



EDEXCEL INTERNATIONAL GCSE (9–1)

# GEOGRAPHY

Student Book

Michael Witherick



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**Michael Witherick**

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# 7 FRAGILE ENVIRONMENTS AND CLIMATE CHANGE

## LEARNING OBJECTIVES

By the end of this chapter, you should know:

- The distributions and characteristics of fragile environments
- The causes of desertification and deforestation
- The causes of **climate change**
- The impacts of desertification
- The impacts of deforestation
- The negative effects of climate change
- How technology can help to reduce the threat of desertification
- The different approaches to the management of the tropical rainforest in a named region
- Different responses to **global warming** and climate change from individuals, organisations and governments

This chapter is about processes and pressures that are making some environments increasingly 'fragile'. Desertification of the semi-arid areas of the world is partly the outcome of population growth exceeding environmental carrying capacities. Deforestation of the tropical rainforest is the result of a large-scale and unsustainable exploitation of its resources. Global warming and climate change are increasing the fragility of some environments. What, if anything, can be done by way of new technologies and different management strategies to reduce the fragility? What are the responsibilities of individuals, organisations and governments?

## 7.1 FRAGILE ENVIRONMENTS

### CHARACTERISTICS

The well-being of the Earth's physical environments is of vital importance to us all. Our living standards and our health depend on the quality of those environments. However, natural environments are very **fragile**. There is a delicate balance between non-living parts (climate, rocks, soils) and living parts (plants, animals). Natural hazards, such as fires, high winds and volcanic eruptions, have always disturbed environments and made them more fragile (Figure 7.1). However, in most cases, they have recovered. For thousands of years, people have been making use of environmental resources to provide food, fuel and building materials. They have done so without causing too much environmental damage. Early people lived in harmony with the environment.

► Figure 7.1: Fire is a natural environmental hazard



#### DID YOU KNOW?

Many environments are 'fragile' because of the delicate nature of most ecosystems. Look at Part 5.2 (page 000) to help you to understand why.

### CHECK YOUR UNDERSTANDING

In what ways do people threaten ecosystems?

However, the growth of the world's population today threatens to disturb the fragile balance of environments. People have disturbed 90 per cent of the Earth to some degree or another. It is hard to find areas of truly natural wilderness untouched by human activity.

### DISTRIBUTIONS

The fragility of environments is closely related to the pressure that is put on them. The ecological footprint is a measure of the mark that humans make on the natural world. It considers how much land and sea are required to provide us with the water, energy and food we need to support our lifestyles. If the Earth's resources were shared equally, it is believed that a 'fair share' for everyone would be a little less than 2 hectares of the globe. The UK has an ecological footprint of about 5.5 global hectares per person. This means that if everyone in the world consumed resources at the rate of people in the UK, we would need two more planets to sustain the world's present population. Figure 7.2 shows how the ecological footprint varies around the world. It gives us an impression of where we might expect environments to be made fragile by people.



