Conservation of natural resources

Unit 5

Contents

5.1 Definition of resources

By the end of this section you should be able to:

- Define natural resources.
- Define renewable and non-renewable resources.
- Classify natural resources as renewable and non-renewable.
- Define conservation as the protection and preservation of our natural environment.

KEY WORDS

natural resources *resources (actual and potential) supplied by nature*

renewable *capable of being produced indefinitely, not used up*

non-renewable *once used, cannot be easily made or replaced*

extinct *no longer in existence*

conservation *the act of preserving, guarding or protecting*

Ethiopia has many **natural resources**. Natural resources include anything that is found naturally in the country which is useful to human beings. In our country we have gold, platinum, potash, limestone, natural gas, coal and hydropower. We may have some deposits of oil as well. We have timber and many different crop plants, particularly our coffee plantations. We have many different species of animals and plants which make up rich ecosystems. We have many different breeds of domestic animals. Ethiopia is a country rich in natural resources, but many of them will not last forever.

Natural resources can be classified as either **renewable** or **non-renewable**. Renewable resources are mainly living things and their products. Managed carefully, they can be used, reused and replaced. Examples of renewable resources are crop plants, trees, cattle and chickens. Non-renewable resources are not living, and when they are used they cannot be replaced. Examples of non-renewable resources include metals like gold and iron and fossil fuels like gas, coal and oil.

Even renewable resources can be lost if we do not manage them carefully. Trees can produce new trees and forests can last thousands of years – but if all the trees are cut down and used for timber in a very short time the forest will not be able to renew itself and all the species within it will be lost. Similarly if an animal is hunted until there are no more of that species left (extinction) or its habitat is destroyed so it can no longer feed and breed, then another natural resource will be lost forever when the species becomes **extinct**. It may be lost in a particular area, or it may be lost everywhere in the world, when it is totally extinct.

Figure 5.1 *Coffee is an important renewable resource in Ethiopia.*

To protect our natural resources, both here in Ethiopia and around the world, people are becoming more aware of the need for **conservation**. Conservation is the protection and preservation of our natural environment, so that non-renewable resources are used sparingly and renewable resources are managed so that they can last for the foreseeable future.

Activity 5.1: Natural resources of Ethiopia

Have a brainstorming session and think of as many natural resources of Ethiopia as you can.

Now divide them up into renewable resources and non-renewable resources.

Make a poster or collage to show these natural resources. Divide the poster into renewable and non-renewable resources. You can draw the living or non-living things, cut pictures from magazines and stick them on, collect fur or feathers from animals – use your imagination to make your poster as interesting as possible to show people the great variety of natural resources that we have.

Summary

In this section you have learnt that:

- A natural resource is anything natural that is useful
- Some natural resources are renewable – they are mainly living things and their products, and with management they can be used, reused and replaced.
- Some natural resources are non-renewable – they are not living, and when they are used up they cannot be replaced. Classify natural resources as renewable and non-renewable.

Review questions

1. Which of the following is a non-renewable resource?
   A timber
   B gold
   C coffee
   D khat
2. Which of the following is a renewable resource?
   A oil
   B coal
   C gas
   D wood
3. Write about the natural resources of Ethiopia and why we need to take care of them.

5.2 Conservation and biodiversity

By the end of this section you should be able to:

- Define biodiversity as the wealth of species in a given place.
- Explain the importance of conserving biodiversity.
- Summarise the general methods of conserving biodiversity.

One of the most important things that concerns scientists around the world at the moment is the loss of **biodiversity** that is taking place very quickly. This means that renewable resources are disappearing from our countries.

Biodiversity is a measure of the wealth of species in a given place. It includes everything from the smallest microbe to the largest animal.

KEY WORDS

monocultures *the cultivation of single crops*

Sometimes biodiversity is measured just as the number of species in a given area at a particular time. Sometimes it is measured as the number of species breeding in an area at a particular time. This second measure is more accurate. An animal might be just passing through on the day you observe what is there so it is more accurate to measure the species which live and breed in an area! But just counting the number of different species of organisms in an area gives us a good idea of biodiversity and is easier to do.

Why is biodiversity so important?

You have learnt in your work on food chains and food webs how all the organisms in an ecosystem are dependent on one another. You have also learnt that the variety of organisms can affect the physical conditions around them. Ecosystems are linked on a large scale across the Earth. If biodiversity is reduced in one area, the natural balance may be destroyed elsewhere. Healthy biodiversity is important for the health of the planet. The air and water of the Earth are purified by a wide range of organisms. Waste is decomposed and removed by many different organisms. Photosynthesis by plants plays an important part in stabilising the atmosphere and the world climate. Plants absorb water from the soil which evaporates into the atmosphere through transpiration. This helps determine where rain will fall. Plant roots hold the soil together. This reduces the risk of flooding and makes sure that the soil is not blown away and remains fertile. Plant pollination, seed dispersal, soil fertility and the nitrogen cycle are all needed for natural ecosystems and for farming. They rely on good biodiversity to work properly.

Figure 5.2 *An aerial shot of a major migration, demonstrating how hard it is to accurately measure species and diversity.*

Biodiversity also gives us the genetic diversity we need to develop crops to grow in different conditions. A wide range of biodiversity means we can breed the cattle, sheep, goats and other livestock that are best suited to our climate. We can also bring in new genes as climate conditions change. Biodiversity also means that there are many different types of plants and animals which can act as a source of medicines, clothing, food and other useful things for people.

Biodiversity matters for the appearance of our country. Areas that are rich in a wide variety of plants and animals are good to look at. People come from all over the world to admire and enjoy our wonderful biodiversity as we have such a rich heritage of animals and plants. Huge fields with a single crop (called **monocultures**) are not attractive to look at and they do not support a wide range of other animals and plants. However, it is not just a matter of looks. If biodiversity is low, the organisms are much more likely to be attacked by disease as it will spread from one to another very quickly. In a more diverse ecosystem some of the organisms will not be affected by a disease and the spread will be stopped.

However, biodiversity is being lost around the world for many different reasons. In many countries huge areas of land are used to grow single crops such as oil palms, maize and wheat. These monocultures greatly reduce biodiversity. Deforestation is a big

Figure 5.3 *Deforestation such as this seen outside Gonder greatly reduces the biodiversity of the area.*

problem too – here in Ethiopia we have cut down most of our original forests with huge loss of biodiversity. Climate change, pollution and human activities have reduced biodiversity around the world.

Now we understand how important biodiversity is, we need to look at ways in which it can be conserved. **Conservation** means keeping and protecting a living environment. There are a number of ways in which we can conserve biodiversity.

Individual species may be protected, so that it is illegal to capture, kill or harm them.

People can reduce pollution and around the world nations are looking at ways in which they can reduce the levels of carbon dioxide in the atmosphere and reduce climate change if possible.

The loss of habitats can be reduced – for example, if deforestation is stopped and more forests are replanted biodiversity may be increased again.

One of the most effective ways of conserving biodiversity is to protect large areas of habitat so that natural biodiversity is conserved in a very large area. Ethiopia is leading the way in this. We have designated at least 12 regions of the country as National Parks, areas where the wildlife and plants are protected and biodiversity can thrive. You will be looking at some of our National Parks in more detail in this section.

