

# THE ECUADORIAN AMAZON

## The impacts of deforestation on local natural environment and local people

### Content guide:

Death of wildlife, Extinction, Loss of habitat, Impacts on food chains/ecosystems, Soil erosion, Flooding, Threat to local tribes, Loss of their food/supplies or resources, Migration into urban areas, Genocide, Haze/smoke from fires, Jobs for locals.

### Place specific reference:

Locational details; Named tribes, Named places within the rainforest.

Ecuador's Amazon Rainforest is home to truly astounding biodiversity, with more than 300 species of mammal, and 350 species of reptile. Between 1990 and 2018, Ecuador had lost 4.9 million acres of forest due to large-scale deforestation. This has lead to:

### **Death of wildlife, Extinction, Loss of habitat, Impacts on food chains/ecosystems**

- According to Earth's endangered Creatures site, 9 reptile species (including iguanas, caimans, tortoises, turtles, and crocodiles) and 192 amphibian species (including more than 100 species of frogs - Amazon glass frog, toads, salamanders) in Ecuador, are now endangered and close to **extinction**.
- With the **death of wildlife**, numerous **food chains and ecosystems** that rely on these species have also been disrupted.

### **Soil erosion**

- Since the soil is unsheltered, deforestation has led to **soil erosion**, leading to a **loss of habitat** of many animal species.
- Soil erosion has also increased the potential danger of landslides in high-elevation areas like Dracula. Few years back, the only road to Quito, the capital of Ecuador, had been destroyed by a landslide.

### **Threat to local tribes, Loss of their food/supplies/resources, (Due to Flooding)**

- Ecuador's forests serve as a buffer to severe **flooding** (moderate effect of flooding).
- As a result of deforestation, there has been extreme flooding in the Ecuadorian Amazon, causing widespread disarray along the banks of the Bobonaza River,

leaving 100s homeless, also washing away schools, crops & animals - leading to a **loss of food and supplies**.

- Floods have caused a **threat to local tribes** such as the Sarayaku, Pacayaku and Teresa Mama indigenous communities.
- The capacity of Ecuador's largest dam and hydroelectric generator (Paute) has been reduced by half due to sedimentation caused by deforestation in its watershed. As a result, there have been electricity shortages in the major cities of Ecuador.
- Logging activities in Ecuador. The area of Pastaza River Basin has been especially affected by the balsa wood industry.

### **Jobs for locals, Migration into urban areas**

- Due to deforestation, climatic extremes have become common, planting times have become unpredictable and alternating floods and drought have made agriculture almost impossible and no longer profitable, leading to limited **job opportunities for locals**.
- The provinces Loja & Manab were most impacted by this. Due to prolonged droughts, 1000s of families have been forced to **migrate to urban areas** in search of jobs.

**Genocide:** Extensive deforestation in the Ecuadorian Amazon to support the oil industry, has led to mass **genocide** and large-scale disappearance of indigenous tribes.

### **Why deforestation has taken place**

#### Content guide:

**Road building, Logging, Mining, Dam building, Settlement building, Ranching, Commercial agriculture, Manufacturing / industry, Increasing population, etc.**

- Logging/timber (eg. hardwoods / high-value wood / charcoal / firewood / paper making / use for furniture / for export / to earn foreign currency / building materials)
- Mining / quarrying / extraction of minerals (eg. for oil, iron ore, etc.)
- Road building / railways / transport (for access to resources / transport of timber / to connect areas for mining, logging OR eg. Trans-Amazonian Highway).

- Settlement / build houses / growth of cities / resettlement schemes / increasing population growth / industrial development / build factories / processing of raw materials / resources (or eg. of dams/reservoirs)
- Little regulation / enforcement of regulations for generation of HEP.

**Place specific reference:**

Locational details; Named areas / Development schemes, etc.

