and REDD (Reducing Emissions from Deforestation and forest Degradation) are international organisations that have made agreements to protect the tropical rainforest. Countries sign up to these agreements and receive aid and assistance.

- CITES - The main aim is to prevent the trade of endangered animal and plant species across the world. Especially if it threatens the rainforests biodiversity. There are currently 35,000 species listed under CITES protection. There are different levels of protection. Countries have to agree to monitor trade across their borders and punish people importing or exporting products from endangered species if they sign up to CITES.

- REDD—The is a UN (United Nations) scheme that advises governments on how they can reduce deforestation and promote afforestation. Remote sensing is used to monitor deforestation rates. It receives funds from sources such as

Organisation	Advantages	Disadvantages
CITES	181 countries have signed up to it It is targeting the issue	Illegal trade is increasing as demand is high. It cannot manage all 181 countries.
REDD	International expertise is on hand to help tackle deforestation. Funding is attractive to governments	Deforestation is still happening at a rapid scale in South Asia. It is vague about what afforestation means and allows crop plants to be grown instead of native plants.

### Local Actions

Amazon, Brazil—There are several reasons why deforestation rates reduced in Brazil between 1994 and 2013. Pre 2005 deforestation rates were high due to the demand for soya beans so land was cleared to create crops. However, the international price of soya beans dropped in 2005 and so the demand fell. Also, environmental groups used this time to push TNCs to only buy sustainably-grown soya beans. At the same time the Brazilian government increased its commitment to REDD. This was helped by a billion-dollar fund from Norway. The protected areas in the rainforest were expanded and laws against deforestation were enforced by the government and police. Challenge of Sustainable forest management

An alternative method to protect the rainforest is sustainable rainforest management. This aims to prevent damage to the rainforest so that it benefits local people. This combined with ecotourism can create jobs for locals as guides and in hospitality. The tourists are encouraged to buy handcrafted products from locals. This means locals do not illegally log or trade in animal or plant species. The scheme also educates locals on how to live more sustainably such as higher yielding crop use so less land needs to be used. The issue is most of the sustainable management methods require funding to survive, as well as this the schemes only really work in areas that are already protected such as National parks.