Summary

In this section you have learnt that:

- Conservation is the protection and preservation of our natural environment.
- An important aspect of conservation is to preserve biodiversity.
- Biodiversity can be defined in several ways – the most useful is as the wealth of species in a given place.
- Biodiversity is important because it maintains the balance in an ecosystem, produces genetic variety, makes places look good with a mixture of different species rather than a monoculture and helps reduce the spread of disease.

Review questions

1. A monoculture is:
   A a field containing a single crop
   B a clone
   C a country with only one type of person in it
   D an environment with a rich diversity of species
2. How is biodiversity being lost in Ethiopia and why is it important to conserve it?

5.3 Vegetation

By the end of this section you should be able to:

- State some uses of vegetation.
- Discuss the impact of human activity on natural vegetation.
- Discuss how Ethiopian vegetation was affected in history.
- List some of the endemic vegetation species in Ethiopia.
- Discuss methods of conservation of vegetation.
- Narrate how Ethiopian vegetation was affected in history.

Here in Ethiopia we have a rich and varied vegetation. We have ecosystems which vary from desert to tropical rainforests, and the vegetation across the country changes dramatically with the conditions. We have some of the lowest-lying areas of Africa, and some of the highest peaks.

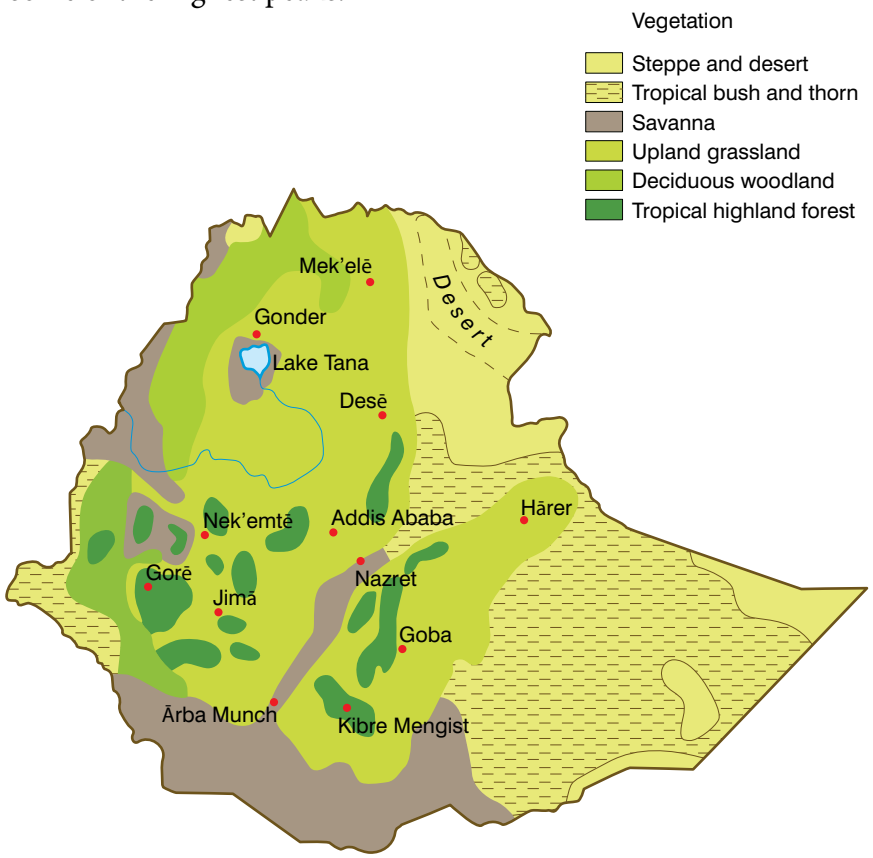


Figure 5.4 *Different areas of vegetation across Ethiopia*

Using plants

Plants are of great importance to human beings all around the world. We use them in many different ways. We use them for food, for example, teff, sorghum, anchote and beans. We use them to make drinks such as tella, and coffee (bunna). The coffee plant is not only used in our homes for drinks, it is very important in our economy as coffee is one of our main exports too. Plants are used for building materials – wood is used to build our homes and plants are used to thatch the roofs. We also export timber such as blue gum (bahir zaf) logs as construction material. We use vegetation to make clothing – cotton and hemp are just two examples of plants that are used to make fabrics for clothing. Plants are also a source of medicines; both herbal medicines and many western medicines are originally based on chemicals from plants. For example, the root bark of the tree known locally as 'waginos' (in Ge'ez) or 'yedega abalo' has been used for centuries to treat dysentery and koso is a medicinal plant that gets rid of worms. Trees provide the building material for many boats. Plants provide us with fuel when we burn wood or use biofuels. And our relatively lush vegetation in Ethiopia means we have the highest bee population in Africa, making us the tenth biggest honey producers in the world. Vegetation is vital for human life and for biodiversity in Ethiopia and across the world.

Figure 5.5 *Here in Ethiopia we rely on our vegetation in many different ways.*

Activity 5.2: The uses of vegetation

Work in small groups and brainstorm as many examples of ways in which people use plants, and of the plants that we use, as you can.

Share your ideas with the whole class.

Then each group can take a different use of vegetation and produce a poster or collage to go on the classroom walls explaining how plants are used in that way and giving as many examples as possible. Try and use examples from your local area and from other places. Make your poster as lively and interesting as you can.

Human effect on vegetation

People can have a major effect on the vegetation of an area. People may cut down and clear large areas of forest. This may be to sell the timber or to make the land available to grow crops or farm cattle. It greatly reduces the biodiversity of the vegetation and often destroys the structure of the soil. People also change the vegetation of an area when they farm the land – they may grow local plants as food or commercial crops (for example teff), or they may grow introduced species for local use or to sell (for example coffee). By fertilising the soil, removing weeds and planting specific crops, people have an effect on the local vegetation. Grazing our domestic animals also affects the vegetation around us. Animals such as goats, sheep and

Figure 5.6 *This* Guizotia abyssinica*, used as a vegetable oil, is just one example of our many endemic species of plants.*

Activity 5.3: Finding out about endemic species

Ethiopia is renowned for its rich diversity of plants and for its endemic species.

Find out as much about our endemic plant species as you can. Make a presentation about some of the endemic species of Ethiopia, particularly any that grow in your own area.

KEY WORDS

endemic *unique to a particular geographic location*

sustainable resource *capable of being maintained and/or replaced*

cattle eat much of the ground vegetation and will stop the growth of large trees and shrubs by eating them when they are small seedlings. People also affect vegetation by pollution and by climate change. Not all of our impacts are negative – people can also work hard to conserve biodiversity and protect an area, and there has been a great deal of work in Ethiopia with the replanting of indigenous trees by people such as Professor Legesse Negash and his team from Addis Ababa University.

Endemic species

Ethiopia is a country which is internationally recognised for its rich diversity of plant species. We have around 7000 different species of higher plants alone, with up to 800 **endemic** species. An endemic species is an organism that is only found in a particular area – so we have around 800 endemic plants which grow wild in parts of Ethiopia. They are very important to both Ethiopian and world biodiversity! Examples of our endemic species include teff (*Eragrostis teff*), many *Euphorbia* spps, noug or niger seed (*Guizotia abyssinica*), enset (*Ensete ventricosum*), *Ficus vasta* Forssk, zigba, juniper (tid), kererro and sembo trees and many other species.