Numerous activities such as logging, charcoal burning, 'slash and burn' farming and cattle ranching by colonists have contributed to high levels of deforestation in Ecuador.

**Logging, Manufacturing / industry, Ranching**

- Balsa wood is a hot commodity in Ecuador. The country exported \$402 million worth of timber in 2020 alone.
- Even the local families were harvesting balsa trees for sale, as balsa was comparatively easier to extract - Eg. Pastaza River Basin.
- Logging has also increased in areas of Ecuador, to supply pulp for the international paper manufacturing industry.
- Levels of deforestation are especially high in the highlands of Ecuador due to the demand for **cattle ranching**.
- The timber industry is responsible for roughly a 3rd of annual deforestation...

**Road building**

- ... and is also a major road builder.
- In the Amazon, the opening of seismic lines, highways and pipelines by the oil industry for easy access into inaccessible areas were direct causes for deforestation.
- Land traffickers and government sponsored highway projects have also augmented the road network, contributing to fragmentation of plant and animal habitats.
- Ecuadorian Amazon is now criss-crossed by more than 9,500 km of roads (1.5 times the Earth's radius).

**Commercial agriculture, Development schemes**

- Palm oil companies continue to convince local farmers and indigenous communities to cut down forests for oil palm plantations, since Ecuadorian areas have perfect climate for palm cultivation.

- 10,000 hectares of palm oil plantations were cut near Shushufindi 30 years ago by Palmeras de Ecuador (largest palm oil company in the region).
- **Development schemes** such as Agrarian Reform Laws promoted colonisation of deforested land for growth of export-oriented industrial agriculture.
- The Green Revolution was also included in the Reform, which introduced HYVs, mechanisation, chemical fertilisers & pesticides. These resulted in forest removal, soil degradation & contamination from agROTOXICS and loss of biodiversity.

### **Increasing population, Settlement building**

- Due to high land prices in certain areas, as well as the **increasing population**, colonists were forced to occupy forest territory for farming and **settlement building**.
- This led to destruction of subsistence resources (forests, wildlife), as they were also unfamiliar with how to sustain these areas,

### **Mining**

- Ecuador's most valuable mineral exports are gold, copper, and silver.
- Large scale mining projects take place in southern Ecuador's most biodiverse areas, where there are mining concessions. For example, the Mirador mine is a large copper mine located in the province of Zamora-Chinchipe in southern Ecuador.
- Deforestation has increased in vulnerable areas like Yasuni National Park, due to the weak environmental legislation. The oil and mining industries take advantage of this.
- The government encourages extractive projects to bring the country out from economic crisis.

**Dam building:** Hydroelectric dams in the Amazon have promoted large-scale deforestation. Moreover, Road construction to access these dam sites, such as the Coca Codo Sinclair Dam in Ecuador, have cleared large areas of forest.

**Tourism:** The Cuyabeno Wildlife Reserve located in the provinces of Orellana Sucumbios has large numbers of tourists visiting it, which threaten conservation and sustainability of forests.

## The characteristics of its ecosystem

NOTE: Must consider more than one ecosystem element (eg. plants and soil)

### Content guide:

Types of vegetation, Types of fauna, Layers, Buttress roots, Drip-tip leaves, Specified links within ecosystem (Eg. Food chains, Nutrient cycles, Soil, Climate, etc.

### Place specific reference:

Locational details; Named flora & fauna, Statistics.

## The characteristics of the vegetation

### Content guide:

Layers, Lianas, Epiphytes, Parasitic vegetation, Buttress roots, Undergrowth

### Place specific reference:

Locational details; Named places, species, etc.

- The Ecuadorian Amazon is home to around 40,000 plant species, with around 400 billion trees.
- The Amazon rainforest is an ecological kaleidoscope - home to around 40,000 plant species, nearly 1300 bird species, 3000 types of fish, 427 species of mammals and 2.5 million different insects.