▲ Figure 7.2: Global variations in the ecological footprint

### ACTIVITY

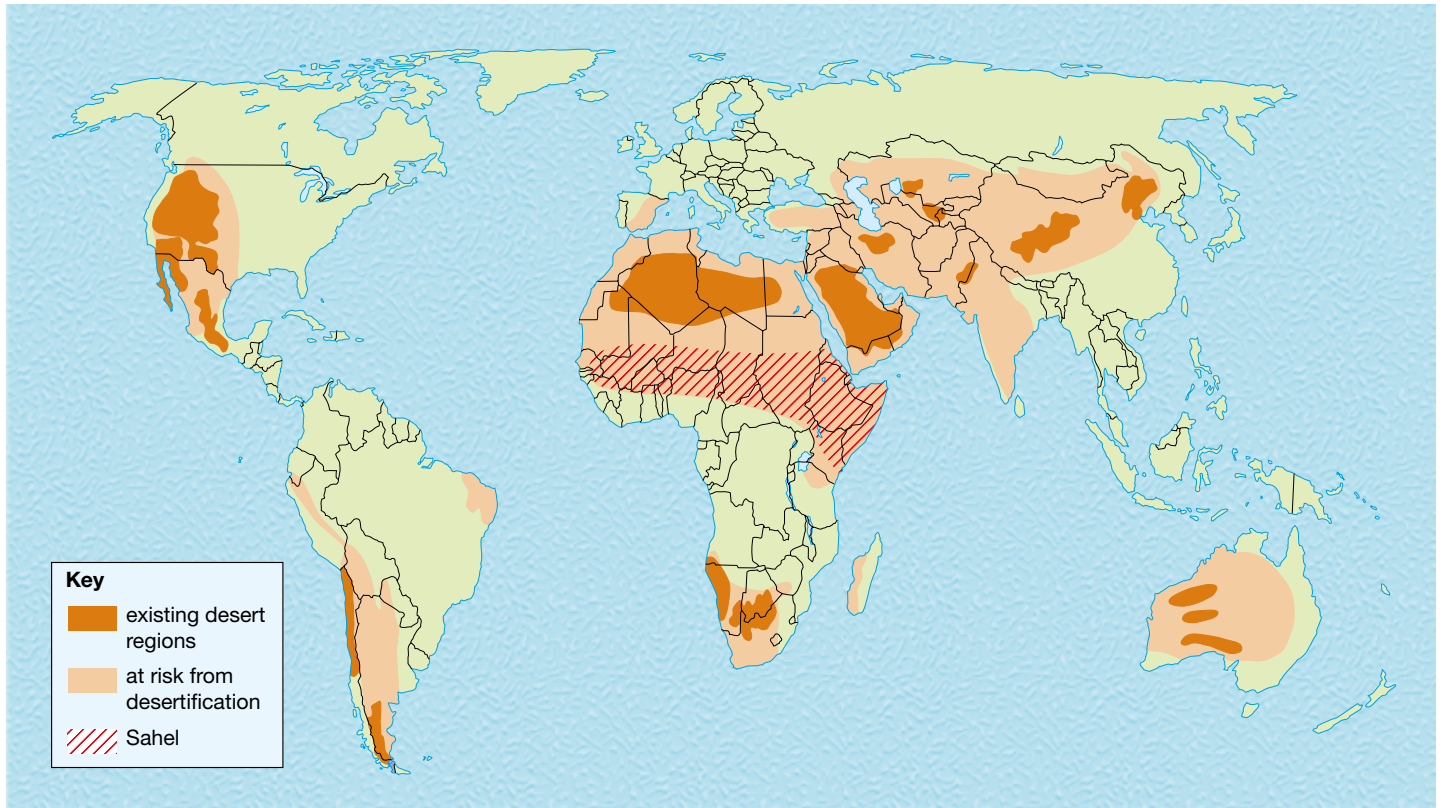
Identify the six countries on the southern half of the map that have unsustainable ecological footprints.

The global picture given by Figure 7.2 is more complicated than this. It does not take into account the fact that developed and emerging countries import large amounts of food and energy. So, these imports deepen the ecological footprints of the countries supplying them.

The global distribution of fragile environments is most influenced by the impact of three processes – **desertification**, deforestation and climate change. The three are linked because the first two are both the causes and consequences of climate change. Together, they are making environments more fragile. Let us now look at first two processes.

### DESERTIFICATION

Desertification is the term used to describe how once-productive land gradually changes into a desert-like landscape. The process is not necessarily irreversible and, as Figure 7.3 shows, it usually takes place in semi-arid land on the edges of existing hot deserts. The worrying message illustrated by Figure 7.3 is that large areas of the world are at risk from desertification. The most conspicuous includes much of southern Asia, the Middle East and North Africa.



▲ Figure 7.3: Areas at risk from desertification

The main characteristics of desertification (Figure 7.4) are:

- absence of surface water
- dried up watercourses and ponds
- lowering of the water table
- vegetation becomes degraded or completely lost
- increased soil erosion as bare soil is exposed to wind
- increase in salt content of the soil
- soil becomes less usable
- increasing presence of dry, loose sand.

**SKILLS** INTERPRETATION

**ACTIVITY**

How many of the symptoms of desertification are visible in Figure 7.4?