The history of Ethiopian vegetation

The history of our vegetation in Ethiopia has not been recorded in as much detail as we might wish. Unfortunately, as we are blessed with such a rich and diverse vegetation, we have not as a nation conserved that gift until recent years. But perhaps we are not too late! We have used our resources without thought for the future – in each area of the country the available vegetation has often been destroyed. However, now we are looking at the past and making great efforts for the future. For example, Emperor Zera Yakob (1434–1468) is said to have organised the collection of the seeds of many indigenous trees such as juniper (tid), olive (woira) and podo (zigba) from the Wof-Washa forest near Debre Sina. He had them planted on the Menagesha Mountain. The Menagesha forest is still one of the best preserved in the whole country. Not all efforts at conservation are completely successful! In 1895 Emperor Menelik II ordered the introduction of bahir zaf (blue gum) to try and replace the native vegetation that was disappearing around many settlements. These trees have since covered much of the Ethiopian highlands and, while they are important for our timber trade, recent studies have shown that they have a damaging effect on the soil and that there is a reduced biodiversity of other plants in areas of bahir zaf vegetation. But apart from these efforts, we have used our vegetation in Ethiopia without thought or co-ordinated conservation efforts for many years. Vegetation should be a **sustainable resource** – plants make more plants and grow continuously, so we can harvest them. But no area of vegetation can withstand rapid harvesting without replanting and conservation. It seems that originally around 35% of Ethiopia was covered in forests and lush vegetation. By 1952 only 16% of that forest cover was left.

By 1980 this was down to 3.6%, 2.7% by 1987 and in 1990 only 2.4% of our beautiful country had forest cover – we had lost most of what is one of the most biodiverse ecosystems in the world. Only a very few forests, such as the Anabe and Yegof forests in Wello and the Menagesha forest in Shewa, are well preserved. Scientists think that the way in which land has traditionally been held communally, with no one responsible for the long-term sustainability of the resources, is at least part of the problem. A lack of accountability and responsibility has led to excess felling, woodland and plantation fires, etc. However, there is an increasing awareness in our country of the need to conserve what remains of our magnificent vegetation and where possible restore and preserve it.

Figure 5.7 *Many Ethiopian families are working hard to grow their crops in a way which is sustainable and does not reduce local biodiversity.*

Conservation

Ways in which we can conserve our vegetation are many and varied. It needs as many people as possible to understand what needs to be done and to work together to conserve and restore our magnificent plant heritage. In 1997 Dr Mesfin Tadesse suggested a number of ways in which we might set about conserving our rich vegetation heritage. Over ten years later, many of his ideas are being carried out. The Government of Ethiopia is working with many different groups to encourage the replanting of land with endemic species. Research institutions are looking at indigenous knowledge and using local practices of looking after resources. Much research into our native plants is going on, and more care taken when introducing exotic plants. The National Herbarium at Addis Ababa has become a world-class institution holding information about Ethiopian plants. And the work of many leading scientists like Professor Legesse Negash, means that replanting indigenous tree species is happening faster and faster in more places across our country. One of the most important ways in which we are conserving our vegetation – and our wildlife – is in the setting up of our internationally famous National Parks. You will be looking at these in more detail in the next section and considering their importance for both animals and plants.

Summary

In this section you have learnt that:

- Vegetation has many different uses from food and clothing to building materials and medicines.
- Human activity can have many different impacts on natural vegetation. Human activity often reduces natural vegetation by deforestation, burning, farming etc.
- There are many endemic vegetation species in Ethiopia which include teff (*Eragrostis teff*), many *Euphorbia* spps, noug or niger seed (*Guizotia abyssinica*), enset (*Ensete ventricosum*), *Ficus vasta* Forssk, zigba, juniper (tid), kererro and sembo trees.
- There are a number of different methods of conservation of vegetation which include protecting natural habitats and replanting endemic species.
- Ethiopian vegetation has been affected by human activities through history for a very long time. Some of this activity has been positive, but often we have damaged and destroyed our woodlands and forests.

Activity 5.4: Conserving local vegetation

You are going to carry out a survey of the vegetation in your area. Find out what type of vegetation you have and identify as many plants as possible.

Plan how you might work with others to conserve an area of land, and what indigenous plants would be likely to grow best near your school.

Present your ideas to the rest of the class and vote for the best conservation idea that is suggested.

Review questions

1. Which of the following is not an endemic Ethiopian plant?
   A tid
   B zigba
   C teff
   D maize
2. Which of the following is not a use of vegetation in Ethiopia?
   A building material
   B fuel
   C car building
   D medicines
3. Explain three ways in which people have an effect on the vegetation of Ethiopia.

5.4 Wildlife

By the end of this section you should be able to:

- State the uses of wildlife.
- Describe the effects of humans on wildlife and its status in Ethiopia.
- List at least five endemic wildlife species of Ethiopia.
- Discuss methods of conservation of wildlife and the uses of National Parks of Ethiopia.
- List at least five national parks of Ethiopia and mention some of the common species that exist in each of the National Parks.

The wildlife of Ethiopia is some of the richest in the world. We have 242 listed mammalian species, which range from huge elephants to tiny elephant shrews. There are around 862 species of birds as well. Insects are another important aspect of Ethiopian wildlife too. This variety of wildlife is useful to people in a number of ways. A rich diversity of animal life is important to maintain our many ecosystems. The wildlife acts as pollinators for our flowering plants and helps to disperse the seeds. Our bees provide the honey for a thriving export business and for the production of tej. The balance of wildlife in different regions helps to maintain the natural balance of the plants as well, with predators keeping down the numbers of herbivores so that they do not destroy all the vegetation. Some of the wildlife acts as a genetic bank for our domestic animals and can be used as a source of genetic diversity. However, one of the most important uses of wildlife in Ethiopia is to generate income from tourism. People from all over the world want to see our

amazing wildlife. Animals such as elephants, lions, cheetahs, rhinos, wildebeest and antelopes are an inspiring sight. Our birdlife too brings people from far and wide. From our birds of prey to our pelicans and flamingos, from our parrots to the rare white-winged flufftail, people come to Ethiopia for our rich diversity of birds alone.

Endemic species

We have a high number of endemic species of different types of wildlife. For example, there are 28 species of mammals, which include the Gelada Baboon, the Walia ibex, Menelik's Bushbuck, the Mountain Nyala, Swayne's Hartebeest and the Ethiopian wolf you have looked at before. Endemic bird species include the heavy-headed, thick-billed raven, the wattled ibis, the black-winged lovebird, the white-collared pigeon and the Prince Ruspolis Turaco. We also have six endemic reptiles and around 33 endemic amphibians. These animals and many others are found only within the boundaries of Ethiopia.