## Emergent layer

- The towering trees of the emergent layer reach up to 200 feet, and have straight, smooth and unbranched trunks.
- These trees are exposed to sunlight and strong winds.
- Some examples include the brazil nut and kapok tree.
- When in bloom, the kapok tree grows beautiful creamy white or pale pink flowers that emit a scent that attracts bats to pollinate the flowers! Pollination also occurs through dispersion of seeds by strong winds.
- The trees also have **buttress roots** which give them extra leverage in the wind, and collect nutrients found in the top layer of the soil.
- Animals found in this layer are usually adapted to fly or glide high above the trees. In the Amazon, common emergent species include birds, bats, gliders and butterflies, out of which bats are the most diverse.
- Large raptors such as the white-tailed hawks and harpy eagles are the top predators.

## Canopy layer

- Made up of dense, overlapping branches that block out sunlight, rain and strong winds, which protect the fragile soil, and also dull sound.
- So, animals are adapted to make shrill and frequent vocalising. Eg- spider monkeys.
- Trees have narrow, downward-pointing “**drip-tip**” **leaves**, which allow water to run off quickly.
- Numerous **epiphytes** such as orchids, bromeliads, and cacti grow on their branches, due to lack of sunlight near the forest floor. Parts of the Ecuadorian Amazon such as Yasuní and Cuyabeno have lots of low, epiphyte-covered trees and bromeliads.
- The canopy also contains the largest food reserve - Acai palms in the canopy provide food for a variety of animal species.
- The 2-toed sloth chews on the leaves, shoots and fruits.
- This layer doesn't receive strong winds, so the trees enclose their seeds in sweet fruits that entice animals to eat the fruit and deposit seeds on the forest floor as droppings. Fig trees are the most familiar fruit tree.
- Macaws and toucans use their large beaks to reach and cut open these fruits. Fruits are also picked up by barking spiders and howler monkeys.
- The canopy is laced together by a network of woody vines known as **lianas**, that climb up the trees to reach the sunlight.
- 1000s of insect species (bees to beetles, borers to butterflies) are the principal diet of canopy's reptiles.

## Parasitic species

- Rafflesia or corpse flower grows in the forest and is parasitic to lianas or vines.
- At least 150 different species of strangler fig, another parasitic species, are found in the forests of the Amazon. These specialised vines completely encase the host plant, in order to draw nutrients from it.

## Undergrowth

- Even darker, stiller, more humid environments.
- The undergrowth or shrub layer near the forest floor of the rainforest consists of trees stunted due to lack of sunlight. These include palms, philodendrons, vines, etc.
- They provide food for a wide range of animals, and their flowers are large or have a strong smell to attract pollinators. Eg.- orchids.

- Animals like the jaguar and green mamba snake camouflage themselves among the leaves.
- Many bats, birds and insects prefer the open airspace of the understory.
- The humidity keeps the skin of amphibians moist.

### **Amazon river**

- Red-bellied piranhas and the boto or pink river dolphins swim in the Amazon river.
- The Amazon River banks are also home to black caimans, reptiles such as alligators.

### **Forest floor & soil**

- 3/4th of Amazonian rainforest is considered a 'wet desert'- it has red and yellow clay like laterite soils as they are rich in  $Al_2O_3$  and  $Fe_2O_3$  which are acidic.
- Near the Amazon basin, there has been no recent volcanic activity to bring up new nutrients. Amazonian soils are so weathered that they are largely devoid of minerals like potassium, calcium and magnesium, which come from rock sources.
- However, even with poor soils, rapid nutrient cycling takes place in the forest floor, supporting the luxuriant growth of tropical rainforests (explain nutrient cycling).
- The forest floor is the darkest layer, extremely difficult for plants to grow.
- Decomposers such as termites, slugs, scorpions, worms, and fungi thrive on the forest floor.
- Pigs, armadillos and anteaters are predators of these insects.
- Larger predators include leopards that prey on small rodents such as rats and lowland pacas.