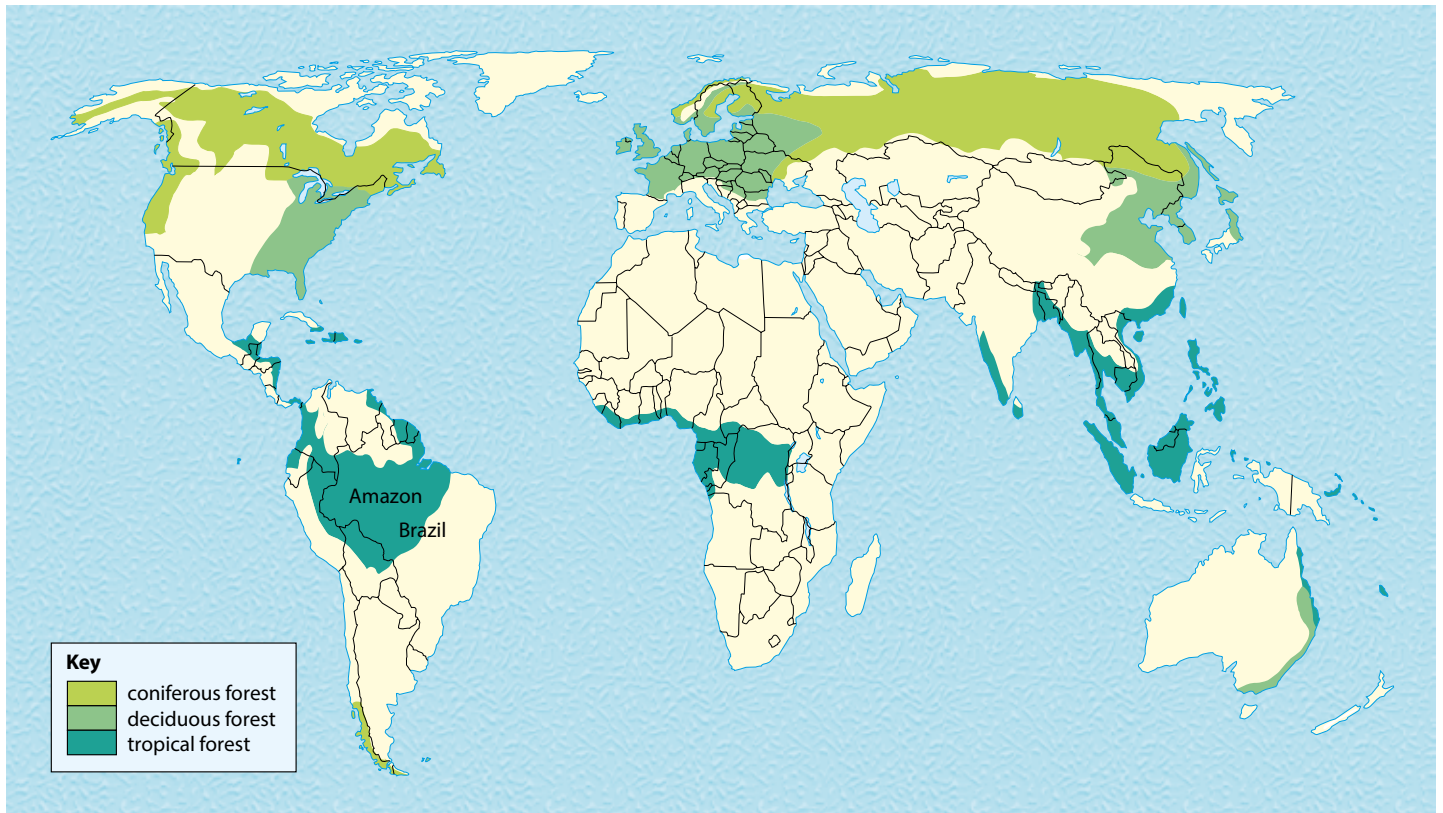


► Figure 7.4: Desertification in Burkina Faso

## DEFORESTATION

Deforestation is the cutting down of trees. Many primary forests in temperate countries have almost disappeared after centuries of logging (cutting down trees for timber) and land clearance, usually to plant crops (Figure 7.5). This deforestation has been most severe in the deciduous forests of the warm temperate parts of Europe, China and the USA. As yet, the coniferous forests of the cold temperate regions of North America and Eurasia remain relatively untouched. However, the same cannot be said of the world's tropical rainforests. Here the speed of deforestation has alarmed scientists and conservationists. The future welfare of tropical rainforests is an important environmental issue.