Human effect on wildlife

What impact have human beings had on the wildlife of the country? Unfortunately, historically our impact has often been negative. The deforestation which has deprived our country of so much plant biodiversity has also caused many species to be pushed to the verge of extinction. At the moment our Institute of Biodiversity, Conservation (the IBC) is warning that at least four mammal species and two bird species are on the brink of extinction as a result of habitat loss. These are the Walia ibex (there are only about 514 left), Mountain Nyala, Ethiopian wolves and Grevy's zebras, while the white-winged flufftail and the Ankober Serin bird are also badly threatened. The IBC explain that deforestation is one of the main reasons for the decline in wildlife in our country – when the forests go, so does the wildlife. Many animals have been hunted and their numbers greatly reduced. This may be to keep them away from crops or to stop them killing and eating domestic animals, or it may be for sport. Wherever people settle they change the environment and make it more difficult for wildlife to survive.

Conservation

However, the human impact on wildlife does not have to be negative. There have been many moves in Ethiopia in recent years to conserve our wildlife, and we will be looking at some of these in detail. Conservation involves protecting habitats and managing populations. Another method involves preventing the spread of disease. For example, in the areas where there are still breeding groups of Ethiopian wolves, scientists work hard to keep domestic dogs vaccinated against dangerous diseases such as rabies. When there was an outbreak of rabies in the Web Valley in 2004, the Ethiopian Wolf Conservation Programme captured and vaccinated 72 wolves. This contained and reduced the damage the disease

Figure 5.8 *Endemic species such as this Gelada Baboon are just one reason why the biodiversity of wildlife in Ethiopia is so well known.*

Activity 5.5: Finding out about endemic species

Ethiopia is renowned for its rich diversity of wildlife and for its endemic species.

Find out as much about our endemic wildlife species as you can. Make a presentation about some of the endemic species of Ethiopia, particularly any that are found in your own area.

would otherwise have done to these precious populations – and made the local dogs healthier too.

Many of the conservation points which we will discuss for animals apply to vegetation as well. Ethiopia is one of the most enlightened of the African countries in its approach to conservation. In particular, we have set up and maintain a number of National Parks.

A National Park is a relatively large area of land which is owned by the Government and is set aside for the protection of vegetation and wildlife and for their appreciation by human beings. A National Park should contain several ecosystems which are not affected by human activities. It is protected legally and there should be staff (rangers) who manage and protect the environment. Visitors can enter the National Parks under carefully controlled conditions for educational, cultural and leisure reasons. Any natural resources within a National Park should not be exploited, although sometimes there may be a need for some building work, and some populations may need to be managed by selective culling to keep the numbers manageable and avoid damaging the ecosystem. When this is necessary, hunting licences may be issued to raise money to help support the park.

By careful management in National Parks, many animals and plants are conserved in Ethiopia and the work is continuing, with local populations becoming more and more involved in protecting our great wildlife diversity. There are some problems – it is not always easy for people to live within a National Park, and some people continue to poach and kill animals even when they are protected. But on the whole, we are making good progress.

Figure 5.9 *This beautiful Nechisar National Park is one of many we have established here in Ethiopia, conserving both vegetation and wildlife. We are setting an example for other countries in Africa and around the world with our focus on conservation.*

Below are listed many of the main National Parks of Ethiopia along with some of the wildlife sanctuaries that have been set up to protect specific species. In each case you can learn about some of the common species of wildlife that exist in each conservation area.

Abijatta-Shalla Lakes National Park is 200 km south of Addis Ababa and it is 887 km^2 in size. More than half of the area is under water in Lake Abijatta and Lake Shalla, but it also includes peaks like Mount Fike, which is 2075 m above sea level. Animals which are found in this beautiful park include flamingos, Great White Pelicans, Grant's Gazelle, Oribi Warthog and Golden Jackals.

Awash National Park is found about 225 km east of Addis Ababa and its southern boundary is formed by the Awash river. Much of it is at an altitude of around 900 m, but it contains a dormant volcano called Fantale which is over 2000 m high. The park is relatively dry, with lots of grassland and acacia woodland. The wildlife supported by this terrain is very varied. There are Beisa oryx, Soemmerrings Gazelle and of course wild pigs. Zebra, dik-dik, Anubis and Hamadryas Baboons, cheetahs, serval and leopards can all be found in this area. The birdlife is also extravagant and varied, including ostriches, Secretary Birds, Carmine Bee-eaters and the Abyssinian Roller.

Bale Mountain National Park is not always easy to get to but it contains a mixture of forest and moorland, and some very rare animals such as the Gelada Baboon, Mountain Nyala and Ethiopian wolves. Other species found there include the Giant Mole Rat, Klipspringer, Menelik's Bushbuck and warthogs.

Gambela National Park is one of our newest National Parks. It is big – over 5000 km^2 – with massive grassland plains and it includes the Baro river. The wildlife that can be seen in this park includes enormous Nile perch, crocodiles and hippos as well as waterbuck, Roan Antelope, hyena, lions, elephants, buffalo, zebra, Vervet Monkeys and black-and-white colobus monkeys.

Rift Valley Lakes National Park is in a chain of seven lakes which run from Debre Zeit towards Kenya. This National Park does have some mammals, including Grant's Gazelle and warthogs, but the wildlife for which it is famous is the birdlife, which includes Greater and Lesser Flamingos, a huge colony of Great White Pelicans, fish eagles, spoonbills, Abdim's Storks and ibises.

Mago National Park has an area of over 2000 km^2. Almost 800 km south-west of Addis Ababa on the east bank of the Omo river, this National Park is largely grassland with some forest around the rivers. It is home to 56 species of our famous plains animals, including giraffe, elephants, lions, buffalo, cheetah, zebra, leopard and oryx. This is one of the remaining places where rare Black Rhinos may be found. Vultures are one of the well-known bird species in this area.

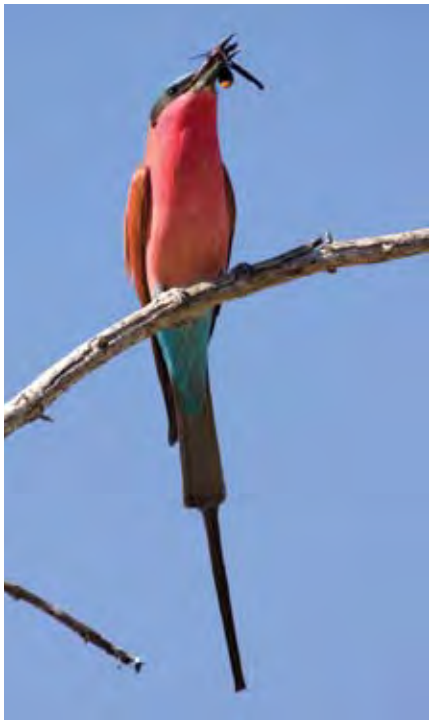


Figure 5.10 *This amazing bird is a Carmine Bee-eater. This species is protected in the Awash National Park.*

Figure 5.11 *These spectacular Simien Mountains are home to some of our rarest endemic animals which are protected by their National Park status.*

Figure 5.12 *The rare Ethiopian wolf which lives in the Bale mountains and is one of our endemic species of animals.*

Omo National Park is very big indeed, covering over 4000 km^2. Over 300 species of birds alone are found here. Animal life includes kudu, hartebeest, oryx, Anubis Baboons, lions, cheetahs, buffalo, giraffes and elephants.