### **Measures to protect the forest**

- The Ecuadorian government has implemented payment for environmental services (PES) programs. An example is the Socio Bosque program which was developed in 2008, providing economic incentives for landowners and rural communities who voluntarily commit to protecting their forests.
- One of the largest of these programs, REDD+ (reducing emissions from deforestation & forest degradation) has been attempting to curb carbon emissions through payments for avoiding deforestation.
- The government agencies monitor to ensure that the land is being conserved.
- The agreements have a 20-year term with payments based on compliance.

- Landowning communities must indicate what they intend to do with the payments they receive. They are usually expected to invest in education, healthcare, control & surveillance, ecotourism or agroforestry.
- Various indigenous communities, such as Kichwa in Ecuador with a population of around 55,000 are implementing innovative approaches to conserve forests on their community's share of land, which is around 6,000 hectares.
- They have formed farmer's cooperatives to oversee production, harvesting, processing and sale of organic guayusa tea (rich in antioxidants) for local & international markets.

## GLOBAL EXAMPLES

### The impacts of deforestation on global natural environment

#### Content guide:

**Build-up of carbon dioxide, Enhanced global warming, Changing rainfall patterns, Drought,** Melting of ice caps/glaciers, Impacts on species/biodiversity, Loss of habitat, Impacts on food chains, **Flooding, Rising sea level,** etc. + **Place specific references.**

**NOTE:** Reference to flooding, loss of habitat, impact on biodiversity, species extinction, etc. as acceptable, providing answer does not state/imply that this is where the deforestation is occurring. (these occur in other areas)

Trees and forests serve as "carbon sinks." Deforestation results in the release of over 1.5 billion tonnes of **carbon dioxide** to the atmosphere each year, and the Amazon and Congo rainforests are currently generating more carbon dioxide than they are absorbing.

**Enhanced global warming** and climate change are also caused by the buildup of carbon dioxide. Indonesia has the highest amount of gas emissions globally, and it is vulnerable to threats such as **rising sea levels** and **shifts in rainfall patterns** due to rising temperatures. In the late 1980s, Java, an Indonesian island, lost 770 metric tonnes of **topsoil** due to deforestation.

Trees also regulate the water cycle, through moisture recycling. Recent evidence shows that regional rainfall would reduce in the Amazon due to deforestation. The loss of 98% of Haiti's forests led to severe **floods** in Haiti in 2004. Illegal harvesting also intensified floods in Kashmir. About 2 million hectares of forest disappear each



year in Africa. In recent years, this has exposed the continent to **droughts** and worsened its ongoing water crisis, especially in Kenya.

In the last 30 to 40 years, forests on Mount Kilimanjaro's lower slopes have vanished, causing the mountain's **glaciers to melt**. With the destruction of the forests, species become extinct everyday, and **biodiversity is reduced**, leading to **loss of habitat**. For example, deforestation poses a threat to the habitat of the orangutan in the tropical forests of Malaysia. It also affects food chains that rely on the presence of healthy trees and grasses.

## THE SAHARA DESERT

### The Climate

#### Content guide:

High temperatures, diurnal temperature range, seasonal change, low precipitation, low humidity, latitude, descending air, **high pressure**, wind direction, cold currents, rain shadow, overhead sun, etc.

#### Place specific reference:

Locational details; Named places within the rainforest, Hadley Cell, statistical detail.

### Why the amount of rainfall in this area is low

#### Content guide:

Proximity to tropics, Inland location, Air pressure, Hadley Cell, Descending air, Lack of water sources, Wind direction/Trade winds, Rain shadow effect, Cold ocean currents.

#### High temperature

- The Sahara desert is characterised by high temperatures of about one 122°F during summers.
- These extremely hot conditions are primarily due to the lack of insulation caused by the lack of cloud cover.
- The Sahara experiences cold winters and hot summers. During the cold season, average monthly temperatures are approximately 55°F.
- Absolute low temperatures of 5°F have also been recorded in the Tibesti Mountains.