▼ Figure 7.5: Global distributions of original and remaining forests



▲ Figure 7.6: A recently deforested landscape

The characteristics of deforestation are obvious (Figure 7.6). They depend, for example, on whether the forest has been subject to clear felling or selective felling. In other words, has the forest been completely cut down (clear felling); or have only the best trees been extracted so that some trees remain (selective felling)? The symptoms of deforestation will also depend on how long ago the deforestation took place. Freshly sawn tree trunks and burned saplings suggest recent action, while large fields used to grow crops surrounded by a fringe of surviving trees indicate that the deforestation took place decades or even centuries ago. As soon as land loses its tree cover, the soil is exposed to the erosive effects of wind and rain.

## SKILLS INTERPRETATION

## CHECK YOUR UNDERSTANDING

Explain the link between deforestation and soil erosion.

## ACTIVITY

Look at Figure 7.5. Briefly describe where the greatest losses of tropical rainforest have occurred.

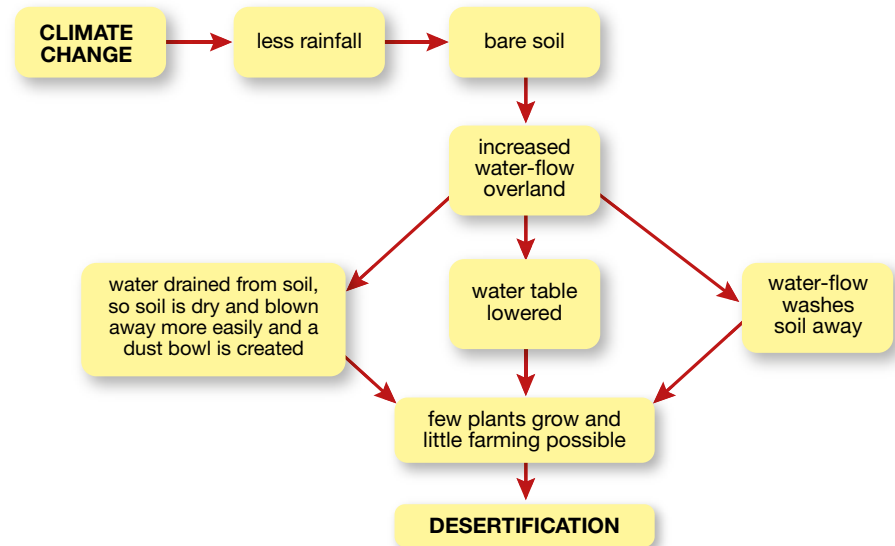
## 7.2 CAUSES OF DESERTIFICATION AND DEFORESTATION

### DESERTIFICATION

Desertification is the result of both natural and human causes. Natural causes (Figure 7.7) are shown below.

- Changing rainfall patterns – rainfall has become less predictable over the past 50 years and the occasional drought year sometimes extends to several years. As a result, the vegetation cover begins to die and leaves bare soil.
- Soil erosion – the removal of soil means less support for the vegetation.
- Intensity of rainfall – when rain does fall it is often for very short, intense periods. This makes it difficult for the soil to capture and store the rain – so water resources are reduced.

► Figure 7.7: Natural causes of desertification



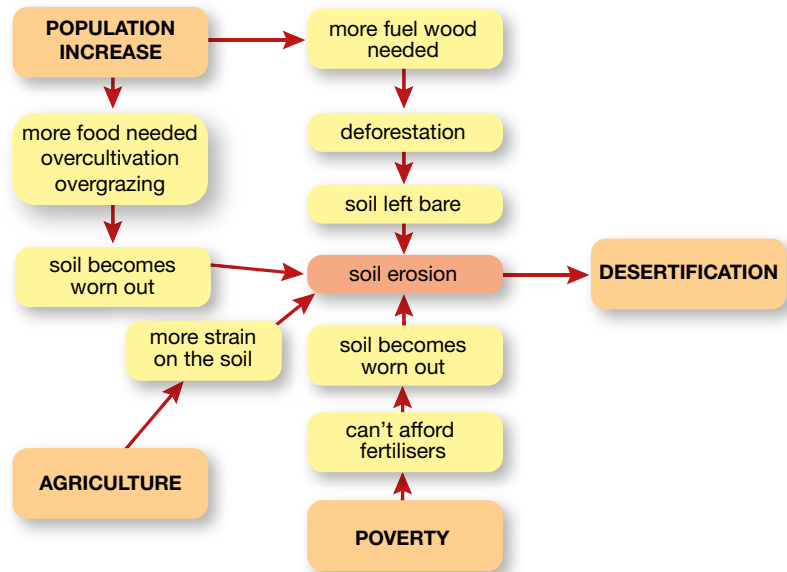
The main human causes of desertification (Figure 7.8) are shown here.