Nechisar National Park is between two lakes, Abaya and Chamo. The habitats include dry bush, savannah and a groundwater forest and, although it is only about 500 km^2, almost 200 species of birds have been recorded here, including Red-billed Hornbills, fish eagles, the Abyssinian Ground-hornbill and the Kori Bustard! Animals which can be seen include crocodiles, Burchell's Zebra, bushbucks, Grey Duiker, Grant's Gazelle and the Greater Kudu. This National Park is very important for the conservation of the rare, endemic Swayne's Hartebeest.

Simien Mountains National Park is home to both spectacular scenery and spectacular and rare wildlife. This major mountain range has been declared a World Heritage Site, and it has many peaks above 4000 m. This is not a hot area, and night temperatures are often cold. This is the area of Ethiopia where a number of our endemic species are protected and conserved. You can find Walia ibex, Ethiopian wolves and Gelada Baboons in this amazing and protected region of our country.

Yangudi Rassa National Park is big and is found in the arid northern Rift lowlands. There is a wide variety of vegetation, from semi-desert and scrubland to savannah and even open woodlands. In this conservation area you can find the wild-ass ancestor of our domestic donkeys, and Greater and Lesser Kudu, Grevy's Zebra and cheetah.

We also have a number of wildlife sanctuaries which are similar to National Parks but focus on the conservation of particular species.

Some examples of these include:

Harar Wildlife Sanctuary is an area of almost 7000 km^2 in the Misraq Hararghe Zone of the Oromia region, which was set up to conserve and protect our native elephant sub-species, *Loxodonta Africana oleansie*. The area is also home to the black-maned lion.

Kuni-Muktar Mountain Nyala Sanctuary is a protected area which has been set up to protect the Mountain Nyala (*Tragelaphus nyala*), an extremely rare endemic animal in Ethiopia. There are fears that there are only between 70 and 200 of these animals left in Ethiopia, and so it is vital to conserve them. Sadly, there are still people in our country who want to hunt these animals for trophies, and so they need a great deal of protection.

Senkelle Swayne's Hartebeest Sanctuary is close to the Lake Rift Valley National Park and it is dedicated to the protection of this rare hartebeest. There are over a thousand of these protected animals in the sanctuary.

In Ethiopia many people are working to conserve our vegetation and wildlife. On a large scale we have National Parks and wildlife sanctuaries. On a smaller scale many individuals and villages are

working to conserve the environment. For our country to succeed, people must be able to live side by side with our great Ethiopian biodiversity of vegetation and wildlife in a sustainable way.

Summary

In this section you have learnt that:

- The wildlife in Ethiopia has many uses from food to encouraging tourism, and from maintaining genetic diversity to providing the original species for our domestic animals.
- Human beings have had a major impact on wildlife and their status in Ethiopia. For many years people have threatened the wild life, hunting animals and often destroying their habitat, e.g. in deforestation. However, increasingly people are protecting and conserving wildlife.
- There are many endemic wildlife species of Ethiopia including Gelada Baboon, the Walia ibex, Menelik's Bushbuck, the Mountain Nyala, Swayne's Hartebeest, the Ethiopian wolf, the heavy-headed, thick-billed raven, the wattled ibis, the black-winged lovebird, the white-collared pigeon and the Prince Ruspolis Turaco.
- There are a number of methods of conservation of wildlife including restoring lost habitat, e.g. replanting forests. Setting up National Parks or reserves where the habitat is protected and the animals are also protected from hunting and poaching is an effective way of conserving threatened species and wildlife biodiversity.
- Ethiopia has many National Parks which are important in the conservation of our endemic wildlife species and others. They include Abijatta-Shalla Lakes National Park, Awash National Park, Bale Mountain National Park, Gambala National Park, Rift Valley Lakes National Park, Mago National Park, Omo National Park, Nechisar National Park, Simien Mountains National Park and Yangudi Rassa National Park.

Review questions

1. Which of the following is not an example of endemic Ethiopian wildlife?

   A Ethiopian wolf

   B cheetah

   C Walia ibex

   D white-winged flufftail

2. Which of the following is a sanctuary rather than a National Park in Ethiopia?

   A Bale

   B Gambala

   C Senkelle

   D Simien

KEY WORDS

pollution *the contamination of the natural environment by harmful substances as a result of human activities*

pollutant *a harmful substance*

hydrocarbons *substances containing only hydrogen and carbon. Fossil fuels are made of hydrocarbons*

particles *very small pieces of solid or liquid matter*

global dimming *a worldwide reduction of the sunlight reaching the Earth's surface, caused by particulate air pollution*

carbon dioxide *a gas produced by living organisms as a waste product of respiration, and as a result of burning wood and fossil fuels*

carbon cycle *the global cycle of movement of carbon, in all of its forms, involving all living things and all parts of the environment*

5.5 Air

By the end of this section you should be able to:

- Explain the causes of air pollution.
- Explain the effects of air pollution.
- Define global warming.
- State the causes of global warming.
- Explain the methods of preventing global warming.

Clean air is essential for our bodies to live as it supplies the oxygen for cellular respiration. We breathe air into and out of our lungs all the time from our birth to our death. Unfortunately, some of our other activities release substances that pollute the air and are harmful to humans, plants and animals.

Pollution is the contamination of the natural environment by harmful substances as a result of human activities. Pollution can happen on a very small, local scale – every time you drop litter, or a dog fouls the street, the local environment is polluted. On the other hand, pollution happens on a very large scale too, affecting whole countries – acid rain, global warming and the ozone hole are all examples of the effects of large-scale air pollution you will be learning about here.

A **pollutant** can be defined as something that contaminates the air, soil and water. In this section we will be concentrating on substances which pollute the air.

What is in air pollution?

Air pollution comes in various forms, each of which has serious implications for our health and well-being as well as for the whole environment.

One type of air pollution is **smoke** produced by burning fuel for energy. Much of the fuel we use is fossil fuel – coal, oil or gas, or electricity produced by burning them. Fossil fuels contain chemicals known as **hydrocarbons**. When these fuels are burnt, tiny **particles** of unburnt hydrocarbons are released into the air. Diesel smoke is a good example of this. The particles are very small pieces of matter. This type of pollution is sometimes referred to as 'black carbon' pollution. The exhaust from burning fuels in cars, homes and industries is a major source of pollution in the air. Even the burning of wood on our fires can release significant quantities of soot into the air causing local air pollution. Smoke pollution worldwide is thought to be causing **global dimming**, blocking out some of the light from the sun.

Another major cause of air pollution is the production of **carbon dioxide**. Carbon dioxide is produced by living organisms as a waste product of respiration. It is used by plants in the process of photosynthesis. Carbon dioxide is also produced as a result of burning wood and fossil fuels.