### **Diurnal temperature range**

In desert regions the heat from the sun directly falls on the land as it is not absorbed into the clouds. This low insulation reduces the temperature of the desert at night, contributing to the **high diurnal temperature range**.

### **Rainfall**

- The climate is dry and subtropical with 2 periods of precipitation.
- The precipitation is highly variable, but on average, it is about 3 inches per year. Most precipitation falls from December through March.
- Another maximum occurs in August, characterised by thunderstorms, which can cause flash floods.
- Water is scarce across the entire region, however the Sahara contains 2 permanent rivers - Nile & Niger.

### **Latitude**

- The Sahara is located within the equatorial region at 23° north of the equator. As a result, it receives overhead sunlight which makes the area very hot.

### **Air pressure**

- The dry subtropical climate of the Northern Sahara is caused by the stable high-pressure air cells centred over the Tropic of Cancer where it is located.
- The large-scale atmospheric convection cells in which air rises at the Equator and sinks at medium latitudes, typically around 30°N and S are known as Hadley Cells.

### **Rainshadow effect**

- The dryness is also contributed by two strong rain shadow effects caused by the Atlas mountains in the north-west and the Ethiopian Highlands in the south-east.
- The windward side of the Atlas Mountains contains large quantities of water vapour from the Atlantic Ocean. This air is forced to rise and expand over the mountain range. This causes the air to cool down, leading to condensation of excess moisture and precipitation over the mountain range.
- On the leeward side, the cold dry air starts to descend, compress, and become warmer.
- This warming causes moisture to evaporate, making clouds disappear, bringing dry conditions in the Sahara.

- This rain shadow is even more pronounced in the Ethiopian Highlands as this mountain range is larger.

### **Trade winds**

- The Sahara is a trade wind desert. Trade winds that heat up near the equator dissipate cloud cover and allow more sunlight to reach the land.
- Hot air known as the Sirocco or Ghibli originates directly from the Sahara Desert, producing hot, dry and dusty conditions. The Sirocco sometimes picks up enough dust and sand, producing sandstorms (especially during spring).

### **Currents**

Cool canary currents near the coasts reduce the ability of the air to carry moisture due to their high density, also contributing to the dry conditions. However, this effect is only slight.

## **Describe the economic opportunities**

### **Mining**

- Algeria (in the heart of the Sahara) possesses several major deposits of iron ore, along with the reserves at Mount Ijil (Western Mauritania) and deposits in Egypt, Tunisia, Morocco and Niger make Sahara a major mining centre.
- Uranium is widely distributed in the Sahara, particularly in Niger.
- Morocco has various phosphate mines, out of which 10% comes from the mine of Bou Craa.
- Fuel resources include coal, oil, and natural gas. Oil was discovered in Algeria after WWII, and major reserves have been found in the western deserts of Egypt.
- Major fields of natural gas have been exploited in Algeria and Egypt.

### **Agriculture**

- Most of the Sahara's people live in oases, and are engaged in agriculture.
- Dates, figs and other fruits are the leading commercial crops.
- Wheat, barley, and varieties of vegetables are raised for local use.
- Crops are grown mainly by irrigation, for example, in the Nile valley.
- Rearing of camels, cattle and goats is an essential part of Sahel in the Sahara. More than 60% of Sahel's population is involved in livestock farming.

## **Tourism**

- Tourism is a growing industry. The locals act as guides and provide transport. Camels may be reared for this purpose.
- Tourism also provides money and jobs for the local people.
- Sandboarding and cross desert treks are few popular tourist attractions.