- Population growth – rapid population increase puts more pressure on the land to grow more food.
- Migration – as desertification takes hold in one area, local people migrate elsewhere in search of food and water. Unfortunately, wherever they settle, they increase the population pressure on the environment.
- **Overgrazing** – too many goats, sheep and cattle can destroy vegetation. This is often most common around water holes in desert fringe areas.
- Over-cultivation – intensive use of marginal land exhausts the soil and crops will not grow.
- Deforestation – trees are cut down for fuel, fencing and housing. The roots no longer bind the soil, leading to soil erosion.

These problems are worse for people in sub-Saharan countries because of years of civil war. Crops and animals have been deliberately destroyed resulting in famine and widespread deaths.

► Figure 7.8: Human causes of desertification

ACTIVITY
<p>In groups, discuss which of the four human causes of desertification is thought to be the most significant. Give your reasons.</p>



As with many other fragile environments, it is usually a combination of different factors which results in damage to a specific area.

It is estimated that about 20 per cent of the world's population has to cope with the effects of desertification in over 60 countries. One region most at risk is the Sahel region of Africa, an area south of the Sahara Desert stretching the width of the continent. It makes up a large part of sub-Saharan Africa, the poorest region of the world.

## CASE STUDY: DESERTIFICATION OF THE SAHEL, AFRICA

The Sahel is a narrow belt of land in central Africa. It borders the southern edge of the Sahara Desert (Figure 7.9). The Sahel has a semi-arid climate as shown in Figure 7.10. Temperatures are always hot and there is a long dry season from June through to January. There is just enough rainfall for grasses to grow, as well as some shrubs and trees in this harsh environment.

The world biomes map (Figure 5.1 on page 000) shows that the Sahel region is classified as savanna. The natural vegetation of savanna is a mixture of grassland, trees and shrubs. However, the mix of each of these three types of vegetation changes as we move northwards from the tropical rainforest. The climate becomes drier, so that wooded savanna gives way to grassland with occasional shrubs. Eventually, on the margins of the hot desert, the savanna is nothing more than thin grassland. It is these areas on the margin of the present desert which are among those most at threat from desertification.

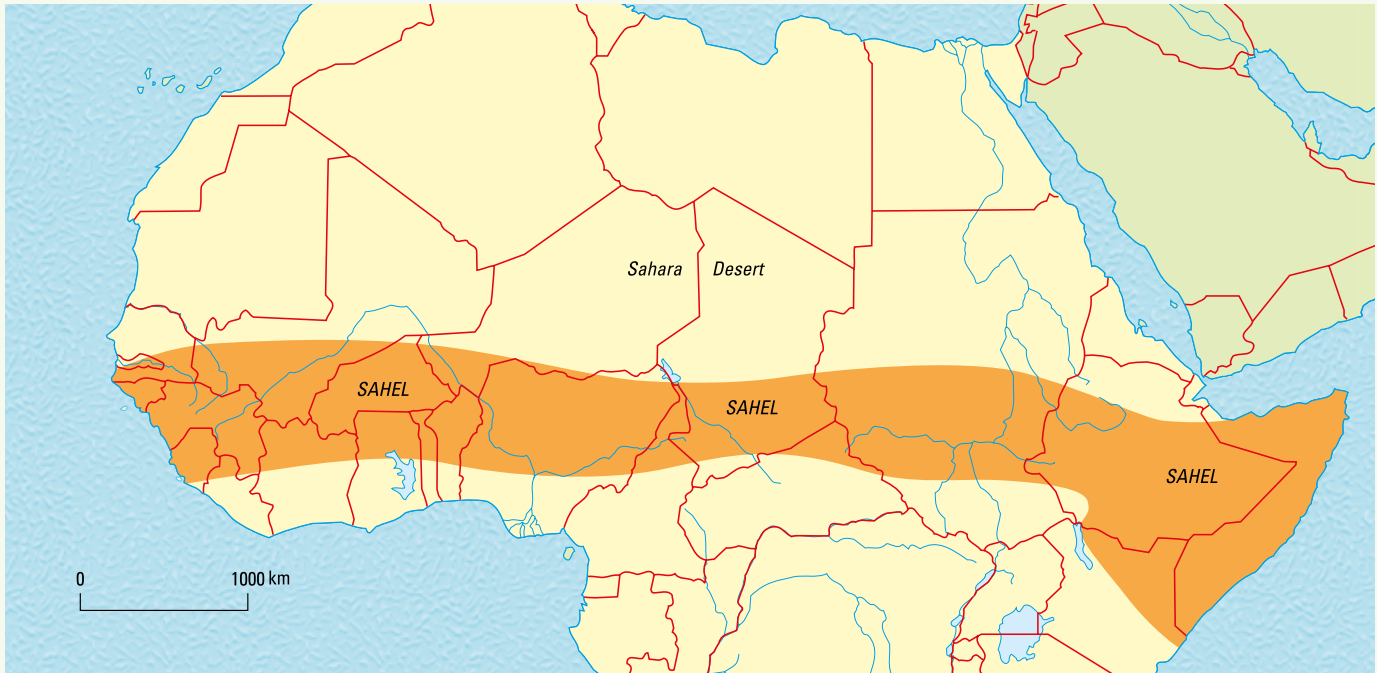
On the equatorial edges of savanna regions there are also more animals. As the trees thin out towards the middle of savanna regions, large herds of wild animals