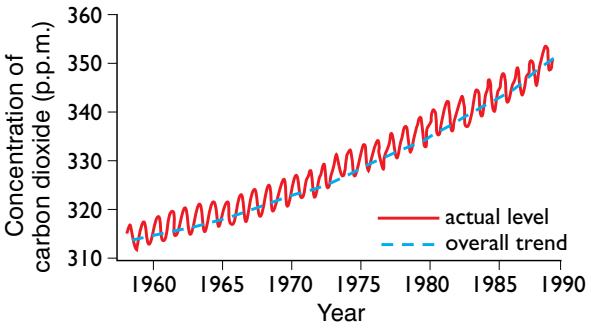


Figure 5.13 *This graph shows how carbon dioxide levels in the air have been steadily increasing. The variations through the year show the difference in the plants taking up carbon dioxide in summer and winter. The measurements are taken at the top of a mountain in Hawaii.*

For millions of years the levels of carbon dioxide released by living things into the atmosphere have been matched by the plants taking it out and the gas dissolving in the seas. As a result the level in the air stayed about the same from year to year. You learnt about this **carbon cycle** in grade 9.

Why is carbon dioxide increasing?

But now the amount of carbon dioxide produced is increasing fast as the result of human activities. Around the world people are burning huge amounts of fossil fuels in cars, planes and also in power stations to generate electricity. This speed means that the natural sinks cannot cope, and so the levels of carbon dioxide are building up.

Carbon dioxide in the atmosphere is important because of the greenhouse effect. It traps some of the heat from the sun and keeps the surface of the Earth warm enough for life as we know it. But the build-up of carbon dioxide gas in the atmosphere from human activities seems to be adding to this greenhouse effect and causing global warming. Although plants take in carbon dioxide and release oxygen, the release of carbon dioxide from human activities is higher than the plants can process. The situation is made worse because all around the world large-scale deforestation is taking place. We are cutting down trees over vast areas of land for timber and to clear the land for farming. In this case, the trees are felled and burned in what is known as 'slash-and-burn' farming. The land produced is only fertile for a short time, after which more forest is destroyed. No trees are planted to replace those cut down.

Deforestation increases the amount of carbon dioxide released into the atmosphere as burning the trees leads to an increase in carbon dioxide levels from combustion. The dead vegetation left behind decays as it is attacked by decomposing micro-organisms, which releases more carbon dioxide.

Normally trees and other plants use carbon dioxide in photosynthesis. They take it from the air and it gets locked up in plant material like wood for years. So when we destroy trees we lose a vital carbon dioxide 'sink'. Dead trees don't take carbon dioxide out of the atmosphere.

Methane is another greenhouse gas that causes air pollution and the levels of this gas are rising too. It has two major sources. As rice grows in swampy conditions, known as paddy fields, methane

DID YOU KNOW?

Cows produce methane all through the day from both ends! A single cow can release from 100–400 litres of methane per day – that's a lot of greenhouse gas.

KEY WORDS

carbon monoxide *a pollutant gas produced as a result of burning fossil fuels*

sulphur dioxide *a pollutant gas produced as a result of burning fossil fuels*

nitrogen oxides *pollutant gases produced as a result of burning fossil fuels*

acid rain *rain with a low pH containing sulphuric acid and nitric acid as a result of dissolving airborne pollutant gases*

is released. Rice is the staple diet of many countries so as the population of the world has grown so has the farming of rice.

The other source of methane is cattle. Cows produce methane during their digestive processes and release it at regular intervals.

In recent years the number of cattle raised to produce cheap meat for fast food like burgers has grown enormously, and so the levels of methane in the atmosphere are rising. Many of these cattle are raised on farms produced by deforestation.

Global warming

So as a result of human activities the amount of carbon dioxide (and methane) in the air is continuing to increase. This build-up acts like a blanket and traps heat close to the surface of our Earth. This causes the temperature at the surface of the Earth to rise. This in turn may have many effects on our climate and health – and it is also thought to contribute to the increased hurricane activity which has affected some areas of the world in recent times.

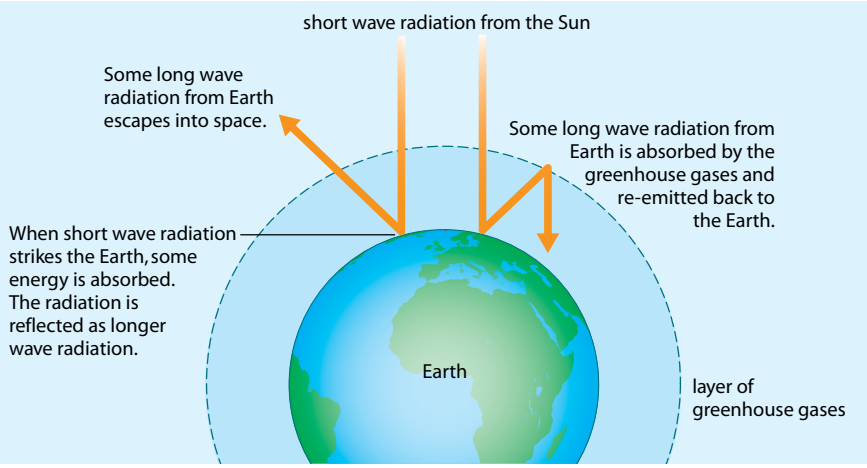


Figure 5.14 *Most scientists believe that global warming is a result of the build-up of air pollutants such as carbon dioxide. The pollution is produced all over the world. Here in Ethiopia we are already feeling the effects.*

Another air pollutant is **carbon monoxide**, also produced by the burning of fossil fuels. It is produced by cars as well as by home water heaters, paraffin lamps and fires if they are not functioning properly. Carbon monoxide is very dangerous because it combines irreversibly with haemoglobin in your blood, reducing the oxygen-carrying capacity. There is carbon monoxide in cigarette smoke, which is why it is so dangerous to smoke if you are pregnant because you can deprive your unborn baby of oxygen. Carbon monoxide poisoning can eventually lead to death and, because the gas has no colour or smell, there is no way of knowing if it is leaking into your home from a faulty lamp.

Acid rain

Acid rain is the result of another form of air pollution. When fossil fuels are burned carbon dioxide is released into the atmosphere as a waste product. However, carbon dioxide is not the only waste gas produced. Fossil fuels often contain sulphur impurities. When these burn they react with oxygen to form sulphur dioxide gas. At high temperatures, for example, in car engines, nitrogen oxides are also released into the atmosphere.

Sulphur dioxide and **nitrogen oxides** pollute the air and can cause serious breathing problems for people if the concentration gets too high. They form a haze of pollution known as smog, which can be a real problem in big cities where there are millions of motor vehicles.

They are also involved in the formation of acid rain. This pollutes land and water over a wide area.

The sulphur dioxide and nitrogen oxides dissolve in the rain and react with oxygen in the air to form dilute sulphuric acid and nitric acid. This makes the rain more acidic – it is known as **acid rain**.

The effect of acid rain

Not surprisingly, acid rain has a damaging effect on the environment. If it falls onto trees, the acid rain can cause direct damage. It may kill the leaves and, as it soaks into the soil, even the roots of the tree may be destroyed. In some parts of the world, huge areas of woodland are dying as a result of acid rain.

Acid rain has an indirect effect on our environment as well as its very direct effect on plants such as trees. As acid rain falls into lakes, rivers and streams the water in them becomes acidic. If the concentration of acid gets too high, plants and animals can no longer survive. Many lakes and streams have become dead, no longer able to support life.