## **Energy generation (Solar Energy)**

- The Sahara provides ideal conditions for generating solar energy. Cloudless skies and 12 hours of sunshine every day supports the generation of electricity through solar panels.
- According to Forbes “We could power the entire world by harnessing solar energy from 1% of The Sahara”.
- Morocco is currently building one of the world’s biggest solar power plants in a project largely funded by the European Union.
- The huge 160-megawatt Noor plant near the town of Ouarzazate uses curved mirrors totalling 1.5 million square metres (16 million square feet) – the size of about 200 football pitches – to capture the sun’s energy in the Sahara.

**For a named area of hot desert you have studied, describe and explain the characteristics of the ecosystem. Name of desert .....**

### **Content guide**

- Plants
- Wildlife
- Climate
- Soils

### Characteristics of vegetation/ adaptations of plants

- **Long/wide roots to reach water in ground/underground water**
- **Wide roots to get water from a wider area/from surface**
- **Spines/thorns to reduce transpiration/evapotranspiration/predators**
- **Wide/fleshy stems to store water/food/energy**
- **Thick/leathery outer part to reduce transpiration/ evapotranspiration**
- **Remain dormant for long period of time to conserve water when there is no rain**
- **Widespread plants so they do not compete for water**
- **Few/small/sunken stomata to reduce transpiration/evapotranspiration;**
- **Low to avoid winds/to reduce transpiration/evapotranspiration;**
- **Light colour to reflect the sunlight/so it doesn't absorb sunlight;**

Characteristics of animals/ adaptations of animals

- Humps
- Long eyelashes
- (find more)

**Place specific reference:** Locational details, Named parts of desert, named types of plants/animals, climate statistics

**For a named area of hot desert which you have studied, describe and explain the characteristics of its vegetation.**

## **Sahara Desert**

- Sahara is home to 500 species of plants, 70 species of mammals, 300 species of birds, 100 species of reptiles and many species of spiders and scorpions.

### **Vegetation**

- The vegetation is generally sparse, with scattered grasses & shrubs.
- Plants are widespread so they do not compete for water.
- Spines/thorns to reduce transpiration/evapotranspiration/predators
- Wide/fleshy stems to store water/food/energy
- Thick/leathery outer part to reduce transpiration/ evapotranspiration
- Few/small/sunken stomata to reduce transpiration/evapotranspiration
- Low to avoid winds/to reduce transpiration/evapotranspiration
- Light colour to reflect the sunlight/so it doesn't absorb sunlight
- Long/wide roots to reach water in ground/underground water
- Wide roots to get water from a wider area/from surface
- Many of the plants are ephemerals that germinate within 3 days of adequate rainfall and sow their seeds within 10 or 15 days of germination.
- Remain dormant for long period of time to conserve water when there is no rain.
- The Saharan highlands consist of woody plants like olive, cypress, and mastic trees.

- Various halophytes (salt-tolerant plants) are found in saline depressions, especially in the western coastal zone.

### **Soils**

- The Sahara is mainly rocky hamada (stone plateaus)
- Soils are low in organic matter and are often biologically inactive.
- Nitrogen-fixing bacteria are present in some areas.
- The soils in depressions are frequently saline.

### **Wildlife**

- Various snails that inhabit the desert are an important source of food for birds and animals: Desert snails survive through periods of dormancy, often remaining inactive for several years before being revived by rainfall.
- The camel that lives in the Sahara is known as the Dromedary or Arabian camel and has one hump.
  - It stores large amounts of fat to help it go without water for up to a week.
  - The fat can be broken down into energy to help it survive without food for several weeks.
  - When the camel has access to water, it can absorb water like a sponge and can drink up to 100 litres of water in 10-15 minutes.
- The camels have thick nostrils & lips and thick eyelashes to protect their eyes from blowing sand.
- Their feet are tough and padded to help them travel in the hot sand.
- Some tropical fauna also exists in the northern Sahara: eg. catfish in Algeria.
- The lakes and pools of the Sahara also contain algae and brine shrimp.
- Other mammal species found in the Sahara include the gerbil and desert hedgehog.