like wildebeest, antelope and zebra are found. On the drier desert edges there is far less wildlife. Rainfall is seasonal and unpredictable and it is very dry for much of the year (Figure 7.10). Here you find nomadic herders who move from place to place with goats and cattle in search of water and grazing.

In the Sahel, some years have less rain than others. Fewer grasses grow and trees die. The landscape becomes much more like desert (Figure 7.11).

Climate change is one cause of desertification. Desertification is also speeded up by human activity. Until the 1960s, water was plentiful and crops and livestock did well in the Sahel. Then there was an increase in population. More and more trees were felled to provide fuel and building materials. It was possibly this that was responsible for the climate becoming drier.

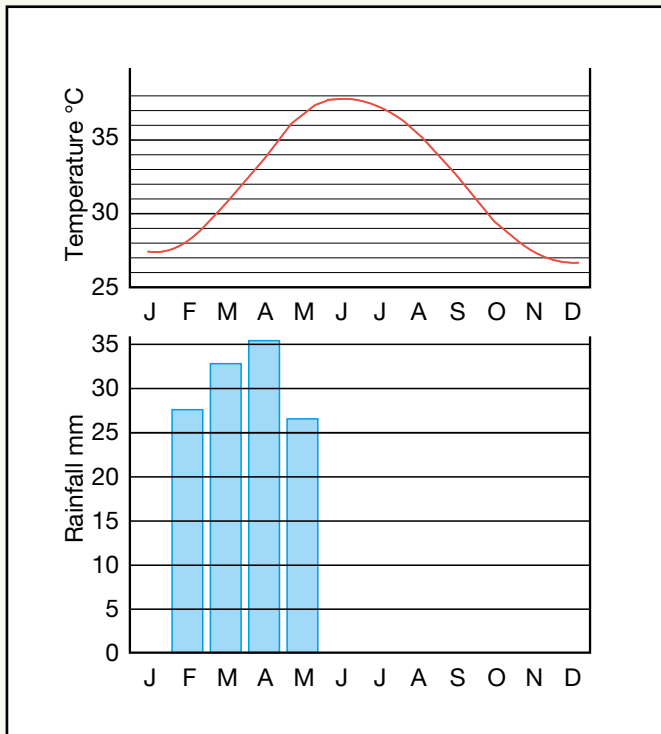
As this was happening, people tried to grow the same crops and rear the same number of animals. This quickly led to over-cultivation and overgrazing and much ground was laid bare. The absence of vegetation meant that no humus was added to the soil. Without



▲ Figure 7.9: Location and present extent of the Sahel

### ACTIVITY

Using an atlas, identify all the countries shown in Figure 7.9 that are part of the Sahel.



▲ Figure 7.10: The climate of the Sahel

humus, the soil was able to hold little or no water. As the soil dried out, it was quickly eroded by wind and occasional flash floods.