It is not only living things that are damaged by acid rain. The weak acid attacks the material of buildings and statues, reacting with any calcium carbonate (limestone or marble) and even with metals.

Acid rain is a difficult form of air pollution to pin down and control. It is formed by pollution from factories. It also comes from the cars and other vehicles we use every day. The source of the gases is pretty widespread. The worst effects of acid rain are often not felt by the country that produced the pollution in the first place. The sulphur and nitrogen oxides are carried high in the air by the prevailing winds. As a result, it is often relatively 'clean' countries that get the pollution and the acid rain from their dirtier neighbours. Their own clean air goes on to benefit someone else!

DID YOU KNOW?

Normal rain has a pH of around 5. It is slightly acidic because of carbon dioxide from animals breathing out being dissolved in the water. Acid rain has been measured with a pH of 2.0 – more acidic than vinegar!

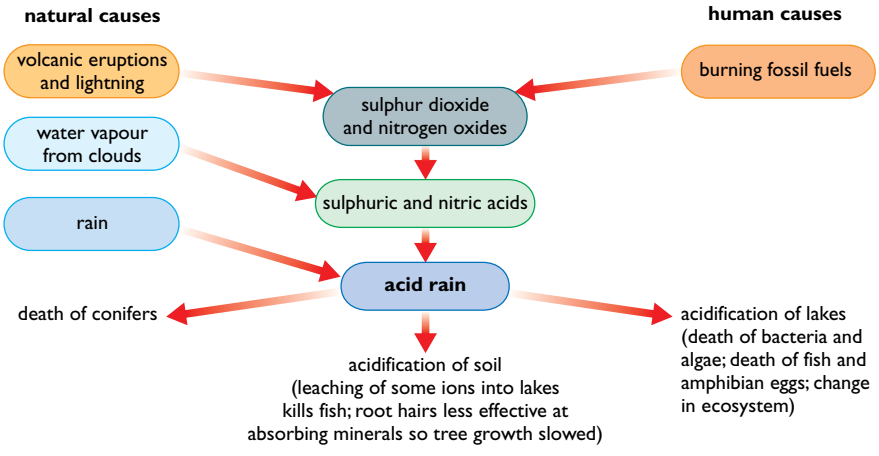


Figure 5.15 *Air pollution in one place can cause acid rain – and serious pollution problems – somewhere else entirely. Depending on the prevailing winds, it can even be in another country!*

One of the ways in which air pollution is affecting the African environment is to kill life in the seas that surround our continent. For example, the beautiful coral reefs are very vulnerable to air pollution in two ways. Firstly, the temperature of the seas is going up as a result of global warming. Just a small rise is enough to kill off the algae on which the coral polyps feed, and so in turn the polyps die and the coral reefs begin to bleach and die as well. Secondly, acid rain falls into the sea and the change in pH affects the calcium salts dissolved in the water and breaks down the coral skeleton itself. Without the coral, many of the unique reef ecosystems of the world will be destroyed forever – so controlling air pollution is very important indeed.

Air pollution in our homes

It may surprise you to learn that air pollution also needs to be considered inside our homes, offices and schools. Some of these pollutants can be created by indoor activities such as smoking and cooking. Fumes from cars come in through the windows. And when the air is polluted, whether inside or out, you cannot avoid breathing it in. One particular problem is air pollution in the home from the use of paraffin lamps to give us light in the evening.

Burning paraffin produces many poisonous chemicals in the air including benzene, carbon monoxide and lead from the wick as well as particles of soot. We may breathe these substances into our lungs every day.

Air pollution can affect our health in many ways with both short-term and long-term effects. Examples of short-term effects include irritation to the eyes, nose and throat, and upper respiratory infections such as bronchitis and pneumonia. Other symptoms can include headaches, nausea and allergic reactions. Long-term health effects of air pollution can include chronic respiratory disease, lung cancer, heart disease and even damage to the brain, nerves, liver or kidneys. Young children are particularly vulnerable. In some cases the pollution of the air in our homes can lead to death. In some places people are using solar power to store electricity during the day, which can then be used at night. This is a safe and pollution-free way of lighting our homes.

Another form of air pollution has led to the depletion of the ozone layer in the atmosphere. Ozone is a gas which is found in the atmosphere of the Earth. It absorbs some of the ultraviolet radiation from the sun. Ultraviolet radiation damages and burns the skin and can cause the development of skin cancers. The ozone layer protects life on Earth from the worst of this damage. For over 50 years people, particularly in the more economically developed countries, used chemicals called CFCs (chlorofluorocarbons) in fridges and freezers as a refrigerant, and in aerosol sprays as the propellant. They did not realise that CFCs can damage the ozone layer. By the time scientists made this discovery, it was too late. Air pollution by CFCs had caused the ozone layer around the Earth to get thinner, particularly over the Antarctic at certain times of the year. This

thin area is often referred to as the 'ozone hole'. Levels of ultraviolet light reaching the surface of the Earth have increased as a result and levels of skin cancers and eye problems caused by ultraviolet light have also increased. However, once people realised the damage this was doing, the use of CFCs has been banned and fridges and freezers containing these compounds are disposed of very carefully. Within about 50 years the ozone hole will heal itself – already levels of atmospheric ozone are higher again. This is one form of air pollution that has been overcome.

People have become more aware of the problems caused by air pollution. In many countries in the world steps are being taken to stop the damage to our environment from air pollution. One of the biggest causes of air pollution is cars and other vehicles. Car exhausts contain carbon dioxide, carbon monoxide, sulphur dioxide and oxides of nitrogen. All of these gases have both a direct and an indirect effect on human health. Around the world people are working hard to reduce the levels of sulphur dioxide and nitrogen oxides in car exhausts. More and more cars are being fitted with catalytic converters. Once hot, these remove the acidic gases before they are released into the air.

Preventing air pollution in Ethiopia

In Ethiopia we do not contribute greatly to air pollution as our way of life is often relatively simple. Relatively few people own cars, and the majority of people cook and heat their homes using traditional fuels such as wood or animal dung. However, burning forests down during deforestation has a bad effect on air pollution levels. In Ethiopian towns and cities, more air pollution is produced than in the countryside. As more people move to cities, the number of vehicles increases and the use of electricity and fuels such as kerosene for cooking also increases. It is important that we take care to keep our pollution levels as low as possible. For example, the use of solar energy to charge batteries so that we can light our homes with clean electricity in the evenings reduces the risk of air pollution from paraffin lamps. This is an important step we can take to protect the health of our children – and it reduces the risk of fires as well. In the meantime, we have to live with the effects of climate change and ozone depletion that is the result of air pollution elsewhere in the world.

Many countries are passing laws which control the amount of air pollution that is allowed by factories and the generation of electricity. People are trying to prevent many types of air pollution, through personal, careful, attention to our interactions with the environment. Individuals can make a difference by reducing the amount of electricity they use, by switching off lights when they are not needed and reducing the level of the air conditioning. People walk or cycle sometimes instead of using cars or buses. In cities people buy local produce with as little packaging as possible – that reduces the fuel used to get food to them, and the chemicals processed to make the packaging. All of these things can make a

real difference in the long term, and the more people who help the better. Here in Ethiopia we have a relatively clean country – let us all work hard to keep it that way, and to conserve our wonderful vegetation and wildlife, so that we can be an example to the world.