Since the 1970s, crop failures have become almost an annual event. Over 100 000 people have died of starvation. Even more people have migrated to less arid areas. Millions of animals have died.

A variety of techniques might prevent the further spread of desertification and also rehabilitate the land already damaged. One successful method of catching rain when it falls is a simple technique set up by Oxfam in Burkina Faso (see Figure 7.35 on page 000.) Small stone walls are built following the slope of the land, which then act as dams when the rain falls; this stops surface water run off and allows water to sink into the soil. This simple, inexpensive method can increase crop yields by up to 50 per cent.

Most scientists think that people are the root cause of desertification. However, recent research using satellite images is showing that some areas suffering from desertification are now showing signs of recovery. They are beginning to receive more rainfall. Could it be that natural changes in climate over short time periods are the root cause of desertification, and not people? Nobody can be sure at present. One thing is certain. The semi-arid lands are fragile environments and people must use them with great care.

SKILLS DECISION MAKING

ACTIVITY

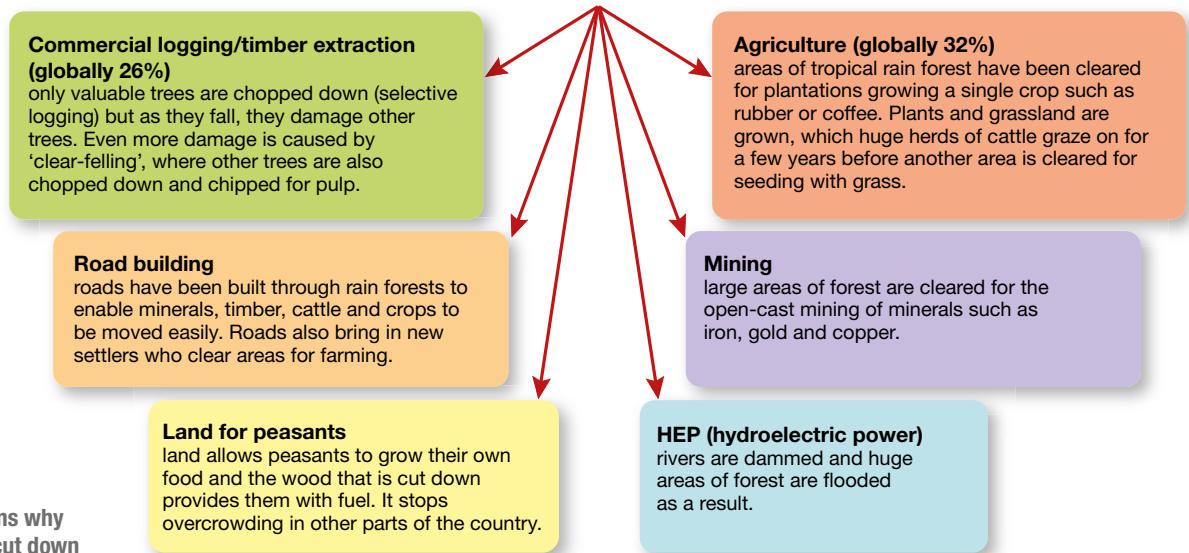
Do you think that migration is a possible solution to the problems of the Sahel? Justify your answer that are part of the Sahel.

► Figure 7.11: Searching for water in the Sahel



DEFORESTATION

Why are rainforests being cut down?



► Figure 7.12: The reasons why rainforests are being cut down

Areas of tropical rainforest are cleared for a variety of reasons (Figure 7.12). Trees are felled for timber and sometimes for their medicinal drugs. Large areas have been deforested to make land for farming, housing and industry. Mining and hydroelectric power (HEP) schemes have also led to land clearance. Sometimes, the logging and land clearance is illegal or without any sort of control. Some developing country governments have encouraged the clearance of forests because:

- the revenue earned from selling timber, minerals and the sources of medicinal drugs helps to pay off debts and to fund economic development
- more land is needed to house and feed the fast-growing populations in countries such as Brazil and Malaysia.

DID YOU KNOW?

The causes of deforestation in Brazil were examined in Part 5.3 (page 000). It is important that you now re-read that section.

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# GEOGRAPHY

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Michael Witherick

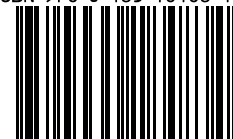
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