Summary

In this section you have learnt that:

- Air pollution is caused in a number of ways including by smoke, by carbon dioxide and carbon monoxide from the burning of fossil fuels, by sulphur dioxide and nitrogen oxides causing acid rain and by benzene, lead and soot in homes and offices from paraffin lamps.
- Air pollution has a number of effects on both the environment and on individuals. These include global dimming, global warming, acid rain as well as problems such as asthma, lung infections and cancer for individuals.
- Global warming is an increase in the temperature at the surface of the earth as a result of an increased greenhouse effect.
- Global warming is caused by an increase in the levels of greenhouse gases such as carbon dioxide and methane in the atmosphere. As a result more heat is trapped by the atmosphere and the temperature at the surface of the earth increases.
- Methods of preventing global warming include reducing the use of fossil fuels and managing the farming of cattle and rice. Stopping deforestation and replanting trees can also help by using up some of the carbon dioxide.
- Ozone depletion caused by the use of CFCs has caused an increase in harmful ultraviolet light reaching the surface of the earth. As the use of CFCs has been controlled, the ozone hole in the atmosphere is getting smaller as the damage is repaired.

Review questions

1. Which of these chemicals has caused the formation of the 'ozone hole'?

   A sulphur dioxide

   B carbon dioxide

   C CFCs

   D nitrogen oxides

2. Which air pollutants can lead to global warming?

   A carbon dioxide and carbon monoxide

   B carbon dioxide and methane

   C methane and sulphur dioxide

   D methane and nitrogen oxides

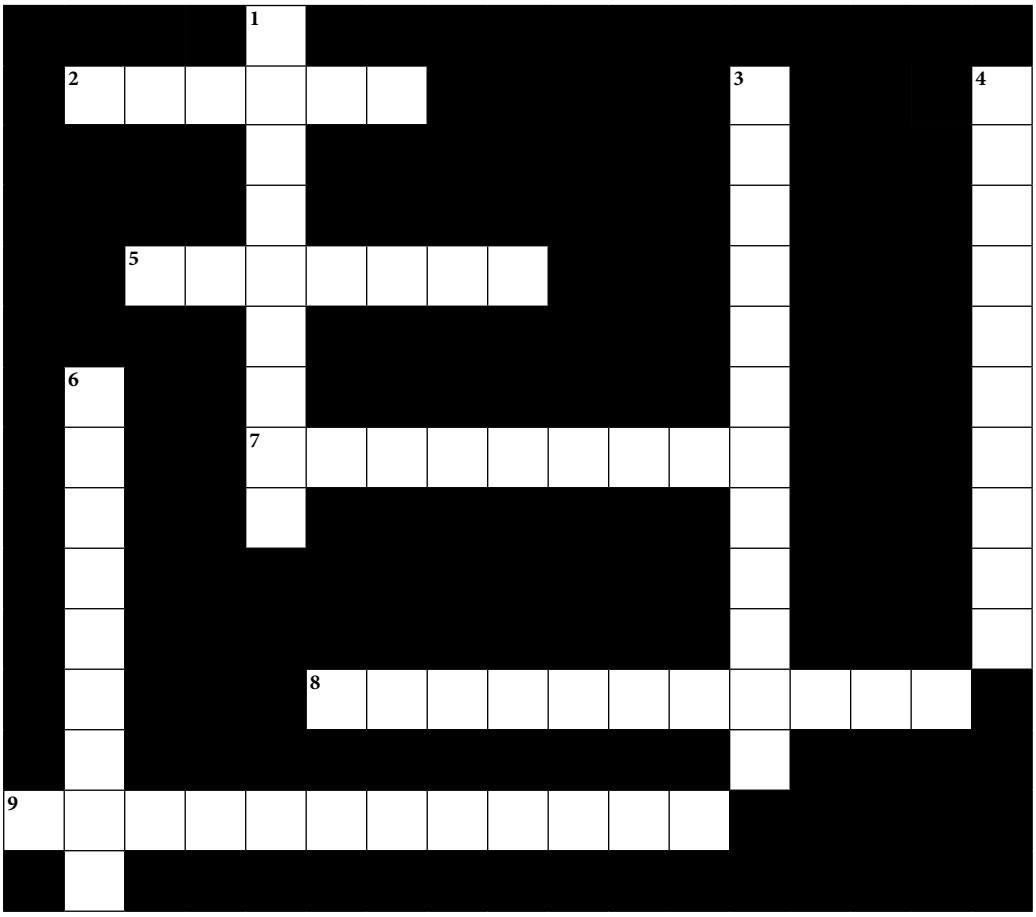
3. How can air pollution affect us in our homes?

End of unit questions

1. Which of the following is a non-renewable resource?
   A eggs
   B teff
   C sweet potato
   D oil
2. Which of the following is a renewable resource?
   A gold
   B coal
   C meat
   D gas
3. Which of these statements describes conservation?
   A Farming an area intensively.
   B The protection and preservation of our natural environment.
   C The rapid loss of habitats.
   D None of the above.
4. Which of the following statements does not explain why biodiversity is important?
   A Biodiversity produces genetic variety.
   B Biodiversity maintains the balance of an ecosystem.
   C Biodiversity reduces the spread of disease.
   D Biodiversity establishes a monoculture.
5. What is biodiversity?
6. Why is biodiversity important?
7. Which of these is not an example of how humans can affect the natural vegetation?
   A classification
   B deforestation
   C burning
   D farming
8. Which of these is not a way of conserving our natural vegetation?
   A protecting natural habitats
   B replanting endemic species
   C farming sustainably
   D slash and burn deforestation

9. Give three ways in which our rich plant diversity can be conserved.
10. Which of the following is not an endemic Ethiopian species of animal?
    A Mountain Nyala
    B Ethiopian wolves
    C Gelada Baboon
    D Roan Antelope
11. Which of these methods is not an effective way of conserving wildlife?
    A setting up National Parks
    B intensive farming
    C controlling hunting
    D restoring lost habitat
12. Explain three ways in which people have an effect on the wildlife of Ethiopia.
13. Give three ways in which our rich wildlife diversity can be conserved and explain why it is so important.
14. Which of these pollutants causes most problems in Ethiopian homes?
    A sulphur dioxide
    B carbon dioxide
    C benzene, lead and soot
    D nitrogen oxides
15. What damage has been caused by CFCs?
    A global warming
    B thinning of the ozone layer
    C acid rain
    D global dimming
16. How do scientists think that human activities are causing global warming?

Copy the crossword puzzle below into your exercise book (or your teacher may give you a photocopy) and solve the numbered clues to complete it.



ACROSS

2 Type of baboon endemic to Ethiopia (6)

5 No longer in existence (7)

7 Capable of being produced indefinitely, not used up (9)

8 Cultivation of a single crop (11)

9 The act of preserving, guarding or protecting part of the natural world (13)

DOWN

1 An area which focuses on the conservation of a particular species (9)

3 A measure of the wealth of species in a given place (12)

4 Plant life (10)

6 The contamination of the natural environment by harmful substances, often as a result of human activities (9)

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